

Physics 280: Session 17

Plan for This Session

Questions

Today from noon to 6pm, office hours in Loomis 430A

Next session, Thursday, 2-3.20pm, March 19th:

Midterm Exam in 150 Animal Sciences Lab

News

Module 6: Nuclear Arsenals

Reuters – Progress in P5+1 Negotiations with Iran

Iran, U.S. line up technical options as push for deal intensifies

11:49am EDT

By [Louis Charbonneau](#) and [Lesley Wroughton](#)

LAUSANNE, Switzerland (Reuters) - Iran and major world powers have been making headway in identifying technical options for a historic nuclear deal as an end-March deadline nears but difficult issues must still be addressed, U.S. and Iranian officials said on Tuesday.

Iran and six world powers are seeking an agreement to curb Iran's most sensitive nuclear activities for at least 10 years in exchange for a gradual end to sanctions on Tehran.

The powers -- Britain, China, France, Germany, Russia and the United States -- aim to complete the framework of a final deal by the end of March and reach a full agreement by June 30.

"We have definitely made progress in terms of identifying technical options for each of the major areas," the U.S. official told reporters on condition of anonymity. "There is no way around it. We still have a ways to go ... But even within this space, we have some tough issues to address."

The official said any framework agreement settled this month would need to have key details, including numbers. "If there is an agreement, I don't see how it could be meaningful without having some quantitative dimensions," he said, without elaborating.

Western and Iranian officials doubted an agreement could be clinched this week and at least one more round of talks would be needed on a deal that could end a 12-year-old nuclear standoff between Tehran and the West over its atomic program.



BBC, Saudi Arabia will Seek any Deal Granted to Iran

Iran deal could start nuclear fuel race - Saudi Arabia

By Barbara Plett Usher
BBC News, Riyadh

A senior member of the Saudi royal family has warned that a deal on Iran's nuclear programme could prompt other regional states to develop atomic fuel.

Prince Turki al-Faisal told the BBC that Saudi Arabia would then seek the same right, as would other nations.

Six world powers are negotiating an agreement aimed at limiting Iran's nuclear activity but not ending it.

Critics have argued this would trigger a nuclear arms race in the region spurred on by Saudi-Iran rivalry.

"I've always said whatever comes out of these talks, we will want the same," said the prince, Saudi Arabia's former intelligence chief.

"So if Iran has the ability to enrich uranium to whatever level, it's not just Saudi Arabia that's going to ask for that.

Physics/Global Studies 280

Module 6: Nuclear Arsenals and Proliferation

Part 1: Overview of Programs and Arsenals

Part 2: Arsenals of the NPT Nuclear-Weapon States:
*The United States, Russia, the United Kingdom,
France, and China*

Part 3: Arsenals of non-NPT and Emerging Nuclear-Weapon States:
India, Pakistan, Israel, North Korea, and Iran

Part 4: Threat Perceptions

Module 6: Programs and Arsenals

Part 1: Overview of Programs and Arsenals

Module 6: Nuclear Arsenals and Proliferation

The New York Times

A Chain Reaction of Proliferation

"The Nuclear Express," a new book on the history of the atomic age, describes the interlocking web of influence and espionage behind the proliferation of nuclear technology. This diagram gives a summary of the authors' tracking of the transfers of nuclear technology and secrets.

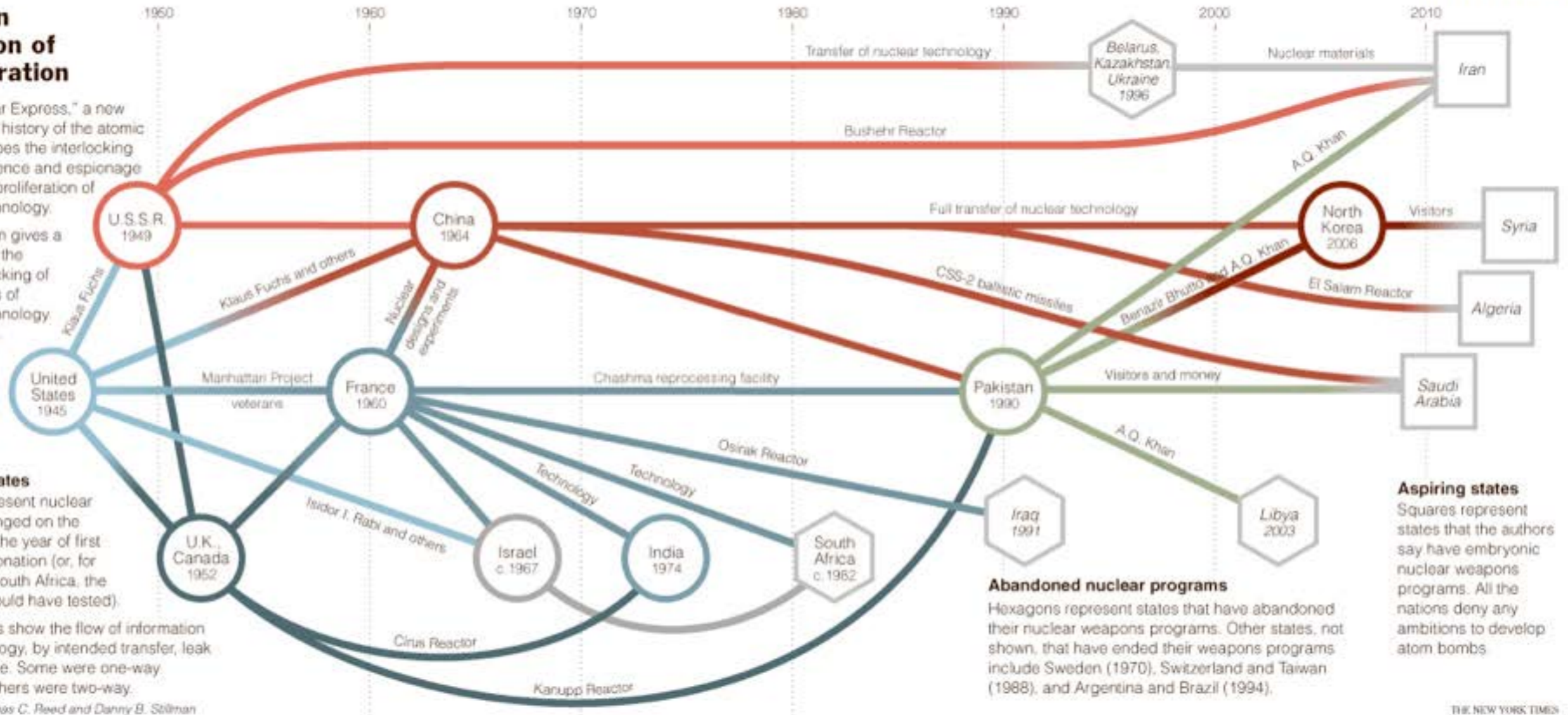
This diagram gives a summary of the authors' tracking of the transfers of nuclear technology and secrets.

Nuclear states

Circles represent nuclear states, arranged on the timeline by the year of first nuclear detonation (or, for Israel and South Africa, the year they could have tested).

Connections show the flow of information and technology, by intended transfer, leak or espionage. Some were one-way transfers; others were two-way.

Sources: Thomas C. Reed and Danny B. Stillman



Aspiring states
Squares represent states that the authors say have embryonic nuclear weapons programs. All the nations deny any ambitions to develop atom bombs

Abandoned nuclear programs

Hexagons represent states that have abandoned their nuclear weapons programs. Other states, not shown, that have ended their weapons programs include Sweden (1970), Switzerland and Taiwan (1988), and Argentina and Brazil (1994).

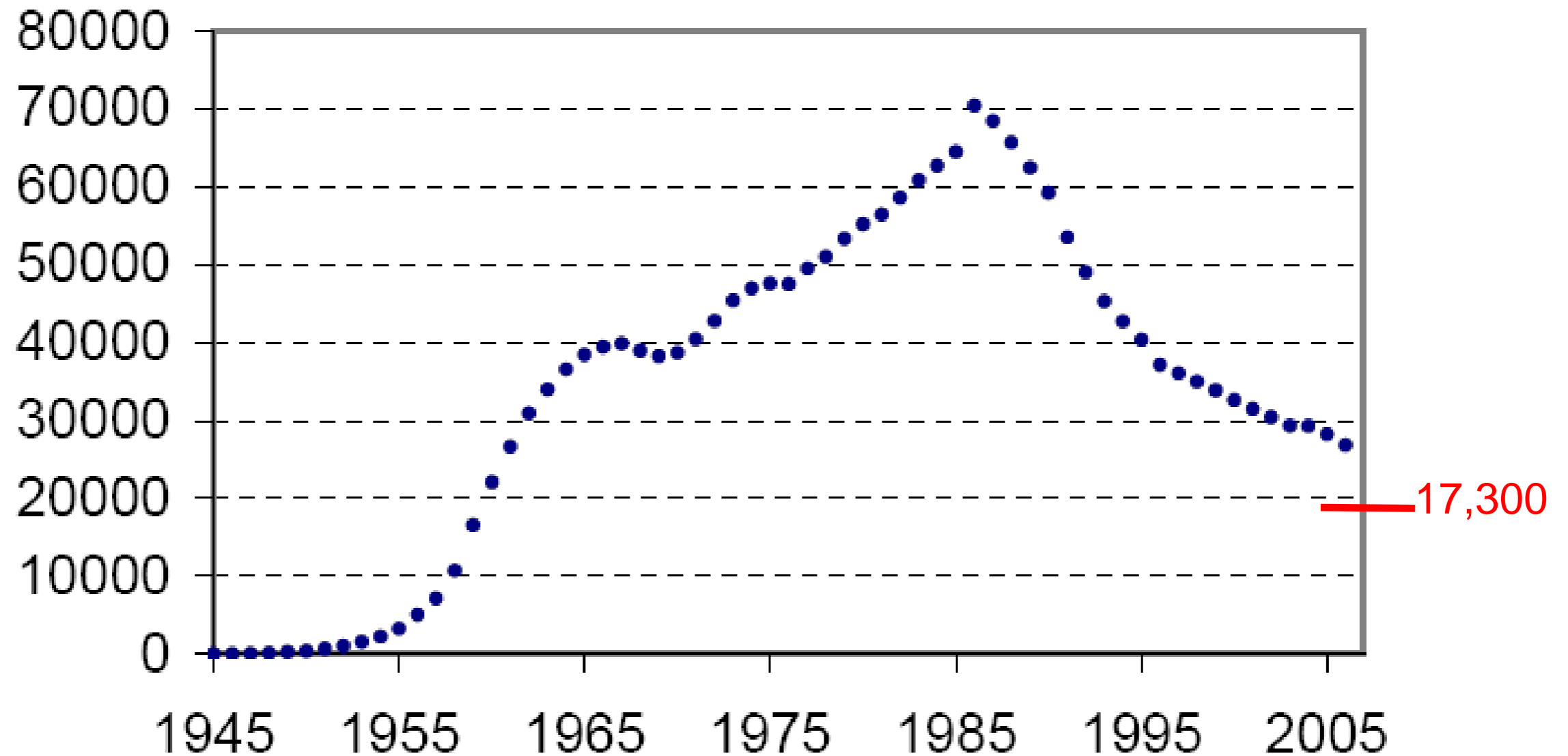
THE NEW YORK TIMES
RECOMMEND

This article has been revised to reflect the following correction:

Correction: December 15, 2008

A chart last Tuesday with an article about the proliferation of the atomic bomb, showing the exchange of nuclear information and technology between countries, misidentified the type of reactor that India acquired from Canada, which allowed India to make fuel for its first nuclear test. It was a CIRUS reactor, not a Candu reactor.

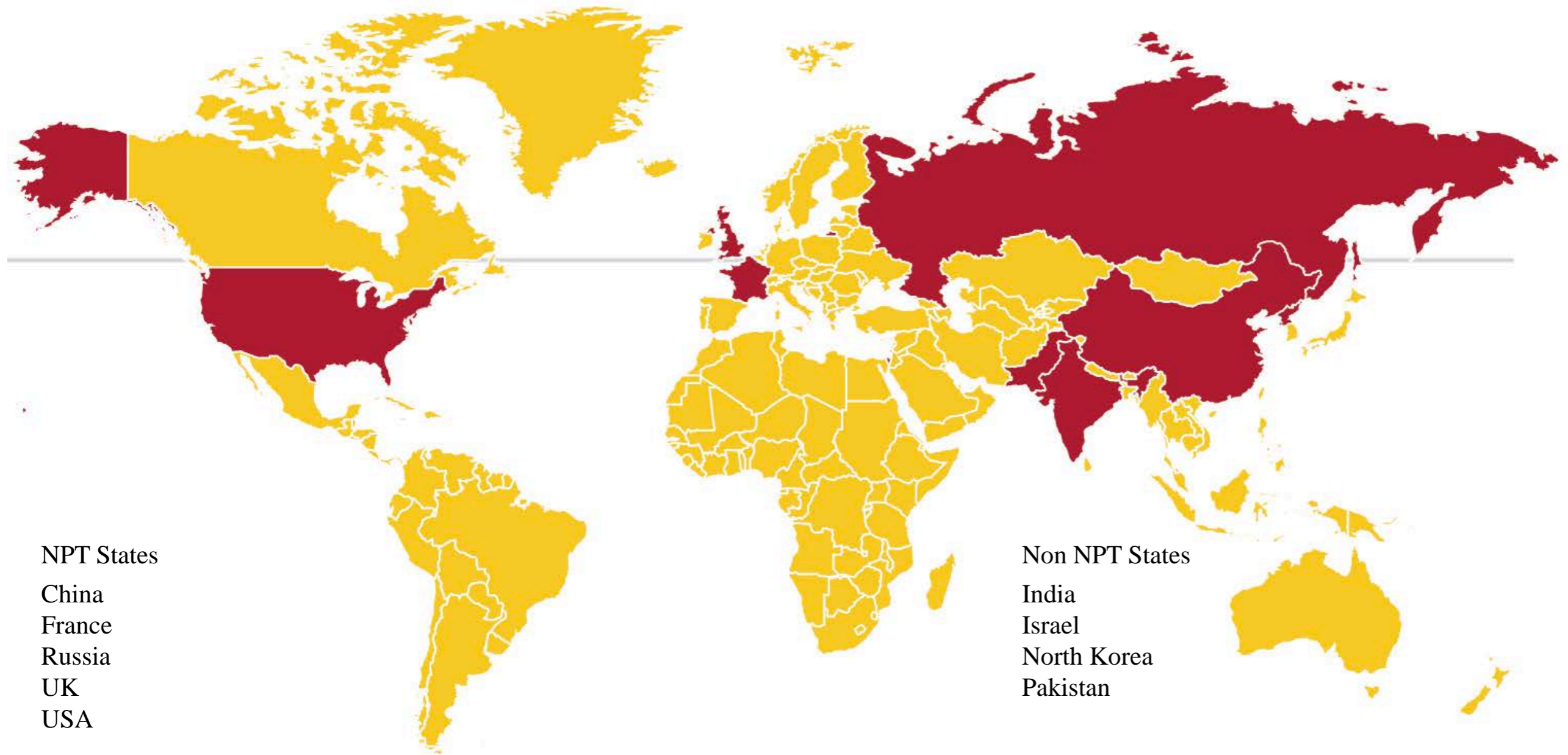
World Nuclear Weapon Stockpiles 1945–2012 (Important)



NRDC, Global nuclear stockpiles, 1945-2006, Bulletin of the Atomic Scientists, Jul-Aug 2006

~ 17,300 total nuclear weapons in Dec 2012

States With Nuclear Weapons in 2012



PLOUGHSHARES FUND ploughshares.org

Global Nuclear Weapon Inventory 2012 (Important)

NPT Nuclear Weapon States (Total Weapons)

China: ~ 240

France: ~ 300

Russia: ~ 8,500

UK: ~ 225

US: ~ 7,700

Global Nuclear Weapon Inventory 2012 (Important)

Non-NPT Nuclear Weapon States (Total Weapons)

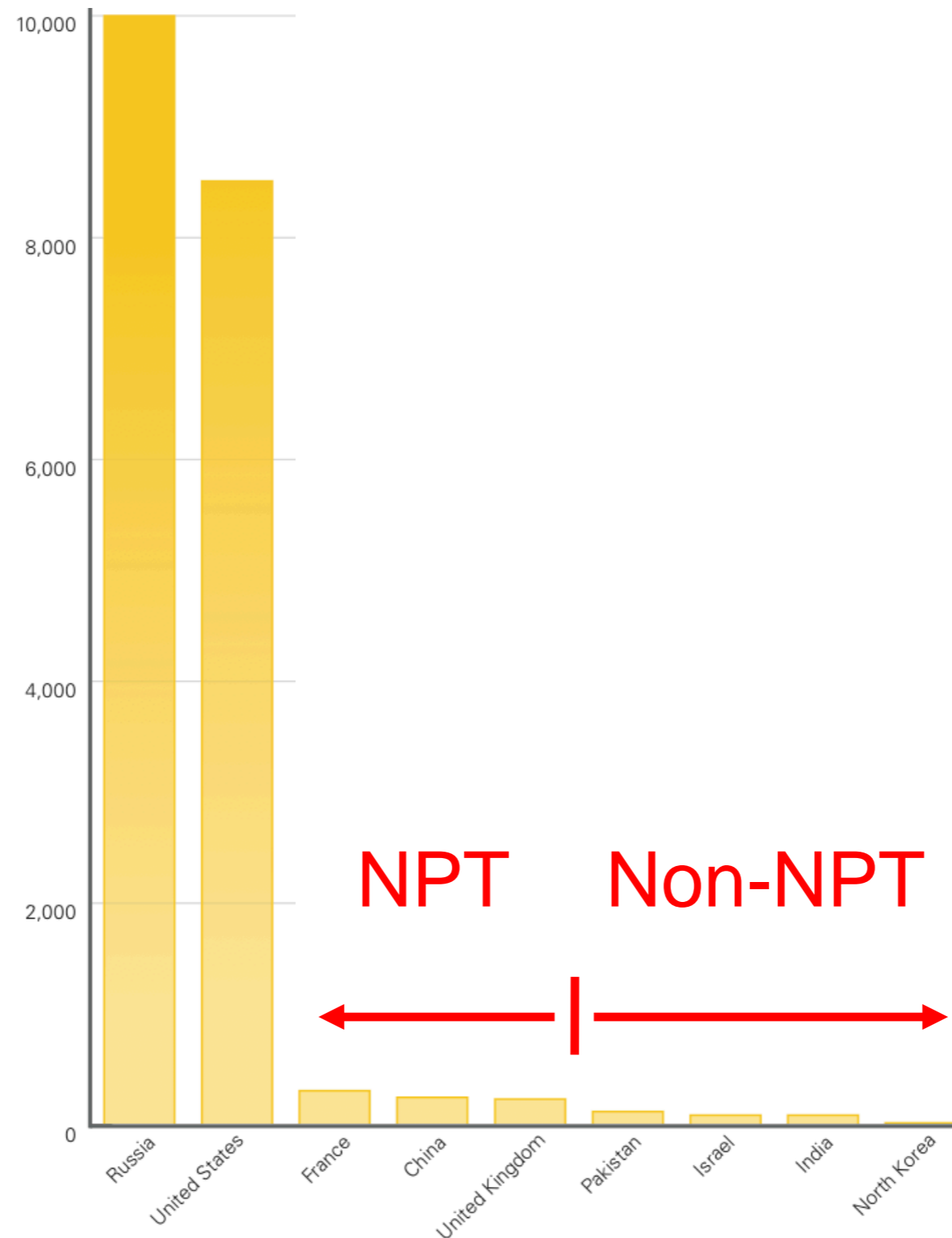
Pakistan: ~ 90–110

Israel: ~ 60–80

India: ~ 80-100

North Korea: < 10

States With Nuclear Weapons in 2012



Nuclear Warheads on Alert

United Nations Institute for Disarmament Research
UNIDIR/2012/6 Hans Kristensen, Matthew McKinzie

Table 1. Estimated alert nuclear forces, 2012

Country	Stockpiled warheads ^a	Alert warheads ^b	Remarks
United States	5,000	920	Split more or less evenly between ICBMs and SLBMs
Russian Federation	4,500	890	Mainly warheads on ICBMs; alert levels vary greatly depending on type
France	300	80 ^c	One SSBN on patrol
United Kingdom	225	48 ^c	One SSBN on patrol
China	240	0	Warheads are not mated with delivery systems or in military custody
Pakistan	100	0	Warheads are not mated with deployed delivery vehicles
India	90	0	Warheads are not mated with deployed delivery vehicles
Israel	80	0	Warheads are not mated with deployed delivery vehicles
Total	~10,540	~1,940	

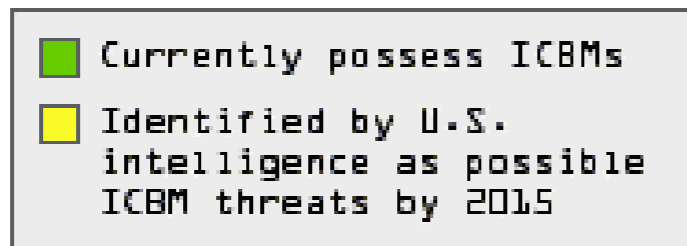
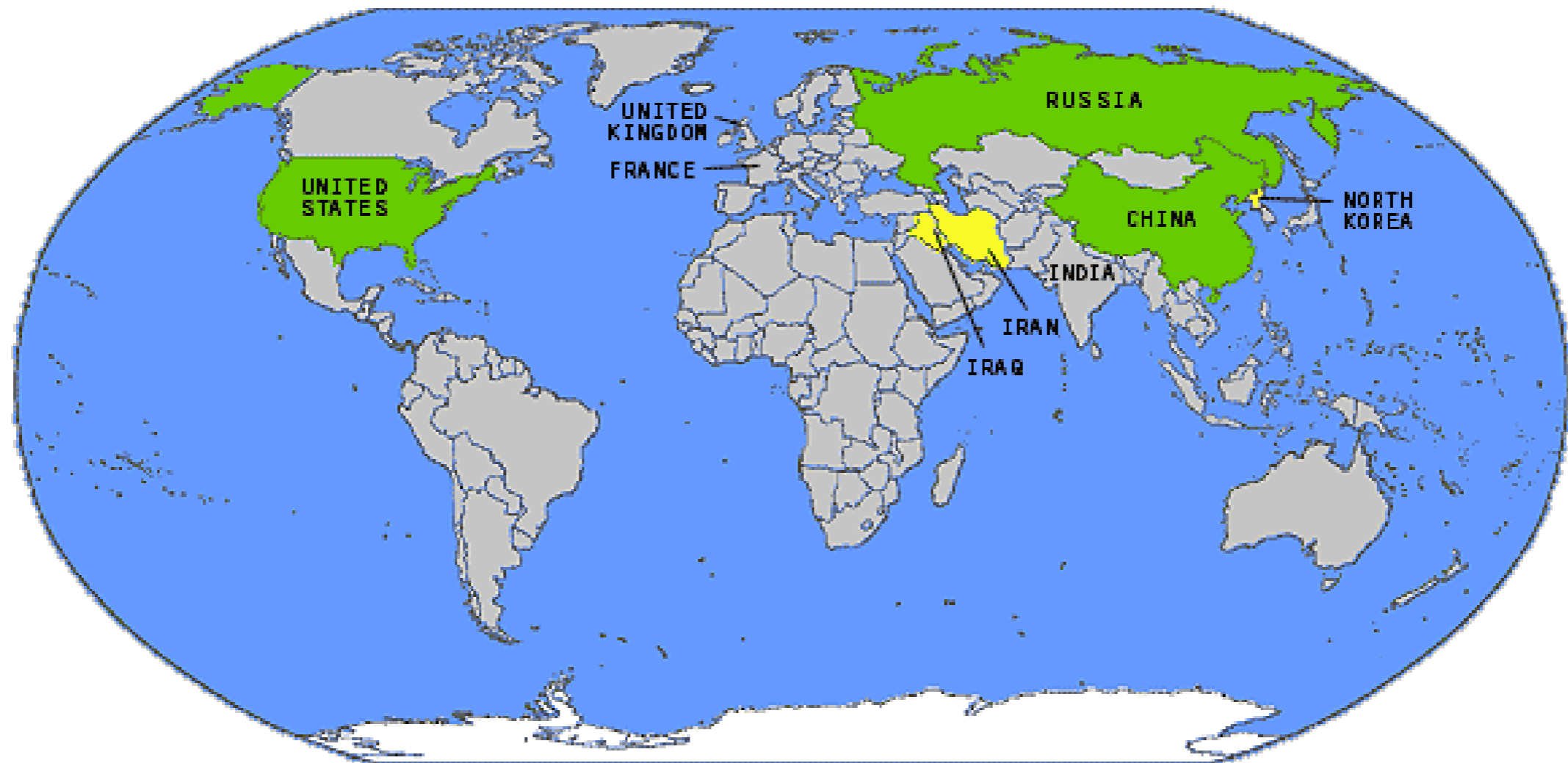
^a This includes warheads in the military stockpile assigned to nuclear forces. Additional retired, but still intact, warheads may be in storage awaiting dismantlement. The United States and the Russian Federation each have several thousand warheads in this category.

^b Warheads are considered on alert if they are deployed on a delivery system that is deployed and ready to launch the weapons within minutes or hours.

^c Although deployed and fully operational, SLBMs on French and British SSBNs are thought to require longer preparation to launch than US and Russian alert weapons.

Ballistic Missile Threats

Map of ICBM Threats - 2001 National Intelligence Council (NIC) Assessment



Ballistic Missiles: Range Capabilities for Different Countries

Afghanistan
 Argentina
 Armenia
 Azerbaijan
 Bahrein
 Belarus
 Bulgaria
 Egypt
 Georgia
 Greece
 Iraq
 Kazakhstan
 Kongo
 Libya
 Slovakia
 South Korea
 Syria
 Taiwan
 Turkey
 Turkmenistan
 U.Arab.Emir.
 Ukraine
 Vietnam
 Yemen

Country	Missile	Range
India	Agni II	2.000 km
Iran	Shahab III	1.300 km
Israel	Jericho III	1.500 km
North Korea	No Dong	1.300 km
	Taepo Ding I	2.000 km
	Taepo Dong II	5.500 km
Pakistan	Ghauri I/No Dong	1.300 km
	Ghauri II	2.000 km
Saudi Arabia	CSS-2	2.600 km

Country	Missile	Range
China	DF-4	13.000 km
France	M45 SLBM	6.000 km
	M4 SLBM	6.000 km
U.K.	Trident II/D-5 SLBM	7.400 km
Russia	SS-18	11.000 km
	SS-19	10.000 km
	SS-24	10.000 km
	SS-25	10.500 km
	SS-27	10.500 km
	SS-N-18 SLBM	6.500/8.000 km
	SS-N-20 SLBM	8.300 km
	SS-N-23 SLBM	8.300 km
USA	Minuteman II	9.650 km
	MX Peacekeeper	9.650 km
	Trident I/C-4 SLBM	7.400 km
	Trident I/D-5 SLBM	7.400 km

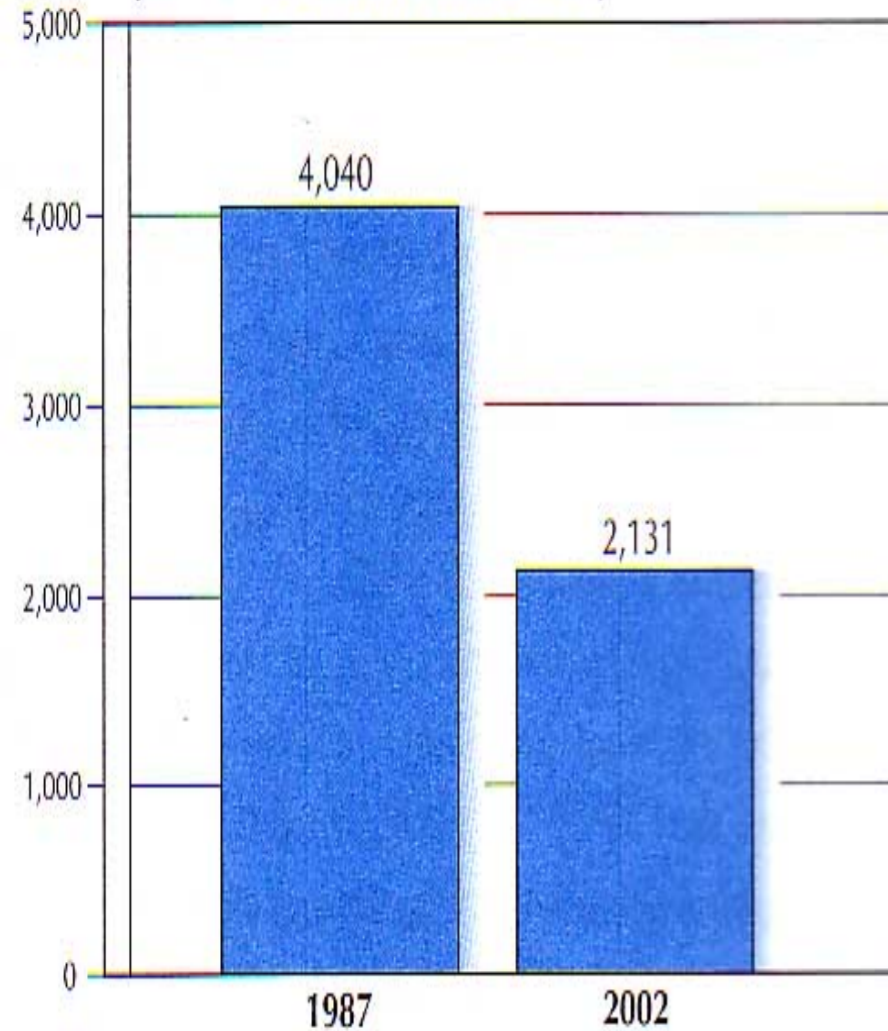
1000 km

5500 km

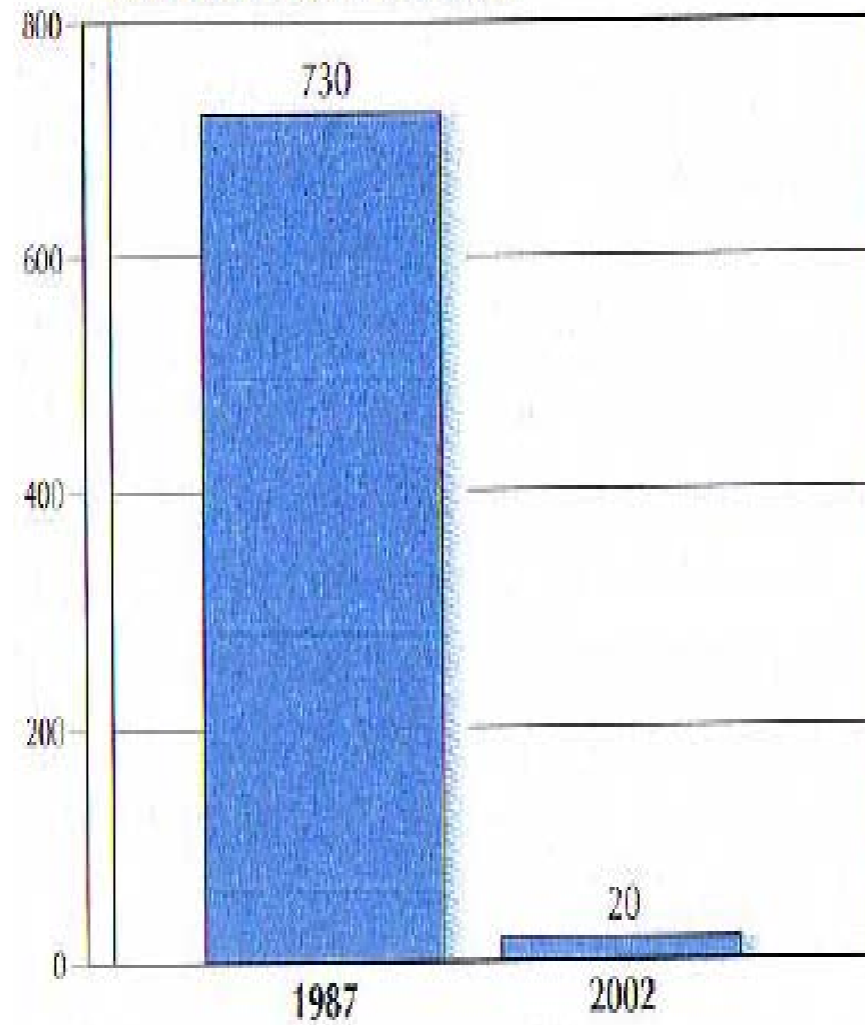
Range

Reductions in Ballistic Missile Numbers 1987–2002

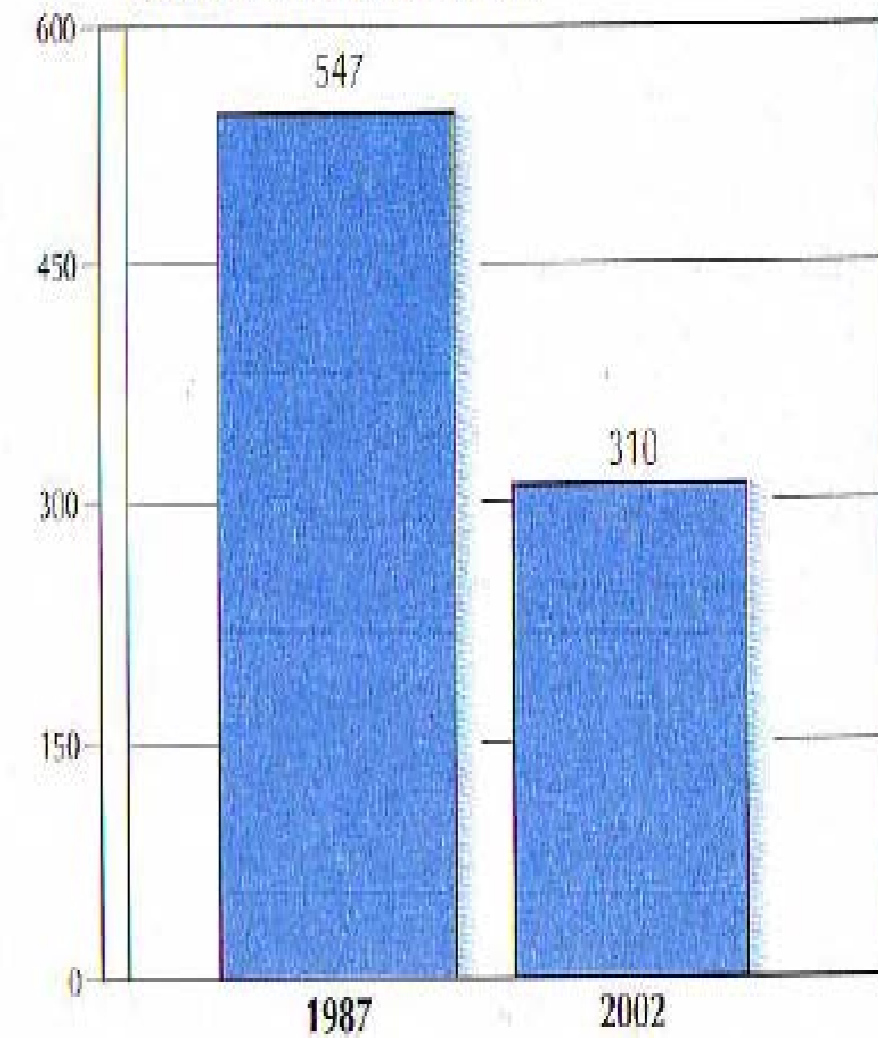
Global Long-Range Ballistic Missile Arsenals
(Combined ICBM and SLBM)



Global Intermediate-Range
Ballistic Missile Arsenals



Global Medium-Range
Ballistic Missile Arsenals



Cirincione, Deadly Arsenals, 2002.

Non-U.S. Nuclear Cruise Missiles 2009

Maximum System	Launch Mode	Warhead Type	Range (miles)	IOC
CHINA				
YJ-63	Air	Conventional	Undetermined	Undetermined
DH-10	Undetermined	Conventional or nuclear	Undetermined	Undetermined
PAKISTAN				
RA'AD	Air	Conventional or Nuclear	200	Undetermined
Babur	Ground	Conventional or Nuclear	200	Undetermined
RUSSIA				
AS-4	Air	Conventional or nuclear	185+	Operational
AS-15	Air	Nuclear	1,500+	Operational
SS-N-21	Submarine	Nuclear	1,500+	Operational

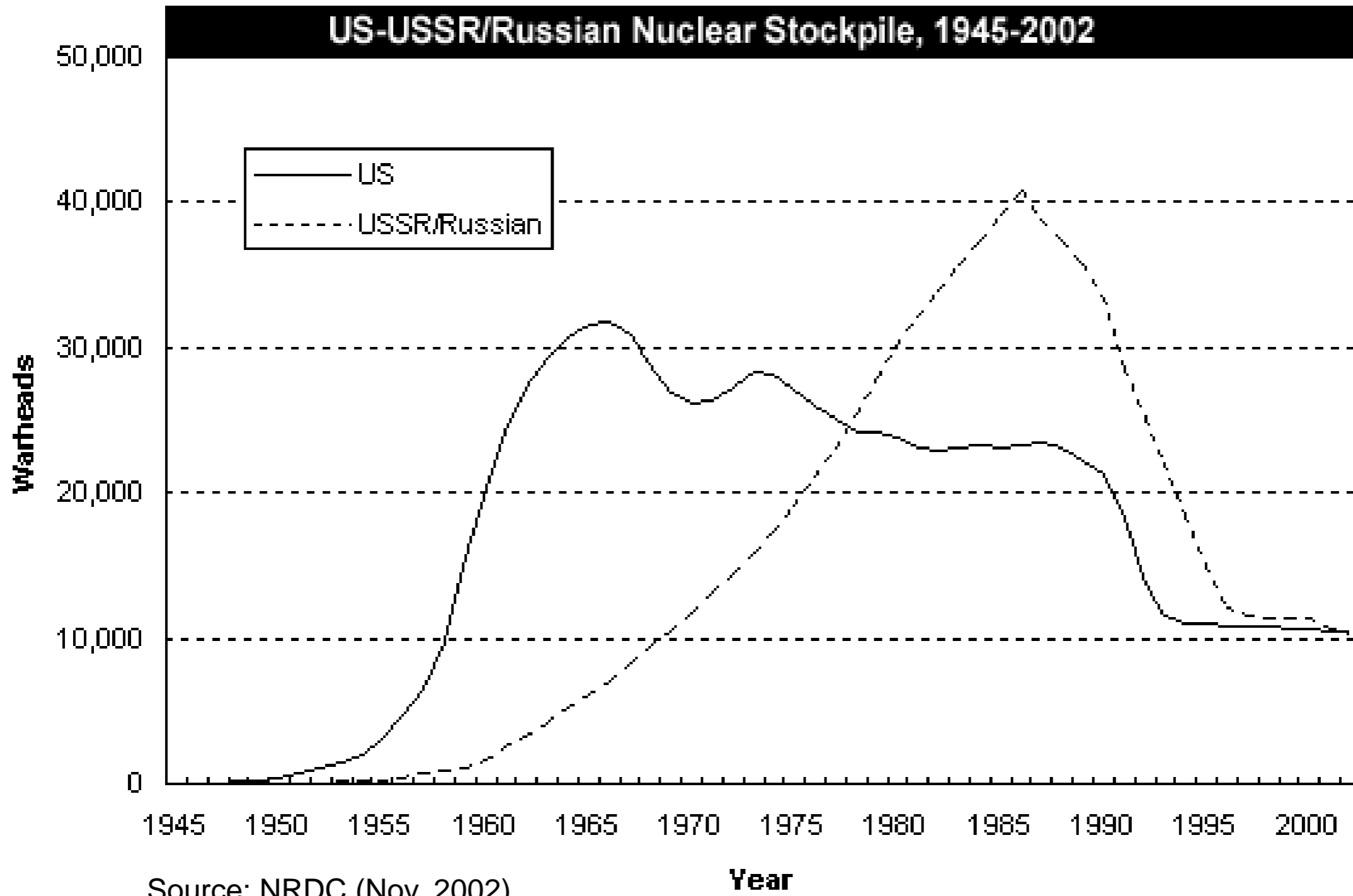
Module 6: Programs and Arsenals

Part 2: Arsenals of the NPT Nuclear-Weapon States

Will cover impact of New Start in Arms Control Module

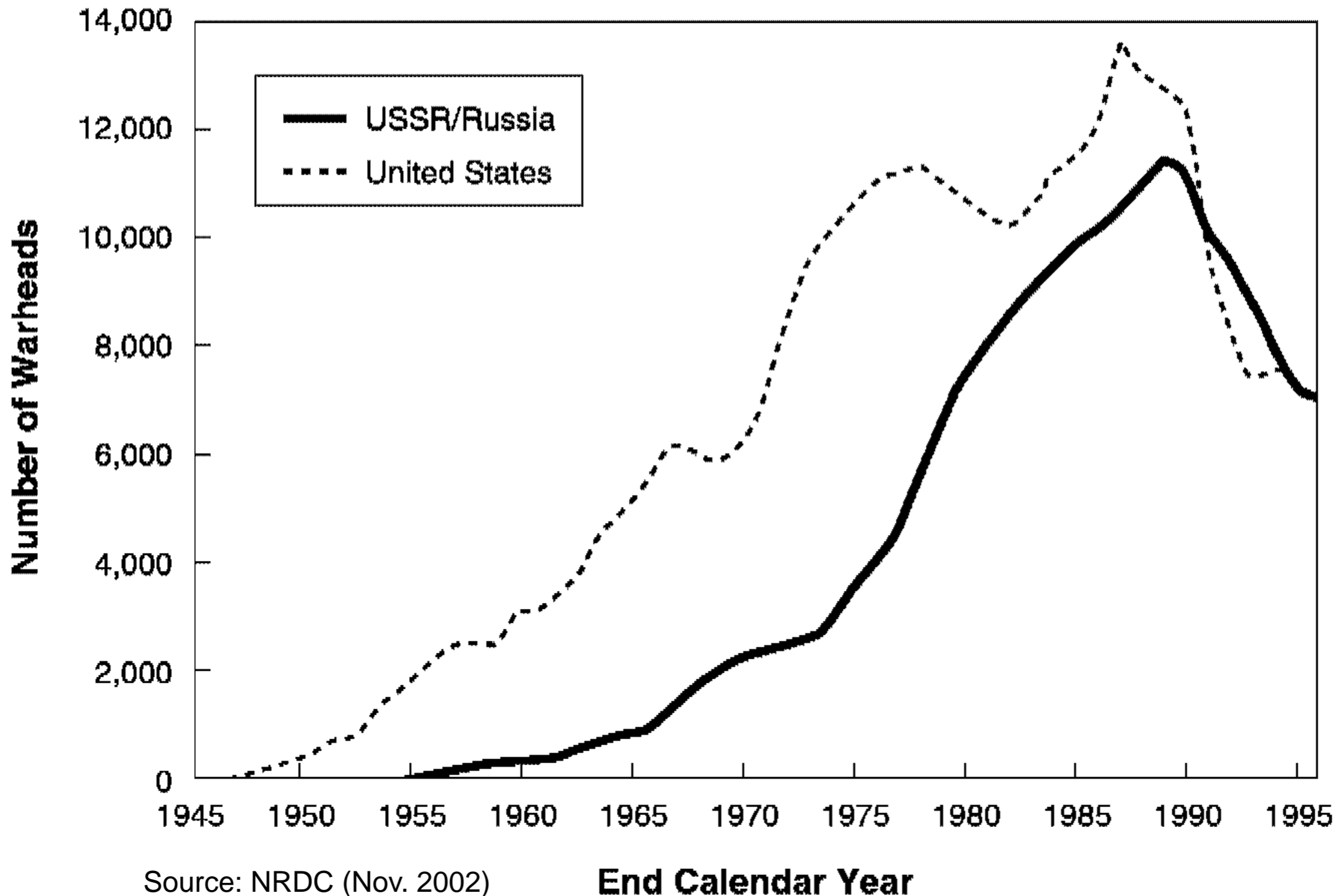
The United States, Russia, the United Kingdom,
France, and China

Evolution of US and SU-Russian Nuclear Stockpiles

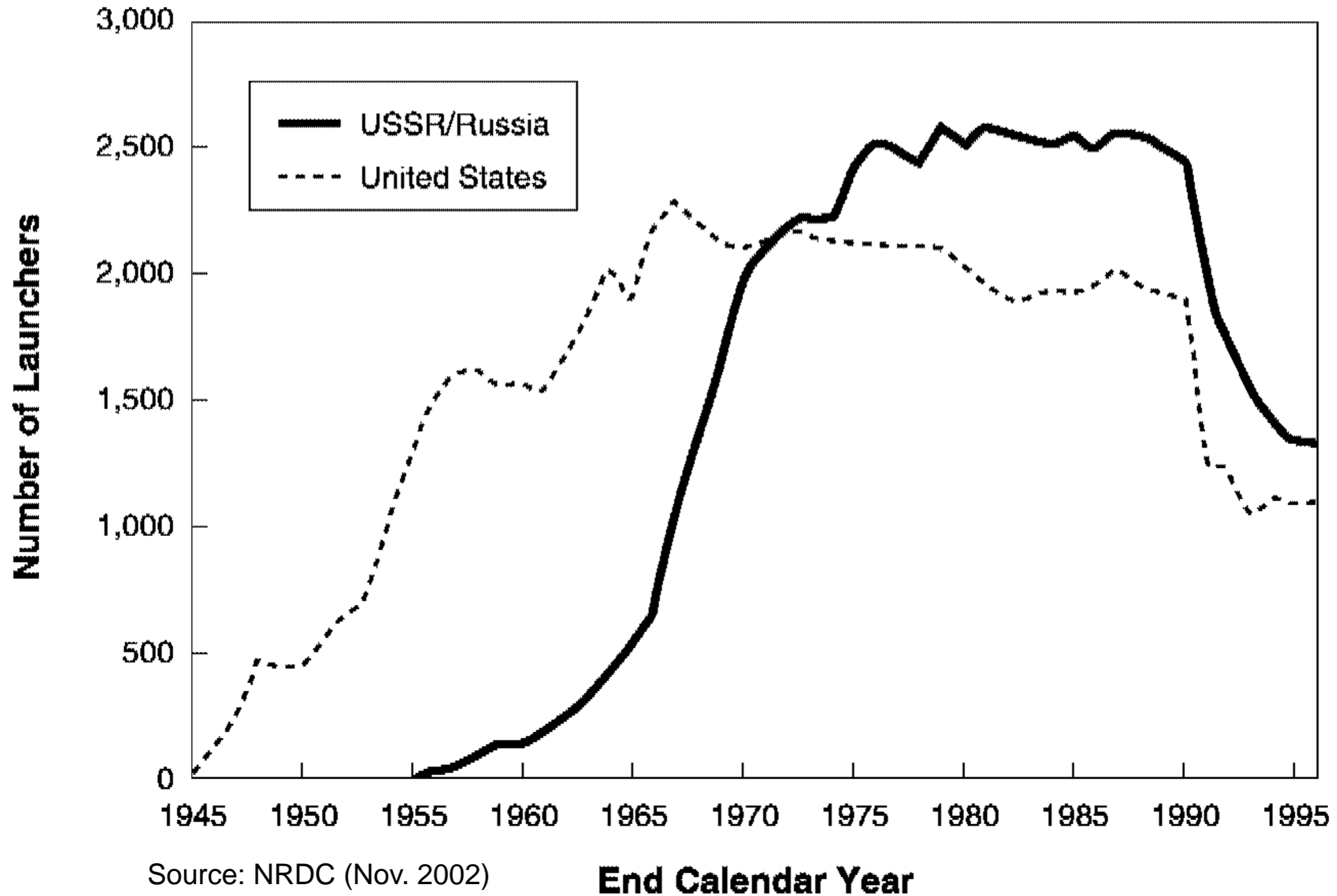


Source: NRDC (Nov. 2002)

Evolution of US and SU-Russian Strategic Nuclear Warhead Numbers



Evolution of US and SU-Russian Strategic Nuclear Launcher Numbers



U.S. and Russian “Tactical” Weapons in Europe

- The U.S. is thought to have 150 – 240 “tactical” nuclear weapons based in Europe, in the form of aerial bombs.
- Most are based in Italy and Turkey, but some are based in Germany, Belgium, and the Netherlands.
- Russia is thought to have about 2,000 operational “tactical” nuclear weapons in its arsenal.

Tactical Nuclear Weapons in Europe

The long-standing position of Washington is that its air-to-surface weapons in Europe connect the security of NATO and the United States. Still, the tactical arms are not intended for use against any particular nation and the infrastructure required to employ the weapons no longer stands at combat readiness.

A December 2008 **report** by an advisory panel to the U.S. Defense Department found that the time required to bring the aircraft that would fire the nuclear weapons into battle mode was "now measured in months rather than minutes."

The report detailed different views within the alliance, with some high-level U.S. officials at NATO headquarters in Belgium described as not being supportive of keeping the tactical weapons in Europe. An anonymous U.S. general was quoted to say that the nuclear bombs were no longer required as Washington could extend its nuclear umbrella to cover European allies from outside the continent.

Evolution of US Nuclear Bomber Forces – 1

Bomber Forces	2000	2001	2002	2007	2012
Bombers (Total Inventory) [1]					
B-52 Stratofortress	94	94	94	94	94
B-2 Spirit	21	21	21	21	21
Total (Bombers)	115	115	115	115	115

Source: NRDC

Evolution of US Nuclear Bomber Forces – 2

Bomber Forces	2000	2001	2002	2007	2012
Bombers Weapons (Force Loadings) [12]					
Bombs [13]	516	516	516	516	1,286
ALCM (AGM-86B) [16]	430	430	430	430	45
ACM (AGM-129A) [17]	430	430	430	430	45
Total (Force Loading Weapons)	1,376	1,376	1,376	1,376	1,376
* The 2007 figure is a goal of the Bush administration's 2001 Nuclear Posture Review					
** The 2012 figure is a limit of the Treaty of Moscow signed on May 24, 2002					

Source: NRDC

Evolution of US SSBN Nuclear Forces

SSBN Forces	2000	2001	2002	2007*	2012**
SSBNs					
Trident [3]	18	18	18	14	14
Total SSBNs	18	18	18	14	14
SLBM Launchers					
Trident with C4 [9]	192	168	168		
Trident with D5 [10]	240	264	264	336	336
Total Launchers	432	432	432	336	336
SLBM Warheads					
W76 (C-4) [14]	1536	1008	1008		
W76 (D-5)	1536	1728	1728	1560	1300
W88 (D-5) [15]	384	384	384	384	380
Total Warheads	3456	3120	3120	1944	1680

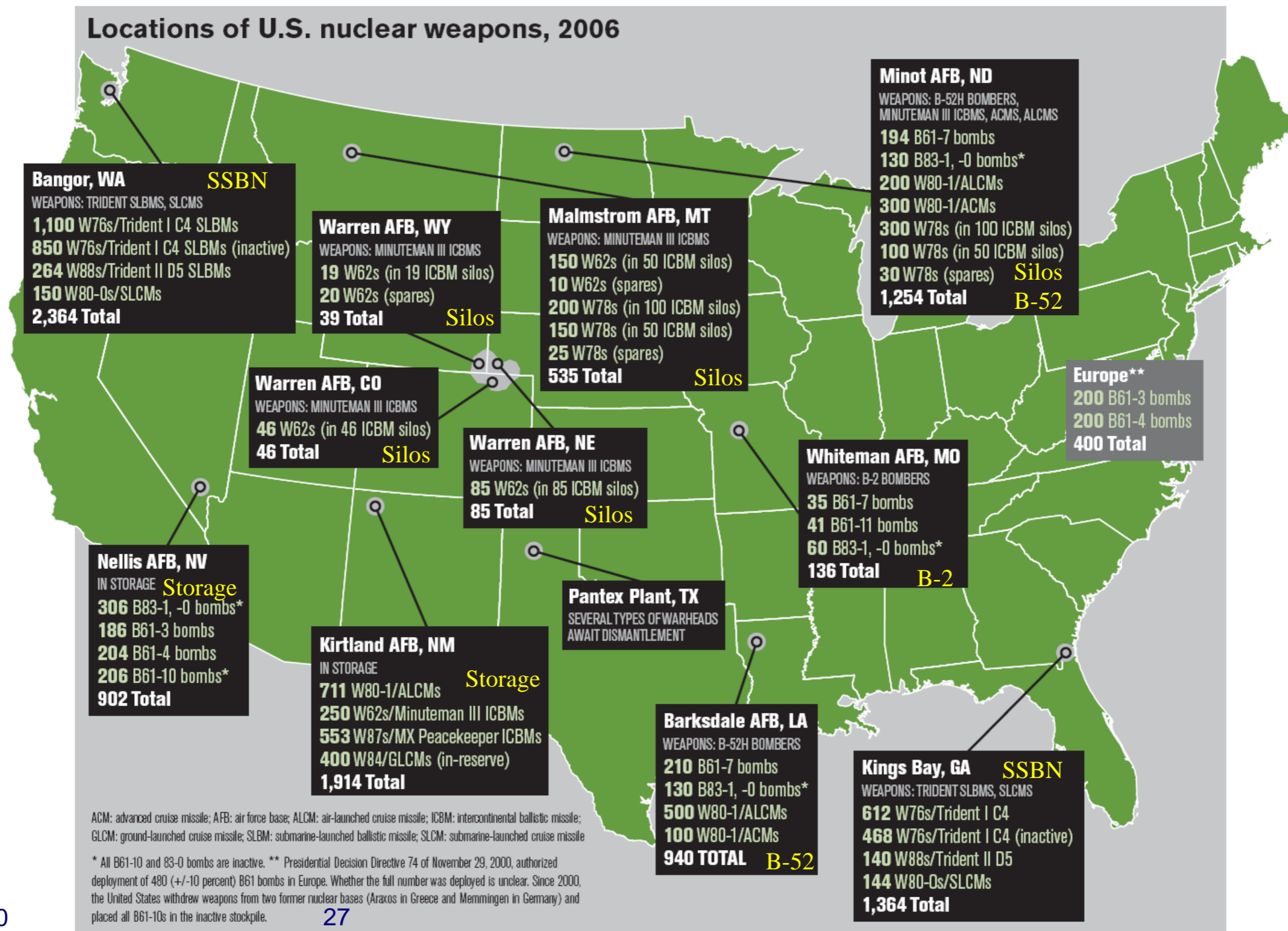
Source: NRDC

Evolution of US ICBM Nuclear Forces

ICBM Forces	2000	2001	2002	2007*	2012**
Launchers					
MINUTEMAN III [8]	500	500	500	500	500
MX (PEACEKEEPER) [9]	50	50	50	50	50
Total Launchers	550	550	550	550	550
ICBM Deployed Warheads					
W62 (MM III) [16]	600	300	300	0	0
W78 (MM III) [17]	900	900	900	300	300
W87 (MX) [18]	500	500	500	200	200
Total (Deployed)	2000	1700	1700	500	500

Source: NRDC

Locations of U.S. Nuclear Weapons



2010 U.S. Nuclear Posture Review



NUCLEAR POSTURE REVIEW REPORT

APRIL 2010

The New York Times • Reprints

Obama Limits When U.S. Would Use Nuclear Arms

By **DAVID E. SANGER** and **PETER BAKER**

WASHINGTON — President Obama said Monday that he was revamping American nuclear strategy to substantially narrow the conditions under which the United States would use nuclear weapons.

But the president said in an interview that he was carving out an exception for “outliers like Iran and North Korea” that have violated or renounced the main treaty to halt nuclear proliferation.

2010 U.S. Nuclear Posture Review

The document to be released Tuesday after months of study led by the Defense Department will declare that “the fundamental role” of nuclear weapons is to deter nuclear attacks on the United States, allies or partners, a narrower presumption than the past. But Mr. Obama rejected the formulation sought by arms control advocates to declare that the “sole role” of nuclear weapons is to deter a nuclear attack.

“We are going to pursue opportunities for further reductions in our nuclear posture, working in tandem with Russia but also working in tandem with NATO as a whole,” he said.

An obvious such issue would be the estimated 200 tactical nuclear weapons the United States still has stationed in Western Europe. Russia has called for their removal, and there is growing interest among European nations in such a move as well. But Mr. Obama said he wanted to consult with NATO allies before making such a commitment.

iClicker Question

About when did the total worldwide nuclear arsenal peak?

- (A) 1955
- (B) 1965
- (C) 1975
- (D) 1985
- (E) 1995

iClicker Answer

About when did the total worldwide nuclear arsenal peak?

(A) 1955

(B) 1965

(C) 1975

(D) 1985

(E) 1995

iClicker Question

About how many nuclear weapons were there at the peak?

- (A) 10,000
- (B) 30,000
- (C) 50,000
- (D) 70,000
- (E) 90,000

iClicker Question

About how many nuclear weapons were there at the peak?

(A) 10,000

(B) 30,000

(C) 50,000

(D) 70,000

(E) 90,000

iClicker Answer

About how many nuclear weapons are in the global inventory today?

- (A) 5,500
- (B) 8,500
- (C) 13,500
- (D) 15,700
- (E) 17,300

iClicker Answer

About how many nuclear weapons are in the global inventory today?

- (A) 5,500
- (B) 8,500
- (C) 13,500
- (D) 15,700
- (E) 17,300**

iClicker Answer

About how many nuclear weapons does China now have *in total*?

- (A) 50
- (B) 100
- (C) 240
- (D) 3,000
- (E) 5,000

iClicker Answer

About how many nuclear weapons does China now have *in total*?

- (A) 50
- (B) 100
- (C) 240**
- (D) 3,000
- (E) 5,000

iClicker Question

About how many nuclear weapons does France now have
in total?

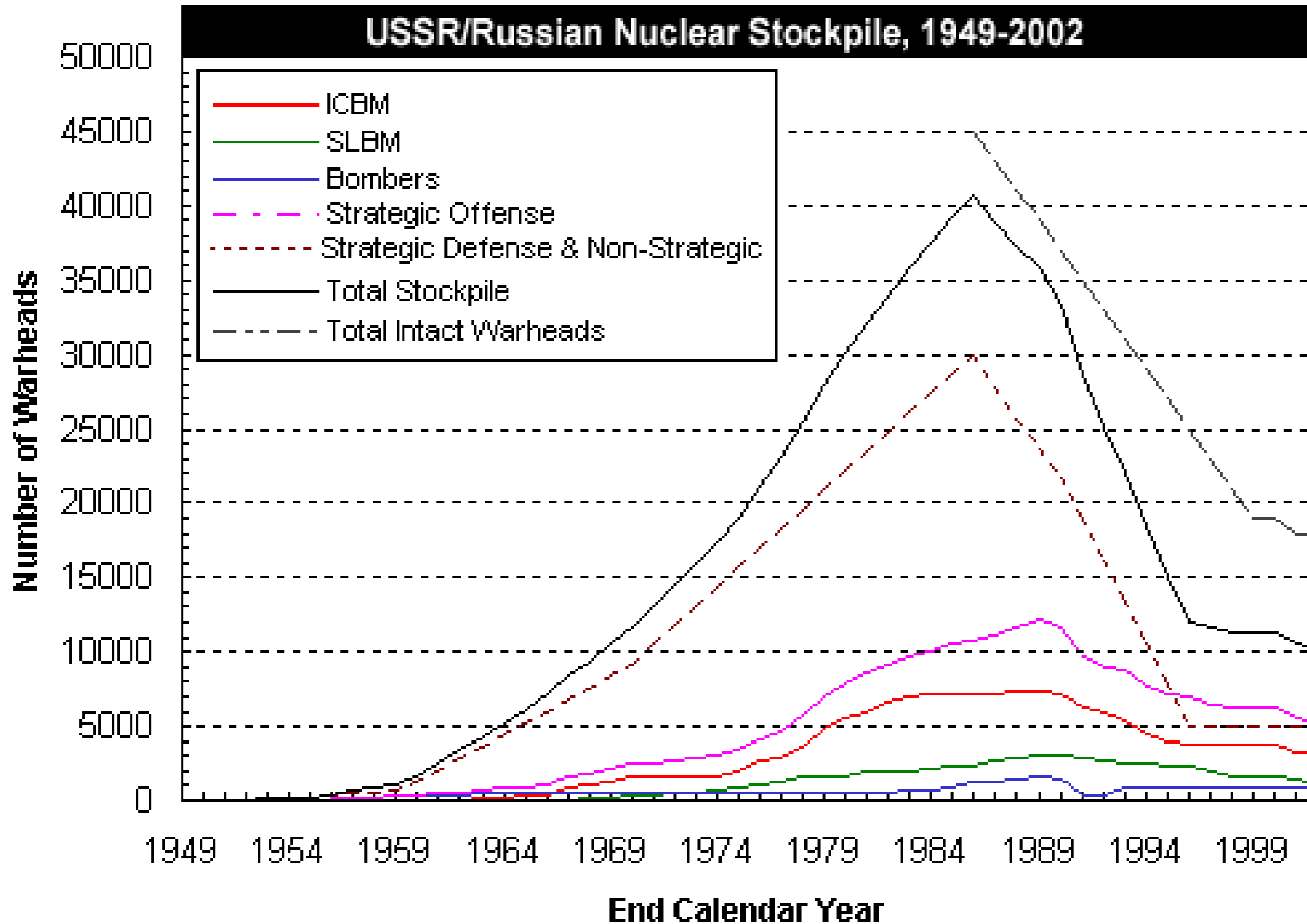
- (A) 50
- (B) 100
- (C) 300
- (D) 1,000
- (E) 5,000

iClicker Question

About how many nuclear weapons does France now have
in total?

- (A) 50
- (B) 100
- (C) 300**
- (D) 1,000
- (E) 5,000

SU-Russian Nuclear Warheads



Russian Nuclear Forces (2011)

Type/name	Russian designation	Launchers deployed	Year	Warheads x yield (kilotons)	Total warheads
<i>Strategic offensive weapons</i>					
ICBMs					
SS-18 M6 Satan	RS-20V	50	1988	10 × 500/800 (MIRV)	500
SS-19 M3 Stiletto	RS-18	50	1980	6 × 400 (MIRV)	300
SS-25 Sickle	RS-12M (Topol)	120	1985	1 × 800	120
SS-27 Mod 1	RS-12M2 (Topol-M)	51	1997	1 × 800	51
SS-27 Mod 1	RS-12M1 (Topol-M)	18	2006	1 × 800?	18
SS-27 Mod 2	RS-24	6	2010	3 × 400? (MIRV)	18
Subtotal		295			1,007
SLBMs					
SS-N-18 M1 Stingray	RSM-50	4/64	1978	3 × 50 (MIRV)	192
SS-N-23 Skiff	R-29RM	1/16	1986	4 × 100 (MIRV)	64
SS-N-23 M1	RSM-54 (Sineva)	5/80	2007	4 × 100 (MIRV) ¹	320
SS-N-32	RSM-56 (Bulava)	(1/16)	(2011)	6 × 100 (MIRV)	(96)
Subtotal		10/160			576
Bombers/weapons					
Bear-H6	Tu-95 MS6	32	1984	6 × AS-15A ALCMs, bombs	192
Bear-H16	Tu-95 MS16	31	1984	16 × AS-15A ALCMs, bombs	496
Blackjack	Tu-160	13	1987	12 × AS-15B ALCMs or AS-16 SRAMs, bombs	156
Subtotal		76			844²
Subtotal strategic offensive forces					~2,430

Russian Nuclear Forces



Russian SS-25 Road-Mobile Launcher



Russian SS-27 Mod 1 ICBM Launch

Russian Nuclear Forces



Russian SS-27 Road-Mobile Launcher

Russian Nuclear Forces (2010)

NONSTRATEGIC AND DEFENSIVE WEAPONS

ABM/Air defense

53T6	Gazelle	68	1986	1 x 1,000/10	68 ²
SA-10	Grumble	1,900	1980	1 x low	630

Land-based air

Bombers/fighters		~524		ASM, bombs	650
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Naval

Submarines/surface ships/air				SLCM, ASW, SAM, ASM, DB, torpedoes	700
------------------------------	--	--	--	------------------------------------	-----

SUBTOTAL NONSTRATEGIC AND DEFENSIVE FORCES ~2,000³

TOTAL ~4,600⁴

1. The Sineva probably carries at least four MIRVed warheads. U.S. intelligence in 2006 estimated that the missile can carry "up to 10" warheads.

2. All Gorgon missiles apparently have been removed from the ABM system.

3. We estimate that an additional 3,300 nonstrategic warheads are in reserve or awaiting dismantlement, leaving a total inventory of approximately 5,300 nonstrategic warheads.

4. We estimate that an additional 7,300 intact warheads are in reserve or awaiting dismantlement, for a total inventory of approximately 12,000 warheads.

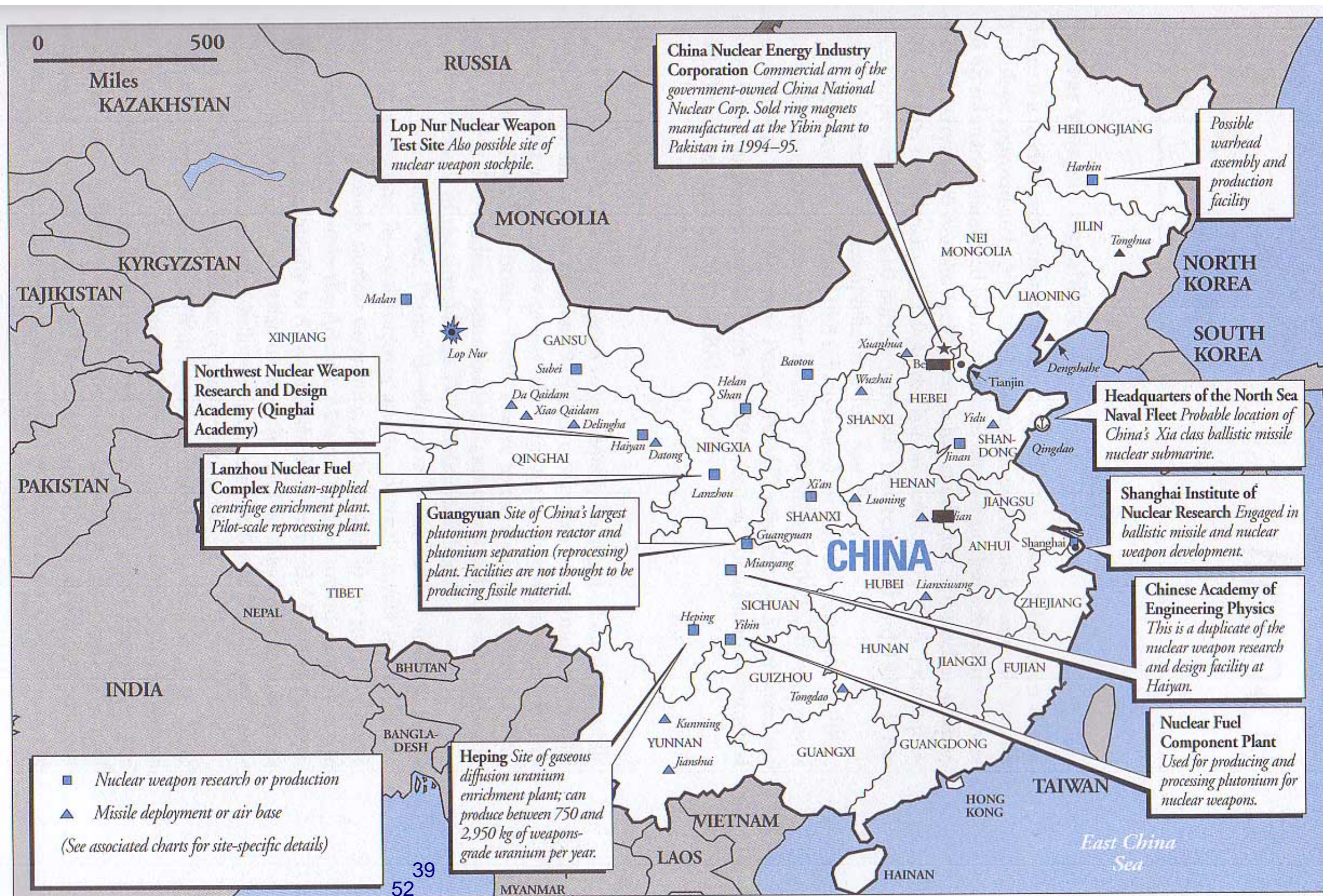
ABM: Antibalistic missile
 ALCM: Air-launched cruise missile
 ASM: Air-to-surface missile
 ASW: Antisubmarine weapon
 DB: Depth bomb
 ICBM: Intercontinental ballistic missile
 MIRV: Multiple independently targetable reentry vehicle
 SAM: Surface-to-air missile
 SLBM: Submarine-launched ballistic missile
 SLCM: Sea-launched cruise missile
 SRAM: Short-range attack missile

Recent Evolution of Russian Nuclear Forces

Evolution of Russian total warheads is very similar to the evolution of US nuclear forces (because of START and New START limits).

Unlike the US, for geopolitical reasons Russia deploys more warheads on its ICBMs than on its SLBMs.

China's Nuclear Infrastructure



Physics 280: Session 18

Plan for This Session

Midterm grades not available yet (sorry!)

RE4v1 due Thursday April 2nd

2nd Extra Credit Opportunity, Friday April 3rd

News and Discussion

Module 6: Nuclear Arsenals (cont'd)

Second Extra Credit Opportunity

Friday April 3. Symposium on Turkish Foreign Policy and Transatlantic Security. The symposium will be day long, but extra credit will only be given for attending one of the following two sessions. If you can attend both please go to the first one, since it is more directly relevant to our class. At 5pm there will also be a reception, which you are welcome to attend but is not extra credit.

3:30- 4:15 pm Nilsu Gören, University of Maryland

"Extended Deterrence and Tactical Nuclear Weapons: The Turkish Case"

4:15- 5:00 pm Kemal Silay, Indiana University

"A Political and Military Predicament: The Escalating Danger of Islamism in Turkey and Discourses against Its NATO Membership"

Location: 2025A SDRP Ikenberry
2nd Floor
301 E. Gregory Dr.
Champaign, IL 61820

Organized and graded by Leah Matchett
→ sign PHYS/GLBL 280 attendance sheet
→ submit extra credit essay by Friday
April 10th at 5pm.

Iran nuclear negotiations enter final day as deadlock persists

US says prospects of deal on the final day are '50-50' as talks remain stuck on Tehran's demand for immediate end to sanctions if nuclear programme is halted

Julian Borger in Lausanne

Tuesday 31 March 2015 05.08 EDT

High-level negotiations on Iran's nuclear programme enter their last day on Tuesday before a deadline for agreeing the outline for a comprehensive settlement, with top diplomats still struggling to overcome persistent obstacles.

The US secretary of state, John Kerry, his Iranian opposite number, Mohammad Javad Zarif, alongside foreign ministers from France, the UK, Germany and China, worked late into the evening on two consecutive nights in an effort to break the deadlock.

Russia's Sergei Lavrov left the talks on Monday afternoon to hold official meetings in Moscow, but said he would return to Lausanne later on Tuesday, telling reporters in the Russian capital that there was a good chance of success.

A US State Department spokeswoman said on Monday night that prospects of a deal on Tuesday were "50-50". Working teams of experts and diplomats were instructed to work through the night on outstanding issues in the search for a breakthrough.

Diplomats said that the principal sticking point was the issue of UN security council sanctions on Iran. Zarif's team is sticking by the demand by their country's supreme leader, Ali Khamenei, for all sanctions to be lifted at once in return for Iranian acceptance of restrictions on its nuclear programme over a period of at least 10 years.

The six-nation group is offering several relief measures, lifting the EU oil embargo and removing banking restrictions in moves synchronised with the suspension of corresponding US sanctions. But it insists that some UN sanctions must stay in place until Iran has convinced the international community it has no intention of pursuing a weapons programme, a task that could take many years.

The Guardian:
Deadline for P5+1 talks
with Iran: Today!

Chinese Nuclear Forces (2008)

LAND-BASED MISSILES

TYPE	NATO DESIGNATION	NO.	YEAR DEPLOYED	WARHEADS x YIELD (KILOTONS)	RANGE (KILOMETERS)	WARHEADS
DF-3A	CSS-2	17	1971	3,100	1 x 3,300	17
DF-4	CSS-3	17	1980	5,400+	1 x 3,300	17
DF-5A	CSS-4	20	1981	13,000+	1 x 4,000–5,000	20
DF-21	CSS-5	55	1991	2,100	1 x 200–300	55
DF-31	?	~6	2008	7,200+	7,200	~6
DF-31A	?	~6	2008	11,200+	11,200	~6

SUBMARINE-LAUNCHED BALLISTIC MISSILES

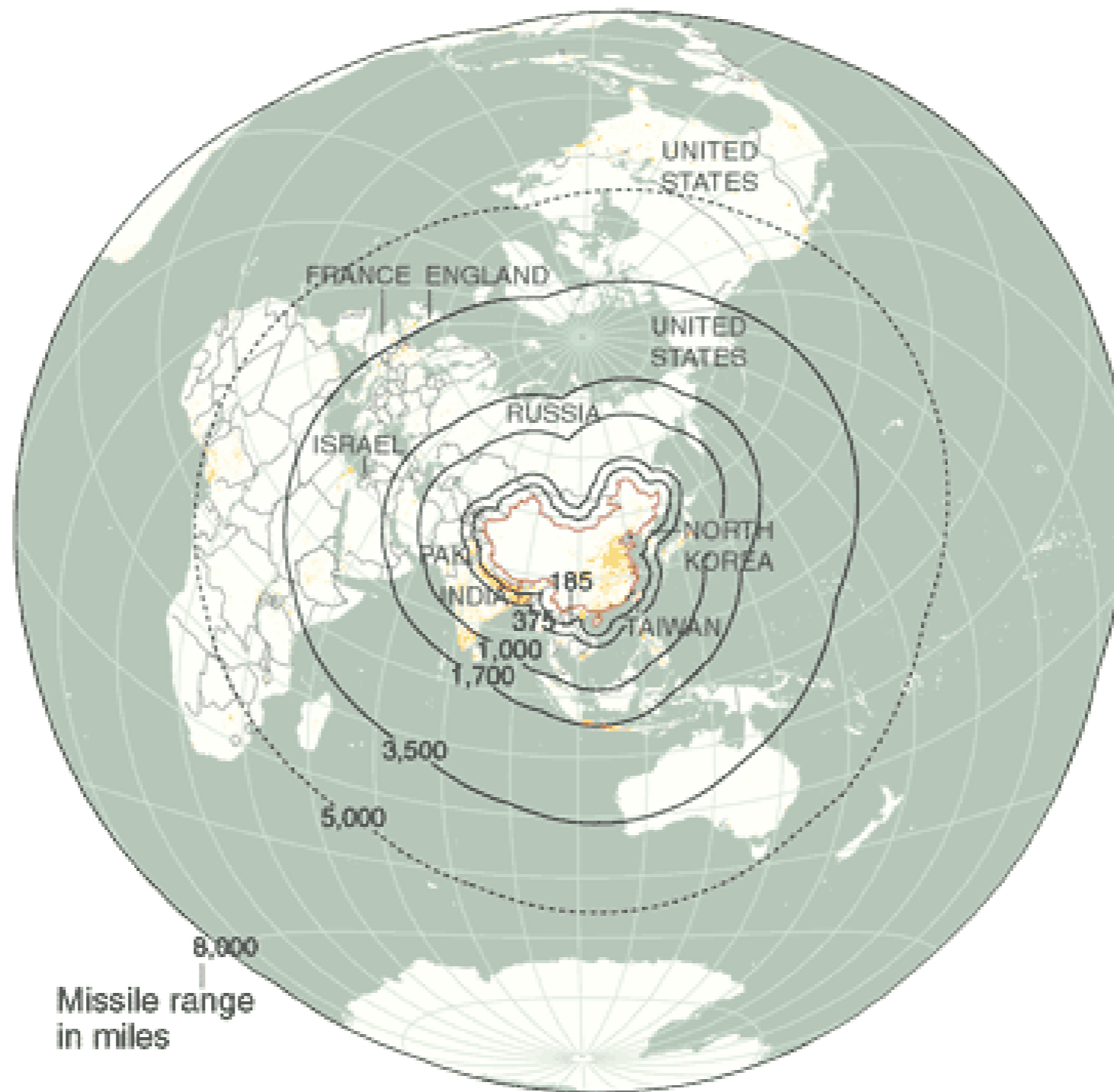
TYPE	NATO DESIGNATION	NO.	YEAR DEPLOYED	WARHEADS x YIELD (KILOTONS)	RANGE (KILOMETERS)	WARHEADS
JL-1*	CSS-NX-3	0	1986	1,000+	1 x 200–300	0
JL-2	CSS-NX-4	0	2009–10?	7,200+	1 x 200–300 ?	0

AIRCRAFT **

TYPE	NATO DESIGNATION	NO.	YEAR DEPLOYED	WARHEADS x YIELD (KILOTONS)	RANGE (KILOMETERS)	WARHEADS
Hong-6	B-6	20	1965	3,100	1 x bomb	~20
Qian-5, others?	Q-5	?	1972–?	—	DH-10 1 x bomb	~15 ~20

TOTAL* ~176**

Ranges of China's Missiles



French Nuclear Forces (2008)

THE FRENCH ARSENAL

LAND-BASED AIRCRAFT	NO.	YEAR OPERATIONAL	RANGE (KILOMETERS)	WARHEADS x YIELD (KILOTONS)	ACTIVE WARHEADS
Mirage 2000N/ASMP	50	1988*	2,750**	1 TN81 X VARIABLE TO 300	50
Rafale F3/ASMP-A	?	2008	2,000	1 TNA X VARIABLE TO ?	—

CARRIER-BASED AIRCRAFT	NO.	YEAR OPERATIONAL	RANGE (KILOMETERS)	WARHEADS x YIELD (KILOTONS)	ACTIVE WARHEADS
Super Étendard/ASMP	10	1978	650**	1 TN81 X VARIABLE TO 300	10
Rafale MK3/ASMP-A	?	(2010)	2,000	1 TNA X VARIABLE TO ?	—

SLBMs	NO.	YEAR OPERATIONAL	RANGE (KILOMETERS)	WARHEADS x YIELD (KILOTONS)	ACTIVE WARHEADS
M45***	48	N/A	4,000+	4–6 TN75 X 100	240

TOTAL: 300

* The ASMP first became operational on the Mirage IV in 1986.

** Maximum range of the ASMP is 300 kilometers; for the ASMP-A it is 500 kilometers.

*** Three sets of 16 M45 missiles are deployed on three of four SSBNs in the operational cycle.

FRENCH SSBNs

NAME/SLBM*	YEAR OPERATIONAL	MISSILE RANGE (KILOMETERS)	WARHEADS x YIELD (KILOTONS)	TOTAL WARHEADS
<i>Le Triomphant</i> /M45	1997	4,000+	4–6 TN75 x 100	80
<i>Le Téméraire</i> /M45	1999	4,000+	4–6 TN75 x 100	80
<i>Le Vigilant</i> /M45	2005	4,000+	4–6 TN75 x 100	80
<i>Le Terrible</i> /M51.1**	(2010)	6,000	4–6 TN75 x 100	0

* Three sets of 16 M45 missiles are deployed on three of four SSBNs in the operational cycle.

** Its first deployment is scheduled for 2010.

SSBN: Nuclear-power ballistic missile submarine

SLBM: Submarine-launched ballistic missile

U.K. Strategic Nuclear Forces

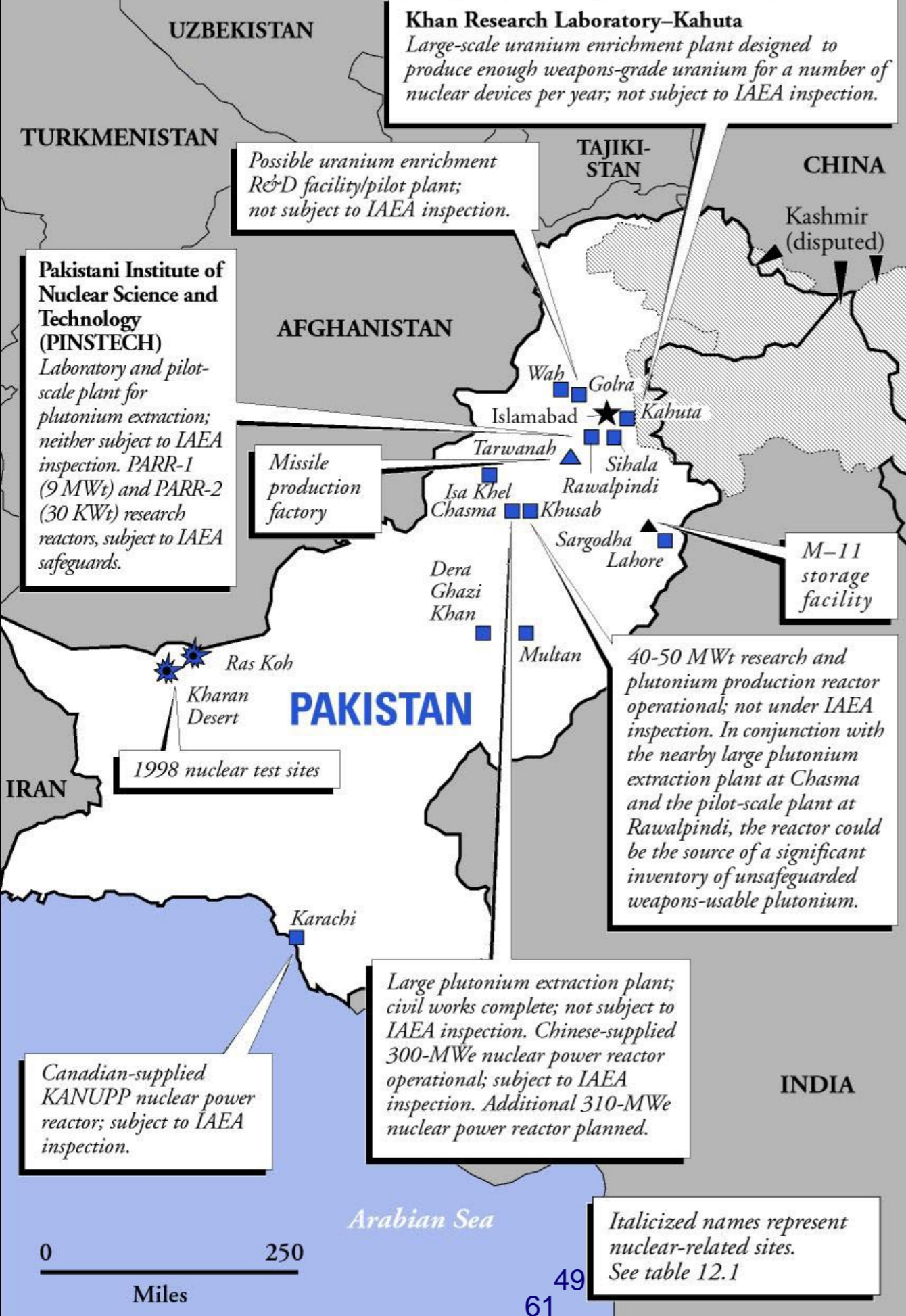
Weapon System	Warheads					
	No. deployed	Year deployed	Range (km)	Warhead x yield	Type	No. in stockpile
SLBMs						
Trident II D-5	64	1994	7,400	1-3 x 100 Kt	MIRV	200
# average loading five warheads per missile, some missiles carry one warhead , various yield options						

Source: NRDC (Nov. 2002)

Module 6: Programs and Arsenals

Part 3: Arsenals of non-NPT and Emerging Nuclear-Weapon States

India, Pakistan, Israel,
North Korea, and Iran



Italicized names represent nuclear-related sites. See table 11.1

Italicized names represent nuclear-related sites. See table 12.1

India's Nuclear and Missile Programs – 1

India's nuclear weapons use plutonium

- India's first nuclear explosive device used explosive material diverted illegally from a civilian nuclear reactor provided by Canada
- Estimated to have produced 225–370 kg of weapons-grade plutonium
- Estimated to have produced a smaller, but publicly unknown, quantity of weapons-grade uranium
- This quantity of plutonium is thought to be enough for India to produce ~50-90 nuclear weapons
- The NRDC estimates that India has 30–35 warheads
- India is thought to have the components to deploy a small number of nuclear weapons within days
- No nuclear weapons are known to be deployed among active military units or deployed on missiles

India's Nuclear and Missile Programs – 2

India's nuclear weapon tests

India			
Date			
May 18, 1974	02:34:55	27.095 N 71.752 E	2-5 kt
May 11, 1998	10:13:42	27.102 N 71.857 E	12 kt*
May 11, 1998	10:13	?	? *
May 13, 1998	06:51	?	? **

Local time is 5 and one-half hours later than GMT

* The Indian government announced that three nuclear devices were detonated simultaneously in two shafts, about one kilometer apart. We count this as two tests.

** Seismic records do not discriminate the explosions of two devices (announced by Indian scientists as being 0.2 kt and 0.6 kt), one or both of which may not have detonated.

Source: NRDC

India's Nuclear and Missile Programs – 3

India's nuclear delivery capability

- India has developed several types of ballistic missiles capable of carrying and delivering a nuclear payload
- Three versions of the short-range, liquid-propellant, road-mobile Prithvi have been developed —
 - Army (range = 150 km, payload = 500 kg)
 - Air Force (range = 250 km, payload = 500–750 kg)
 - Navy (range = 350 km, payload = 500 kg)
- India has developed and successfully tested 3 medium range missiles Agni I-III, with a declared range of up to 3,000 km. The payload for the Agni III missile is assumed to be 1.5 tons.
- Longer range missiles Agni IV and V are under development.
- Prior to 2010 the main delivery vehicles were bomber planes

Indian Nuclear Forces (2008)

AIRCRAFT	RANGE (KILOMETERS)	PAYLOAD (KILOGRAMS)	COMMENT
Mirage 2000H/Vajra	1,800	6,300	Squadron 1 or 7 at Gwalior Air Force Station.
Jaguar IS/IB/Shamsher	1,600	4,775	At Ambala Air Force Station.
LAND-BASED MISSILES	RANGE (KILOMETERS)	PAYLOAD (KILOGRAMS)	COMMENT
Prithvi I	150	1,000	Nuclear version entered service after 1998 with the 333rd and 355th Missile Groups. Will be converted from liquid fuel to solid fuel.
Agni I	700	1,000	First operational training test in 2007; second in 2008. Deployed with army's 334th Missile Group in 2004.
Agni II	2,000	1,000	Under development. Tested August 29, 2004. Deployed with army's 335th Missile Group.
Agni III	3,000	1,500	Under development. Test-launched in 2006 (failed), 2007, and 2008.
SEA-BASED MISSILES	RANGE (KILOMETERS)	PAYLOAD (KILOGRAMS)	COMMENT
Dhanush	350	1,000	Under development. Naval version of Prithvi II. Fourth test March 30, 2007.
Sagarika/K-15	300–700	500–600	Under development. K-15 test-launched February 26, 2008, from a submerged platform; deployment expected after 2010.

Pakistan's Nuclear and Missile Programs – 1

Pakistan's current nuclear weapons mainly use HEU

- Pakistan stole uranium enrichment technology from Urenco; has since supplied it to many other countries of concern
- Is estimated to have produced 585–800 kg of highly enriched uranium
- ACA estimates that it could have 70–90 HEU nuclear weapons
- May possess enough weapon-grade plutonium to produce 3–5 nuclear weapons
- Nuclear weapons are thought to be stored in component form, with the fissile core stored separately from the non-nuclear explosives
- Thought to possess enough components and material to assemble a small number of nuclear weapons in a matter of hours or days

Pakistan's Nuclear and Missile Programs – 2

Pakistan's nuclear weapon tests

Pakistan			
Date			
May 28, 1998	10:16:15	28.862 N 64.818 E	9-12 kt#
May 30, 1998	06:54:55	28.487 N 63:787 E	5 kt
Local time is 5 hours later than GMT			
# Pakistani officials announced that five nuclear devices were tested. Seismic records do not discriminate these and possibly only one device was detonated.			

last revised 11.25.02

Source: NRDC

Pakistan's Nuclear and Missile Programs – 3

Pakistan's nuclear delivery capability

- Thought to have about 30 nuclear-capable short-range Chinese M-11 surface-to-surface missiles, which have a range of 280–300 km
- Announced deployment of the Shaheen I in 2001
- Tested Ghauri I (range > 1,300 km, payload = 700 kg)
- Tested Ghauri II (range = 2,000 km, payload = 850 kg)
- Displayed but never tested the 2,000-km Shaheen II
- Primary nuclear capable aircraft is the F-16, which can deliver a 1,000-kg bomb to a distance of 1,400 km

Pakistani Nuclear Forces (2009)

We estimate that Pakistan has produced 70-90 nuclear warheads that can be deployed on the following delivery vehicles:

TYPE	RANGE ¹ (kilometers)	PAYLOAD (kilograms)
Aircraft		
F-16A/B	1,600	1 bomb (4,500)
Mirage V	2,100	1 bomb (4,000)
Ballistic missiles		
Ghaznavi (Hatf-3)	~400	Conventional or nuclear (500)
Shaheen-1 (Hatf-4)	450+	Conventional or nuclear (1,000)
Shaheen-2 (Hatf-6)*	2,000+	Conventional or nuclear (1,000)
Ghauri (Hatf-5)	1,200+	Conventional or nuclear (1,000)
Cruise missiles		
Babur (Hatf-7)*	320+	Conventional or nuclear (n/a)
Ra'ad (Hatf-8)*	320+	Conventional or nuclear (n/a)

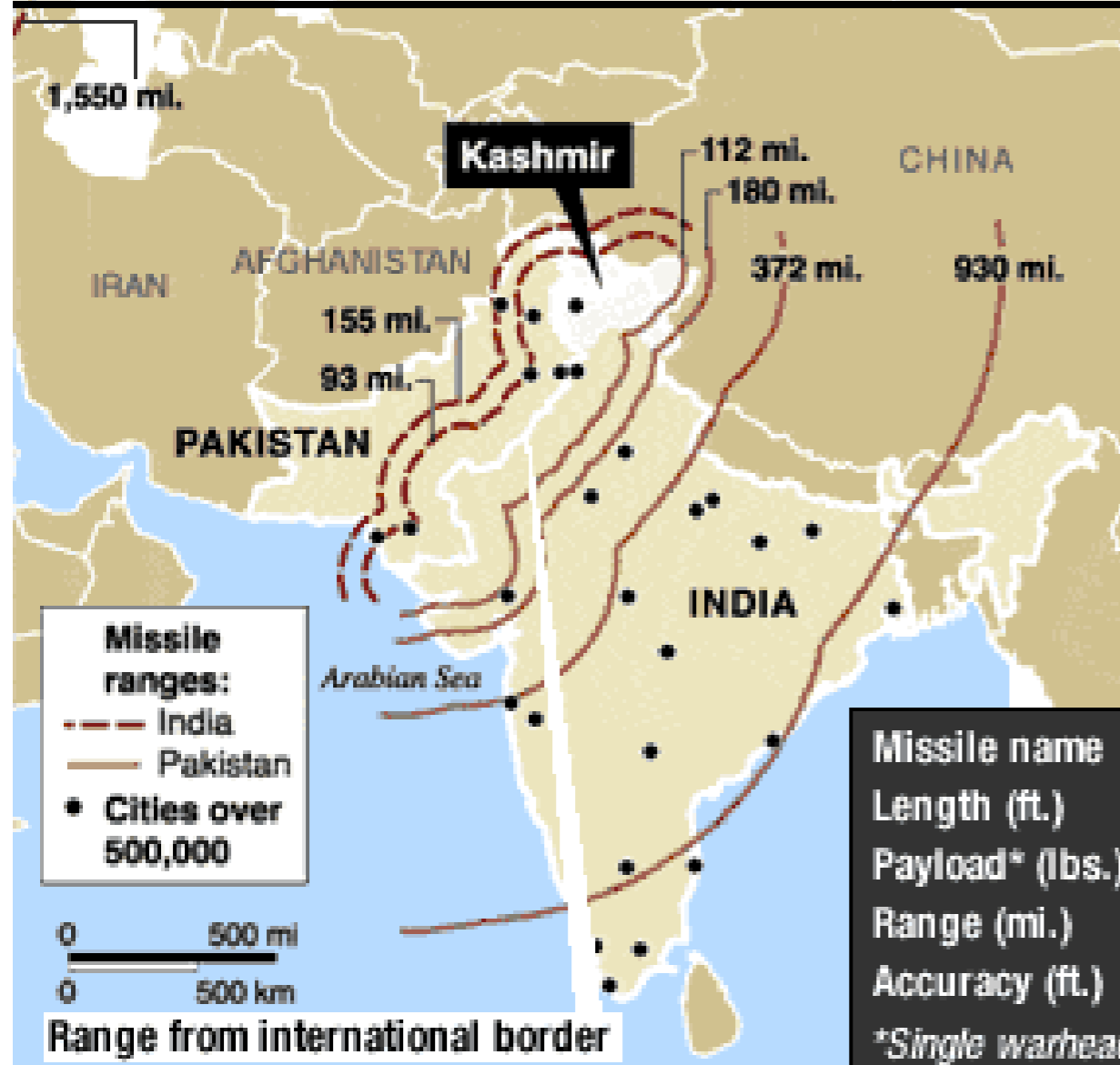
Pakistani Ra'ad Air-Launched Cruise Missile



Pakistani Ra'ad Air Launched Cruise Missile

Summary of India's and Pakistan's Ballistic Missile Systems

With India and Pakistan both possessing nuclear weapons and the means to deliver them great distances, a possible war could result in millions of deaths in both countries. The following illustrates the range of missiles:



SOURCES: Associated Press; Pakistan Armed Forces; Jane's Information Group

	INDIA				PAKISTAN			
Missile name	Agni 1	Agni 2	Prithvi 1	Prithvi 2	Ghauri 1	Shaheen 1	Ghauri 2	Shaheen 2
Length (ft.)	69.3	66	28.2	28.2	28	33	39.6	52.5
Payload* (lbs.)	2,200	2,200	1,760	1,100**	1,100	1,100	2,200	2,640
Range (mi.)	1,560	2,190	94	156	375	940	1,440	1,560
Accuracy (ft.)	495	330	165	248	660	n/a	660	8,250

*Single warhead **up to 1,650 lbs.

Source: CNN (May 2003)

Israel's Nuclear Weapons Complex



Israel's Nuclear and Missile Programs – 1

Israel's nuclear weapons primarily use Pu

- Is thought to have completed its first nuclear device by late 1966 or early 1967, probably using HEU stolen from the United States
- Is reported to have hurriedly assembled deliverable devices just before the 1967 six-day war.
- Is estimated to have produced ~ 400–700 kg of weapons-grade plutonium
- Is thought to have enough plutonium to fabricate ~ 100–200 nuclear weapons
- Is thought to have ~ 75–200 fission weapons (but some sources disagree, claiming much more capability, including modern thermonuclear weapons)

Israel's Nuclear and Missile Programs – 2

Israel's nuclear delivery capability

- Jericho I: short-range, solid-propellant (range = 500 km, payload = 500 kg). Developed with the French. Deployed in 1973. Land- and rail-mobile.
- Jericho II: medium-range, solid-propellant (range = 1,500 km, payload = 1,000 kg). Developed with the French. Deployed in 1990; currently has ~ 100. Land- and rail-mobile.
- Jericho III: intermediate-range, solid-propellant (range approx. 4,000 km, payload = 1,000 kg). Indigenous. Tested. Operational?
- Israel could also deliver nuclear weapons using its U.S.-supplied F-4E and F-16 aircraft.
- Israel could also deliver nuclear weapons using its cruise missiles (the U.S.-supplied Harpoon, range = 120 km, payload = 220 kg, or a new 1,200-km cruise missile).

Summary of Israel's Nuclear Delivery Systems

Strategic forces

	Year deployed	Range (kilometer)	Comment
Aircraft			
F-16A/B/C/D/I Fighting Falcon	1980	1,600	Bombs possibly stored at Tel Nof, Nevatim, Ramon, Ramat-David, and Hatzor
F-15I Ra'am (Thunder)	1998	4,450	Could be used for long-range strike role
Land-based missiles			
Jericho I	1972	1,200	Possibly 50 at Zekharyeh
Jericho II	1984–85	1,800	Possibly 50 at Zekharyeh, on TELs in caves
Sea-based missiles			
<i>Dolphin</i> -class submarines	2002 (?)	?	Modified Harpoon missiles for land-attack
Non-strategic forces			
Artillery and landmines	?	?	Reports of these weapons cannot be confirmed

Source: Bulletin of the Atomic Scientists (Sept./Oct. 2002)

iClicker Question

Based on the range of its delivery systems the nuclear weapons arsenal in Pakistan responds to strategic threats from

- A. China
- B. India
- C. China and India
- D. China, India and Russia
- E. Russia

iClicker Question

iClicker Answer

Based on the range of its delivery systems the nuclear weapons arsenal in Pakistan responds to strategic threats from

- A. China
- B. India**
- C. China and India
- D. China, India and Russia
- E. Russia

iClicker Question

Which countries have Uranium enrichment plants that are monitored by the IAEA?

- A. Pakistan and India
- B. The Netherlands and Germany
- C. Pakistan
- D. India

iClicker Question

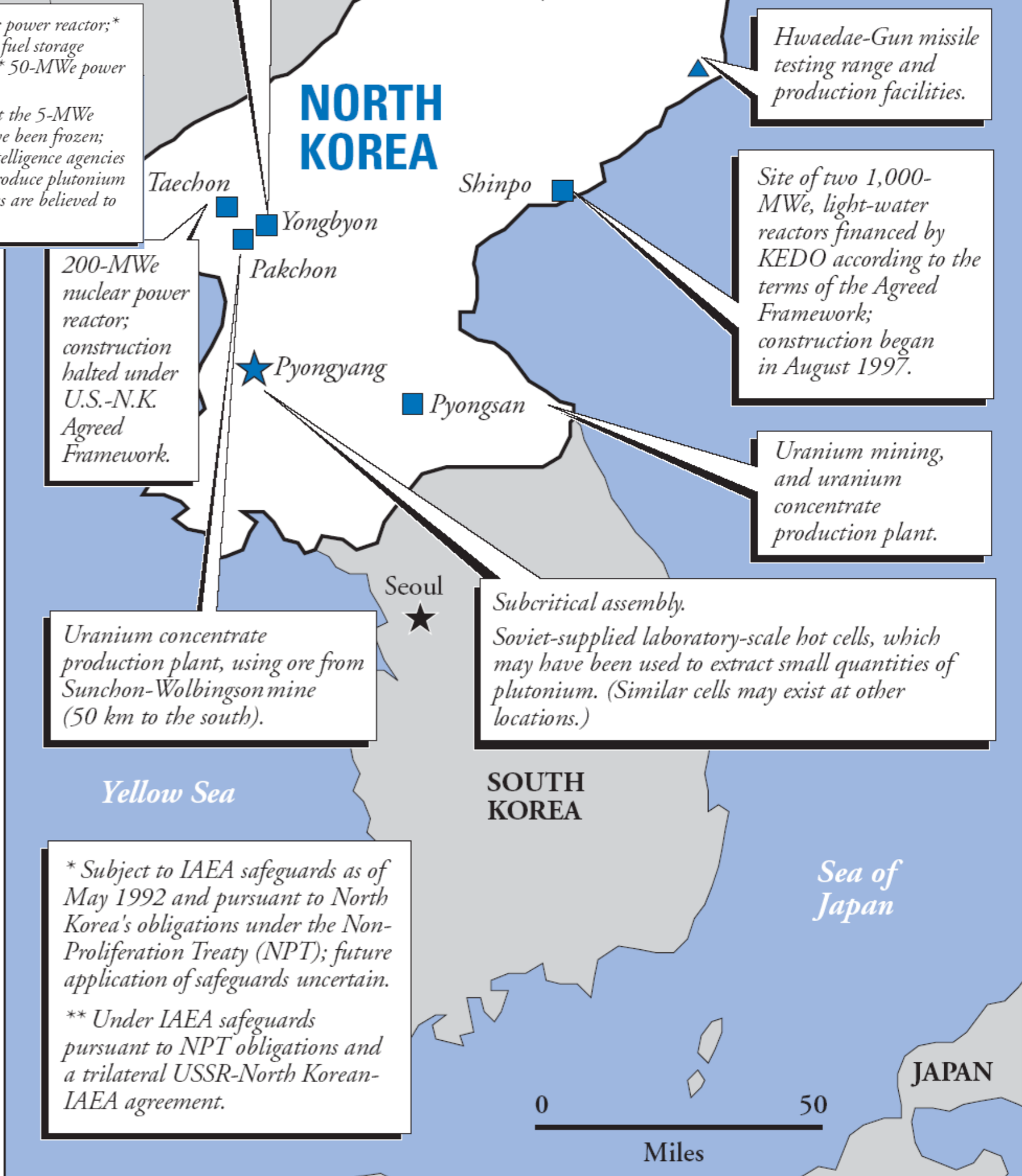
iClicker Question

Which countries have Uranium enrichment plants that are monitored by the IAEA?

- A. Pakistan and India
- B. The Netherlands and Germany**
- C. Pakistan
- D. India

Yongbyon Nuclear Research Center Site of a 5-MWe experimental nuclear power reactor;* a partially completed plutonium extraction facility;* a fuel fabrication plant;* fuel storage facilities;* and a Soviet-supplied IRT research reactor** and critical assembly.** 50-MWe power reactor previously under construction.

Under the Oct. 21, 1994, U.S.-North Korean Agreed Framework, activities at the 5-MWe gas-graphite reactor, the fuel fabrication facility, and the reprocessing plant have been frozen; construction also has been halted on the 50-MWe gas-graphite reactor. U.S. intelligence agencies believe that North Korea has used the 5-MWe reactor and extraction plant to produce plutonium (possibly enough for 1 or 2 nuclear weapons). Wastes from the extraction process are believed to be stored at two undeclared sites near the center.



* Subject to IAEA safeguards as of May 1992 and pursuant to North Korea's obligations under the Non-Proliferation Treaty (NPT); future application of safeguards uncertain.

** Under IAEA safeguards pursuant to NPT obligations and a trilateral USSR-North Korean-IAEA agreement.

North Korea's Nuclear Program – 1

History —

- 1950s: NK nuclear research reportedly begins.
- At this time NK was a Soviet Client state and its nuclear engineers were largely trained at Soviet scientific institutes.
- 1965: NK begins operating a small research reactor it received from the USSR.
- mid-1980s: Concerns over NK's nuclear weapons program grow when US intelligence satellites reportedly photograph construction of a research reactor and the beginnings of a reprocessing facility at Yongbyon.

North Korea's Nuclear Program – 2

History (cont'd) —

- 1985 April: NK accedes to the NPT after a concerted sales effort by the USSR, which hopes to sell light-water reactors (LWRs) to NK for electrical power generation. These are never built, in part due to the collapse of the Soviet Union.
- 1986: NK publicly makes withdrawal of US nuclear weapons from SK a condition of its completion of the safeguard agreement required by the NPT, completes negotiation of the safeguard agreement with the IAEA within 18 months after acceding to the NPT, as the NPT requires.
- 1991: US signals it will withdraw its nuclear weapons from SK as part of its global return of tactical nuclear weapons to United States territory. (The United States had stationed a large number — sometimes more than 700 — nuclear weapons in SK as part of its alliance with SK and its Cold War strategy of flexible response to a possible attack by the USSR or its allies.)

North Korea's Nuclear Program – 3

History (cont'd) —

- 1989: NK is reported to have shut down its main research and plutonium production reactor for approximately 100 days.
- The US Intelligence Community judges that this was enough time for NK to extract enough nuclear material to build a nuclear device and to refuel the entire reactor
- Neither the US nor any other country takes any direct action in response to this development.
- Instead, the international community presses NK to join the NPT and come into full compliance with its obligations under the NPT and makes this a condition for further progress on diplomatic issues.
- NK is believed to have extracted enough Pu for 1 or 2 nuclear bombs.

North Korea's Nuclear Program – 3

APPROXIMATE FISSILE MATERIAL REQUIREMENTS FOR PURE FISSION NUCLEAR WEAPONS								
	<i>technical capability</i>			Yield (kilotons)	<i>technical capability</i>			
	<i>low</i>	<i>medium</i>	<i>high</i>		<i>low</i>	<i>medium</i>	<i>high</i>	
weapon- grade plutonium (kilograms)	3	1.5	1	1	8	4	2.5	highly enriched uranium (kilograms)
	4	2.5	1.5	5	11	6	3.5	
	5	3	2	10	13	7	4	
	6	3.5	3	20	16	9	5	

Source: NRDC (April 2003)

North Korea's Nuclear Program – 5

History (cont'd) —

- 1992 April 9: NK finally approves its NPT safeguard agreement.
- 1992 May: Inspections to verify the accuracy of NK's initial declaration begin. NK informs the IAEA it conducted a one-time Pu extraction experiment on “damaged” fuel rods removed from the reactor at Yongbyon in 1989 but extracted only 90 grams of Pu ($< 1/40$ of the amount needed to produce a nuclear device).
- IAEA chemical analysis indicates NK had separated plutonium in four campaigns over a 3-year period beginning in 1989 and that NK possesses more Pu than it had declared to the IAEA or to the international community.
- 1993: NK announces it is withdrawing from the NPT.
- 1994: US threatens war with NK. President Carter flies to NK and negotiates a nuclear agreement to avoid war.

Key Elements of the 1994 Agreed Framework

North Korea	United States
<p>North Korea freezes its operation and construction of nuclear facilities under IAEA supervision.</p> <p>North Korea allows the canning and nonreprocessing of spent fuel from its 5-MW reactor under IAEA monitoring. Fuel to be removed from North Korea.</p> <p>North Korea agrees to provide all necessary information and access, "including taking all steps that may be deemed necessary by the IAEA" to determine the accuracy of North Korea's initial declaration on past plutonium production</p> <p>North Korea agrees to begin dismantling its finished and incomplete nuclear facilities and to begin removal of spent fuel upon delivery of key reactor components for first light-water reactor.</p> <p>North Korea agrees to complete dismantling of its nuclear facilities and removal of its spent fuel upon delivery of key components for second reactor.</p>	<p>The United States agrees to provide heavy fuel oil to replace the electrical production potential of the shutdown 5-MW reactor.</p> <p>The United States agrees to establish an international consortium to construct two modern, light-water reactors in North Korea.</p> <p>International consortium agrees to complete a significant portion of the reactor complex, not including key components.</p> <p>International consortium to deliver key components for first light-water reactor.</p> <p>International consortium to deliver key components for second light-water reactor.</p>

North Korea's Nuclear Program – 6

History (cont'd) —

- 1994 October: The US and NK sign the 1994 Agreed Framework. A key goal of the Agreed Framework is for NK to replace its indigenous gas-graphite reactors with imported LWRs, which are good for electrical power generation but less useful for making bomb material.
- 1994 November: The new Republican majority in the US Congress rejects the Agreed Framework and refuses to fund its execution.
- 1994–1998: Execution of the Agreed Framework is plagued with political and technical problems and fails to make much progress.
- 1998 August: NK launches a 3-stage Taepo Dong-1 rocket with a range of 1,500–2,000 km; 3rd stage explodes at ignition.
- 1999 September: NK agrees to a moratorium on testing of long-range missiles as long as arms talks with the US continue.

North Korea's Nuclear Program – 7

History (cont'd) —

- 2000 September: US and NK resume direct talks in New York on nuclear weapons, missiles, and terrorism.
- 2000 October: NK 2nd in command visits Washington, DC, meets President Clinton and US Secretaries of State and Defense.
- 2000 October: US and NK issue Joint Communiqué:
 - Neither government has hostile intent toward the other.
 - Both commit to building a new relationship free from past enmity.
- 2000 October: NK states that it will not further test the Taepo Dong-1 missile; President Clinton announces he will travel to NK.
- 2000 December: Clinton announces he will not leave US to travel to NK during the constitutional crisis created by the Presidential election dispute; time runs out.

Physics 280: Session 19

Plan for This Session

Questions

Extra Credit Assignment due on Friday, April 3rd

3:30- 4:15 pm Nilsu Gören, University of Maryland

"Extended Deterrence and Tactical Nuclear Weapons: The Turkish Case"

4:15- 5:00 pm Kemal Sılay, Indiana University

"A Political and Military Predicament: The Escalating Danger of Islamism in Turkey and Discourses against Its NATO Membership"

News

Module 6: Nuclear Arsenals (cont'd)

- o North Korea cont'd

- o Iran

Video Presentation: Kim's Nuclear Gambit

North Korea's Nuclear Program – 8

History (cont'd) —

- Secretary of State Colin Powell says President Bush will continue the engagement with NK currently in progress.
- 2001 June: President Bush announces desire for “serious discussions” with NK.
- 2002 January: Bush II labels NK part of “an axis of evil”.
- 2002 October: Visiting US official publicly challenges NK, US claims NK has uranium enrichment effort that violates the 1994 Agreed Framework.
- 2002 November: KEDO (Korean Energy Development Organization) consortium suspends fuel oil deliveries to NK, alleging NK has violated the Agreed Framework.

North Korea's Nuclear Program – 9

History (cont'd) —

- 2002 December: NK announces it is restarting its reactor because US violated the Agreed Framework, ends its cooperation with the IAEA, orders inspectors out.
- 2003 January: NK announces it is withdrawing from the NPT.
- 2004: NK tells visiting US experts it has separated the Pu in the spent reactor fuel at Yongbyon and is making nuclear weapons, shows “Pu” to visiting experts. NK is believed to have extracted 24–42 kg of Pu, enough for 6–12 nuclear bombs.
- 2006 October 9: NK tests a Pu nuclear explosive device.
- 2007 February 28: New 6-party agreement announced (see separate slide).
- 2009 April 5: NK launches a long-range rocket, is condemned by the UN, announces it will build its own LWR without outside help.
- 2009 May 25: NK tests a second nuclear explosive device.

Six-Party Agreement (2007 Feb 28)

An important first step toward complete, verifiable, and irreversible denuclearization of the Korean peninsula and the establishment of a more stable, peaceful, and prosperous Northeast Asia.

The D.P.R.K. agreed that it will, within 60 days:

- Shut down and seal Yongbyon nuclear facility for eventual abandonment
- Invite IAEA to conduct necessary monitoring and verifications
- Discuss with the other parties a list of all its nuclear programs, including plutonium extracted from used fuel rods, that would be abandoned

The other Parties agreed that they will:

- Provide emergency energy assistance to North Korea in the initial phase
- Make an initial shipment of emergency energy assistance equivalent to 50,000 tons of heavy fuel oil (HFO) within the first 60 days of the agreement

Five working groups will be established to carry out initial actions and formulate specific plans to implement the agreement, leading to a denuclearized D.P.R.K. and a permanent peace.

North Korea's Nuclear Program – 10

History (cont'd) —

- 2011 Dec 17 Kim Jon-un ascends to Supreme Leader of NK
- 2012 Feb 29: NK agrees to freeze nuclear program in exchange for energy and food relieve.
- 2012 Apr. 12: Unsuccessful NK missile test leads to cancellation of food and energy relieve agreement.
- 2012 May 4: Reports that NK has resumed construction of LWR for Pu production at Yongbyon.
- 2012 Dec. 12: Successful test of long range missile launching satellite into orbit
- 2013 Feb. 12: NK tests third nuclear explosive device.
- 2014 March Activities at nuclear test site consistent with preparations for a fourth nuclear test.

Agreement Aid for

Stopping Nuclear Work in February 2012

The New York Times

North Koreans Agree to Freeze Nuclear Work; U.S. to Give Aid => 240,000 metric tons of food aid

By STEVEN LEE MYERS and CHOE SANG-HUN

WASHINGTON — North Korea announced on Wednesday that it would suspend its nuclear weapons tests and uranium enrichment and allow international inspectors to monitor activities at its main nuclear complex. The surprise announcement raised the possibility of ending a diplomatic impasse that has allowed the country's nuclear program to continue for years without international oversight.

The Obama administration called the steps “important, if limited.” But the announcement seemed to signal that North Korea's new leader, Kim Jong-un, is at least willing to consider a return to negotiations and to engage with the United States, which pledged in exchange to ship tons of food aid to the isolated, impoverished nation.

Impact of Aid

Los Angeles Times

North Korea: What does 240,000 metric tons of food mean?

February 29, 2012 | 1:20 pm

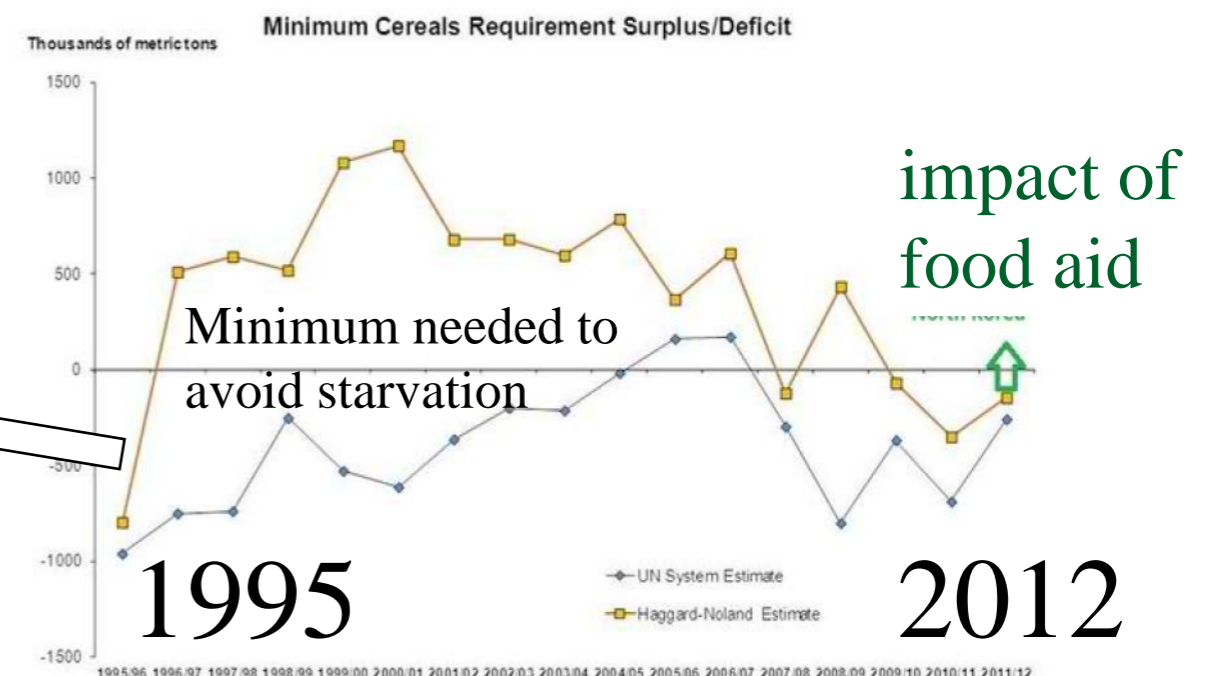
Hunger is a known menace in North Korea: In most of the country, even a bowl of rice is a rare treat. North Korea and the U.S. are poised to **strip** would bring 240,000 metric tons of food aid to the impoverished country if it suspends nuclear weapons tests and enrichment.

What would all that food really mean for North Korea? Here's a quick look.

Experts **Stephan Haggard** and **Marcus Noland** have estimated that North Korea has been falling below the minimum grain supplies needed for ex have enough food, as the graph below shows.

The yellow line represents their estimates; the blue line is U.N. estimates, which are somewhat lower. The Times added a green arrow to show how metric tons of U.S. aid could change that.

Famine in North Korea 1995 – 1998
unknown number of victims
estimates 600,000 – 3,000,000
in a population of 23 million



North Korea's Nuclear Program – 11

Recent situation (see the assigned reading written by Hecker) —

- 2010 November: NK showed visiting U.S. experts (Carlin, Hecker, and Lewis)
 - An openly constructed, recently completed small but industrial-scale centrifuge uranium-enrichment facility
 - An experimental light-water reactor (LWR) under construction
- NK claimed 2,000 P-2 centrifuges in 6 cascades in the modern facility at Yongbyon (built with external help from Khan)
- Publicly displayed facility is sufficient to produce
 - 2 tons of LEU/year, enough to supply the LWR under construction
 - 1 bomb/year of HEU, if slightly reconfigured
- Experts believe NK has undisclosed centrifuge facilities at other sites, probably producing weapon-grade HEU. NK has fundamentally changed its nuclear strategy.
- New leadership under Kim Jong-un appears to continue nuclear weapons program aggressively.

North Korea's Nuclear Program – 12

- NK's new nuclear strategy —
 - Appears to have abandoned its Pu program, shutting down its 5 MWe gas-graphite reactor and giving up on external assistance for LWRs
 - Is attempting to construct an experimental 25-30 MWe LWR of indigenous design as part of an electrical power program (probably not for bomb Pu)
- Major concerns about NK's new nuclear strategy —
 - Can NK construct its own LWR safely?
 - Will NK's enrichment program lead to additional weapons or export?

North Korea's Nuclear Program – 13

- Can NK construct its own LWR safely?
 - NK appears to have no experience with key LWR design and safety issues.
 - Radiation-resistant steels and stringent construction are needed to withstand the intense, long-term radiation produced by LWRs.
 - NK has little experience with uranium oxide fuels and fuel-cladding alloys.
 - The concrete reactor foundation is insufficiently robust.
 - The concrete containment shell is being poured in small sections from a small concrete mixer.
 - These safety concerns will increase dramatically if NK builds larger LWRs, because the risks would extend well beyond NK's borders.

North Korea's Nuclear Program – 14

- Will NK's enrichment program lead to additional weapons or export?
 - Bomb-grade HEU can be produced by slightly reconfiguring the existing centrifuge cascade
 - NK has indigenous U ore and all the know-how and equipment needed to make feedstock for its centrifuge cascades
- NK can ratchet up the current nuclear threat by
 - Greatly expanding its HEU production at undisclosed sites
 - Increasing substantially the size of its nuclear arsenal
 - Conducting additional nuclear tests to increase the sophistication of its nuclear weapon designs
 - Exporting nuclear weapon materials or technology
- NK's categorical denial of any earlier enrichment activities, when they clearly existed, complicates diplomatic reengagement

What to Do About NK's Nuclear Program?

- Top priority: prevent NK from expanding its arsenal or exporting its nuclear technologies
- Long-term goal: denuclearize the Korean peninsula
- Few options but to reengage NK diplomatically
- Hecker advocates 3 No's supported by 1 Yes:
 - No more bombs
 - No better bombs (which means no more testing)
 - No export of bombs or bomb technology and materials
 - Yes to meeting NK's fundamental security concerns
- What are NK's fundamental security requirements?
 - Normalization of relations with the United States
 - Energy and economic aid / Regime survival

North Korea's Ballistic Missile Capabilities

NORTH KOREAN BALLISTIC MISSILES			
	Range (kilometers)	Payload (kilograms)	Comment
Scud B	320	1,000	Reverse-engineered Soviet Scud B
Scud C	500	770	Conventional explosives, chemical, and cluster warheads
Nodong	1,350–1,500	770–1,200	Test fired in May 1993; flew 500 kilometers. Close to 100 deployed. Designed to carry a nuclear warhead
Taepodong-1	1,500–2,500	1,000–1,500	Test-launched August 31, 1998
Taepodong-2	3,500–6,000	700–1,000	Not yet tested
Taepodong-2 (three-stage)	up to 15,000	several hundred	More than a decade away

Source: NRDC (April 2003)

Unha-2 rocket for Satellite launch derived from Tepodong-2
Unha-3

Unsuccessful test launch 4-5-2009
Test launches 4-12-2012 (unsuccessful)
and 12-12-2012 (successful)

Ranges of North Korea's Missiles



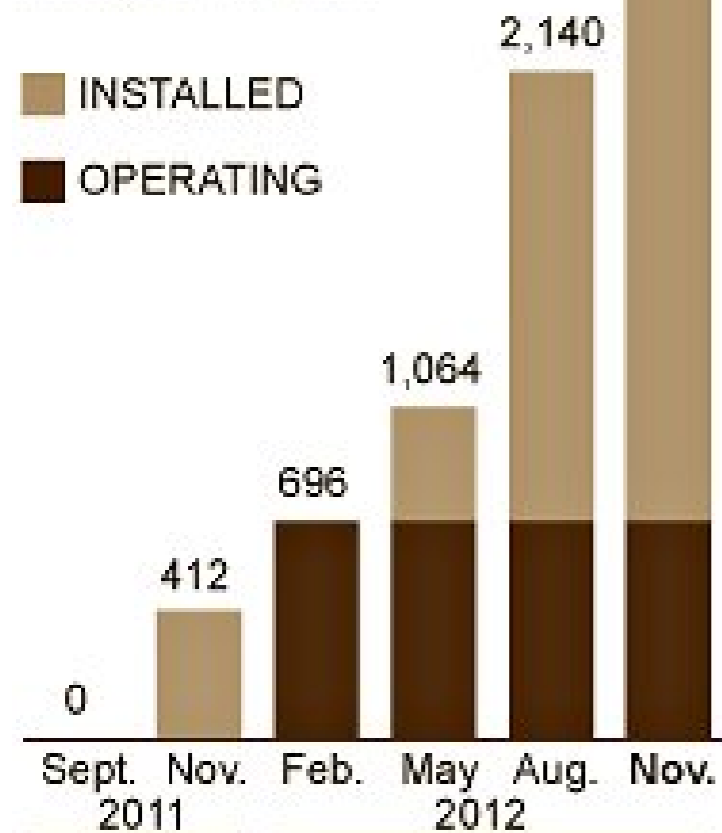
Kim's Nuclear Gambit

Video Presentation:
Kim's Nuclear Gambit

Iran's Nuclear Complex

Making Progress

Iran's Fordo complex, built inside a mountain near Qum, now has the full capacity of centrifuges, 2,784, that it was designed to hold.



Source: International Atomic Energy Agency

Iran's nuclear facilities

Iran has revealed to the U.N. nuclear watchdog the existence of a second uranium enrichment plant.



Iran's Nuclear and Missile Programs – 1

Iran's nuclear weapon capability —

- Iran has the basic nuclear technology and infrastructure needed to build nuclear weapons
- The intelligence services of Israel, the United Kingdom, Germany and the United States have publicly confirmed that it has a long-term program to manufacture nuclear weapons

Iran's Nuclear and Missile Programs – 2

Iran's nuclear program has continued to advance —

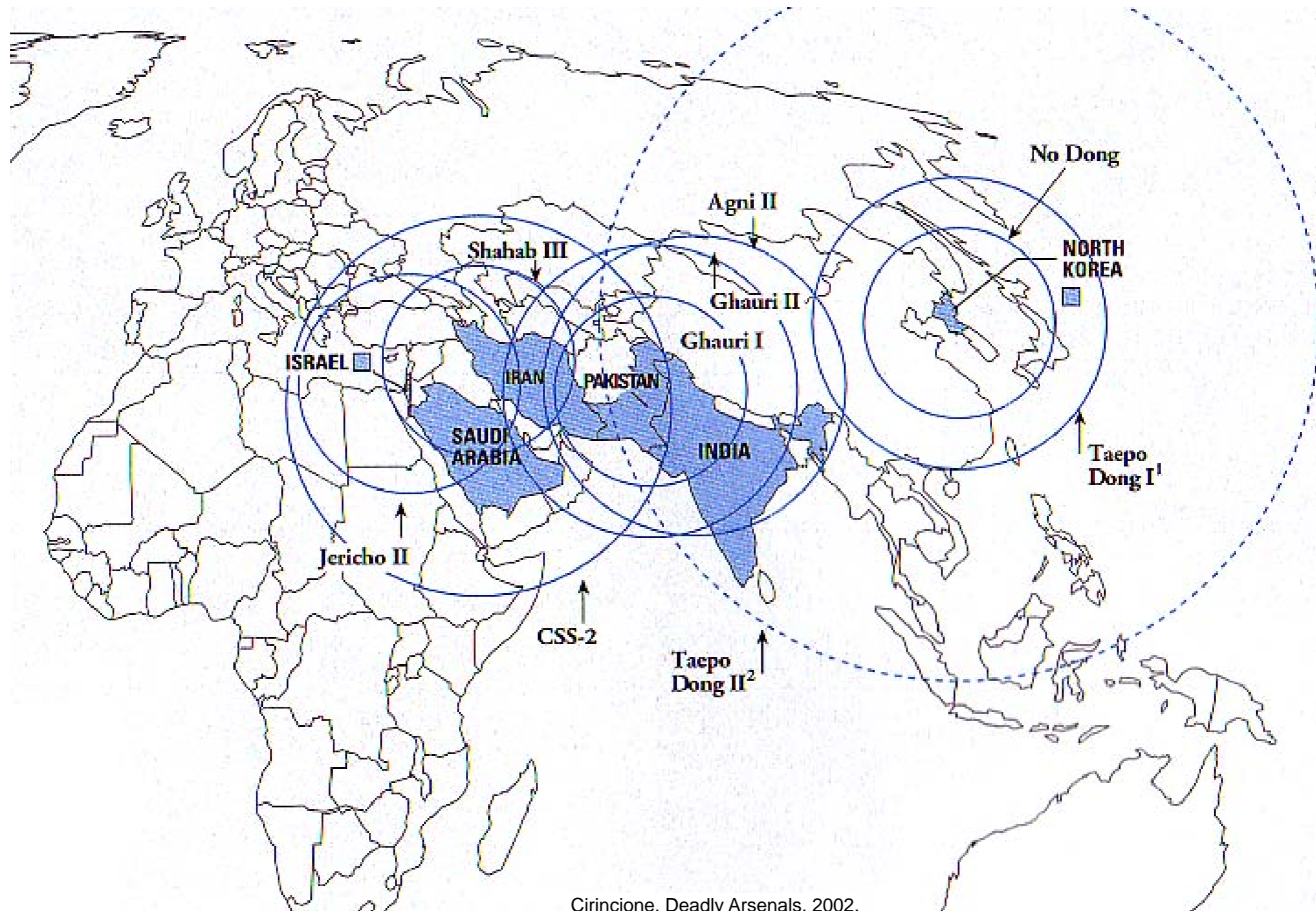
- It has completed a large gas-centrifuge uranium enrichment facility at Natanz with 7000 centrifuges in June 2009.
- In its June 2009 report the IAEA estimated that Iran has produced more than 1200 kg of LEU in Natanz.
- The 7000-centrifuge plant could produce material for 3-4 bombs every year. Currently however, Iran enriches only LEU (up to 20% U-235).
- Iran has disclosed the existence of a second enrichment site in September 2009 (after western intelligence organization had become aware of the facility) inside a mountain near Qom with about 2700 centrifuges.
- Presently it is not believed that Iran has enriched U-235 beyond 20%. However from the existing LEU inventory sufficient HEU for a nuclear warhead could be produced in 3 months given its centrifuge plants.

Iran's Nuclear and Missile Programs – 4

Iran's nuclear delivery capability —

- About 300 Scud-B short-range missiles (range = 300 km, payload = 1,000 kg)
- About 100 Scud-C short-range missiles (range = 500 km)
- Iran is manufacturing Scuds with North Korean assistance
- Iran has 200 Chinese-supplied CSS-8 short-range missiles (range = 150 km, payload = 150 kg)
- Iran has tested the medium-range Shahab III, a derivative of the North Korean NoDong (range = 1,300 km, payload = 750 kg)
- Iran appears to have abandoned development of the Shahab IV (range = 2,000 km, payload = 1,000 kg)

Ranges of Current and Projected Ballistic Missile



Cirincione, Deadly Arsenals, 2002.

Status of World Nuclear Forces December 2012

Country	Operational Strategic	Operational Nonstrategic	Reserve/ Nondeployed	Military Stockpile	Total Inventory
Russia	2,430 ^a	0 ^b	3,000 ^c	5,500	10,000 ^d
United States	1,950 ^e	200 ^f	2,850 ^g	5,000	8,500 ^h
France	290	n.a.	? ⁱ	300	300
China	0 ^j	? ^j	180	240	240 ^j
United Kingdom	160 ^k	n.a.	65	225	225 ^k
Israel	0	n.a.	80	80	80 ^l
Pakistan	0	n.a.	90-110	90-110	90-110 ^m
India	0	n.a.	80-100	80-100	80-100 ⁿ
North Korea	0	n.a.	<10	<10	<10 ^o
Total:^p	~4,830	~200	~6,400	~11,500	~19,500

* All numbers are estimates and further described in the [Nuclear Notebook](#) in the *Bulletin of the Atomic Scientists*, and the nuclear appendix in the [SIPRI Yearbook](#). Additional reports are published on the [FAS Strategic Security Blog](#). Unlike those publications, this table is updated continuously as new information becomes available. Current update: **March 6, 2012**.

<http://www.fas.org/programs/ssp/nukes/nuclearweapons/nukestatus.html>

End of Module 6: Programs and Arsenals

Module 6: Programs and Arsenals

Supplementary Slides

U.S. Strategic Nuclear Weapons (2009)

ICBMs

Minuteman III	500
MX	50
Total ICBMs	550

SLBMs

Trident I/C-4	4/96
Trident II/D-5	14/336

Total SLBMs 268

Bombers

B-1	47
B-2	18
B-52	141
Total	206

bombers

TOTAL 1188

Total Warheads 9,400

New START Nuclear Force Levels – U.S.

The United States (UPDATED 02/29/10)

	July 2009 Old START	2010 Actual operationally deployed launches (total launchers)	ca. 2020 New START operationally deployed launchers (total launchers) [estimate]	ca. 2020 New START warheads [estimate]
ICBMs				
Minuteman III	500	450	350	350
MX	50	0		
Total ICBMs	550	450	350	350

New START Nuclear Force Levels – U.S.

SLBMs

Trident I/C-4 4/96

Trident II/D-5 14/336	12/288 (14/336)	12/288 (14/336)	1152
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Total SLBMs 268	288 (336)	288 (336)	1152
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Bombers

B-1	47	0	
B-2	18	16 (18)	16
B-52	141	44 (93)	32
Total	206	60 (111)	48

bombers

TOTAL	1188	798 (897)	686 (797)	1550
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New START Nuclear Force Levels – Russia

Russia

	July 2009 START	2010 Old Actual operationally deployed launches (total launchers)	ca. 2020 New START operationally deployed launchers (total launchers) [estimate]	ca. 2020 New START warheads [estimate]
ICBMs				
SS-25	176	171		
SS-27 silo	50	50	60	60
SS-27 road	15	18	27	27
RS-24			85	255
SS-19	120	70		
SS-18	104	59	20	200
Total ICBMs	465	367	192	542

New START Nuclear Force Levels – Russia

SLBMs

Delta III/SS- N-18	6/96	4/64		
Delta IV/SS-N- 23	6/96	4/64 (6/96)	4/64	256
Typhoon/SS- N-20	2/40	0/0		
Borey/Bulava	2/36	0/0	4/64	384
Total SLBMs	268	128 (164)	128	640
Bombers				
Tu-160	13	13	13	13
Tu-95MS	63	63	63	63
Total bombers	76	76	76	76
TOTAL	809	571 (603)	396 (396)	1258

SU-Russian Nuclear Warheads

End	Strategic Warheads				Non-	Stockpiled	Awaiting	Intact
Year	ICBM	SLBM	Bombers	Total	Strategic	Warheads	Dism'tlem't	Warheads
1989	7,382	3,085	1,651	12,117	23,700	35,817	3,195	39,000
1990	7,285	3,045	1,485	11,815	21,700	33,515	3,583	37,000
1991	6,411	2,932	1,329	10,672	18,933	29,606	6,405	35,000
1992	6,011	2,617	1,462	10,089	16,167	26,256	7,845	33,000
1993	5,414	2,503	1,468	9,385	13,400	22,785	8,899	31,000
1994	4,530	2,436	1,468	8,434	10,633	19,067	10,601	29,000
1995	3,894	2,386	1,468	7,748	7,867	15,615	12,022	27,000
1996	3,768	2,386	1,468	7,622	5,100	12,722	12,915	25,000
1997	3,759	1,915	840	6,514	4,750	11,264	11,736	23,000
1998	3,770	1,655	840	6,264	4,500	10,764	10,236	21,000
1999	3,717	1,655	830	6,201	4,250	10,451	9,799	20,250
2000	3,717	1,655	830	6,201	4,000	10,201	9,299	19,500
2001	3,162	1,453	911	5,526	3,600	9,126	9,076	18,750
2002	3,162	1,126	911	5,199	3,380	8,579	9,421	18,000

Source: NRDC (Nov. 2002)

U.S. Nuclear Warheads

End	Strategic Warheads				Non-Strategic	Stockpiled	Awaiting	Intact
Year	ICBM	SLBM	Bombers	Total	Warheads	Warheads	Dism'tlem't	Warheads
1989	2,592	5,410	5,965	13,967	8,207	22,174	285	22,458
1990	2,591	5,474	5,330	13,395	7,816	21,211	471	21,682
1991	2,128	3,626	3,400	9,154	9,152	18,306	1,764	20,070
1992	2,127	3,626	3,691	9,444	4,287	13,731	4,559	18,290
1993	2,126	2,819	3,567	8,512	3,024	11,536	5,246	16,782
1994	2,215	3,021	3,565	8,801	2,211	11,012	4,426	15,438
1995	2,199	3,222	3,538	8,959	1,994	10,953	3,266	14,219
1996	2,196	3,424	3,028	8,648	2,238	10,886	2,421	13,307
1997	2,111	3,626	3,018	8,755	2,075	10,829	1,881	12,710
1998	2,104	3,626	3,014	8,744	2,019	10,763	1,153	11,916
1999	2,104	3,626	2,951	8,681	2,017	10,698	960	11,658
2000	2,104	3,626	2,949	8,679	1,936	10,615	570	11,185
2001	2,089	3,273	2,947	8,309	2,182	10,491	416	10,907
2002	2,089	3,600	2,945	8,634	1,821	10,455	274	10,729

Source: NRDC (Nov. 2002)

U.S. Strategic Nuclear Warheads – 1

STRATEGIC FORCES					
Warhead/Weapon	First Produced	Yield (kilotons)	User	Number (warheads)	Status
Bombs					
B61-7 Strategic	10/66	10 to 350	AF	470	The Mod-7 is the only version in the strategic stockpile. The Mod-7 is a converted Mod-1 with a Cat D PAL and IHE.
B61-11	11/97	10 to 350	AF	55	Mod-11 is an earth penetrator.
B83/B83-1	6/83	low to 1,200	AF	620	Strategic bomb replaced B28, B43, B53.
Submarine-launched ballistic missiles					
W76/Trident I C4	6/78	100	N	3,200	Under START I over 1,500 W76 warheads from retired Trident I SSBNs were used to arm Atlantic Fleet Trident II SSBNs.
W88/Trident II D5	9/88	475	N	400	Warheads supplement the W76 warhead to arm Atlantic Fleet Trident II SSBNs.

Source: NRDC (Nov. 2002)

U.S. Strategic Nuclear Warheads – 2

Warhead/Weapon	First Produced	Yield (kilotons)	User	Number (warheads)	Status
Intercontinental ballistic missiles					
W62/Minuteman III	3/70	170	AF	615	Will be retired around 2009.
W78/Minuteman III	8/79	335	AF	920	300 will be used to arm single warhead MMIIIs by 2012.
W87-0/MX	4/86	300	AF	550	Missile will be retired, and 200 W87s used for single warhead MMIII by 2012.
Air-launched cruise missiles					
W80-1/ALCM	12/81	5 and 150	AF	1,400	Some 900 ALCMs are in storage with their warheads removed. W80s are used to arm ACMs.
W80-1/ACM	?/90	5 and 150	AF	400	Operational in 1991. The original program of 1,461 ACMs has been cut to 460. Uses W80 warheads from ALCMs.

Source: NRDC (Nov. 2002)

U.S. Strategic Nuclear Forces – 1

Type	Name	Launchers/ SSBNs	Year deployed	Warheads x yield (kiloton)	Total warheads*	Total megatons*
ICBMs						
LGM-30G	Minuteman III	500	--	--	1,200	353
	Mk-12	(200)	1970	1 or 3 W62 x 170 (MIRV)	(300)	(51)
	Mk-12A	(300)	1979	3 W78 x 335 (MIRV)	(900)	(302)
LGM-118A	MX/Peacekeeper	50 10	1986	10 W87 x 300 (MIRV)	500 100	150
Total ICBMs		550			1,700	503

Source: NRDC (Nov. 2002)

510

1,150

NRDC (Jan/Feb 2005)

U.S. Strategic Nuclear Forces – 2

Type	Name	Launchers/ SSBNs	Year deployed	Warheads x yield (kiloton)	Total warheads*	Total megatons*
SLBMs						
UGM-96A	Trident I C4	168/7 ⁴⁸	1979	6 W76 x 100 (MIRV)	1,008	100
UGM-133A	Trident II D5	264/11 ²⁸⁸	--	--	--	--
	Mk 4	--	1992	8 W76 x 100 (MIRV)	1,728	173
	Mk 5	--	1990	8 W88 x 475 (MIRV)	384	--
Total SLBMs		432/18			3,120	273
		336/14				
Bomber/weapons**						
B-2	Spirit	21/16	1994	B61-7/-11, B83 bombs	800	280
B-52H	Stratofortress	94/56	1961	ACM/ALCM/W80 x 5-150 kt	860	130
Total Bomber/weapons		115/72			1,660	410

Source: NRDC (Nov. 2002)

NRDC (Jan/Feb 2005)
FKL, Phys. Dep. © 2015

U.S. Non-Strategic Nuclear Weapons

NON-STRATEGIC FORCES					
Warhead/Weapon	First Produced	Yield (kilotons)	User	Number (warheads)	Status
B61 Tactical Bomb	3/75	0.3 to 170	AF, NATO	1,290	Mods-3,-4,-10. The Mod 10 is a converted W85 Pershing II warhead. All three Mods have Cat F PALs and IHE. Each Mod has four yield options: The B61-3 (0.3, 1.5, 60 and 170 Kt), the B61-4 (0.3, 1.5, 10, and 45 Kt), and the B61-10 (0.3, 5, 10, and 80 Kt).
W80-0/SLCM	12/83	5 and 150	N	320	Nuclear SLCMs now stored ashore. Original program of 758 SLCMs for 200 ships and submarines was reduced to 367 SLCMs for 25 Sturgeon-class, 62 Los Angeles-class, and 3 Seawolf-class attack submarines.

ACM: advanced cruise missile; **AF:** Air Force; **ALCM:** air-launched cruise missile; **IHE:** Insensitive High Explosive; **N:** Navy; **NATO:** non-U.S. delivery systems; **PAL:** Permissive Action Link.

Source: NRDC (Nov. 2002)

Summary of U.S. Nuclear Forces 2007

	Type/Designation	No.	Year deployed	Warheads x yield (KILOTONS)	Active/Spares
ICBMs	LGM-30G Minuteman III				
	Mk-12	150	1970	1 W62 x 170	150
	Mk-12	50	1970	3 W62 x 170 (MIRV)	150/30
	Mk-12A	300	1979	2-3 W78 x 335 (MIRV)	750/35
	Total	500			1,050/65
SLBMs	UGM-133A Trident II D5*				
	Mk-4	n/a	1992	6 W76 x 100 (MIRV)	1,632/80
	Mk-5	n/a	1990	6 W88 x 455 (MIRV)	384/20
	Total	336			2,016/100
Bombers	B-52H Stratofortress	94/56**	1961	ALCM/W80-1 x 5-150 ACM/W80-1 x 5-150	1,000/30 400/20
	B-2A Spirit	21/16	1994	B61-7, -11, B83-1	555
	Total	115/72			1,955/50***
Nonstrategic forces	Tomahawk SLCM	325	1984	1 W80-0 x 5-150	100
	B61-3, -4 bombs	n/a	1979	0.3-170	400
	Total	325			500

* Conversion of the Henry Jackson and the Alabama to Trident II D5 SLBMs will be completed in 2007 and 2008, respectively, bringing to 14 the number of SSBNs capable of carrying D5s.

** The first figure is the aircraft inventory, including those used for training, testing, and backup. The second figure is the primary mission aircraft inventory, the number of operational aircraft assigned for nuclear and or conventional missions.

*** The large pool of bombs and cruise missiles allows for multiple loading possibilities, depending upon the mission.

GRAND TOTAL

NRDC, Jan/Feb. 2007

~ 5,521/215

Russian Nuclear Weapons and Delivery Vehicles

- Russia maintain the world's second-largest largest force of deployed strategic nuclear weapons
- Under the counting rules of the START I, Russia maintains an accountable strategic nuclear force of 981 delivery vehicles with 4,732 associated warheads, although the deployed number is less
- In addition, Russia is estimated to have about 3,400 operational nonstrategic warheads and about 8,800 additional intact warheads
- The Russia may have as many as 16,000 intact nuclear weapons
- If present trends continue, Russia may have less than 2,000 deployed strategic nuclear weapons by 2010 and may have less than 200 ICBMs.

Russian Strategic Nuclear Forces – 1

Category/Type	Weapon System	Launchers	Warheads*
Strategic Offense			
ICBMs	SS-18 (144), SS-19 (137), SS-24 (36), SS-25 (360), SS-27 (29)	706	3,011
SLBMs	SS-N-18 (96), SS-N-20 (40), SS-N-23 (96)	232	1,072
Bombers	15 Blackjack, 32 Bear-H6, 31 Bear-H16 (AS-15 ALCMs, AS-16 SRAMs, bombs)	78	868
Total Strategic Offense			~5,000
Strategic Defense			
SAMs	SA-5B Gammon, SA-10 Grumble	1,200	1,200
Total Strategic Defense			1,200

Source: NRDC (Nov. 2002)

Russian Strategic Nuclear Forces – 2

Type	Name	Launchers	Year deployed	Warheads x yield (kiloton)	Total warheads	Total megatons
ICBMs						
SS-18 M4/M5/M6	Satan (RS-20)	144	1979	10 x 550/750 (MIRV)	1,440	792
SS-19 M3	Stiletto (RS-18)	137	1979	6 x 550 (MIRV)	822	452
SS-24 M1/M2	Scalpel (RS-22)	36	1987	10 x 550 (MIRV)	360	198
SS-25	Sickle (RS-12M)	360	1985	1 x 550	360	198
SS-27	n.a.	29	1997	1 x 550	29	16
Total ICBMs		706			3,011	1,656

Source: NRDC (Nov. 2002)

Russian Strategic Nuclear Forces – 3

Type	Name	Launchers	Year deployed	Warheads x yield (kiloton)	Total warheads	Total megatons
SLBMs						
SS-N-18 M1	Stingray (RSM-50)	96 (6)#	1978	3 x 500 (MIRV)	288**	144
SS-N-20 M1/M2	Sturgeon (RSM-52)	40 (2)#	1983	10 x 200 (MIRV)	400	80
SS-N-23	Skiff (RSM-54)	96 (6)#	1986	4 x 100 (MIRV)	384	38
Total SLBMs		232			1,072	262
Bomber/weapons						
Tu-95MS6	Bear H6	32	1984	6 AS-15A ALCMs or bombs	192	48
Tu-95MS16	Bear H16	31	--	16 AS-15A ALCM or bombs	496	124
Tu-160	Blackjack	15	1987	12 AS-15B ALCMs or 12 AS-16 SRAMs, or 12 bombs	180	45
Total Bomber/weapons		78			868	217

Source: NRDC (Nov. 2002)

Russian Non-Strategic Nuclear Forces

Category/Type	Weapon System	Launchers	Warheads*
Land-based Non-strategic			
Bombers and fighters	Backfire (105), Fencer (280) (AS-4 ASM, AS-6 ASM, AS-16 SRAM, bombs)	385	1,540
Total Land-based Non-strategic			1,700
Naval Non-strategic			
Attack aircraft	Backfire (45), Fencer (50) (AS-4 ASM, bombs)	95	190
SLCMs	SS-N-9, SS-N-12, SS-N-19, SS-N-21, SS-N-22	--	240
ASW weapons	SS-N-15, SS-N-16, torpedoes, depth bombs	na	210
Total Naval Non-strategic			540

Source: NRDC (Nov. 2002)

Summary of Russian Strategic Nuclear Forces 2007

	Type	Name	Launchers	Year deployed	Warheads x yield (KILOTONS)	Total warheads
ICBMs	SS-18	Satan	80	1979	10 x 550/750 (MIRV)	800
	SS-19	Stiletto	126	1980	6 x 550/750 (MIRV)	756
	SS-25	Sickle	242	1985	1 x 550	242
	SS-27	Topol-M	42	1997	1 x 550	42
	SS-27A	Topol-M1	3	2006	1 x 550 (?)	3
			493			1,843
SLBMs	SS-N-18 M1	Stingray	5/80*	1978	3 x 200 (MIRV)	240
	SS-N-23	Skiff	6/96	1986	4 x 100 (MIRV)	384
			11/176			624
Bombers	Tu-95 MS6	Bear H6	32	1984	6 x AS-15A ALCMs or bombs	192
	Tu-95 MS16	Bear H16	32	1984	16 x AS-15A ALCMs or bombs	512
	Tu-160	Blackjack	14**	1987	12 x AS-15B ALCMs, AS-16 SRAMs, or bombs	168
			78 30			872
GRAND TOTAL			132			~ 3,339***

•One Pacific-based Delta III has been converted to a missile test-launch platform.
 ** Two Tu-160s that were to enter service in 2005 have not yet become operational.

*** Additional 9,300 intact strategic and nonstrategic warheads are estimated to be in reserve or awaiting dismantlement.

forces 2005

Russian Nonstrategic and Defensive Weapons

	Type	Name	Launchers	Year deployed	Warheads x yield (KILOTONS)	Total warheads
ABM	51T6/53T6	Gorgon/ Gazelle	32/68	1989/1986	1 x 1000/10	100
Air defense	SA-10	Grumble	1,900	1980	1 x low yield	600
Land-based aircraft	Bombers/ fighters	n/a	~ 490	n/a	ASM or bombs	974
Naval	Submarines/ surface ships/ fighters	n/a	n/a	n/a	SLCMs, ASWs, SAMs, ASMs, bombs, or torpedoes	655
GRAND TOTAL			NRDC, March/April. 2007			2,329

Russian Projected Strategic Warheads

	2007	2012	2020
ICBMs	1,843	665 *	254 *
SLBMs	624	600	744
Bombers	872	788	728
Total	3,339	2,053	1,726

* Assumes no MIRV on Topol-Ms.

NRDC, March/April. 2007

French Strategic Nuclear Forces

Weapon System	Warheads					
	No. deployed	Year deployed	Range (km)	Warhead x yield	Type	No. in stockpile
Aircraft						
Mirage 2000N/ASMP	45	1988/1988	2,750	1 x 300 Kt	TN 81	50
Submarine-based missiles						
MSBS M4A/B	16	1985/1987	6,000	6 x 150 Kt	TN 70/71	96
MSBS M45	32	1996	6,000	6 x 100 Kt	TN 75	192
Carrier-based aircraft						
Super Étendard/ASMP	24	1978/1989	650	1 x 300 Kt	TN 81	10
Total						~350

Source: NRDC (Nov. 2002)

Chinese Strategic Nuclear Forces 2006

	Type	NATO designation	Number	Year deployed	Range (KILOMETERS)	Warhead x yield (KILOTONS)	Total warheads
Land-based missiles	DF-3A	CSS-2	16	1971	3,100	1 x 3,300	16
	DF-4	CSS-3	22	1980	> 5,500	1 x 3,300	22
	DF-5A	CSS-4	20	1981	13,000	1 x 4,000-5,000	20
	DF-21, -21A	CSS-5	21	1991	2,100	1 x 200-300	21
	DF-31	CSS-X-10	0	~ 2006	~ 8,000	1 x ?	0
	DF-31A	?	0	2007-09	~12,000	1 x ?	0
Sea-based missiles	JL-1*	CSS-NX-3	12	1986	1,000-1,700	1 x 200-300	12
	JL-2	CSS-NX-4	0	2008-10	~ 8,000	1 x ?	0
Nuclear-capable aircraft**	Hong-6	B-6	20	1965	3,100	1 x bomb	~ 20
	Qian-5, etc.	n/a	?	1972, ?	n/a	1 x bomb	~ 20
TOTAL			37 136				~ 130***

Indian Nuclear Forces (2008)

Type/Designation	Range (kilometers)	Payload (kilograms)	Comment
Aircraft			
MiG-27 Flogger/Bahadur	800	4,000	At Hindan Air Base
Jaguar IS/IB/Shamsher	1,600	4,775	At Ambala Air Base
Missiles			
Prithvi I	150	1,000	Deployed, may have nuclear role
Agni I	1,500	1,000	Tested, status unknown
Agni II	2,000	1,000	Test fired January 2001, deployment expected soon; a 700-kilometer-range version test launched January 25, 2002

Summary of India's Nuclear Delivery Systems

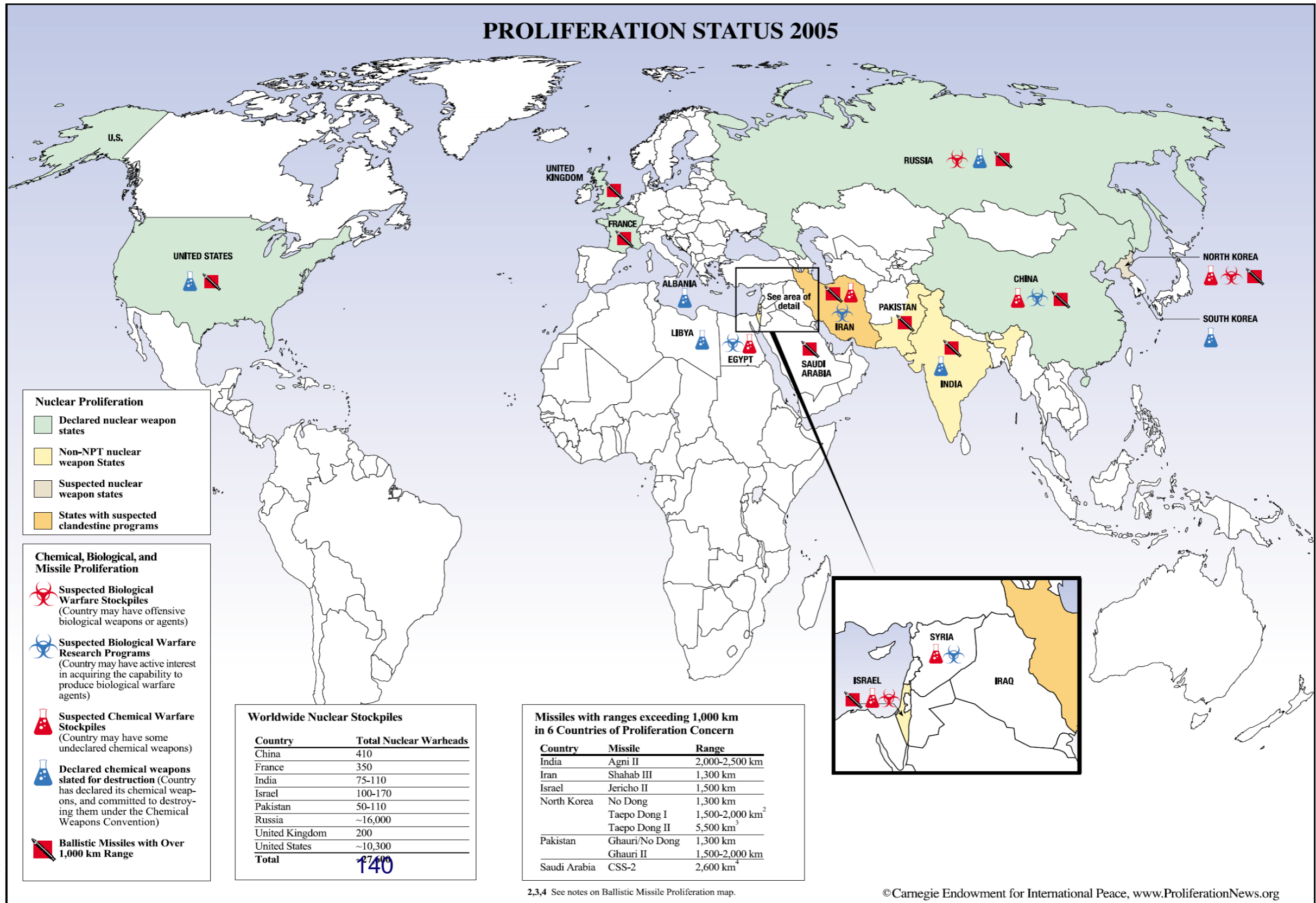
Type/Designation	Range (kilometers)	Payload (kilograms)	Comment
Aircraft			
Mirage 2000H/ Vajra	1,800	6,300	India has 40 of this type of aircraft, possibly located at Gwalior Air Force Station.
Jaguar IS/IB/ Shamsher	1,600	4,775	India has 131 of this type of aircraft, possibly located at Shamsher Ambala Air Force Station.
Missiles			
Agni I	700+	1,000	Thirty-six missiles deployed with the army's new 334 Missile Group in 2004.
Agni II	2,000+	1,000	Thirty-six missiles deployed with the army's 335 Missile Group in 2004.
Agni III	3,000+	1,500	Under development. Test scheduled for the end of 2005.
Prithvi	150	1,000	Army version. Deployed with 333 and 355 Missile Groups. Will be converted from liquid to solid fuel.
Dhanush	350	1,000	Under development. Naval version of Prithvi II. Third test was held on November 7, 2004.
Sagarika	300+ ⁴⁴ 138	?	Under development. Possible flight-test in late 2005; deployment scheduled for 2010 or later.

Summary of Pakistan's Nuclear Delivery Systems

Type / Designation	Range (km)	Payload (kg)	Comment
<i>Aircraft</i>			
F-16A/B	1,600	5,450	At Sargodha AB
<i>Missiles</i>			
Ghauri I (Hatf-5)	1,300-1,500	500-750	Basically North Korean No Dong missile
Ghauri II (Hatf-6)	2,000-2,300	750-1,000	Test-fired on April 14, 1999

Source: NRDC (Nov. 2002)

Nuclear Weapons and Proliferation



New York Times: Timeline of North Korea's Nuclear Program

Suggested Reading as input for Discussion
of North Korea's Nuclear Program on Thursday:

**Review of the timeline of North Korea's Nuclear Program
in the New York Times:**

[http://www.nytimes.com/interactive/2013/
02/05/world/asia/northkorea-timeline.html](http://www.nytimes.com/interactive/2013/02/05/world/asia/northkorea-timeline.html)

March 2013: North Korea Threatens Missile Attacks on South Korea, Japan and the United States

The New York Times

March 26, 2013

North Korea Calls Hawaii and U.S. Mainland Targets

By CHOE SANG-HUN

SEOUL, South Korea — North Korea's military said it put all its missile and artillery units on "the highest alert" on Tuesday, ordering them to be ready to hit South Korea, as well as the United States and its military installations in Hawaii and Guam.

The threat from the North's Korean People's Army Supreme Command came only hours after President Park Geun-hye of South Korea warned that the North Korean leadership could ensure its survival only when it abandons its nuclear weapons, long-range missiles, provocations and threats.

North Korea said on Tuesday that all of its strategic rocket and long-range artillery units "are assigned to strike bases of the U.S. imperialist aggressor troops in the U.S. mainland and on Hawaii and Guam and other operational zones in the Pacific as well as all the enemy targets in South Korea and its vicinity."

"They should be mindful that everything will be reduced to ashes and flames the moment the first attack is unleashed," the North Korean command said in a statement carried by the North's official Korean Central News Agency.

Tensions on the Korean Peninsula have risen after North Korea's launching of a three-stage rocket in December and its third nuclear test last month. In response, Washington and Seoul pushed for a United Nations Security Council resolution imposing more sanctions on North Korea and this month began their annual joint military drills intended to warn North Korea against attacking the South.

March 2013: US Strengthening Pacific Missile Defense

The New York Times

March 15, 2013

U.S. Is Bolstering Missile Defense to Deter North Korea

By THOM SHANKER, DAVID E. SANGER and MARTIN FACKLER

WASHINGTON — The Pentagon will spend \$1 billion to deploy additional ballistic missile interceptors along the Pacific Coast to counter the growing reach of North Korea's weapons, a decision accelerated by Pyongyang's recent belligerence and indications that Kim Jong-un, the North Korean leader, is resisting China's efforts to restrain him.

The new deployments, announced by Defense Secretary Chuck Hagel on Friday, will increase the number of ground-based interceptors in California and Alaska to 44 from 30 by 2017.

The missiles have a mixed record in testing, hitting dummy targets just 50 percent of the time, but officials said Friday's announcement was intended not merely to present a credible deterrence to the North's limited intercontinental ballistic missile arsenal. They said it is also meant to show South Korea and Japan that the United States is willing to commit resources to deterring the North and, at the same time, warn Beijing that it must restrain its ally or face an expanding American military focus on Asia.

News: North Korea Responds to Annual US-South Korean Military Exercise with Live Artillery Fire

REUTERS March 31st, 2014

North, South Korea trade artillery rounds into the sea: Seoul

Mon, Mar 31 2014

By Jack Kim

SEOUL (Reuters) - North Korea fired more than 100 artillery rounds into South Korean waters as part of a drill on Monday, prompting the South to fire back, officials in Seoul said, but the exercise appeared to be more saber-rattling from Pyongyang rather than the start of a military standoff.

The North had flagged its intentions to conduct the exercise in response to U.N. condemnation of last week's missile launches by Pyongyang and against what it says are threatening military drills in the South by U.S. forces.

North Korea also accused the South of "gangster-like" behavior at the weekend by "abducting" one of its fishing boats and threatened to retaliate. The South said it had sent the boat back after it drifted into its waters.

More than 100 North Korean shells out of 500 or so fired landed in South Korean waters, prompting marines from the South to fire back with more than 300 rounds into the North's waters, defense officials in Seoul said.

Seoul also scrambled F-15s on its side of the maritime border, they said.

"We believe the North's maritime firing is a planned provocation and an attempt to test our military's determination to defend the Northern Limit Line and to get an upper hand in South-North relations," South Korean Defence Ministry spokesman Kim Min-seok said.



News: North Korea Threats New Nuclear Test

The New York Times by Choe, Sang-Hun, March 30th, 2014

SEOUL, South Korea — North Korea threatened on Sunday to carry out a “new form” of nuclear test, a year after its third nuclear test raised military tensions on the divided Korean Peninsula and prompted the United Nations to tighten sanctions against the North.

The North’s Foreign Ministry did not clarify what it meant by a “new form” in its statement, carried by the North’s official Korean Central News Agency. But Washington and its allies have long suspected the country of trying to make nuclear devices small and sophisticated enough to be delivered by intercontinental ballistic missiles it was also developing.

...

North Korea later told South Korea that it will carry out live-fire military drills on Monday near the rivals’ disputed western sea border, the scene of naval skirmishes in recent years. It designated seven zones for its drills and warned South Korean fishing boats out of the areas, the Office of the Joint Chiefs of Staff of the South Korean military said.

But pressure has been growing on Japan to dump some of the trappings of its deterrent regardless. **The U.S. wants Japan to return 331 kilos of weapons grade plutonium** ... that it supplied during the Cold War. Japan and the U.S. are expected to sign a deal for the return at a nuclear security summit next week in the Netherlands.

...

Yet Japan is sending mixed signals. It also has plans to open a **new fast-breeder plutonium reactor in Rokkasho in October**. The reactor would be able to produce 8 tons of plutonium a year, or enough for 1,000 Nagasaki-sized weapons.

...

China seems to take the basement bomb seriously. It has taken advantage of the publicity over the pending return of the 331 kilos to ask that Japan dispose of its larger stockpile of plutonium, and keep the new Rokkasho plant off-line. Chinese officials have argued that Rokkasho was launched when Japan had ambitious plans to use plutonium as fuel for a whole new generation of reactors, but that those plans are on hold post-Fukushima and the plutonium no longer has a peacetime use.

...

Japan, of course, has its own security concerns with China and North Korea. **North Korea's nuclear weapons program is a direct threat to Japan.** Some of its Nodong missiles, with a range capability of hitting anywhere in Japan, are believed to be nuclear-armed. "Nodong is a Japan weapon," said Spector.

...

There are fears that if Japan opens the Rakkosho plant, it will encourage South Korea to go the same route as its neighbor. The U.S. and South Korea have been negotiating a new civilian nuclear cooperation pact. The South wants to reprocess plutonium, but the U.S. is resisting providing cooperation or U.S. nuclear materials.

News: Japan is going to Return Weapons Grade Plutonium and HEU

NEW YORK TIMES, March 23rd, Japan to Let U.S. Assume Control of Nuclear Cache

THE HAGUE — Japan will announce Monday that it will turn over to Washington more than 700 pounds of weapons-grade plutonium and a large quantity of highly enriched uranium, a decades-old research stockpile that is large enough to build dozens of nuclear weapons, according to American and Japanese officials.

The announcement is the biggest single success in President Obama's five-year-long push to secure the world's most dangerous materials, and will come as world leaders gather here on Monday for a nuclear security summit meeting. Since Mr. Obama began the meetings with world leaders — this will be the third — 13 nations have eliminated their caches of nuclear materials and scores more have hardened security at their storage facilities to prevent theft by potential terrorists.

Japan's agreement to transfer the material — the amount of highly enriched uranium has not been announced but is estimated at 450 pounds — has both practical and political significance. For years these stores of weapons-grade material were not a secret, but were lightly guarded at best; a reporter for [The New York Times](#) who visited the main storage site at Tokaimura in the early 1990s found unarmed guards and a site less-well protected than many banks. While security has improved, the stores have long been considered vulnerable.

Iran has cited Japan's large stockpiles of bomb-ready material as evidence of a double standard about which nations can be trusted. And last month China began publicly denouncing Japan's supply, in apparent warning that a rightward, nationalistic turn in Japanese politics could result in the country seeking its own weapons.

At various moments right-wing politicians in Japan have referred to the stockpile as a deterrent, suggesting that it was useful to have material so that the world knows Japan, with its advanced technological acumen, could easily fashion it into weapons.

Public perception in India about Nuclear Weapons Program in Pakistan

It is **unfavorable** and **suspicious** since the Nuclear Program in Pakistan was founded by A Q Khan. Also aided by the political problems in the countries, it makes peaceful negotiations difficult.

India and Pakistan have fought **3 wars** after the Independence in 1947 which resulted into the partition. Since then, they have been at loggerheads on the issue of **Kashmir**.

Just recently (Jan 10, 2013) there was firing across the borders in which 3 soldiers died. (New York Times)

News reports of Pakistan developing **tactical nukes** (Kristen and Norris) to check the **asymmetrical** nature of Indian geography worries the entire nation and not just the border states.



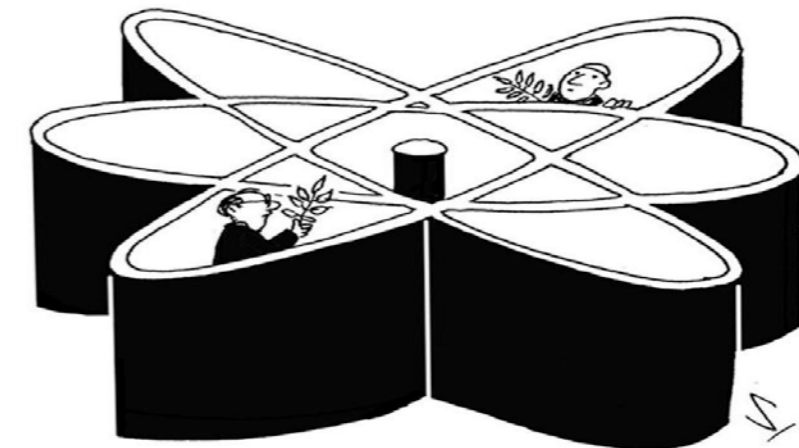
Public Opinion about Nuclear Program in India

India is a **developing country** with many fundamental issues of social inequality, poverty but given that India is surrounded by '**enemies or arch rivals**', the Indian public believes that the Nuclear Program **is necessary for National security**.

Since both these neighboring powers (China and Pakistan) are nuclear powers, it was of paramount importance that India developed nuclear capabilities.

Also, Nuclear power plants can help reduce the grave power problems of the country.

Traditionally Indians are peace-loving and have used non-violent methods of Satyagraha given by Mahatma Gandhi to fight their freedom struggle. Thus, **people do not support use of Nuclear weapons** given a conflict with Pakistan and hope for the negotiations between the two nations to **go beyond trade and border control**.

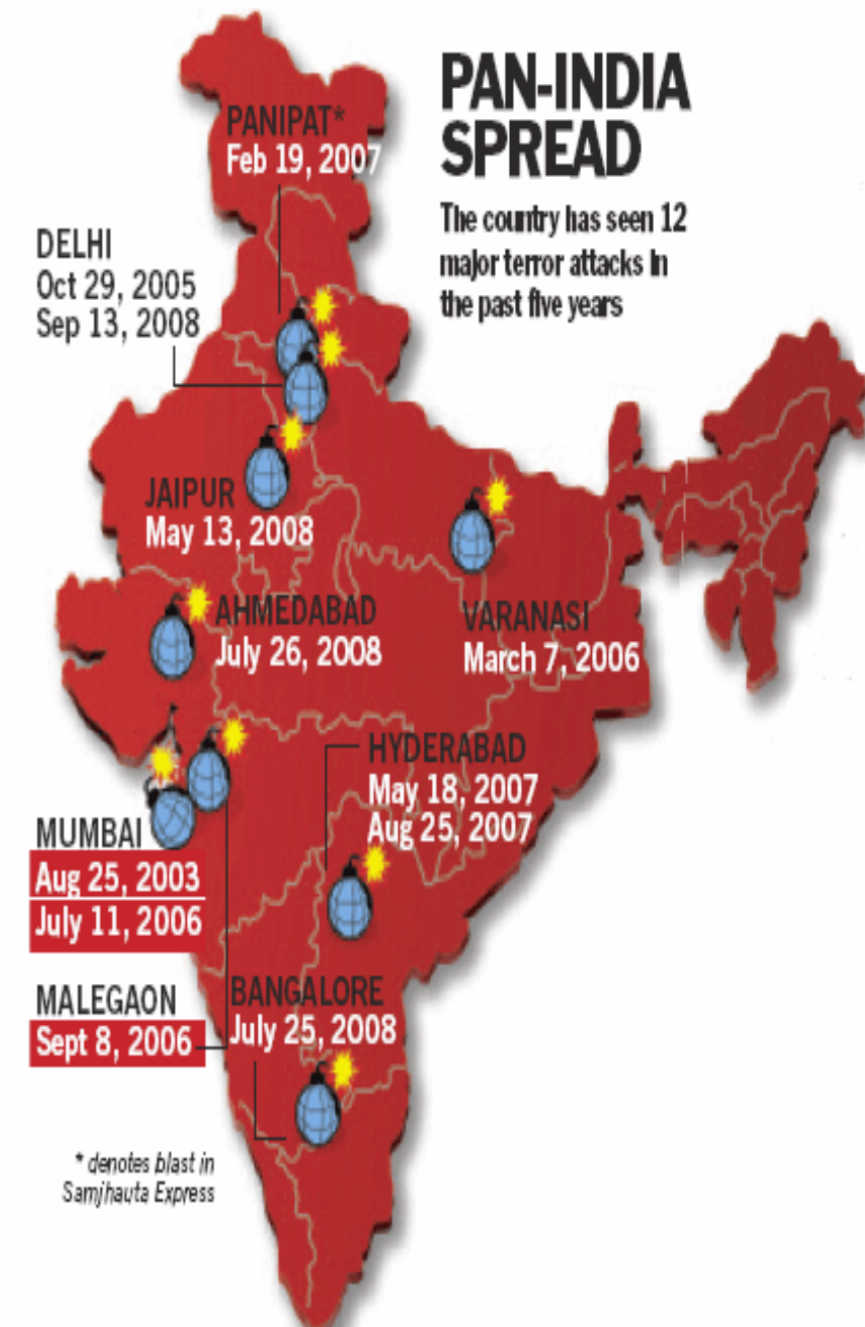


Expectations towards the US with regards to actions towards Pakistan's nuclear weapons program.

Given that the US has funded the Pakistan's Army in the past, India expects the US to **ensure that their funds or weapons do not end up in the wrong hands.**

India has been a recipient of many gruesome acts of **terrorism** (some of them like **2008, Mumbai** found to be based in Pakistan) and hopes that US takes action against any such non-state actors who could use the enmity between the two nations and start a nuclear war-fare, which would have long-term effects not just in India but in the world.

It also hopes for aid in any negotiations given the experience of US in Cold War. It should help convince Pakistan that **limited nuclear war is a contradiction in itself** and continuing to build the arsenal will just lead to deterioration of any peaceful negotiations and a possible arms race.



Graphics by PRADHANT CHAUHARY

Source: <http://forums.bharat-rakshak.com/viewtopic.php?t=4572>