Physics 280: Session 17

Plan for This Session

Questions

Next session (Thursday, 2-3.20pm, March 14th):

Midterm Exam in 100 Noyes

Module 6: Nuclear Arsenals

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

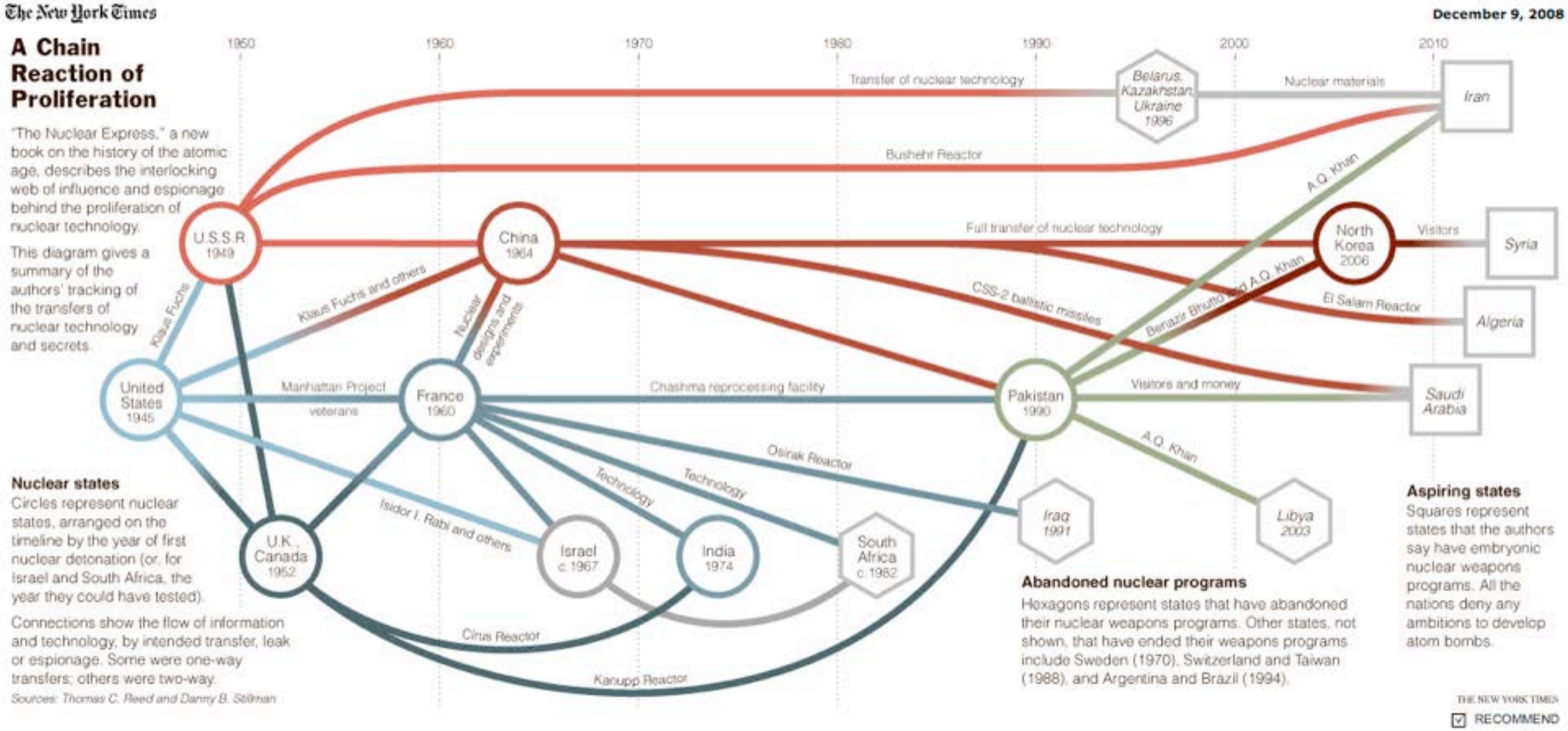
Part 3: Arsenals of non-NPT and Emerging Nuclear-Weapon States:
India, Pakistan, Israel, North Korea, and Iran

Part 4: Threat Perceptions

Module 6: Programs and Arsenals

Part 1: Overview of Programs and Arsenals

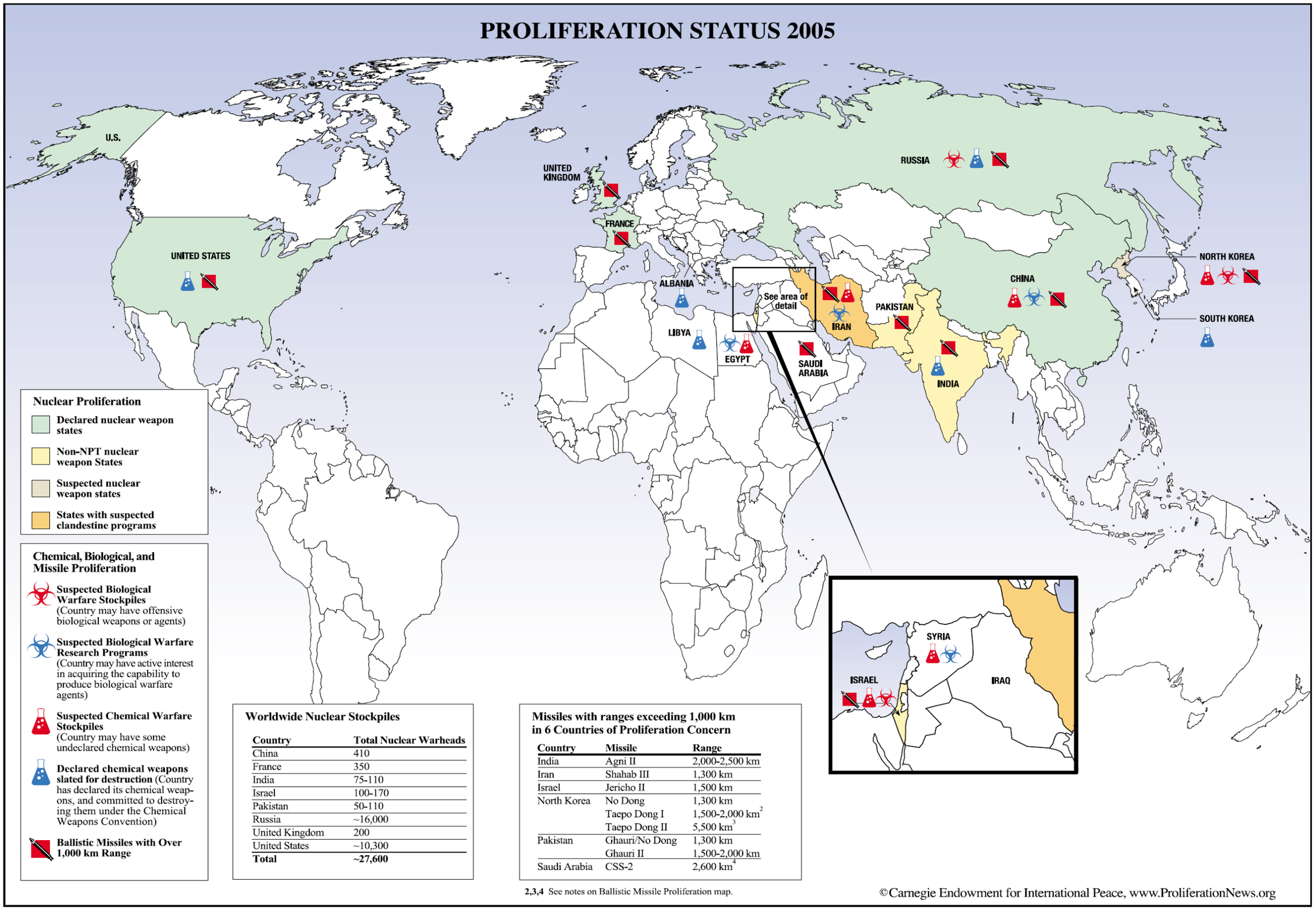
Module 6: Nuclear Arsenals and Proliferation



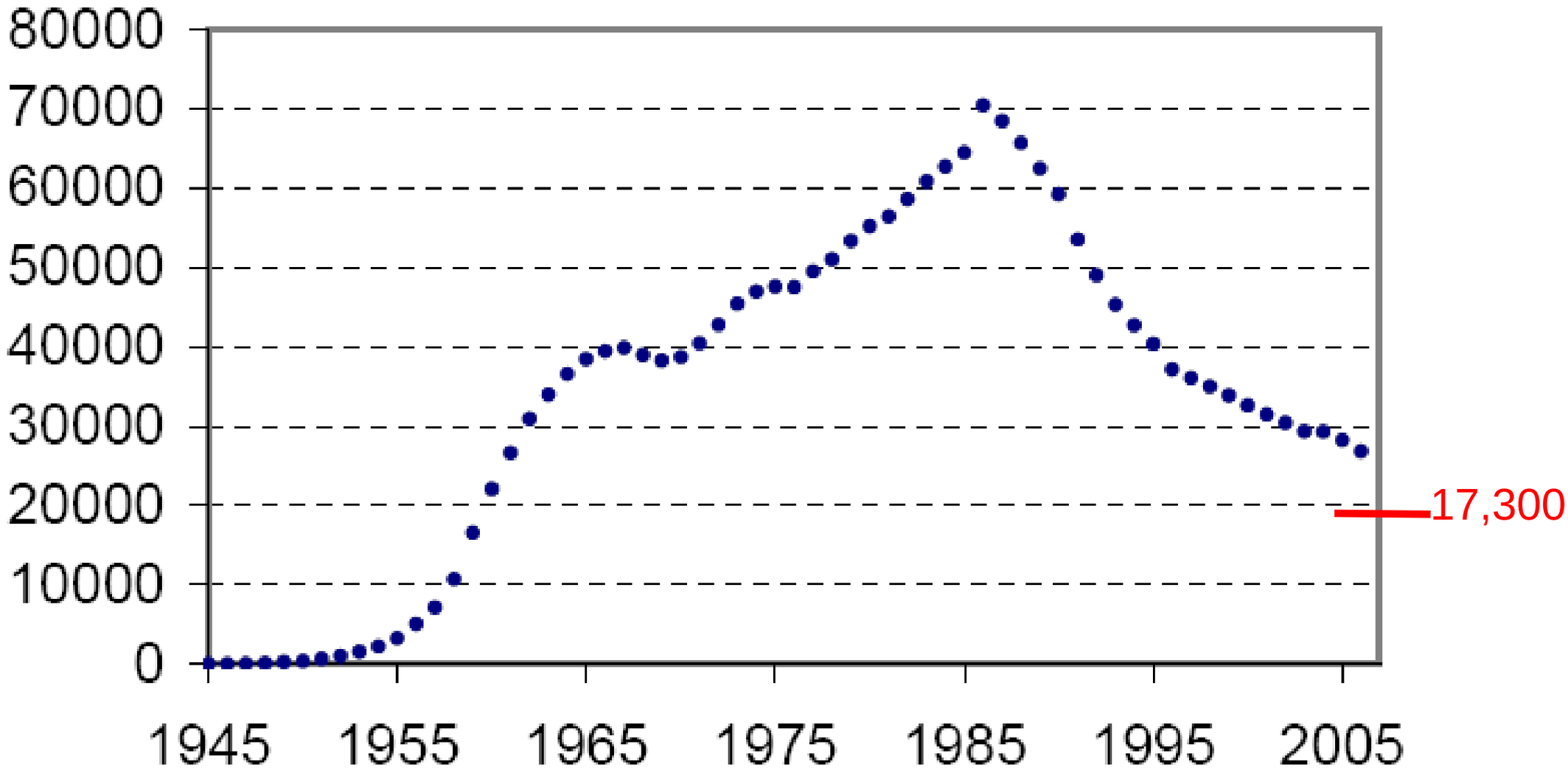
This article has been revised to reflect the following correction:

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.

Nuclear Weapons and Proliferation



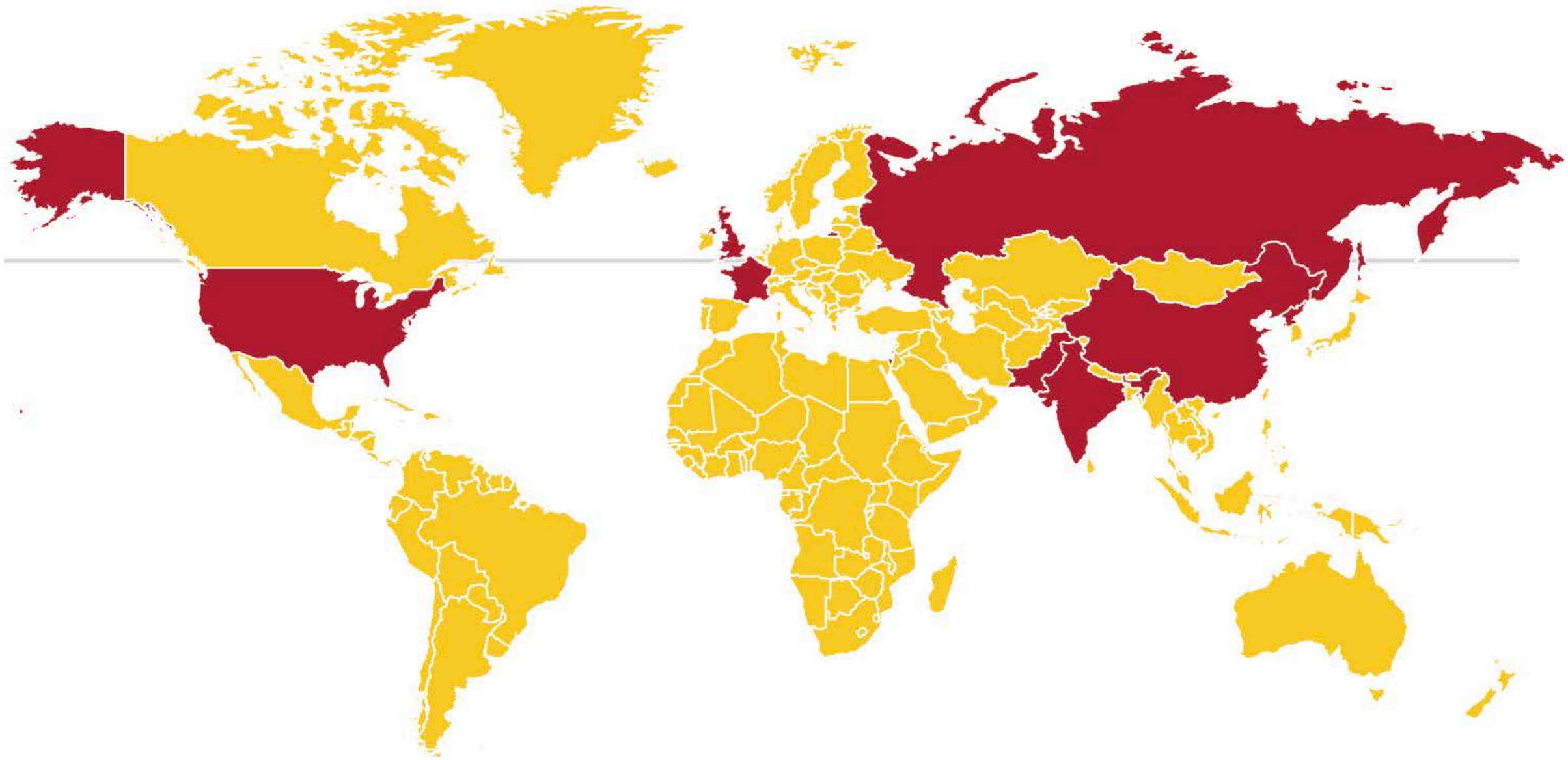
World Nuclear Weapon Stockpiles 1945–2012 (Important)



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

PLOUGHSHARES FUND ploughshares.org

Global Nuclear Weapon Inventory 2012 (Important)

Non-NPT Nuclear Weapon States (Total Weapons)

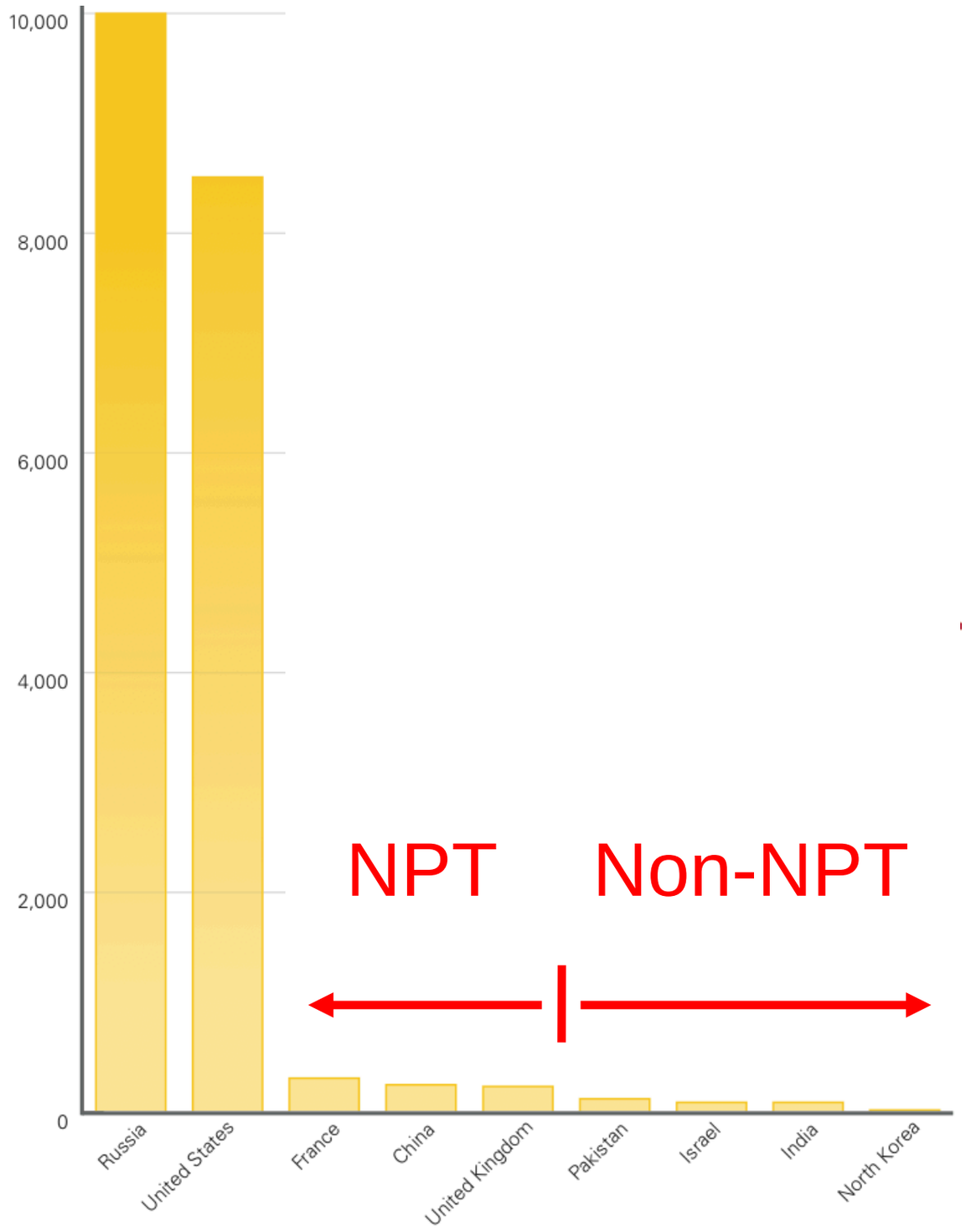
Pakistan: ~ 90–110

Israel: ~ 60–80

India: ~ 80-100

North Korea: < 10

States With Nuclear Weapons in 2012



PLOUGHSHARES FUND ploughshares.org

Status of World Nuclear Forces December 2012

Status of World Nuclear Forces End-2012*

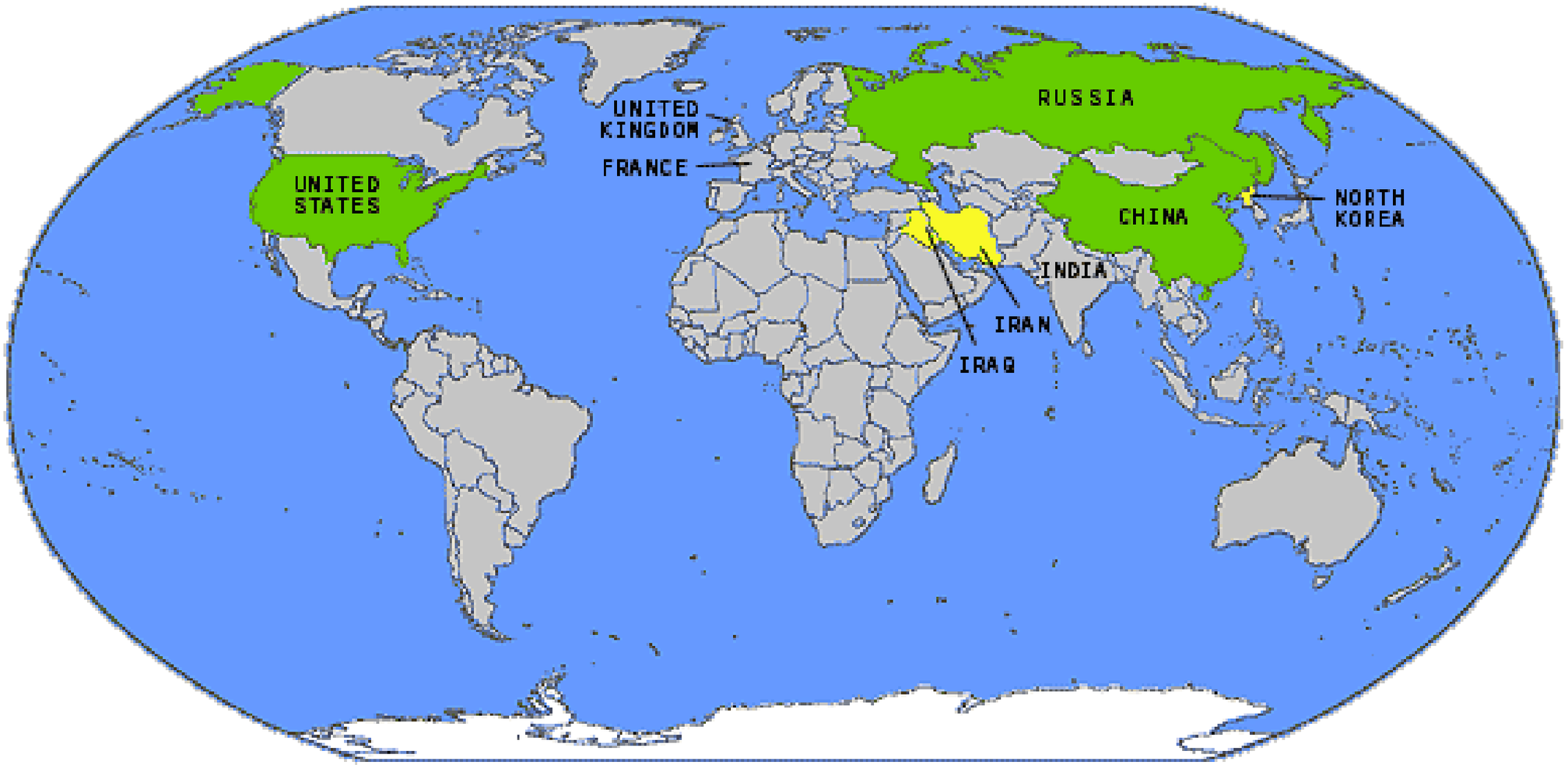
Country	Operational Strategic	Operational Nonstrategic	Reserve/ Nondeployed	Military Stockpile	Total Inventory
Russia	1,740[a]	0[b]	2,700[c]	4,500	8,500[d]
United States	1,950[e]	200[f]	2,500[g]	4,650	7,700[h]
France	290	n.a.	?[i]	300	300
China	0[j]	?[j]	180	240	240[j]
United Kingdom	160[k]	n.a.	65	225	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]	**~4,100**	**~200**	**~5,700**	**~10,200**	**~17,300**

* All numbers are approximate estimates and further described in the Nuclear Notebook in the *Bulletin of the Atomic Scientists*, and the nuclear appendix in the SIPRI Yearbook. See also status and 10-year projection of U.S. and Russian forces. 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: **December 18, 2012.**

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

Overview of Programs and Arsenals

Map of ICBM Threats (2001 NIC Assessment)



Ballistic Missiles and Missile Programs

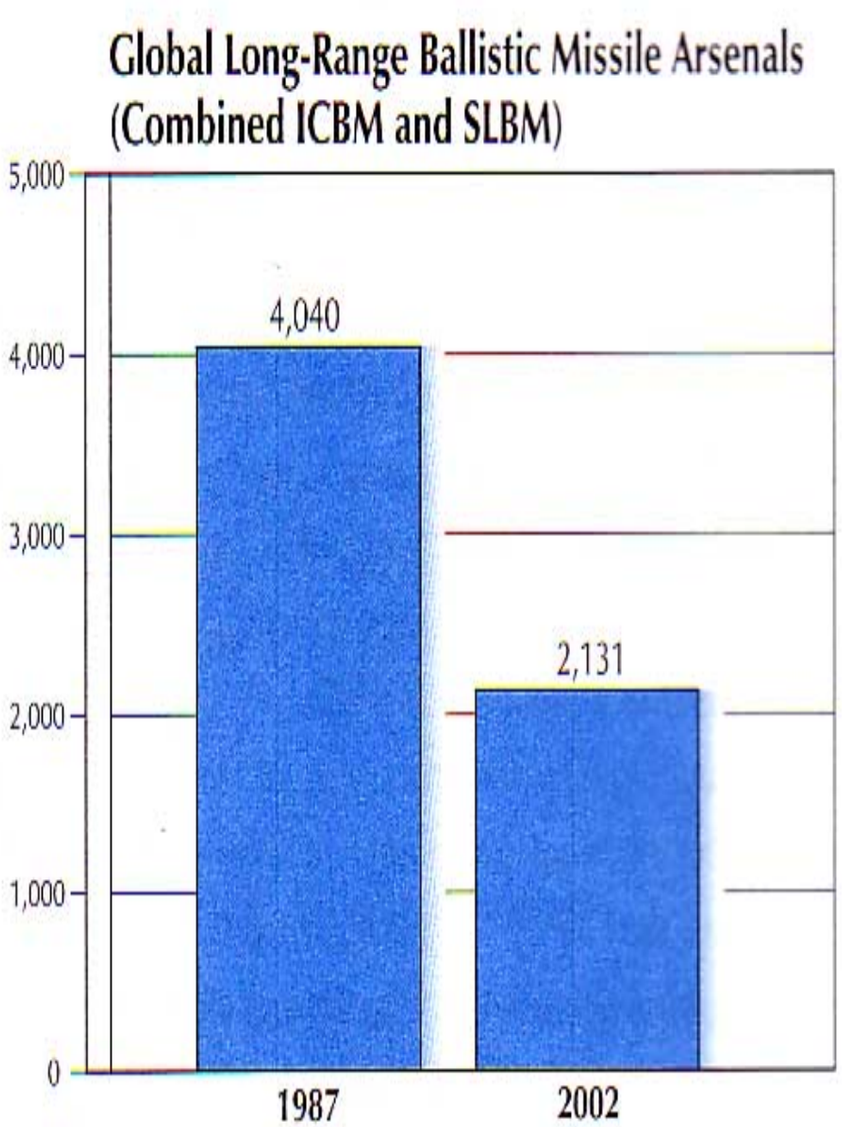
Afghanistan
Argentina
Armenia
Azerbaijan
Bahrein
Belarus
Bulgaria
Egypt
Georgia
Greece
Iraq
Kazakhstan
Kongo
Libya
Slovakia
South Korea
Syria
Taiwan
Turkey
Turkmenistan
U.Arab.Emir.
Ukraine
Vietnam
Yemen

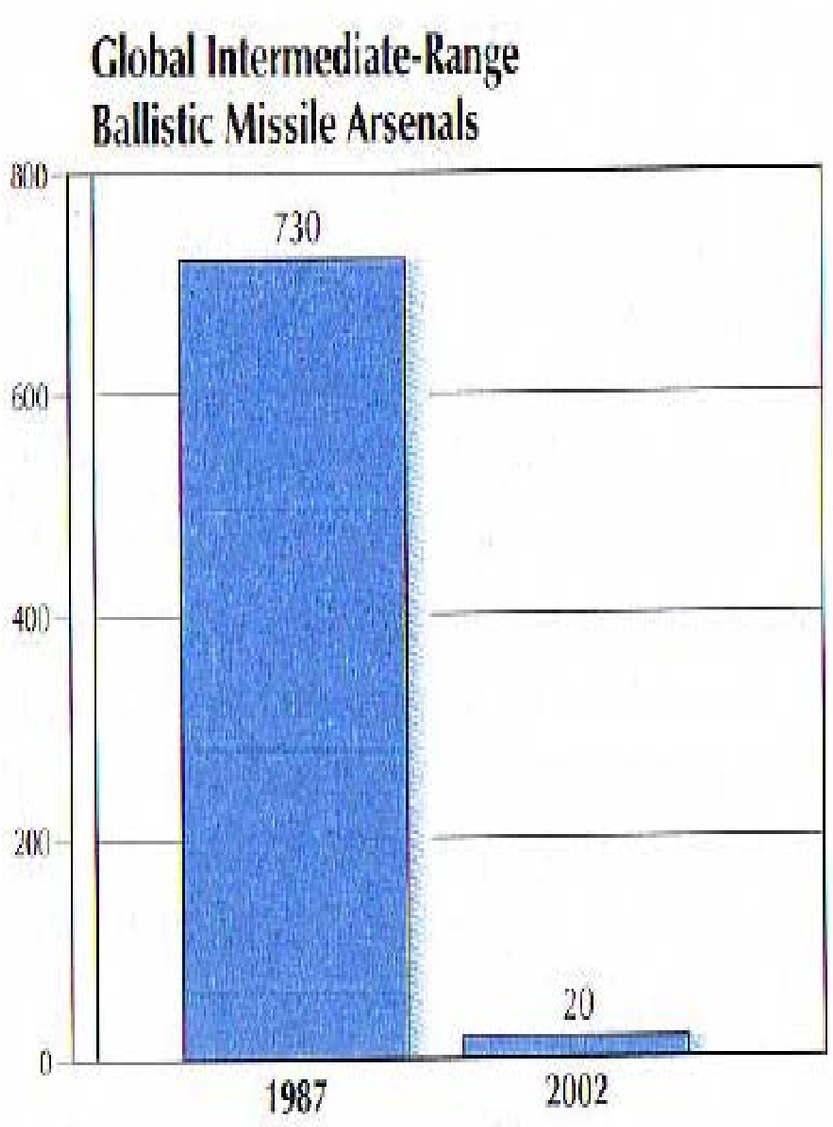
Country	Missile	Range
India	Agni II	2.000 km
Iran	Shahab III	1.300 km
Israel	Jericho III	1.500 km
North Korea	No Dong	1.300 km
	Taepo Ding I	2.000 km
	Taepo Dong II	5.500 km
Pakistan	Ghauri I/No Dong	1.300 km
	Ghauri II	2.000 km
Saudi Arabia	CSS-2	2.600 km

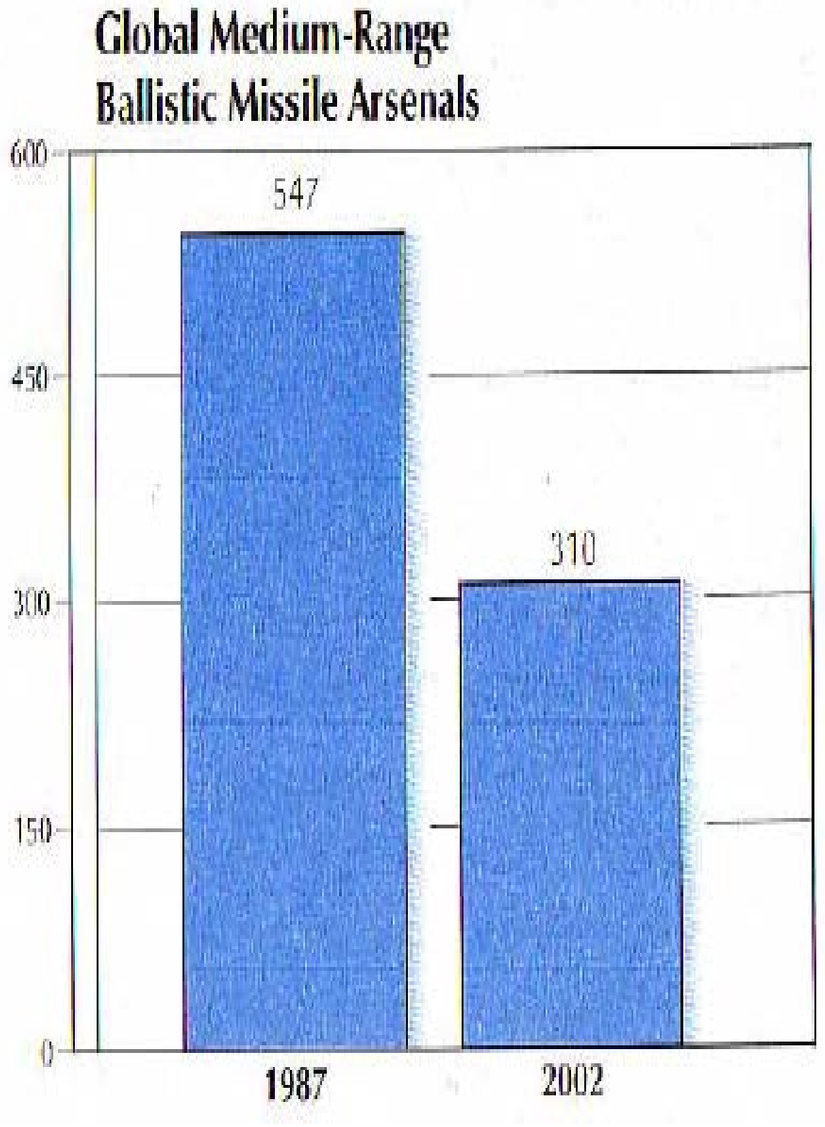
Country	Missile	Range
China	DF-4	13.000 km
France	M45 SLBM	6.000 km
	M4 SLBM	6.000 km
U.K.	Trident II/D-5 SLBM	7.400 km
Russia	SS-18	11.000 km
	SS-19	10.000 km
	SS-24	10.000 km
	SS-25	10.500 km
	SS-27	10.500 km
	SS-N-18 SLBM	6.500/8.000 km
	SS-N-20 SLBM	8.300 km
	SS-N-23 SLBM	8.300 km
USA	Minuteman II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







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

COUNTRY	TYPE*	RANGE (KILOMETERS)	YEAR DEPLOYED	STATUS AS OF 1987	STATUS AS OF 2007
United States	Advanced cruise missile (AGM-129A)	> 2,500	1990	in production	deployed
	Air-launched cruise missile (AGM-86B)	2,500	1986	deployed	deployed
	Enhanced cruise missile	—	—	not deployed	not deployed
	Ground-launched cruise missile (BGM-109)	2,500	1983	deployed	not deployed
	Sea-launched cruise missile (BGM-109A)	2,500	1984	deployed	deployed

Sources: 2009 NASIC Report,
Arms Control Association

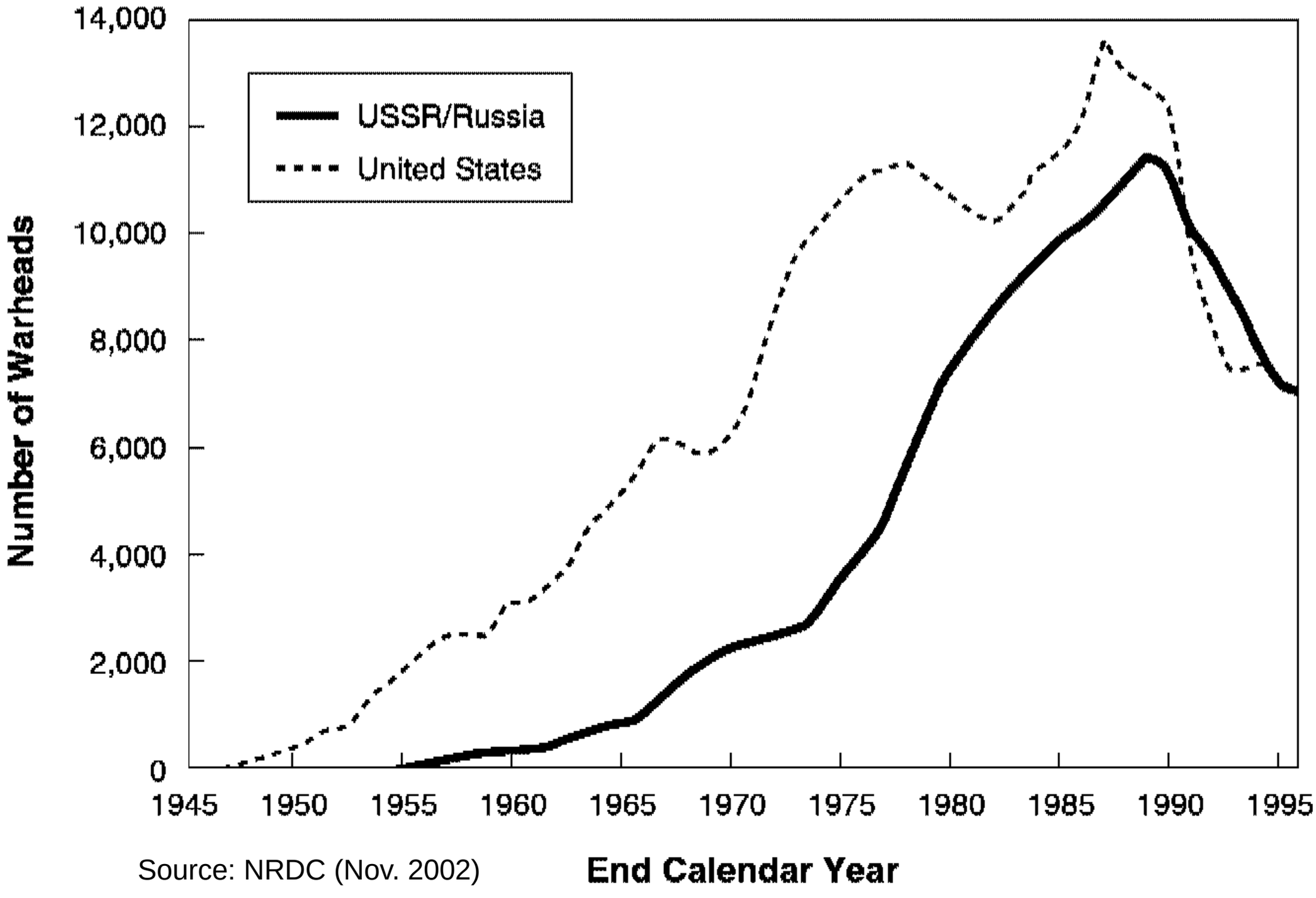
Pakistani Ra’ad Air-Launched Cruise Missile

Pakistani Ra’ad Air Launched Cruise Missile

Part 2: Arsenals of the NPT Nuclear-Weapon States

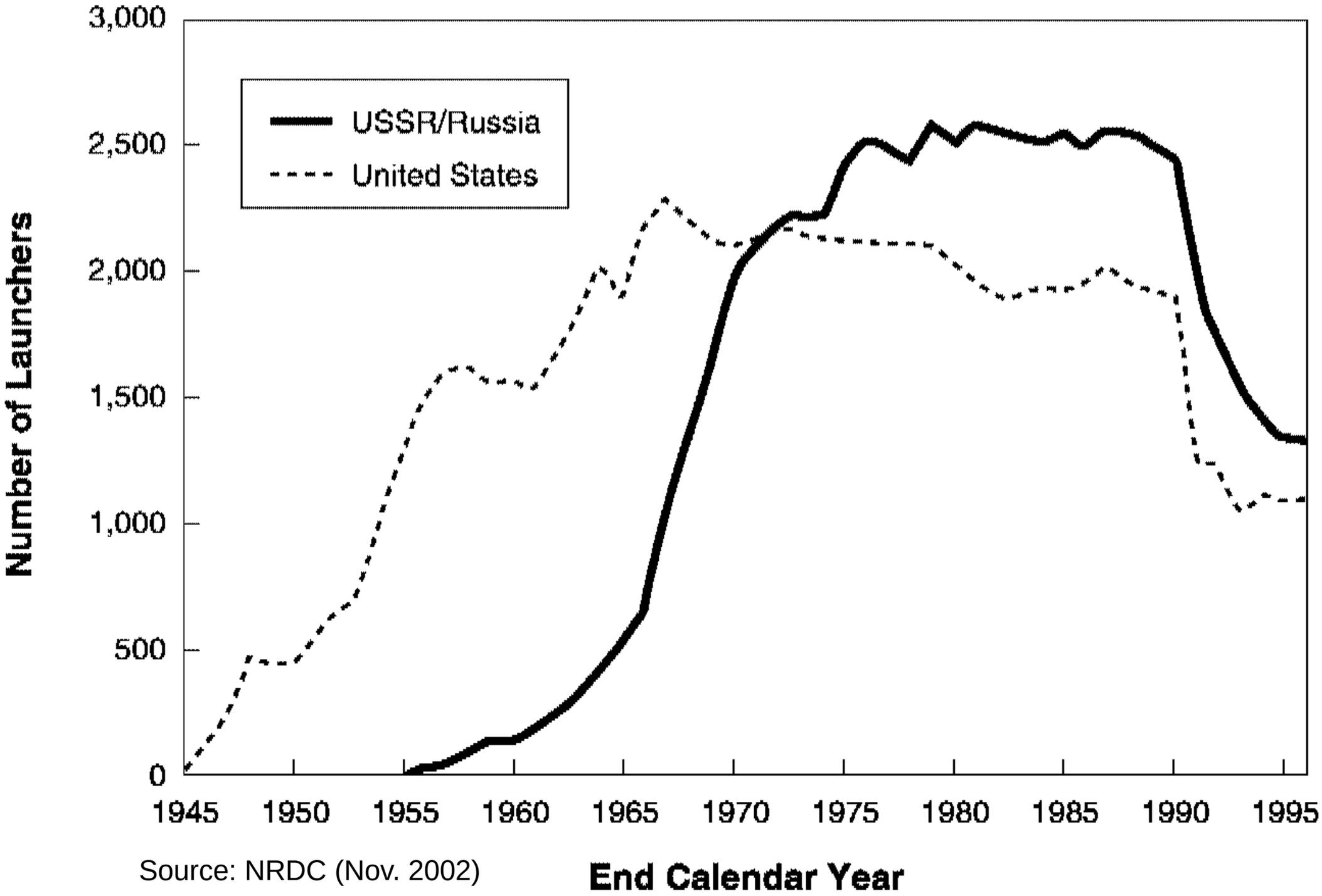
The United States, Russia, the United Kingdom, France, and China

Evolution of US and SU-Russian Strategic Nuclear Warhead Numbers



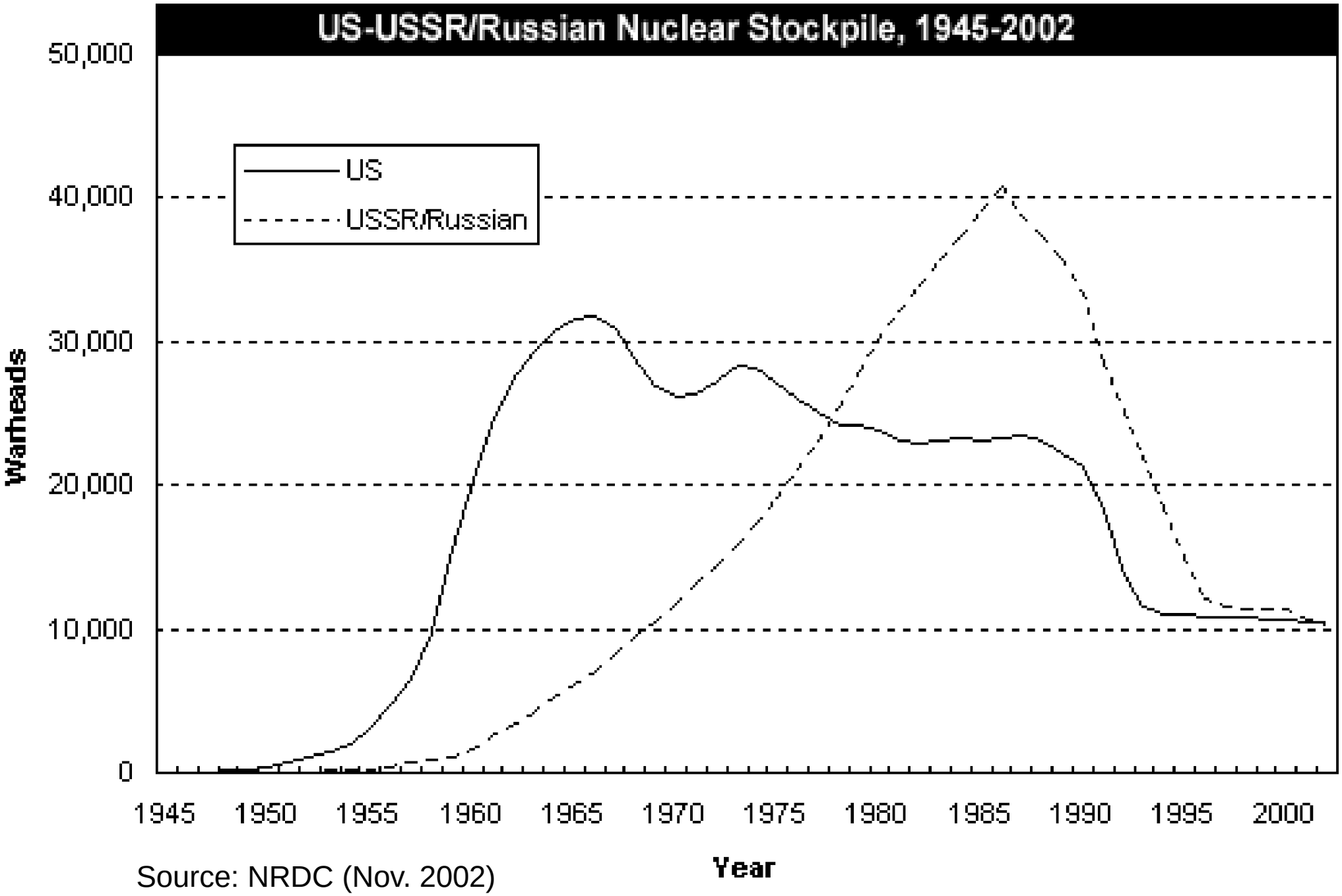
Source: NRDC (Nov. 2002)

Evolution of US and SU-Russian Strategic Nuclear Launcher Numbers



Source: NRDC (Nov. 2002)

Evolution of US and SU-Russian Nuclear Stockpiles



Source: NRDC (Nov. 2002)

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**

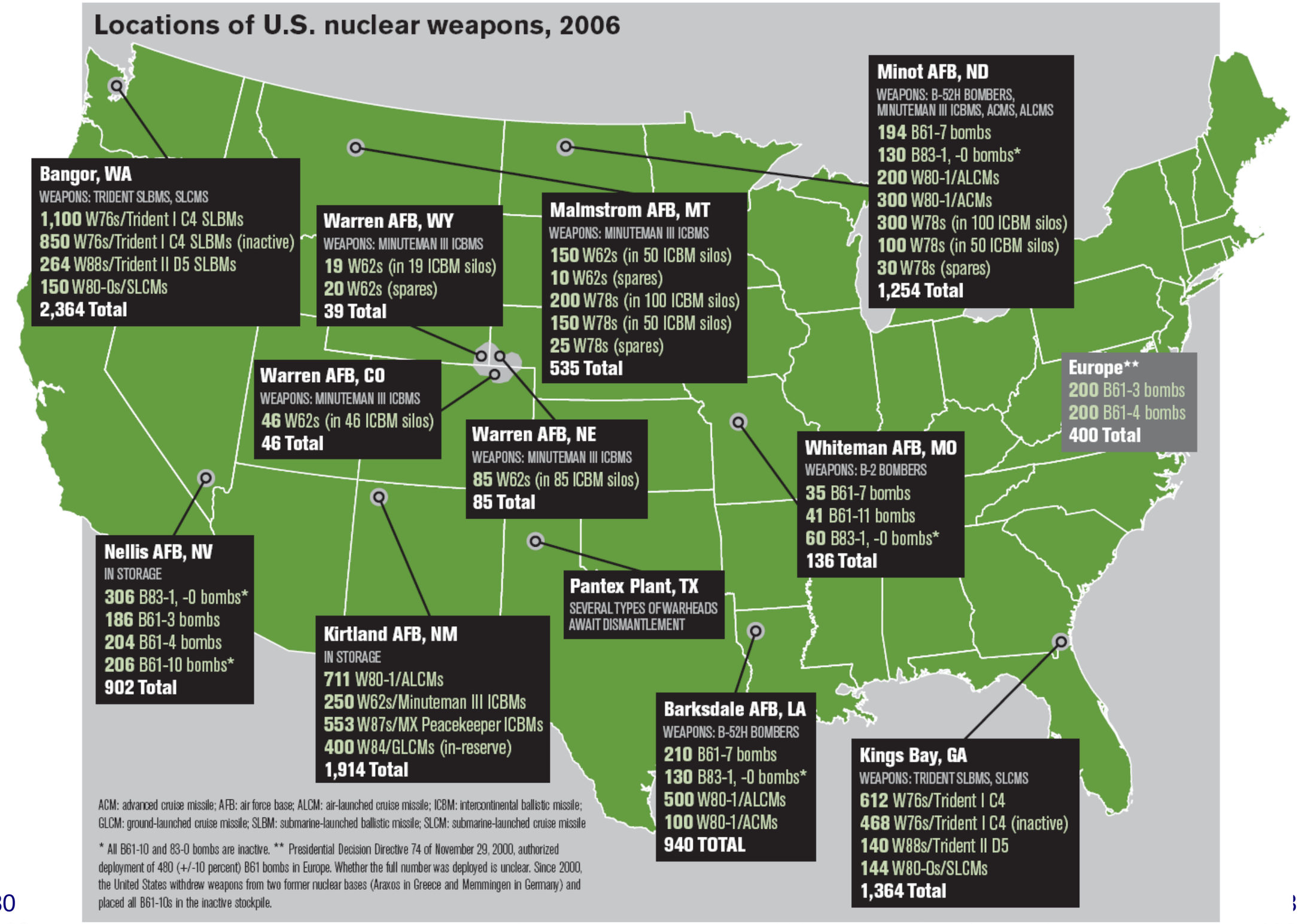
Source: NRDC

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



NRDC, Where the Bombs are, 2006, Bulletin of the Atomic Scientists, Nov-Dec 2006

2010 U.S. Nuclear Posture Review

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

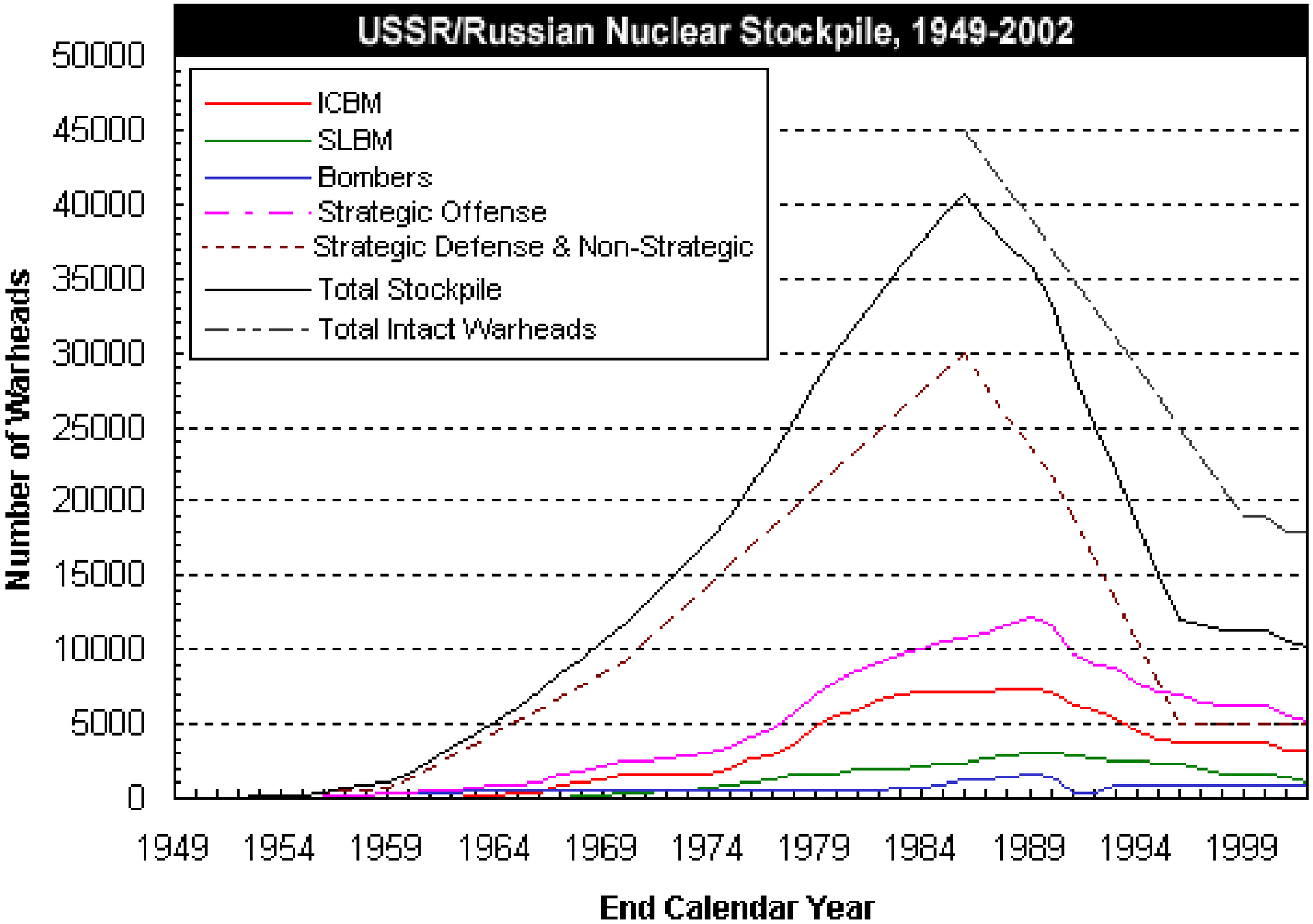
(C) 300

(D) 1,000

(E) 5,000

Carnegie Endowment for International Peace, *Deadly Arsenals* (2002), **www.ceip.org**

SU-Russian Nuclear Warheads



Source: NRDC (Nov. 2002)

Russian Nuclear Forces (2011)

Type/name	Russian designation	Launchers	Year deployed	Warheads x yield (kilotons)	Total warheads
Strategic offensive weapons					
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**			**844**[2]
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
Naval					
Submarines/surface ships/air				SLCM, ASW, SAM, ASM, DB, torpedoes	700
SUBTOTAL NONSTRATEGIC AND DEFENSIVE FORCES					**~2,000[3]**
TOTAL					**~4,600[4]**

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.

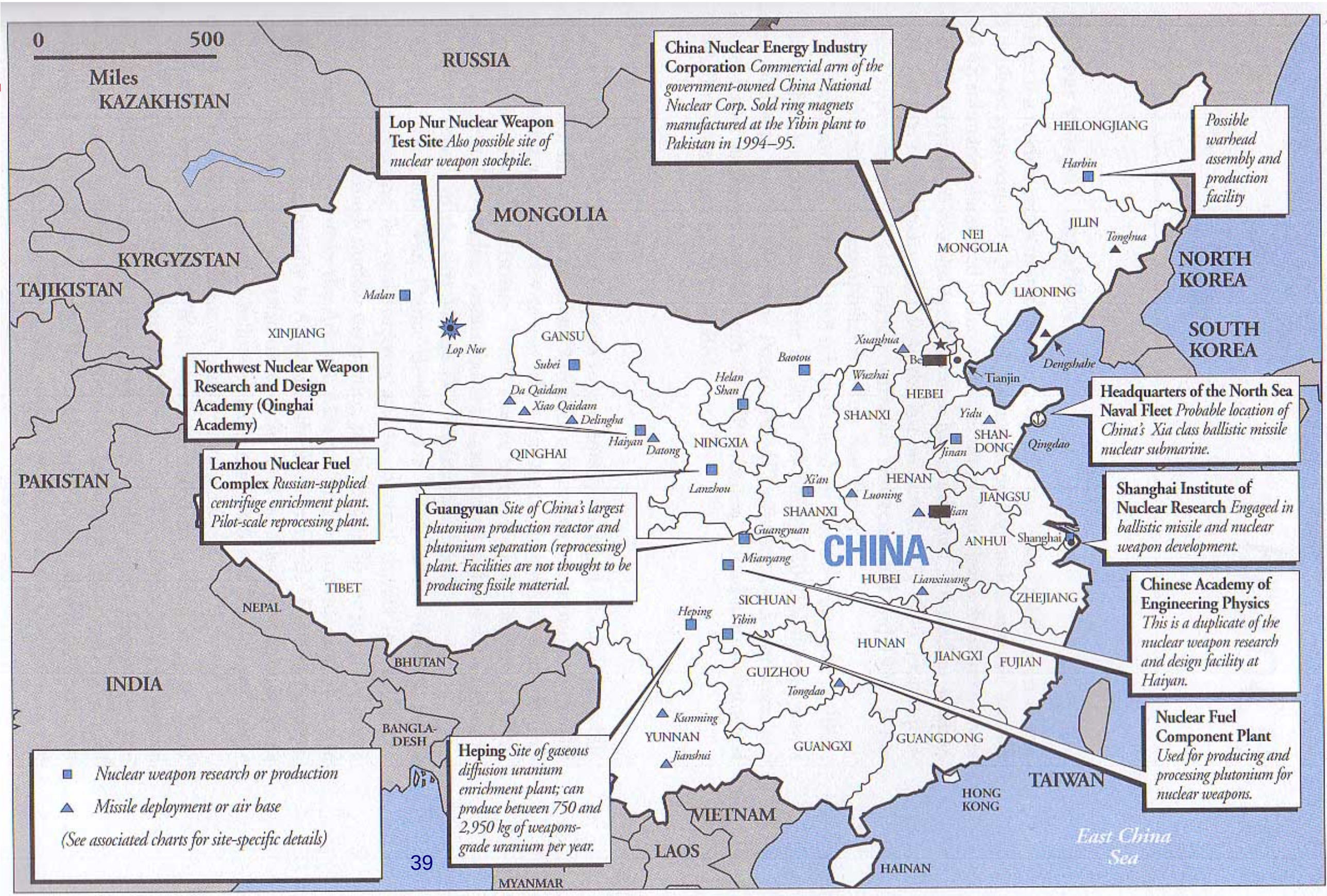
ABM: Antiballistic missile
ALCM: Air-launched cruise missile
ASM: Air-to-surface missile
ASW: Antisubmarine weapon
DB: Depth bomb
ICBM: Intercontinental ballistic missile
MIRV: Multiple independently targetable reentry vehicle
SAM: Surface-to-air missile
SLBM: Submarine-launched ballistic missile
SLCM: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



Carnegie Endowment for International Peace, *Deadly Arsenals* (2002), **www.ceip.org**

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 **

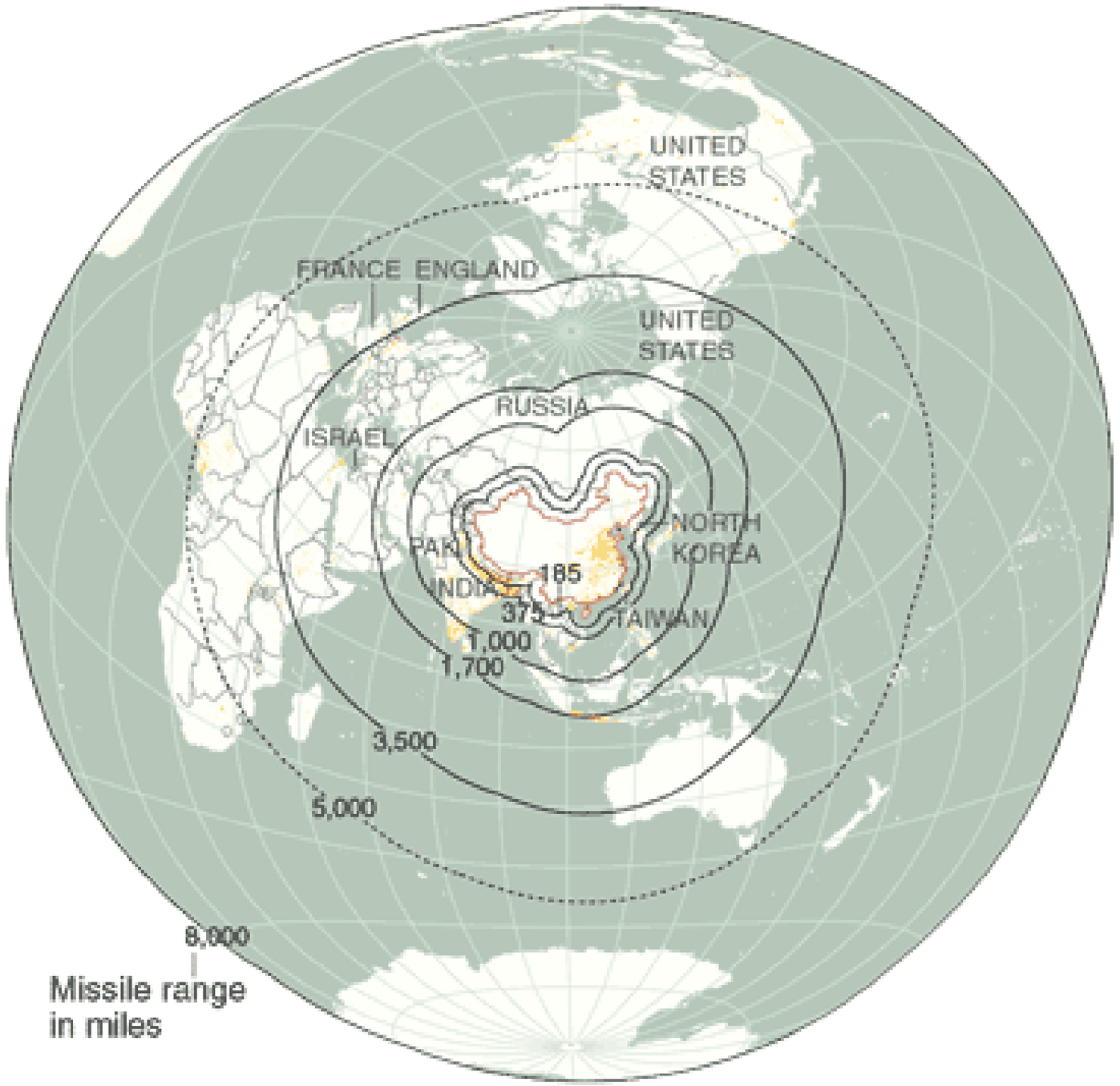
TYPE	NATO DESIGNATION	NO.	YEAR DEPLOYED	WARHEADS x YIELD (KILOTONS)	RANGE (KILOMETERS)	WARHEADS
Hong-6	B-6	20	1965	3,100	1 x bomb	~20
					DH-10	~15
Qian-5, others?	Q-5	?	1972–?	—	1 x bomb	~20

TOTAL* ~176**

Chinese Nuclear Forces

Chinese CSS-10 Road-Mobile Launcher

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

* 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.

TOTAL: 300

FRENCH SSBNs

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

Physics 280: Session 18

Plan for This Session

RE4v1 due this Thursday

Questions

News and Discussion

Module 6: Nuclear Arsenals (cont'd)

News: North Korea Continues Threats to 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.

News: 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

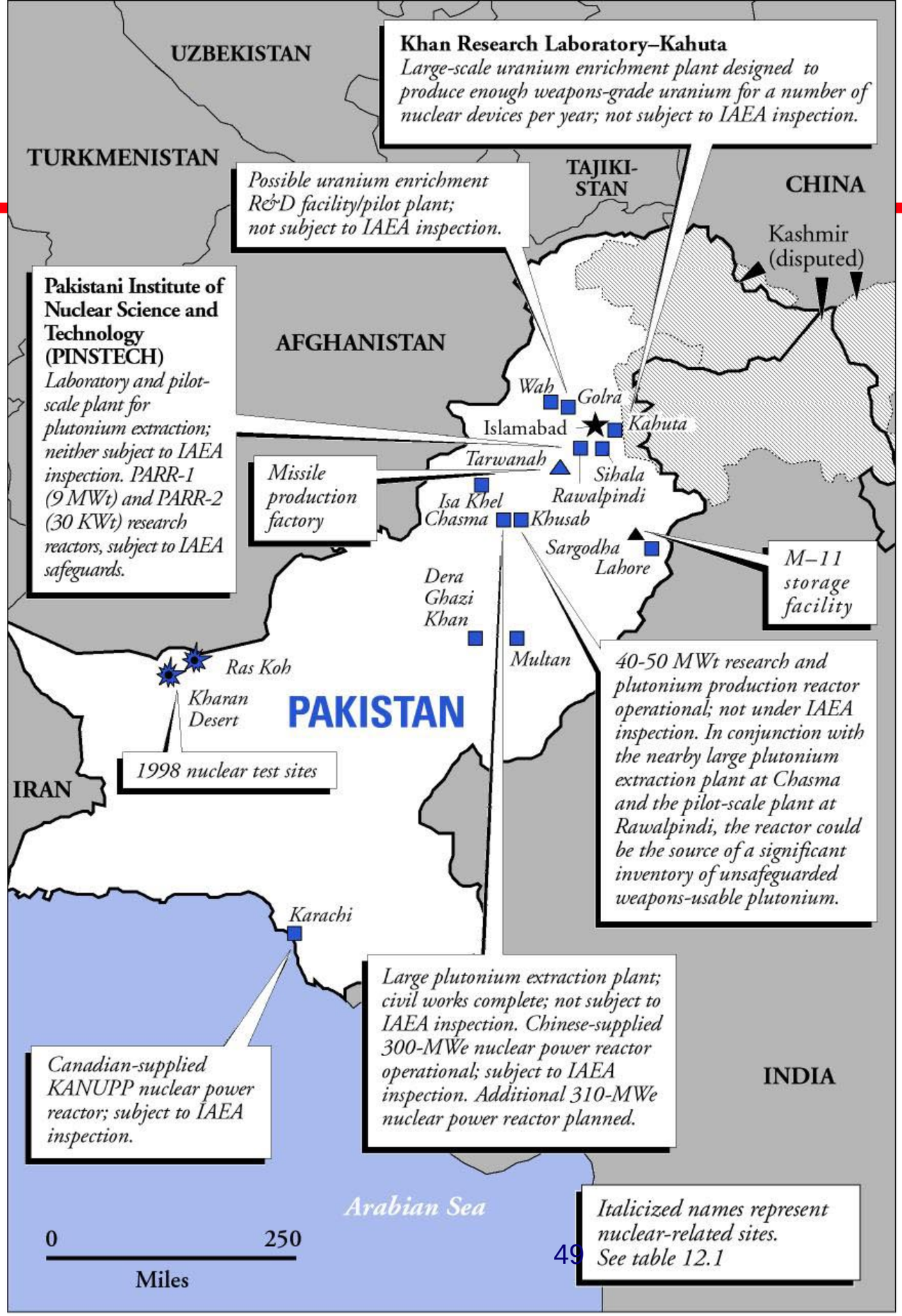
WASHINGTON — The Pentagon will spend $1 billion to deploy additional ballistic missile interceptors along the Pacific Coast to counter the growing reach of North Korea's weapons, a decision accelerated by Pyongyang's recent belligerence and indications that Kim Jong-un, the North Korean leader, is resisting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

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

India, Pakistan, Israel, North Korea, and Iran



Carnegie Endowment for International Peace, *Deadly Arsenals* (2002), **www.ceip.org**

Carnegie Endowment for International Peace, *Deadly Arsenals* (2002), **www.ceip.org**

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 where 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)

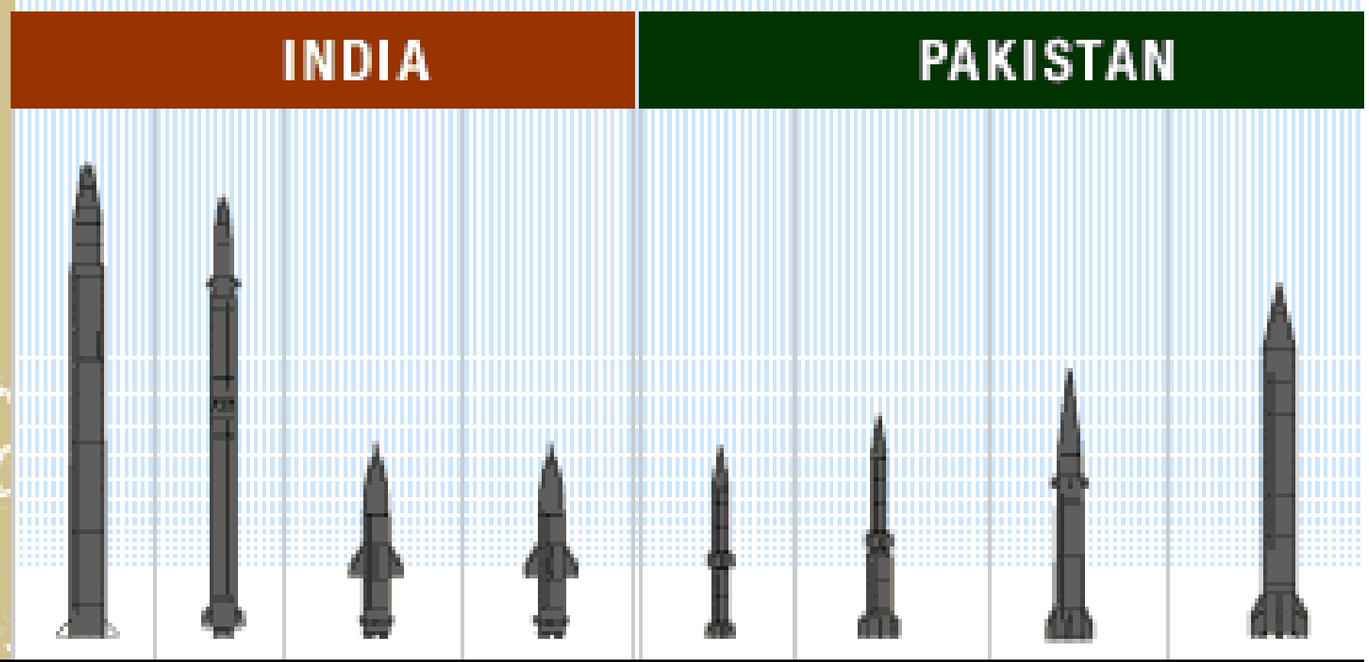
We estimate that Pakistan has produced 70-90 nuclear warheads that can be deployed on the following delivery vehicles:

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)

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



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

Carnegie Endowment for International Peace, *Deadly Arsenals* (2002), www.ceip.org

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			
Dolphin-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

About when did the number operational U.S. nuclear warheads peak?

A. 1970

B. 1975

C. 1980

D. 1985

E. 1990

iClicker Question

About when did the number operational U.S. nuclear warheads peak?

A. 1970

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C. 1980

D. 1985

E. 1990

iClicker Question

About how many operational nuclear warheads did the U.S. have when the number peaked?

A. 1,000

B. 5,000

C. 10,000

D. 15,000

E. 20,000

iClicker Question

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A. 1,000

B. 5,000

C. 10,000

D. 15,000

E. 20,000

iClicker Question

About when did the number of operational U.S.S.R. nuclear warheads peak?

A. 1970

B. 1975

C. 1980

D. 1985

E. 1990

iClicker Question

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D. 15,000

E. 20,000

iClicker Question

About how many operational nuclear warheads did the U.S.S.R. have when the number peaked?

A. 1,000

B. 5,000

C. 10,000

D. 15,000

E. 20,000

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.

NORTH KOREA

Hwaedae-Gun missile testing range and production facilities.

Site of two 1,000-MWe, light-water reactors financed by KEDO according to the terms of the Agreed Framework; construction began in August 1997.

Taechon

Yongbyon

Pakchon

Shinpo

200-MWe nuclear power reactor; construction halted under U.S.-N.K. Agreed Framework.

Pyongyang

Pyongsan

Uranium mining, and uranium concentrate production plant.

Seoul

Subcritical assembly.

Soviet-supplied laboratory-scale hot cells, which may have been used to extract small quantities of plutonium. (Similar cells may exist at other locations.)

Uranium concentrate production plant, using ore from Sunchon-Wolbingson mine (50 km to the south).

Yellow Sea

SOUTH KOREA

Sea of Japan

JAPAN

* 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.

0 50

Miles

Carnegie Endowment for International Peace, *Deadly Arsenals* (2002), **www.ceip.org**

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.
- 1989: Reports in the open press indicate for the first time that NK has a plutonium production reactor and extraction capability.

North Korea's Nuclear Program – 2

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

	technical capability			Yield	*technical capability*			
	low	*medium*	*high*	(kilotons)	*low*	*medium*	*high*	
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 – 4

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 – 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
North Korea freezes its operation and construction of nuclear facilities under IAEA supervision.	The United States agrees to provide heavy fuel oil to replace the electrical production potential of the shutdown 5-MW reactor.
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.	The United States agrees to establish an international consortium to construct two modern, light-water reactors in North Korea.
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	International consortium agrees to complete a significant portion of the reactor complex, not including key components.
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.	International consortium to deliver key components for first light-water reactor.
North Korea agrees to complete dismantling of its nuclear facilities and removal of its spent fuel upon delivery of key components for second reactor.	International consortium to deliver key components for second light-water reactor.

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 Communique:
  - —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.

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.

North Korea's Nuclear Program – 10

History (cont'd) —

- 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.

New 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 – 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 (build 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

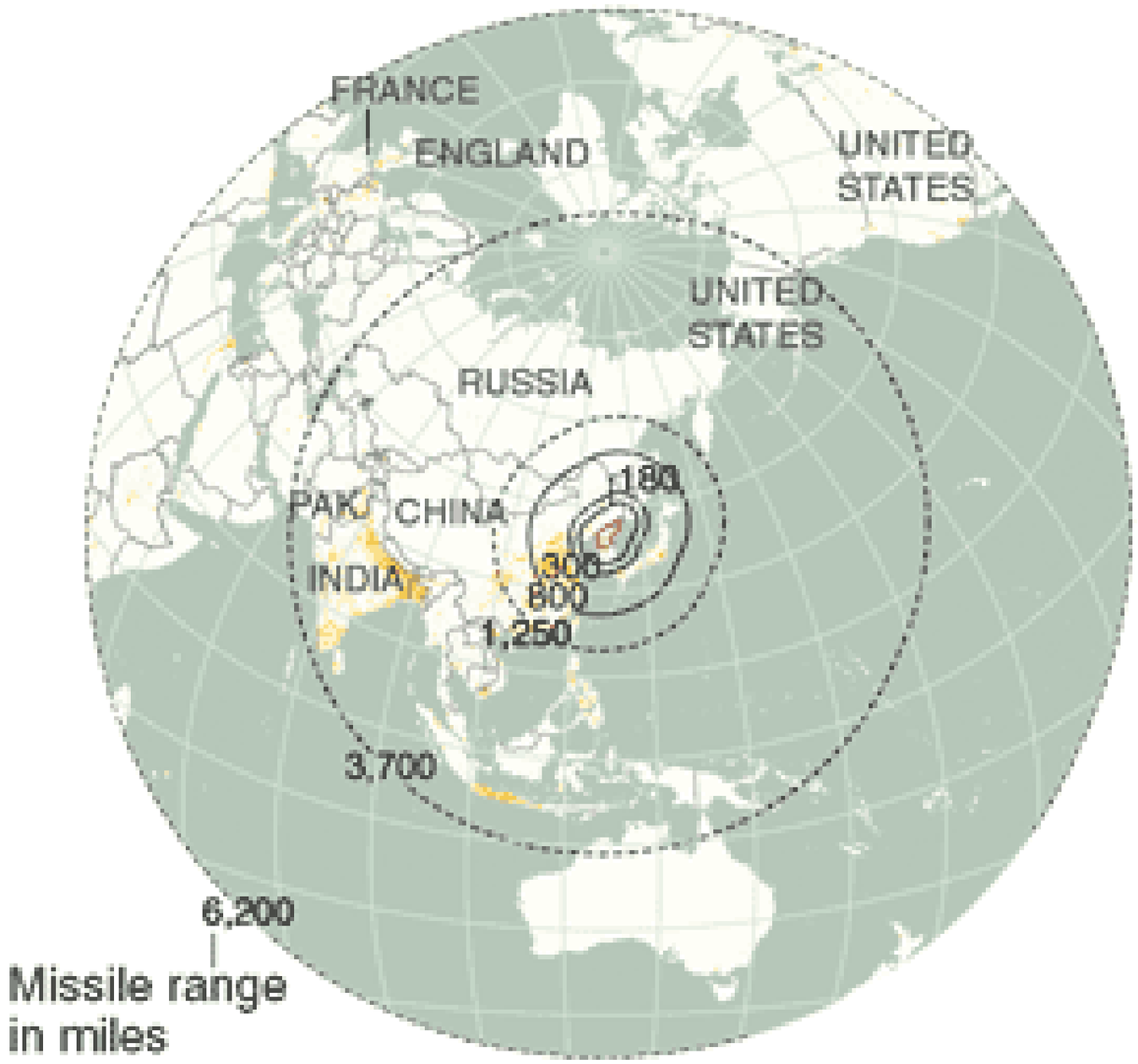
North Korea's Ballistic Missile Capabilities

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 Unsuccessful test launch 4-5-2009
Unha-3 Test launches 4-12-2012 (unsuccessful) and 12-12-2012 (successful)

Ranges of North Korea's Missiles



Physics 280: Session 19

Plan for This Session

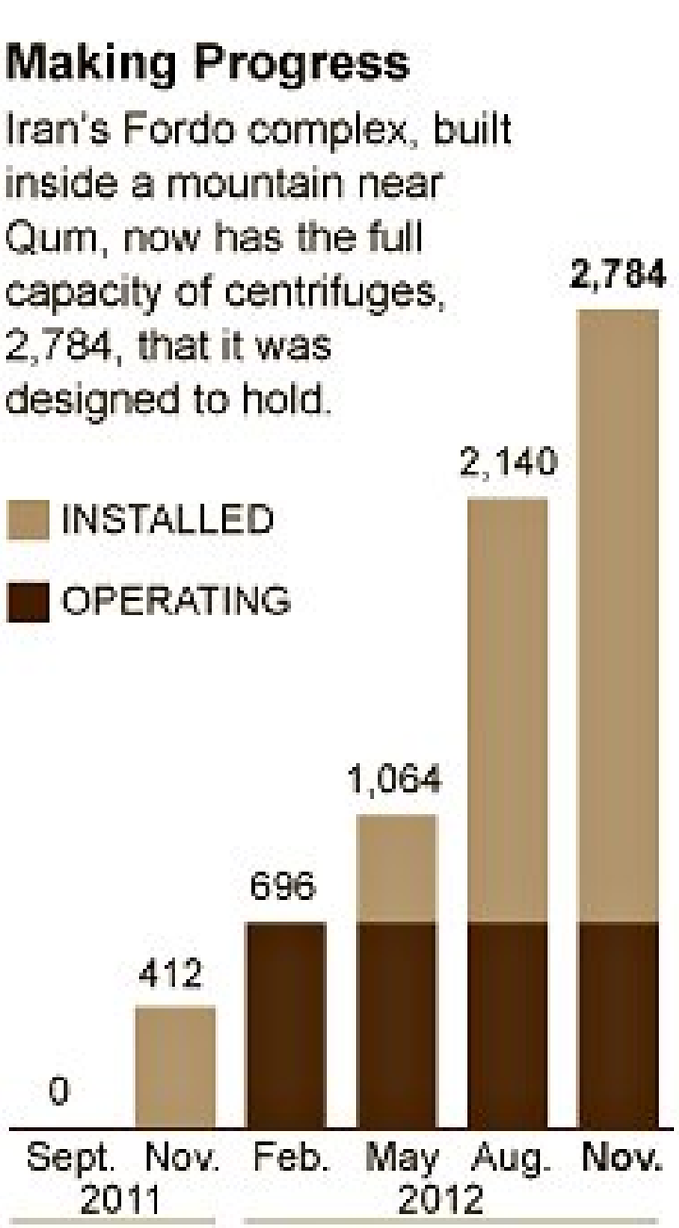
Questions

Module 6: Nuclear Arsenals (cont'd)

- o Iran
- o Indian view with regards to Pakistan's Nuclear Program
  presented by Sphurti Joglekar
- o Deterrence in the middle east
  presented by Nir Friedman

Video Presentation: Kim's Nuclear Gambit

Iran's Nuclear Complex



13p280 Programs and Arsenals, p. 101

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 —

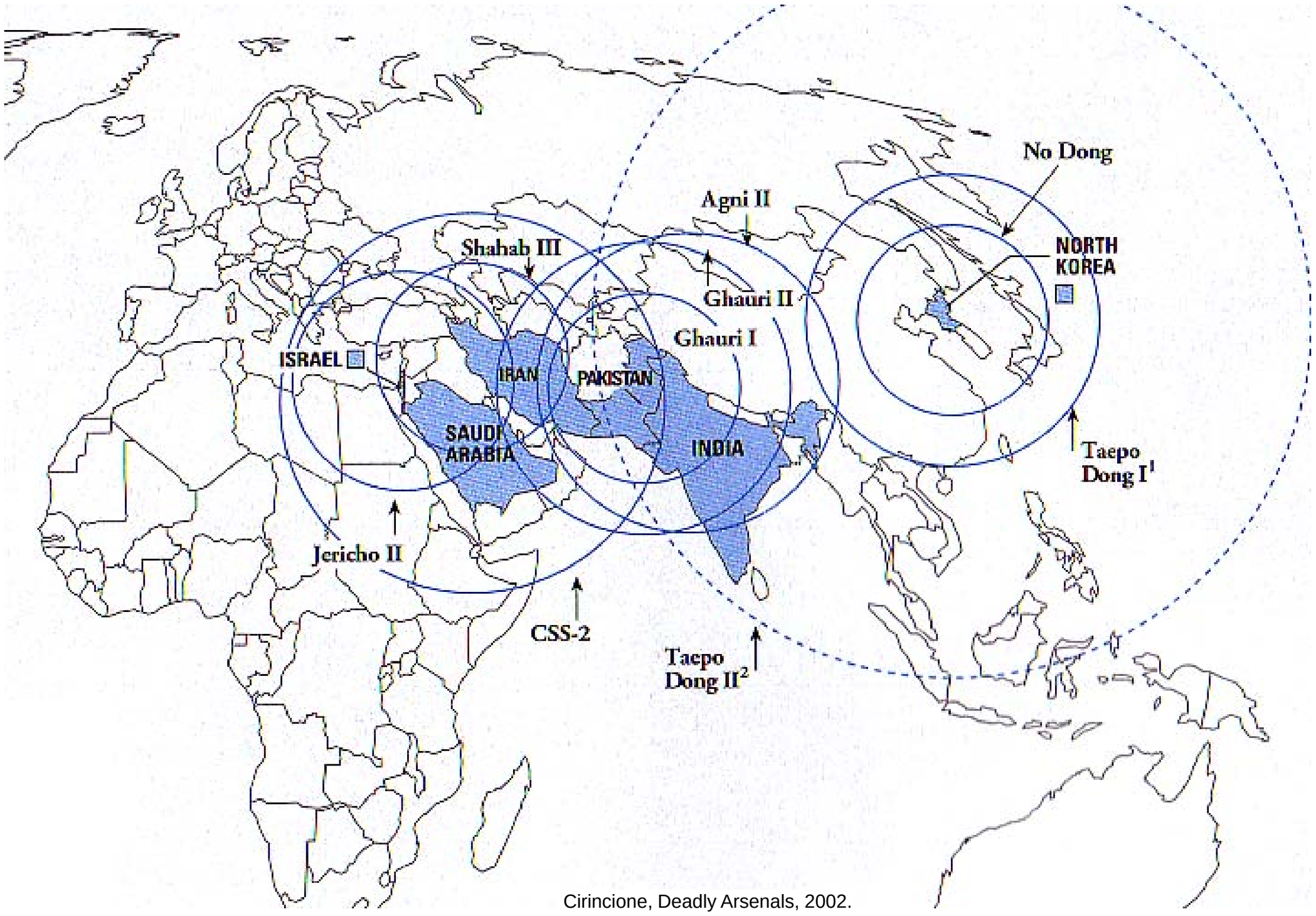
- It has completed a large gas-centrifuge uranium enrichment facility at Natanz with 7000 centrifuges in June 2009.
- In its June 2009 report the IAEA estimated that Iran has produced more than 1200 kg of LEU in Natanz.
- The 7000-centrifuge plant could produce material for 3-4 bombs every year. Currently 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.

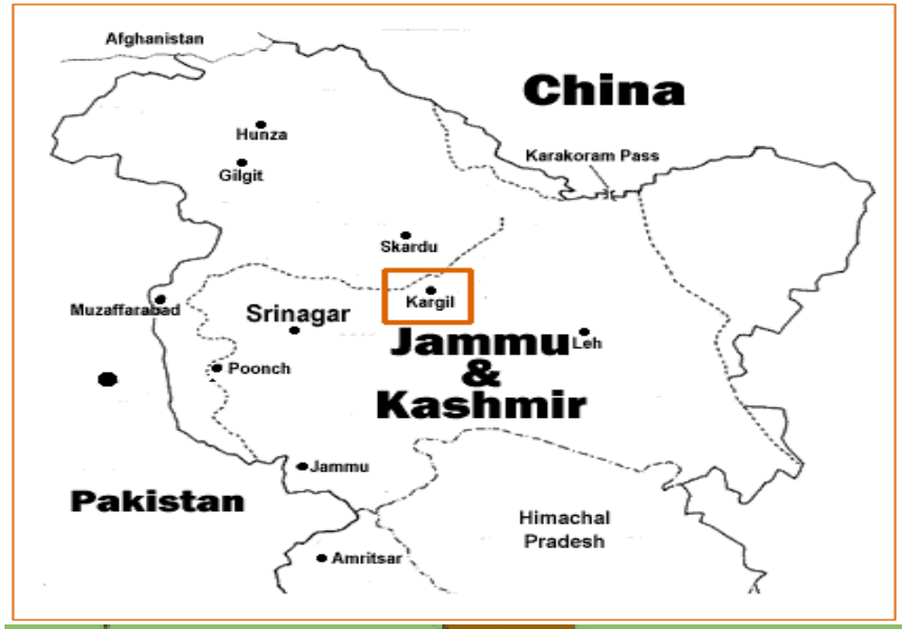
Public Perception in India about Nuclear Weapons Program in Pakistan I (by Sphurti Joglekar)

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) there was firing across the borders in which 3 soldiers died. (New York Times)

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



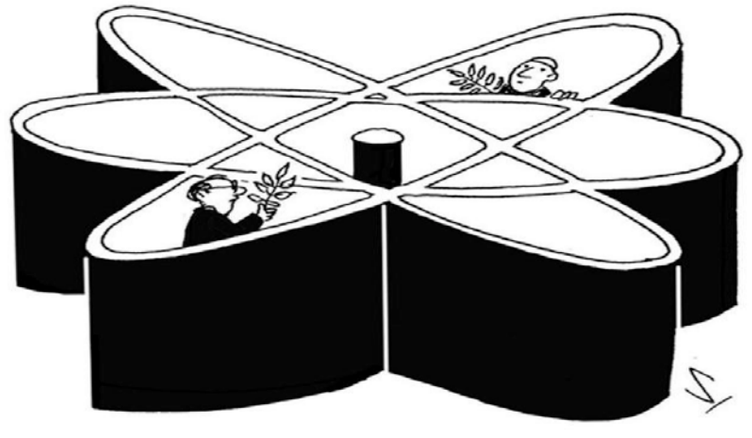
Public Opinion about Nuclear Program in India II

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.

In addition, Nuclear power plants help reducing the grave power shortage 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.



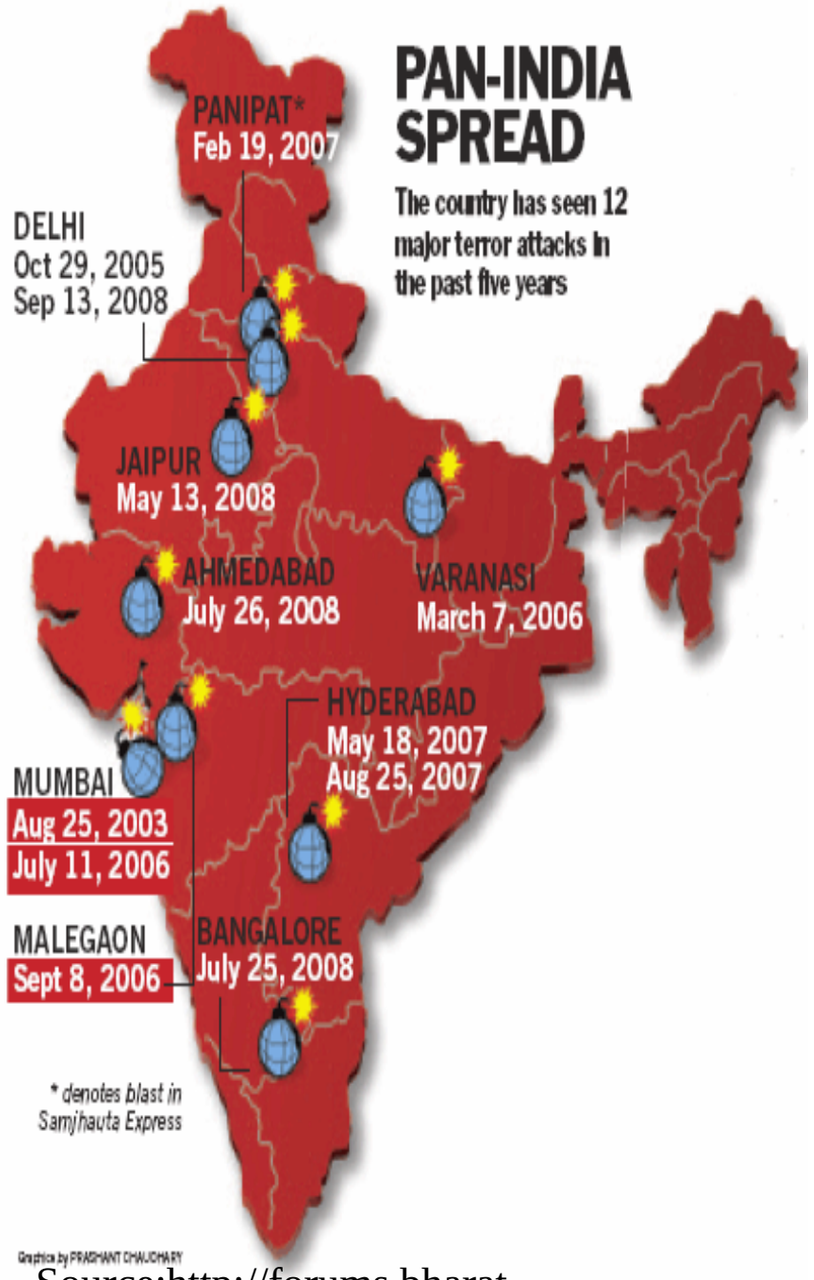
Source:http://www.thehindu.com/multimedia/dynamic/00903/26TH_INDO-PAK_NUCLE_903535f.jpg

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

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 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.



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

Yom Kippur War – 1973 I (by Nir Friedman)

- In 1967:
  - Israel victorious in Six Days War (Egypt, Syria, Jordan)
  - Acquires nuclear weapons
- Yom Kippur War is a surprise attack launched by Egypt & Syria
- Israel: primarily reserve army, high vulnerable to surprise

Yom Kippur War – 1973 II
Did Nuclear Deterrence Fail?

- Syrian attack: almost broke through to cities
- Defense Minister: “The Third Temple is falling”
- Significance of war for Israelis:
  - Destroyed feeling of invulnerability built up during the Six Days War
  - Less discussed: failure of nuclear deterrence
- No usage, or known threat of nuclear weapons

Hezbollah and Iran III

- “We categorically reject any compromise with Israel or recognizing its legitimacy, this position is definitive, even if everyone recognizes 'Israel' ”
- Relationship with Iran strong and growing stronger:
  - "What we see now is that Hezbollah is going to do things today that are in Iran's interest even if they expressly run counter to the interests of Lebanon and Hezbollah's own interest there."
- Iran itself: mixed messages (as with nuclear program)

War with ‘cancerous tumor Israel’ will eventually happen, says Iranian general

Commander of Revolutionary Guard Mohammad Ali Jafari claims Iran will ‘destroy the Jewish state’

By YOEL GOLDMAN | September 22, 2012, 2:11 pm | 13

Commander of Iran's Revolutionary Guard, Gen. Mohammad Ali Jafari, attends a press conference in Tehran earlier this month (photo credit: AP/Vahid Salemi)

Kim’s Nuclear Gambit

Video Presentation:

Kim’s Nuclear Gambit

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**
Total Warheads	**9,400**

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 bombers	**206**
TOTAL	**1188**

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
Total SLBMs	**268**	**288 (336)**	**288 (336)**	**1152**
Bombers				
B-1	47	0		
B-2	18	16 (18)	16 (18)	16
B-52	141	44 (93)	32 (93)	32
Total bombers	**206**	**60 (111)**	**48 (111)**	**48**
TOTAL	**1188**	**798 (897)**	**686 (797)**	**1550**

New START Nuclear Force Levels – Russia

Russia

	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				
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)

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**
	GRAND TOTAL				**~5,521/215**

* 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.

NRDC, Jan/Feb. 2007

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, 32Bear–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			872
GRAND TOTAL						~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.

NRDC, March/April. 2007

r 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					2,329

NRDC, March/April. 2007

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						~130***

NRDC, May/June. 2006

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+	?	Under development. Possible flight-test in late 2005; deployment scheduled for 2010 or later.

Source: NRDC (2005)

Summary of Pakistan's Nuclear Delivery Systems

Type/Designation	Range (km)	Payload (kg)	Comment
Aircraft			
F-16A/B	1,600	5,450	At Sargodha AB
Missiles			
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)

End of Module 6