Plan for This Session

Student questions

Next session: Midterm Exam (100 MSEB)

Module 6: Nuclear Arsenals
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

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.

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. Stolman

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

PROLIFERATION STATUS 2005

Chemical, Biological, and Missile Proliferation

- Suspected Biological Warfare Stockpiles (Country may have offensive biological weapons or agents)
- Suspected Biological Warfare Research Programs (Country may have active interest in acquiring the capability to produce biological warfare agents)
- Suspected Chemical Warfare Stockpiles (Country may have some undeclared chemical weapons)
- Declared chemical weapons slated for destruction (Country has declared its chemical weapons, and committed to destroying them under the Chemical Weapons Convention)
- Ballistic Missiles with Over 1,000 km Range

Worldwide Nuclear Stockpiles

<table>
<thead>
<tr>
<th>Country</th>
<th>Total Nuclear Warheads</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>410</td>
</tr>
<tr>
<td>France</td>
<td>358</td>
</tr>
<tr>
<td>India</td>
<td>78-110</td>
</tr>
<tr>
<td>Israel</td>
<td>100-170</td>
</tr>
<tr>
<td>Pakistan</td>
<td>50-110</td>
</tr>
<tr>
<td>Russia</td>
<td>~16,000</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>290</td>
</tr>
<tr>
<td>United States</td>
<td>~10,300</td>
</tr>
<tr>
<td>Total</td>
<td>~27,600</td>
</tr>
</tbody>
</table>

Missiles with ranges exceeding 1,000 km in 6 Countries of Proliferation Concern

<table>
<thead>
<tr>
<th>Country</th>
<th>Missile</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>Agni II</td>
<td>2,000-2,500 km</td>
</tr>
<tr>
<td>Iran</td>
<td>Shahab III</td>
<td>1,200 km</td>
</tr>
<tr>
<td>Israel</td>
<td>Jericho II</td>
<td>1,500 km</td>
</tr>
<tr>
<td>North Korea</td>
<td>No Dong</td>
<td>1,200 km</td>
</tr>
<tr>
<td>North Korea</td>
<td>Taepo Dong I</td>
<td>1,500-2,000 km</td>
</tr>
<tr>
<td>North Korea</td>
<td>Taepo Dong II</td>
<td>5,000 km</td>
</tr>
<tr>
<td>Pakistan</td>
<td>Ghauri No Dong</td>
<td>1,300 km</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>CSS-2</td>
<td>2,600 km</td>
</tr>
</tbody>
</table>

World Nuclear Weapon Stockpiles 1945–2012 (Important)

~ 19,500 total nuclear weapons in 2012

States With Nuclear Weapons in 2012
Global Nuclear Weapon Inventory 2012 (Important)

NPT Nuclear Weapon States (Total Weapons)

China: \(~ 240\)
France: \(~ 300\)
Russia: \(~ 10,000\)
UK: \(~ 225\)
US: \(~ 8,500\)
Non-NPT Nuclear Weapon States (Total Weapons)

Pakistan: ~ 90–110
Israel: ~ 60–80
India: ~ 60–80
North Korea: < 10
States With Nuclear Weapons in 2012

NPT     Non-NPT
# Status of World Nuclear Forces 2012

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

* 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.

Overview of Programs and Arsenals

Map of ICBM Threats (2001 NIC Assessment)

- Green: Currently possess ICBMs
- Yellow: Identified by U.S. intelligence as possible ICBM threats by 2015
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

<table>
<thead>
<tr>
<th>Maximum System</th>
<th>Launch Mode</th>
<th>Warhead Type</th>
<th>Range (miles)</th>
<th>IOC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CHINA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YJ-63</td>
<td>Air</td>
<td>Conventional</td>
<td>Undetermined</td>
<td>Undetermined</td>
</tr>
<tr>
<td>DH-10</td>
<td>Undetermined</td>
<td>Conventional or nuclear</td>
<td>Undetermined</td>
<td>Undetermined</td>
</tr>
<tr>
<td><strong>PAKISTAN</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RA‘AD</td>
<td>Air</td>
<td>Conventional or Nuclear</td>
<td>200</td>
<td>Undetermined</td>
</tr>
<tr>
<td>Babur</td>
<td>Ground</td>
<td>Conventional or Nuclear</td>
<td>200</td>
<td>Undetermined</td>
</tr>
<tr>
<td><strong>RUSSIA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS-4</td>
<td>Air</td>
<td>Conventional or nuclear</td>
<td>185+</td>
<td>Operational</td>
</tr>
<tr>
<td>AS-15</td>
<td>Air</td>
<td>Nuclear</td>
<td>1,500+</td>
<td>Operational</td>
</tr>
<tr>
<td>SS-N-21</td>
<td>Submarine</td>
<td>Nuclear</td>
<td>1,500+</td>
<td>Operational</td>
</tr>
</tbody>
</table>

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

Sources: 2009 NASIC Report, Arms Control Association
Pakistani Ra’ad Air-Launched Cruise Missile
Module 6: Programs and Arsenals

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 Nuclear Warhead Numbers

Source: NRDC (Nov. 2002)
Evolution of US and SU-Russian 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 Warhead Numbers

Source: NRDC (Nov. 2002)
## Evolution of US Nuclear Bomber Forces – 1

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bombers (Total Inventory)</strong> [1]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-52 Stratofortress</td>
<td>94</td>
<td>94</td>
<td>94</td>
<td>94</td>
<td>94</td>
</tr>
<tr>
<td>B-2 Spirit</td>
<td>21</td>
<td>21</td>
<td>21</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td><strong>Total (Bombers)</strong></td>
<td><strong>115</strong></td>
<td><strong>115</strong></td>
<td><strong>115</strong></td>
<td><strong>115</strong></td>
<td><strong>115</strong></td>
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</tbody>
</table>

Source: NRDC
## Evolution of US Nuclear Bomber Forces – 2

<table>
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<tbody>
<tr>
<td>Bombers Weapons (Force Loadings) [12]</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bombs [13]</td>
<td>516</td>
<td>516</td>
<td>516</td>
<td>516</td>
<td>1,286</td>
</tr>
<tr>
<td>ALCM (AGM-86B) [16]</td>
<td>430</td>
<td>430</td>
<td>430</td>
<td>430</td>
<td>45</td>
</tr>
<tr>
<td>ACM (AGM-129A) [17]</td>
<td>430</td>
<td>430</td>
<td>430</td>
<td>430</td>
<td>45</td>
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<tr>
<td>Total (Force Loading Weapons)</td>
<td>1,376</td>
<td>1,376</td>
<td>1,376</td>
<td>1,376</td>
<td>1,376</td>
</tr>
</tbody>
</table>

* 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

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

Source: NRDC
## Evolution of US ICBM Nuclear Forces

<table>
<thead>
<tr>
<th>ICBM Forces</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2007*</th>
<th>2012**</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Launchers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MINUTEMAN III [8]</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>MX (PEACEKEEPER) [9]</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total Launchers</strong></td>
<td>550</td>
<td>550</td>
<td>550</td>
<td>550</td>
<td>550</td>
</tr>
<tr>
<td><strong>ICBM Deployed Warheads</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W62 (MM III) [16]</td>
<td>600</td>
<td>300</td>
<td>300</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>W78 (MM III) [17]</td>
<td>900</td>
<td>900</td>
<td>900</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>W87 (MX) [18]</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total (Deployed)</strong></td>
<td>2000</td>
<td>1700</td>
<td>1700</td>
<td>500</td>
<td>500</td>
</tr>
</tbody>
</table>

Source: NRDC
Locations of U.S. Nuclear Weapons

NRDC, Where the Bombs are, 2006, Bulletin of the Atomic Scientists, Nov-Dec 2006
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.
Discussing his approach to nuclear security the day before formally releasing his new strategy, Mr. Obama described his policy as part of a broader effort to edge the world toward making nuclear weapons obsolete, and to create incentives for countries to give up any nuclear ambitions. To set an example, the new strategy renounces the development of any new nuclear weapons, overruling the initial position of his own defense secretary.

Mr. Obama’s strategy is a sharp shift from those of his predecessors and seeks to revamp the nation’s nuclear posture for a new age in which rogue states and terrorist organizations are greater threats than traditional powers like Russia and China.
It eliminates much of the ambiguity that has deliberately existed in American nuclear policy since the opening days of the cold war. For the first time, the United States is explicitly committing not to use nuclear weapons against non-nuclear states that are in compliance with the Nuclear Nonproliferation Treaty, even if they attacked the United States with biological or chemical weapons or launched a crippling cyberattack.

Those threats, Mr. Obama argued, could be deterred with “a series of graded options,” a combination of old and new conventional weapons. “I’m going to preserve all the tools that are necessary in order to make sure that the American people are safe and secure,” he said in the interview in the Oval Office.
The release of the new strategy, known as the Nuclear Posture Review, opens an intensive nine days of nuclear diplomacy geared toward reducing weapons. Mr. Obama plans to fly to Prague to sign a new arms-control agreement with Russia on Thursday and then next week will host 47 world leaders in Washington for a summit meeting on nuclear security.

The strategy to be released on Tuesday is months late, partly because Mr. Obama had to adjudicate among advisers who feared he was not changing American policy significantly enough, and those who feared that anything too precipitous could embolden potential adversaries. One senior official said that the new strategy was the product of 150 meetings, including 30 convened by the White House National Security Council, and that even then Mr. Obama had to step in to order rewrites.
He ended up with a document that differed considerably from the one President George W. Bush published in early 2002, just three months after the Sept. 11 attacks. Mr. Bush, too, argued for a post-cold-war rethinking of nuclear deterrence, reducing American reliance on those weapons.

But Mr. Bush’s document also reserved the right to use nuclear weapons “to deter a wide range of threats,” including banned chemical and biological weapons and large-scale conventional attacks. Mr. Obama’s strategy abandons that option — except if the attack is by a nuclear state, or a nonsignatory or violator of the nonproliferation treaty.
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.
In 2011, the United States Planned to Greatly Increase its Spending on Nuclear Weapons

Funding for U.S. Nuclear Triad Set to Grow

Tom Z. Collina

President Barack Obama last month sent Congress a budget request for fiscal year 2012 that would significantly increase funding for maintenance of the nuclear stockpile, modernization of the weapons production complex, upgrades to strategic delivery systems, and deployment of ballistic missile interceptors.

All told, these commitments, which were key to winning Department of Defense and Senate support for the New Strategic Arms Reduction Treaty (New START), would add up to almost $300 billion over the next decade. The budget documents add specifics to the earlier commitments.
FY13. The total request for the National Nuclear Security Administration (NNSA), the quasi-independent unit within DOE that manages the US nuclear weapons program, is $11.536 billion, a 5% increase over FY12 enacted.

Even with NCTIR (Nuclear Counterterrorism and Incident Response) classified as a nonproliferation project, the request for weapons activities is $4.6 billion (170%) higher than the request for nonproliferation funds.

Due both to fiscal constraints imposed by the Budget Control Act (BCA) and proposals under development by the Pentagon, the future shape and size of the U.S. nuclear deterrent is unclear.
iClicker Question

About when did the total worldwide nuclear arsenal peak?

1955
1965
1975
1985
1995
About when did the total worldwide nuclear arsenal peak?

1955
1965
1975
1985
1995
About how many nuclear weapons were there at the peak?

10,000
30,000
50,000
70,000
90,000
About how many nuclear weapons were there at the peak?

10,000
30,000
50,000
70,000
90,000
About how many nuclear weapons are in the global inventory today?

- 5,500
- 8,500
- 13,500
- 16,500
- 19,500
About how many nuclear weapons are in the global inventory today?

- 5,500
- 8,500
- 13,500
- 16,500
- 19,500

19,500
About how many nuclear weapons does China now have *in total*?

50
100
250
3,000
5,000
About how many nuclear weapons does China now have *in total*?

- 50
- 100
- 250
- 3,000
- 5,000
About how many nuclear weapons does France now have in total?

50
100
300
1,000
5,000
iClicker Question

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

50
100
**300**
1,000
5,000
SU-Russian Nuclear Warheads

Source: NRDC (Nov. 2002)
## Russian Nuclear Forces (2011)

<table>
<thead>
<tr>
<th>Type/name</th>
<th>Russian designation</th>
<th>Year</th>
<th>Warheads x yield (kilotons)</th>
<th>Total warhead</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ICBMs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS-18 M6 Satan</td>
<td>RS-20V</td>
<td>1988</td>
<td>10 × 500/800 (MIRV)</td>
<td>500</td>
</tr>
<tr>
<td>SS-19 M3 Stiletto</td>
<td>RS-18</td>
<td>1980</td>
<td>6 × 400 (MIRV)</td>
<td>300</td>
</tr>
<tr>
<td>SS-25 Sickle</td>
<td>RS-12M (Topol)</td>
<td>1985</td>
<td>1 × 800</td>
<td>120</td>
</tr>
<tr>
<td>SS-27 Mod 1</td>
<td>RS-12M2 (Topol-M)</td>
<td>1997</td>
<td>1 × 800</td>
<td>51</td>
</tr>
<tr>
<td>SS-27 Mod 1</td>
<td>RS-12M1 (Topol-M)</td>
<td>2006</td>
<td>1 × 800?</td>
<td>18</td>
</tr>
<tr>
<td>SS-27 Mod 2</td>
<td>RS-24</td>
<td>2010</td>
<td>3 × 400? (MIRV)</td>
<td>18</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>1,007</strong></td>
</tr>
<tr>
<td><strong>SLBMs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS-N-18 M1 Stingray</td>
<td>RSM-50</td>
<td>1978</td>
<td>3 × 50 (MIRV)</td>
<td>192</td>
</tr>
<tr>
<td>SS-N-23 Skiff</td>
<td>R-29RM</td>
<td>1986</td>
<td>4 × 100 (MIRV)</td>
<td>64</td>
</tr>
<tr>
<td>SS-N-23 M1</td>
<td>RSM-54 (Sineva)</td>
<td>2007</td>
<td>4 × 100 (MIRV)</td>
<td>320</td>
</tr>
<tr>
<td>SS-N-32</td>
<td>RSM-56 (Bulava)</td>
<td>(2011)</td>
<td>6 × 100 (MIRV)</td>
<td>(96)</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>576</strong></td>
</tr>
<tr>
<td><strong>Bombers/weapons</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bear-H6</td>
<td>Tu-95 MS6</td>
<td>1984</td>
<td>6 × AS-15A ALCMs, bombs</td>
<td>192</td>
</tr>
<tr>
<td>Bear-H16</td>
<td>Tu-95 MS16</td>
<td>1984</td>
<td>16 × AS-15A ALCMs, bombs</td>
<td>496</td>
</tr>
<tr>
<td>Blackjack</td>
<td>Tu-160</td>
<td>1987</td>
<td>12 × AS-15B ALCMs or AS-16 SRAMs, bombs</td>
<td>156</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>844</strong></td>
</tr>
<tr>
<td><strong>Subtotal strategic offensive forces</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>2,430</strong></td>
</tr>
</tbody>
</table>
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
### NONSTRATEGIC AND DEFENSIVE WEAPONS

#### ABM/Air defense

<table>
<thead>
<tr>
<th>Missle</th>
<th>System</th>
<th>1986</th>
<th>1 x 1000/10</th>
</tr>
</thead>
<tbody>
<tr>
<td>53T6</td>
<td>Gazelle</td>
<td>68</td>
<td>1 x 1000/10</td>
</tr>
<tr>
<td>SA-10</td>
<td>Grumble</td>
<td>1,900</td>
<td>1 x low</td>
</tr>
</tbody>
</table>

#### 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

### TOTAL

~4,600

1. The Sineva probably carries at least four MIRV'ed 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.
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.
### Chinese Nuclear Forces (2008)

#### Land-Based Missiles

<table>
<thead>
<tr>
<th>Type</th>
<th>NATO Designation</th>
<th>No.</th>
<th>Year Deployed</th>
<th>Warheads x Yield (Kilotons)</th>
<th>Range (Kilometers)</th>
<th>Warheads</th>
</tr>
</thead>
<tbody>
<tr>
<td>DF-3A</td>
<td>CSS-2</td>
<td>17</td>
<td>1971</td>
<td>3,100</td>
<td>1 x 3,300</td>
<td>17</td>
</tr>
<tr>
<td>DF-4</td>
<td>CSS-3</td>
<td>17</td>
<td>1980</td>
<td>5,400+</td>
<td>1 x 3,300</td>
<td>17</td>
</tr>
<tr>
<td>DF-5A</td>
<td>CSS-4</td>
<td>20</td>
<td>1981</td>
<td>13,000+</td>
<td>1 x 4,000–5,000</td>
<td>20</td>
</tr>
<tr>
<td>DF-21</td>
<td>CSS-5</td>
<td>55</td>
<td>1991</td>
<td>2,100</td>
<td>1 x 200–300</td>
<td>55</td>
</tr>
<tr>
<td>DF-31</td>
<td></td>
<td>~6</td>
<td>2008</td>
<td>7,200+</td>
<td>7,200</td>
<td>~6</td>
</tr>
<tr>
<td>DF-31A</td>
<td></td>
<td>~6</td>
<td>2008</td>
<td>11,200+</td>
<td>11,200</td>
<td>~6</td>
</tr>
</tbody>
</table>

#### Submarine-Launched Ballistic Missiles

<table>
<thead>
<tr>
<th>Type</th>
<th>NATO Designation</th>
<th>No.</th>
<th>Year Deployed</th>
<th>Warheads x Yield (Kilotons)</th>
<th>Range (Kilometers)</th>
<th>Warheads</th>
</tr>
</thead>
<tbody>
<tr>
<td>JL-1*</td>
<td>CSS-NX-3</td>
<td>0</td>
<td>1986</td>
<td>1,000+</td>
<td>1 x 200–300</td>
<td>0</td>
</tr>
<tr>
<td>JL-2</td>
<td>CSS-NX-4</td>
<td>0</td>
<td>2009–10?</td>
<td>7,200+</td>
<td>1 x 200–300</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Aircraft

<table>
<thead>
<tr>
<th>Type</th>
<th>NATO Designation</th>
<th>No.</th>
<th>Year Deployed</th>
<th>Warheads x Yield (Kilotons)</th>
<th>Range (Kilometers)</th>
<th>Warheads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hong-6</td>
<td>B-6</td>
<td>20</td>
<td>1965</td>
<td>3,100</td>
<td>1 x bomb</td>
<td>~20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DH-10</td>
<td>~15</td>
</tr>
<tr>
<td>Qian-5</td>
<td>Q-5</td>
<td>?</td>
<td>1972–?</td>
<td></td>
<td>1 x bomb</td>
<td>~20</td>
</tr>
</tbody>
</table>

**TOTAL**: ~176
Ranges of China’s Missiles
### French Nuclear Forces (2008)

#### The French Arsenal

<table>
<thead>
<tr>
<th>Land-Based Aircraft</th>
<th>No.</th>
<th>Year Operational</th>
<th>Range (kilometers)</th>
<th>Warheads x Yield (kilotons)</th>
<th>Active Warheads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mirage 2000N/ASMP</td>
<td>50</td>
<td>1988*</td>
<td>2,750**</td>
<td>1 TN81 x Variable to 300</td>
<td>50</td>
</tr>
<tr>
<td>Rafale F3/ASMP-A</td>
<td>?</td>
<td>2008</td>
<td>2,000</td>
<td>1 TNA x Variable to ?</td>
<td>—</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Carrier-Based Aircraft</th>
<th>No.</th>
<th>Year Operational</th>
<th>Range (kilometers)</th>
<th>Warheads x Yield (kilotons)</th>
<th>Active Warheads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Super Étendard/ASMP</td>
<td>10</td>
<td>1978</td>
<td>650**</td>
<td>1 TN81 x Variable to 300</td>
<td>10</td>
</tr>
<tr>
<td>Rafale MK3/ASMP-A</td>
<td>?</td>
<td>(2010)</td>
<td>2,000</td>
<td>1 TNA x Variable to ?</td>
<td>—</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SLBMs</th>
<th>No.</th>
<th>Year Operational</th>
<th>Range (kilometers)</th>
<th>Warheads x Yield (kilotons)</th>
<th>Active Warheads</th>
</tr>
</thead>
<tbody>
<tr>
<td>M45***</td>
<td>48</td>
<td>N/A</td>
<td>4,000+</td>
<td>4–6 TN75 x 100</td>
<td>240</td>
</tr>
</tbody>
</table>

* The ASMP first became operational on the Mirage IV in 1985.
** Maximum range of the ASMP is 300 kilometers; for the ASMP-A it is 500 kilometers.
*** Three sets of 15 M45 missiles are deployed on three of four SSBNs in the operational cycle.

#### French SSBNs

<table>
<thead>
<tr>
<th>Name/SLBM</th>
<th>Year Operational</th>
<th>Missile Range (kilometers)</th>
<th>Warheads x Yield (kilotons)</th>
<th>Total Warheads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Le Triomphant/M45</td>
<td>1997</td>
<td>4,000+</td>
<td>4–6 TN75 x 100</td>
<td>80</td>
</tr>
<tr>
<td>Le Téméraire/M45</td>
<td>1999</td>
<td>4,000+</td>
<td>4–6 TN75 x 100</td>
<td>80</td>
</tr>
<tr>
<td>Le Vigilant/M45</td>
<td>2005</td>
<td>4,000+</td>
<td>4–6 TN75 x 100</td>
<td>80</td>
</tr>
<tr>
<td>Le Terrible/M51.1</td>
<td>(2010)</td>
<td>6,000</td>
<td>4–6 TN75 x 100</td>
<td>0</td>
</tr>
</tbody>
</table>

* Three sets of 16 M45 missiles are deployed on three of four SSBNs in the operational cycle.
** Its first deployment is scheduled for 2010.
# U.K. Strategic Nuclear Forces

<table>
<thead>
<tr>
<th>Weapon System</th>
<th>No. deployed</th>
<th>Year deployed</th>
<th>Range (km)</th>
<th>Warhead x yield</th>
<th>Type</th>
<th>No. in stockpile</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SLBMs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trident II D-5</td>
<td>64</td>
<td>1994</td>
<td>7,400</td>
<td>1–3 x 100 Kt</td>
<td>MIRV</td>
<td>200</td>
</tr>
</tbody>
</table>

Source: NRDC (Nov. 2002)

# average loading five warheads per missile, some missiles carry one warhead, various yield options
Plan for This Session

RE4v1 due this Thursday, 3-29

Questions

News and Discussion

Module 6: Nuclear Arsenals (cont’d)
Thursday, March 29  
10:00 - 11:30 am  
*Location:* Alice Campbell Alumni Center Ballroom, 601 S.Lincoln, Urbana  

**State of the European Union Address**  
João Vale de Almeida  
EU Ambassador and Head of the EU Delegation to the US  

Topics include:  

EU policy, including the eurozone crisis, the EU’s approach to Iran’s nuclear program, transatlantic cooperation in addressing the Arab Spring, and European integration of new member countries as well as minority immigrant populations
History:

President Obama identified nuclear terrorism as the “most immediate and extreme threat to global security,” in a speech in Prague in April 2009. The President announced “a new international effort to secure all vulnerable nuclear material around the world within four years.”

The President hosted the first Nuclear Security Summit in Washington, DC, in April 2010. Heads of state from 47 countries gathered to lay out their priorities and focus the world’s attention on the issue.

Results included voluntary measures of about half of the attending countries to reduce or better secure nuclear materials and the reaffirmation of existing efforts, for example UN resolution 1540, committing states to prevent no-state actors from acquiring nuclear weapons or the ratification of Convention on the Physical Protection of Nuclear Materials (CPPNM).

see Securing Nuclear Materials: The 2010 Summit and Issues for Congress by Mary Beth Nikitin, Specialist in Nonproliferation, October 31, 2011
Fears About North Korea and Iran Will Dominate Nuclear Summit Meeting in Seoul

By MARK LANDLER

SEOUl, South Korea — President Obama will join the leaders of more than 50 countries here next week for a nuclear security summit meeting, where fears about two rogue states, North Korea and Iran, will loom over a gathering ostensibly about the perils of nuclear terrorism.

The flare-up of tensions with North Korea is a reminder, experts say, of how crafty a negotiator the country can be. Days after announcing the satellite launch, the North Koreans invited inspectors from the International Atomic Energy Agency to tour nuclear facilities there.

That could put the United States in an awkward position, the experts said. If North Korea goes ahead with the launch and the administration rescinds its food aid, the North will have a pretext to expel the inspectors from the country and blame Washington.
Bloomberg Businessweek

World Leaders to Strengthen Nuclear Security: Statement Text

Posted on March 27, 2012

Nuclear Materials

4. Recognizing that highly enriched uranium (HEU) and separated plutonium require special precautions, we reemphasize the importance of appropriately securing, accounting for and consolidating these materials. We also encourage States to consider the safe, secure and timely removal and disposition of nuclear materials from facilities no longer using them, as appropriate, and consistent with national security considerations and development objectives.

5. We recognize that the development, within the framework of the IAEA, of options for national policies on HEU management will advance nuclear security objectives. We encourage States to take measures to minimize the use of HEU, including through the conversion of reactors from highly enriched to low enriched uranium (LEU) fuel, where technically and economically feasible, taking into account the need for assured supplies of medical isotopes, and encourage States in a position to do so, by the end of 2013, to announce voluntary specific actions intended to minimize the use of HEU. We also encourage States to promote the use of LEU fuels and targets in commercial applications such as isotope production, and in this regard, welcome relevant international cooperation on high-density LEU fuel to support the conversion of research and test reactors.
World Leaders to Strengthen Nuclear Security: St.
Nuclear Materials
Role of the IAEA
IAEA plays central role in international nuclear security, pledge to increase funding

News and Discussion
Global Nuclear Security Architecture
Structure of Statement
Nuclear Materials

4. Recognizing that high-enriched uranium (HEU) and Plutonium (Pu) continue to be at the heart of the nuclear security challenge, world leaders recommitted to reduce the global supply of HEU and Pu. They endorsed the voluntary framework to reduce HEU and Pu and agreed to take specific action to further reduce HEU inventories, including through the conversion of HEU to low-enriched uranium (LEU) fuel. They also endorsed voluntary measures to reduce the use and storage of HEU and Pu by the end of 2013, and to avoid, as far as possible, the use of HEU in advanced reactor applications.

5. World leaders recognized that the development, within the framework of international cooperation, of advanced reactor technologies and closed fuel cycles, could help reduce the global supply of HEU and Pu. They endorsed efforts to accelerate the pace of such development and agreed to support international cooperation and collaboration on advanced reactor technologies and closed fuel cycles.

Role of the IAEA
IAEA plays central role in international nuclear security, pledge to increase funding

Structure of Statement
Global Nuclear Security Architecture
Nuclear Materials

1. The IAEA plays a central role in the international nuclear security architecture by providing technical assistance, expertise, and advice to States in the implementation of the global nuclear security framework.

2. World leaders endorsed the role of the IAEA in international nuclear security, recognizing the need for increased funding to support the implementation of the global nuclear security framework.

3. World leaders endorsed the importance of international cooperation in the field of nuclear security, including through the IAEA, and agreed to support the implementation of the global nuclear security framework.

4. World leaders endorsed the importance of international cooperation in the field of nuclear security, including through the IAEA, and agreed to support the implementation of the global nuclear security framework.
Module 6: Programs and Arsenals

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

India, Pakistan, Israel, North Korea, and Iran
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 50–100 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 weapon tests

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Latitude/Longitude</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 18, 1974</td>
<td>02:34:55</td>
<td>27.095 N 71.752 E</td>
<td>2-5 kt</td>
</tr>
<tr>
<td>May 11, 1998</td>
<td>10:13:42</td>
<td>27.102 N 71.857 E</td>
<td>12 kt*</td>
</tr>
</tbody>
</table>

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 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 also developed and in 1999 successfully tested the medium-range Agni II, with a declared range of 2,000–2,500 km

• However, fighter-bombers are thought to be the only delivery system that could be used before 2010
# Indian Nuclear Forces (2008)

<table>
<thead>
<tr>
<th>AIRCRAFT</th>
<th>RANGE (KILOMETERS)</th>
<th>PAYLOAD (KILOGRAMS)</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mirage 2000H/Vajra</td>
<td>1,800</td>
<td>6,300</td>
<td>Squadron 1 or 7 at Gwalior Air Force Station.</td>
</tr>
<tr>
<td>Jaguar IS/IB/Shamsher</td>
<td>1,600</td>
<td>4,775</td>
<td>At Ambala Air Force Station.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LAND-BASED MISSILES</th>
<th>RANGE (KILOMETERS)</th>
<th>PAYLOAD (KILOGRAMS)</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prithvi I</td>
<td>150</td>
<td>1,000</td>
<td>Nuclear version entered service after 1998 with the 333rd and 355th Missile Groups. Will be converted from liquid fuel to solid fuel.</td>
</tr>
<tr>
<td>Agni II</td>
<td>2,000</td>
<td>1,000</td>
<td>Under development. Tested August 29, 2004. Deployed with army’s 335th Missile Group.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SEA-BASED MISSILES</th>
<th>RANGE (KILOMETERS)</th>
<th>PAYLOAD (KILOGRAMS)</th>
<th>COMMENT</th>
</tr>
</thead>
</table>
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 weapon tests

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Latitude N</th>
<th>Longitude E</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 28, 1998</td>
<td>10:16:15</td>
<td>28.862</td>
<td>64.818</td>
<td>9-12 kt#</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Missile name</th>
<th>Agni 1</th>
<th>Agni 2</th>
<th>Prithvi 1</th>
<th>Prithvi 2</th>
<th>Ghauri 1</th>
<th>Shaheen 1</th>
<th>Ghauri 2</th>
<th>Shaheen 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (ft.)</td>
<td>69.3</td>
<td>66</td>
<td>28.2</td>
<td>28.2</td>
<td>28</td>
<td>33</td>
<td>39.6</td>
<td>52.5</td>
</tr>
<tr>
<td>Payload* (lbs.)</td>
<td>2,200</td>
<td>2,200</td>
<td>1,760</td>
<td>1,100**</td>
<td>1,100</td>
<td>1,100</td>
<td>2,200</td>
<td>2,640</td>
</tr>
<tr>
<td>Range (mi.)</td>
<td>1,560</td>
<td>2,190</td>
<td>94</td>
<td>156</td>
<td>375</td>
<td>940</td>
<td>1,440</td>
<td>1,560</td>
</tr>
<tr>
<td>Accuracy (ft.)</td>
<td>495</td>
<td>330</td>
<td>165</td>
<td>248</td>
<td>660</td>
<td>660</td>
<td>660</td>
<td>8,250</td>
</tr>
</tbody>
</table>

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

Source: CNN (May 2003)
Israel’s Nuclear Weapons Complex

Negev Nuclear Research Center
Dimona is the location of Israel’s nuclear weapon program, including plutonium production using IRR 2 research reactor (40-150 MWe) and associated plutonium extraction plant; and related uranium purification, uranium conversion, and fuel fabrication facilities. Site of small-scale laser and centrifuge uranium enrichment programs and discontinued lithium-6 and lithium deuteride production activities. No activities at Dimona are subject to IAEA inspection.
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 delivery capability


• 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 missile).
## Summary of Israel’s Nuclear Delivery Systems

### Strategic forces

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>Year deployed</th>
<th>Range (kilometer)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-16A/B/C/D/I Fighting Falcon</td>
<td>1980</td>
<td>1,600</td>
<td>Bombs possibly stored at Tel Nof, Nevatim, Ramon, Ramat-David, and Hatzor</td>
</tr>
<tr>
<td>F-15I Ra’am (Thunder)</td>
<td>1998</td>
<td>4,450</td>
<td>Could be used for long-range strike role</td>
</tr>
</tbody>
</table>

**Land-based missiles**

<table>
<thead>
<tr>
<th></th>
<th>Year deployed</th>
<th>Range (kilometer)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jericho I</td>
<td>1972</td>
<td>1,200</td>
<td>Possibly 50 at Zekharyeh</td>
</tr>
<tr>
<td>Jericho II</td>
<td>1984–85</td>
<td>1,800</td>
<td>Possibly 50 at Zekharyeh, on TELs in caves</td>
</tr>
</tbody>
</table>

**Sea-based missiles**

- *Dolphin*-class submarines
  - Year: 2002 (?)
  - Range: ?
  - Comment: Modified Harpoon missiles for land-attack

### Non-strategic forces

**Artillery and landmines**

- Comments: Reports of these weapons cannot be confirmed

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

1970
1975
1980
1985
1990
iClicker Question

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

- 1970
- 1975
- 1980
- **1985**
- 1990
About how many operational nuclear warheads did the U.S. have when the number peaked?

1,000
5,000
10,000
15,000
20,000
iClicker Question

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

1,000
5,000
10,000
**15,000**
20,000
iClicker Question

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

1970
1975
1980
1985
1990
About when did the number of operational U.S.S.R. nuclear warheads peak?

1970
1975
1980
1985
1990
About how many operational nuclear warheads did the U.S.S.R. have when the number peaked?

1,000
5,000
10,000
15,000
20,000
About how many operational nuclear warheads did the U.S.S.R. have when the number peaked?

1,000
5,000
10,000
15,000
20,000
Yongbyon Nuclear Research Center Site of a 5-MW nuclear power reactor; a partially completed plutonium extraction facility; a fuel fabrication plant; fuel storage facilities; and a Soviet-supplied IR research reactor and critical assembly. 50-MW reactor previously under construction.

Under the Oct. 21, 1994, U.S.-North Korean Agreed Framework, activities at the 5-MW gas-graphite reactor, the fuel fabrication facility, and the reprocessing plant have been frozen; construction also has been halted on the 50-MW gas-graphite reactor. U.S. intelligence agencies believe that North Korea has used the 5-MW 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.

• 1989: Reports in the open press indicate for the first time that NK has a plutonium production reactor and extraction capability.
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.
## APPROXIMATE FISSION MATERIAL REQUIREMENTS FOR PURE FISSION NUCLEAR WEAPONS

<table>
<thead>
<tr>
<th>technical capability</th>
<th>Yield (kilotons)</th>
<th>technical capability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>low</td>
<td>medium</td>
</tr>
<tr>
<td>weapon-grade plutonium</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Source: NRDC (April 2003)
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.)
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

<table>
<thead>
<tr>
<th>North Korea</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Korea freezes its operation and construction of nuclear facilities under IAEA supervision.</td>
<td>The United States agrees to provide heavy fuel oil to replace the electrical production potential of the shutdown 5-MW reactor.</td>
</tr>
<tr>
<td>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.</td>
<td>The United States agrees to establish an international consortium to construct two modern, light-water reactors in North Korea.</td>
</tr>
<tr>
<td>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.</td>
<td>International consortium agrees to complete a significant portion of the reactor complex, not including key components.</td>
</tr>
<tr>
<td>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.</td>
<td>International consortium to deliver key components for first light-water reactor.</td>
</tr>
<tr>
<td>North Korea agrees to complete dismantling of its nuclear facilities and removal of its spent fuel upon delivery of key components for second reactor.</td>
<td>International consortium to deliver key components for second light-water reactor.</td>
</tr>
</tbody>
</table>
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.
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.
History (cont’d) —

- Secretary of State Colin Powell says President Bush will continue the engagement with NK currently in progress.

- 2001 March 7: Clinton administration official says agreement for NK to eliminate its medium- and long-range missiles and cease exports was very close. President Bush rejects existing understandings with NK, delays further discussions, and publicly insults the Presidents of SK and NK.

- 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 consortium suspends fuel oil deliveries to NK, alleging NK has violated the Agreed Framework.
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 next 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.

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.
Current 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, with a total capacity of 8,000 SWU/year (got 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.
- Experts believe that NK has fundamentally changed its nuclear strategy.
North Korea’s Nuclear Program – 11

• 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 – 12

• 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 – 13

• 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
  - Starting point could be the October 2000 agreement abandoned by Bush
## North Korea’s Ballistic Missile Capabilities

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

Source: NRDC (April 2003)
Ranges of North Korea’s Missiles
Plan for This Session

Questions

Module 6: Nuclear Arsenals (cont’d)

Kim’s Nuclear Gambit
Iran’s Nuclear Complex
Iran’s nuclear weapon capability —

- Iran has the basic nuclear technology and infrastructure needed to build nuclear weapons

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

- It is thought that Iran has not yet made a nuclear weapon (in February 2003, the U.S. Defense Intelligence Agency estimated that Iran could have a nuclear weapon by 2010)

- Iran’s rate of progress in developing nuclear weapons will depend strongly on what assistance it receives from Russia and China and whether it can illicitly acquire the needed special nuclear material
Iran’s nuclear program has continued to advance —

- It has completed a large gas-centrifuge uranium enrichment facility at Natanz.
- No nuclear material was in the centrifuges at Natanz when the IAEA visited.
- A 1000-centrifuge pilot plant could produce material for one bomb every 1–2 years.
- The IAEA believes Iran probably introduced nuclear material into centrifuges at another, undisclosed location in order to test the centrifuges; this would be a violation of the NPT.
In 2003, Iran announced a change in its nuclear program —

• Iranian President Mohammad Khatami announced that Iran has started mining uranium and is developing the facilities for a complete nuclear fuel cycle

• On March 3, 2003, Hassan Rowhani, the Secretary of the Supreme National Security Council, announced that a plant near Isfahan designed to convert uranium oxide to uranium hexafluoride was now complete.

• Iran is dragging its feet on more rigorous IAEA inspections.

• Russia is constructing a nuclear reactor at Bushehr that will provide dual-use technology that Iran does not now have.
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 No Dong (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
End of Module 6: Programs and Arsenals