Nuclear Weapons: Transparency and Risk Reduction

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BEFORE THE NUCLEAR AGE...

- 24 July 1943: “Operation Gomorrah” - Allies fire-bombed Hamburg with high explosive, incendiary, phosphorous and napalm bombs
  - resulting firestorm 1,500-foot-high tornado of fire, hurricane force 150 mile per-hour winds, fire sucked in oxygen no oxygen to breathe, 20 square miles of the city centre burned for nine full days, temperature in the firestorm 1,400 degrees Fahrenheit, 42,000+ killed 37,000 injured (civilians)
  - Royal Air Force alone sent 3,000 bombers in 4 raids on Hamburg, dropping 9,000 tons of bombs
BEFORE THE NUCLEAR AGE...

- 13 February 1945: Allies bombed Dresden in two waves, three hours apart - first round of bombing consisted of high explosives, second round used incendiary bombs: created a self-sustaining firestorm, over 1500 degrees, 15 sq km totally demolished
- 3,900+ tons of high explosive and incendiary bombs, dropped by 722 RAF bombers in the first attack
- US sent 527 bombers to continue 14 Feb.
- 35,000-135,000 killed (unsure partly because of the refugees in Dresden at the time)

BEFORE THE NUCLEAR AGE...

- 23 February 1945: US fire-bombed Tokyo - 100 USAF B-29s demolished 1 square mile of Tokyo
- 10 March: “Operation Meetinghouse” - 334 B-29s dropped 1,700 tons of explosive and incendiary bombs, destroying 16 square miles
- 88,000+ killed, 41,000+ injured
- single most destructive bombing raid in history
THE ADVENT OF THE NUCLEAR AGE

- **6 August 1945:** less than one month after the Trinity explosion, the “Little Boy” uranium bomb dropped by a USAF bomber on Hiroshima, killed approximately **70,000 people immediately**, and **another 70,000 within 5 years from radiation**.

- **9 August 1945:** a “Fat Man” implosion bomb dropped by a USAF bomber on Nagasaki, killed an estimated **40,000 people**.
THE ADVENT OF THE NUCLEAR AGE

- Within the first 2–4 months of the bombings, the acute effects killed 90,000–166,000 people in Hiroshima and 60,000–80,000 in Nagasaki, roughly half of the deaths in each city occurring on the first day.

- Hiroshima estimated that, of the people who died on the day of the explosion, 60% died from flash or flame burns, 30% from falling debris and 10% from other causes.

- During the following months, large numbers died from the effect of burns, radiation sickness, and other injuries, compounded by illness.

- US estimate of the total immediate and short term cause of death, 15–20% died from radiation sickness, 20–30% from burns, and 50–60% from other injuries, compounded by illness.

- In both cities, most of the dead were civilians, although Hiroshima had a sizeable garrison.

History: US Nuclear Weapons in Japan (1)

- **1954 > 1972**: 19 different types of US nuclear weapons were deployed in Okinawa, but with fewer than around 1,000 warheads at any one time” (Robert S. Norris, William M. Arkin and William Burr, 1999 *Bulletin of the Atomic Scientists*)

- U.S. nuclear weapons were deployed on Okinawa prior to Okinawa’s reversion to Japan on 15 May 1972 (DoD Open Government: [http://open.defense.gov/Initiatives/FRDDeclassification.aspx](http://open.defense.gov/Initiatives/FRDDeclassification.aspx))

- **1956 > 1966**: U.S. nuclear weapons also were deployed on Chichi Jima and Iwo Jima
  [http://nsarchive.gwu.edu/NSAEBB/NSAEBB22/index.html](http://nsarchive.gwu.edu/NSAEBB/NSAEBB22/index.html)
History: US Nuclear Weapons in Japan (2)

Mark-7 A-bomb (Okinawa), 23 October 1962

History: US Nuclear Weapons in Japan (3)

Mark-28 Nuclear Weapon (Okinawa) (70 KT >> 1.4 MT)
History: US Nuclear Weapons in Japan (4)

MACE-B Cruise Missile (Okinawa) W-28 warhead 1 MT

Nuclear/Biological/Chemical Weapon Effects Compared
NUCLEAR NON-PROLIFERATION TREATY (NPT)

- Considering the devastation that would be visited upon all mankind by a nuclear war and the consequent need to make every effort to avert the danger of such a war and to take measures to safeguard the security of peoples
- Believing that the proliferation of nuclear weapons would seriously enhance the danger of nuclear war

Humanitarian Impact of Nuclear Weapons: 10 Questions for NWS/NWPS

- **10 Questions for NWS/NWPS:**
  1. What are the human health and environmental consequences of nuclear-weapon development / testing programmes since inception?
  2. What are the fail-safe mechanisms for dealing with false alarms and safety/security system failures, as well as back-up systems and their reliability under stress conditions?
  3. What mechanisms are in place to prevent accidental detonation of nuclear weapons in deployed and storage modes, including the human health and environmental remediation procedures and infrastructure?
Humanitarian Impact of Nuclear Weapons:
10 Questions for NWS/NWPS

4. What is the record of system breakdowns and normal accidents of nuclear weapon systems?

5. What are the design basis threat assumptions/calculations of catastrophic, unplanned, *force majeure* or force of nature events with regard to nuclear weapons safety and security?

6. What scenarios have been considered for regional / global food security, human health, psychological and critical infrastructure implications of any detonation of nuclear weapons?

7. What public education efforts have been implemented with regard to the dangers and risks of nuclear weapons and nuclear doctrines?

8. When do the leaders of the NWS/NWPS plan to convene a global summit, along the lines of the Nuclear Security Summits, to address issues of nuclear disarmament?

9. When can the international community expect the NWS/NWPS to support or join the ‘Humanitarian Initiative on Nuclear Weapons’?
10 Questions for NWS/NWPS:

10. What are the viable processes to achieve the disarmament and elimination of nuclear weapons, including the safe/secure disposition of related weapon usable nuclear materials, and the time frame for doing so?

International Panel on Fissile Materials (IPFM): Presentation 2014

Transparency Matrix, 2014

Information on nuclear warhead and fissile material inventories and status

<table>
<thead>
<tr>
<th></th>
<th>United States</th>
<th>Russia</th>
<th>Britain</th>
<th>France</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of total warheads</td>
<td>Approximate</td>
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<td>Yes (upper limit)</td>
<td>Yes (upper limit)</td>
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<tr>
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<td>Excess/Disposal</td>
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<tr>
<td>Verification</td>
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### IPFM TRANSPARENCY SCORECARD, 2015

**INFORMATION ON NUCLEAR WARHEAD AND FISSILE MATERIAL INVENTORIES AND STATUS**

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</thead>
<tbody>
<tr>
<td>Number of total warheads</td>
<td>Approximate Yes (upper limit)</td>
<td>Yes (upper limit)</td>
<td>Relative (out of date)</td>
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<td>Yes (planned)</td>
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<td>Dismantlements</td>
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<td>Fissile material stockpiles</td>
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<td>Partial (some plutonium)</td>
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<tr>
<td>Production histories</td>
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<td>No</td>
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</tbody>
</table>

### Nuclear warhead cycle

[Diagram showing the nuclear warhead cycle]

- Materials Production
- Weapons Availability
- Weapons Stockpile
- Weapons Disassembly
- Storage
- Disposal

- Uranium
- Plutonium
-Weapon assembly
- Nuclear warhead
- Disassembly process
- High-level waste
- Low-level waste
- Anaerobic digestion
- Uranium recycling

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### Table 1. Plutonium Material Balance

<table>
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<th>MT Pu</th>
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<tr>
<td>Acquisitions</td>
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<tr>
<td>Government Production Reactor</td>
<td>305.4*</td>
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<tr>
<td>Government Nonproduction Reactor</td>
<td>0.6</td>
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<tr>
<td>U.S. Civilian Industry</td>
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<tr>
<td>Foreign Countries</td>
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<tr>
<td><strong>Total</strong></td>
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<tr>
<td>Removals</td>
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<td>Exposed in Wartime and Tests</td>
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<td>Inventory Differences</td>
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<tr>
<td>Waste (Normal Operating Losses)</td>
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<tr>
<td>Plutonium Transmuted</td>
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<tr>
<td>Decay and Other Removals</td>
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<td>U.S. Civilian Industry</td>
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<td>Foreign Countries</td>
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<tr>
<td><strong>Total Acquisitions</strong></td>
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<td><strong>Total Removals</strong></td>
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<td>Classified Transactions &amp; NonReporting</td>
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<tr>
<td><strong>Actual Inventory</strong></td>
<td><strong>99.5</strong></td>
</tr>
</tbody>
</table>

*The combined Research and Development plutonium production figure in U.S. MT is less than the two.

### Figure 3
Plutonium Inventory By Grade
(September 1994 - Metric Tons)

- Fuel Grade (13.2)
- Reactor Grade (1.3)
- Weapon Grade (85.0)

Total Inventory = 99.5 MT
Figure 4
Location Of DOE/DoD Plutonium Inventory
(September 1994 - Metric Tons)

Los Alamos National Laboratory (2.7)
Savannah River (2.0)
Argonne National Laboratory-West (4.0)
Hanford (11.0)
Rocky Flats (12.7)
Idaho National Engineering Laboratory (0.5)
Lawrence Livermore National Laboratory (0.3)
Others (0.2)
DoD and Pantex Plant (66.1)

Total Inventory = 99.5 MT

Figure 11
Plutonium Inventory Differences
(Kilograms)

Hanford +1,265.6
Idaho National Engineering Laboratory-West -3.6
Lawrence Livermore National Laboratory +5.5
Rocky Flats +1,191.8
Los Alamos National Laboratory +27.5
Savannah River +232.0

Total = +2,750.1 kg
+= Decrease from book inventory
-= Increase from book inventory

Other Sites = +16.7
HEU PROGRAMMATIC REQUIREMENTS

From a programmatic perspective, the U.S. HEU inventory can be divided into two categories—required HEU and surplus HEU. As shown in Figure 3-4, a total of 1624 MTHU is required HEU and a total of 1223 MTHU is surplus HEU. Required HEU is defined in this report as material that is currently in active use or planned future use for weapons and non-weapons programs. Surplus HEU is no longer required by the DOD and is planned for disposition either through blending or dispersed operations.

Figure 3-4: U.S. HEU Inventory Composition as of September 30, 2016

<table>
<thead>
<tr>
<th>Location</th>
<th>2016 MTHU (17.9 THM)</th>
<th>2015 MTHU (17.4 THM)</th>
<th>Total MTHU (17.6 THM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savannah River Site</td>
<td>23.6</td>
<td>23.6</td>
<td>23.6</td>
</tr>
<tr>
<td>Rocky Flats Environmental Site</td>
<td>10.9</td>
<td>10.9</td>
<td>10.9</td>
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<tr>
<td>Oak Ridge Laboratory</td>
<td>1.9</td>
<td>1.9</td>
<td>1.9</td>
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<tr>
<td>Other</td>
<td>0.2</td>
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<tr>
<td>Total</td>
<td>26.6</td>
<td>26.6</td>
<td>26.6</td>
</tr>
</tbody>
</table>

Note: Data may not add due to rounding.
The Results We Need in 2016

POLICY RECOMMENDATIONS FOR THE NUCLEAR SECURITY SUMMIT

85% of all nuclear stocks exist in military nuclear programs

Recent incidents highlight the critical need for strengthening security of military materials

All military materials are not routinely subject to voluntary mechanisms to enhance security and confidence

This creates uncertainty about the quality of security for military materials—the vast majority of nuclear material

The only way to eliminate risk of theft is to eliminate nuclear material. Until that goal is reached, nuclear materials need effective and sustainable security

Effective and sustainable security requires continuous improvement
Two Goals:

1. Achieve effective and sustainable security for all nuclear weapons and weapons-usable materials; and

2. Provide assurances that materials and weapons are secure

Recommendation #1: Establish common interpretation of what UNSCR 1540 obligation for “appropriate effective” security requires and commit to specific steps to achieve that standard

- Protection against full spectrum of plausible adversary capabilities
- Accounting and control systems capable of detecting any significant theft
- Regular, in-depth inspection, peer review, and realistic testing to ensure that security and accounting systems really are effective
- Programmes to assess and improve staff security culture
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- Protection against full spectrum of plausible adversary capabilities
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- Programmes to assess and improve staff security culture

Recommendation #2: Call on all States with such materials to provide assurances that they have effective security, drawing on past cooperative approaches

- Possible to provide assurances while protecting sensitive information
- Best practice exchanges, e.g. bi-, or multilateral
- Lab-to-Lab, Mil-to-Mil, Regulator-to-Regulator
- Confidential Information Exchanges
Recommendation #3: Reaffirm previous commitments

- 2014 NSS “fundamental responsibility...”
- UNSCR 1540 “Appropriate and Effective”

Recommendation #4: Identify Appropriate Forums for Advancing Discussions

- NWS (P5) process
- Global Initiative to Combat Nuclear Terrorism
- Margins of the Conference on Disarmament
- NPT Action Plan Commitment
- Not recommended: IAEA mandate for security of military nuclear materials and weapons
Nuclear-Weapon-Free World

“My friends, we have failed, we just could not agree to control your warlike passions...”