Strategic Deterrence: Its Future if the Bomb Spreads

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Questions to be addressed

1. Does nuclear proliferation weaken deterrence? Short answer-- yes

2. How likely is more nuclear proliferation? Short answer-- plenty

3. What can be done? Short answer-- a lot
1. Does nuclear proliferation weaken deterrence?
Conventional wisdom: So far, so good
1945-1949: Unipolarity, Pretty Stable
1950-1952: Bipolarity, Pretty Edgy

U.S.  

U.S.S.R.
1953-1962: Additional uncertainties
1963-2005: Even before N. Korea, tricky
Where we’re headed
A Realist’s take:

“If one imagines a world of tens of nations with nuclear weapons and major powers trying to balance their own deterrent equations, plus the deterrent equations of the subsystems, deterrence calculation would become impossibly complicated. To assume that, in such a world, nuclear catastrophe could be avoided would be unrealistic.”

-Henry Kissinger

How likely is more nuclear proliferation?
Workable weapons designs are now more readily available
Iran’s Bomb Design

Interactive Iranian Nuclear Weapon Schematic:
(with links to reports on key individual components)

- Outer casing
- Shock wave generator
- Main charge
- Flyer plate
- Air gap
- Uranium 235 core
- Neutron source (uranium deuteride initiator)

An Iranian schematic (with translation), from the Nuclear Archive, of a levitated nuclear weapon design, i.e. one with an air gap and flyer plate to increase compression of the core, based on the use of weapon-grade uranium.

Iran was planning to make 5 nuclear weapons. Read our full report on this, or the summary. “Project 110” under the Amad Plan was in charge of the production of the nuclear weapons (see organizational chart).

* Information on the main charge can also be found in the shock wave generator report.
1956 design, Swedish 2-point ellipsoid
Future thermonuclear tech transfers?
The Next NPT Withdrawal: Something They’re Talking About
Next up?
China’s provocative nuclear growth: A proliferation catalyst?
China’s nuclear weapons numbers projected to grow
Chinese heavy water reactors

- Two Candu-6 reactors (600 MWe each) at Qinshan
- Capable now of producing ~650 kilograms of plutonium a year — enough for roughly >150 bombs a year
- China announced it is building two more HWRs. These will produce another ~650 kgs, enough for >150 additional bombs per year
How Much Plutonium Could a 1 GWe LWR Generate/Year?

Pu (kg) produced per year

- 150 kg
- 250 kg

~1 AP1000 Reactor

- ~48 bombs
- ~37 bombs

Weapons-grade Pu
- 4 kg weapons-grade Pu assumed per bomb based on DOE estimate.

Reactor-grade Pu
- PRC has 42.8 GW of power generation.
- 5.2 kg reactor-grade Pu assumed per bomb based on estimate by Richard L. Garwin (see http://fas.org/sgp/980826-pu.htm).
- 250 kg reactor-grade Pu conservatively assumed per reactor year.
Chinese Fast Reactors

China Experimental Fast Reactor, 20 MWe,

China Fast Reactor, 600 Mwe (110 wFPU/year)
800 tHM/yr Rokkasho plant: ~1,600 bombs’ worth pu/yr, 2021 planned opening

50 tHM/yr Pilot plant: ~100 bombs worth of plutonium/yr

Planned 800 tHM/yr EDF plant: ~1600 bombs worth of pu/yr

200 tHM/year plant is now under construction: ~400 bombs worth of pu/yr
China’s & Japan’s “Peaceful” Plutonium production competition

Japan’s stock of separated plutonium could decline slowly—or climb rapidly if Rokkasho Reprocessing Plant operates

Enough for 6,000 - 12,000 nuclear weapons

Metric tons of separated plutonium

Reprocessing starts in 2021

No reprocessing, Maximum MOX use

UK has offered to take title to Japan’s plutonium held there (for a price to be determined)

More than 22,000 bombs’ worth of

- 50 tHM cap
- 200 tHM cap
- 800 tHM cap

- 72 tons
- 28 tons
- 13.8 tons
China could build small, hard to detect military reprocessing plants
East Asian uranium enrichment plans
## Notional Chinese Weapons Materials Production Options — to 2025 and 2230

### PLUTONIUM

<table>
<thead>
<tr>
<th>Source</th>
<th>2025 Production</th>
<th>2030 Production</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Existing 2 HWRs</strong></td>
<td>650 kgs./year of WgPu</td>
<td>3,250 kgs</td>
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<tr>
<td><strong>Planned 2 AHWRs</strong></td>
<td>650 kgs/year of WgPu</td>
<td>3,250 kgs</td>
</tr>
<tr>
<td><strong>2 1-Gwe LWRs</strong></td>
<td>300 kgs./year of WgPu</td>
<td>1,500 kgs</td>
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<tr>
<td><strong>600 Mwe CFR.</strong></td>
<td>200 kgs/year of WgPu</td>
<td>4,750 kgs</td>
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### URANIUM

<table>
<thead>
<tr>
<th>Source</th>
<th>2025 Production</th>
<th>2030 Production</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Medium case running Plant 814</strong></td>
<td>30,000 kgs</td>
<td>60,000 kgs</td>
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What can be done?
1st: Deter additional NPT withdrawals

- Clarify now with Russia and China and at the next NPT Review Conference what will happen to states that announce their intent to withdraw, e.g.:
  - Stipulate now that IAEA safeguards will remain in force on all declared nuclear materials and facilities, even if a state withdraws
  - Commit now to block military and certain civil assistance if the withdrawing state is in noncompliance with its IAEA obligations
Make fissile production an arms control topic with Moscow and Beijing

- Besides freezing and declaring warhead numbers, urge Moscow and China to declare fissile holdings

- Exploit ROK pyroreprocessing pause and Japan’s delay on opening Rokkosho to 2022 to ask China to suspend its reprocessing and fast reactor program, offering to do likewise

- Seek Russian and Chinese support for a reprocessing enrichment free zone in the Middle East
3rd: Stop pushing nuclear energy abroad in the name of national security

• Be more candid about the military vulnerabilities of nuclear plants to drones and accurate missiles

• Assess if the IAEA can meet its own timeliness detection goals and if they need to be updated; clarify what can be safeguarded

• Use economic models to determine the quickest, cheapest ways to reduce green house gases and to guide US export financing

• Ask GAO, CBO and outside energy economists to quantify current energy subsidies
Finally: Focus on investments essential to support whatever nuclear and conventional forces we have

- C4I, especially space-based assets
- Long-range precise strike systems
- Submersibles
- Unmanned systems
- Low-cost rockets with reusable booster systems
- Advanced, low-cost per shot active defenses
- Low-cost super hard concrete structures
Additional slides
3rd: Compete to channel, cap, and eliminate deadly strategic contests

- Take the Administration’s Nuclear Posture Review guidance seriously: Leverage future military deployments to produce Track II, INF Treaty-like results:
  - Support French policy to develop space keep out zones and bodyguards?
  - Limit number of intercontinental hypersonics?
  - Call for a moratorium on reprocessing in the Pacific Rim (including the US) and on uranium enrichment expansions?
2nd: Tailor strategic modernization to deemphasize reliance on nuclear arms

- Enhance C4I, prioritize avoiding strategic lobotomies
- Focus more on increasing aim points
- Emphasize precision guidance in hypersonics, advanced missiles & artillery, etc., to reduce need for high-yields & to force adversaries to spend more on defenses
- Ditto, submersible systems
N. KOREAN TRITIUM PRODUCTION

Suspected DPRK Li6 production plant

Reactors N. Korea could use to irradiate Li6 to produce Tritium

Suspected DPRK tritium extraction plant
ROK & Japanese Thermonuclear Potential

Wosong Tritium Removal Facility
Tritium (4 kgs) to boost 1,000 weapons
Existing fissile stockpiles now make nuclear ramp-ups and break-outs much quicker and larger
Current plutonium stocks: grist for 100s to 1,000s of new warheads
Stockpiles of weapons-grade uranium
A.Q. Khan: AKA, nuclear Johnny Appleseed