Civilian Nuclear Power and Nuclear Non-Proliferation: How to minimize risks associated with expansion of nuclear fuel cycle activities?

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Worldwide Stockpile of HEU(2008) -2000 tons owned by US, Russia

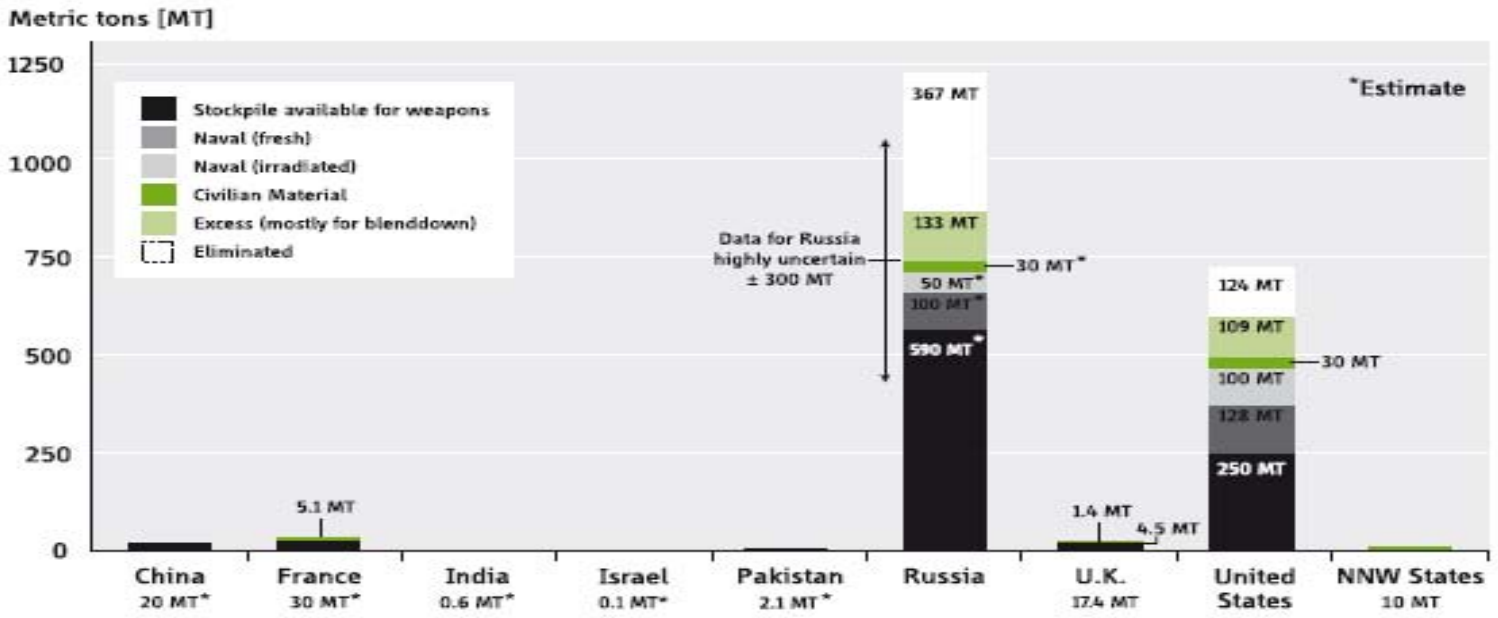

Figure 1.2. National stocks of highly enriched uranium as of mid-2009. The numbers for the United Kingdom and United States are based on their publications. The civilian HEU stocks of France, the United Kingdom are based on their public declarations to the IAEA. Numbers with asterisks are non-governmental estimates, often with large uncertainties.[22] Numbers for Russian and U.S. excess HEU are for June 2009. HEU in non-nuclear weapon (NNW) states is under IAEA safeguards. A 20% uncertainty is assumed in the figures for total stocks in China, Pakistan and Russia, and for the military stockpile in France, and 50% for India.

Source: International Panel on Fissile Materials (IPFM), Global Fissile Material Report 2009, (2009)

Civilian Stockpile of HEU

- can be converted to LEU for research reactors

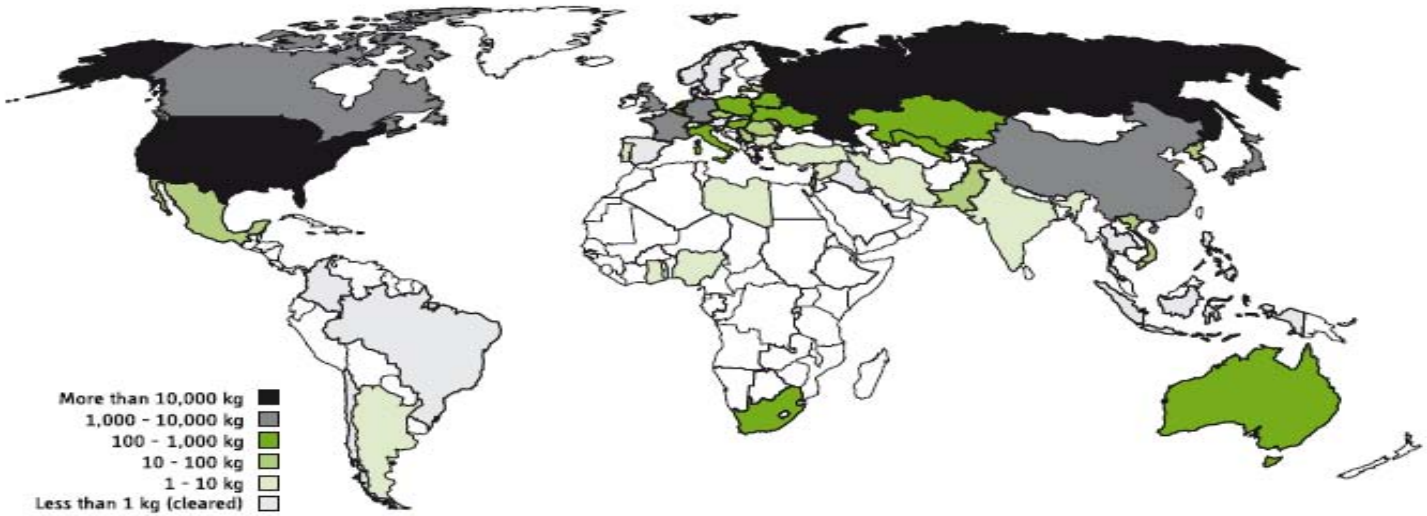

Figure 1.3. Civilian HEU is still distributed around the globe in large quantities. International efforts to convert HEU-fueled research reactors to LEU have reduced the annual demand of the material by about 250 kg of HEU per year. Yet, there are still about 100 sites in 40 countries where the material can be found in significant quantities, at operational or shut down, but not yet decommissioned HEU-fueled reactors.

Source: International Panel on Fissile Material (IPFM),"Global Fissile Material Report 2007",
http://www.fissilematerials.org/ipfm/site_down/gfmr07.pdf

Worldwide Stockpile of Pu (2008)

-250 tons each for civilian and military use

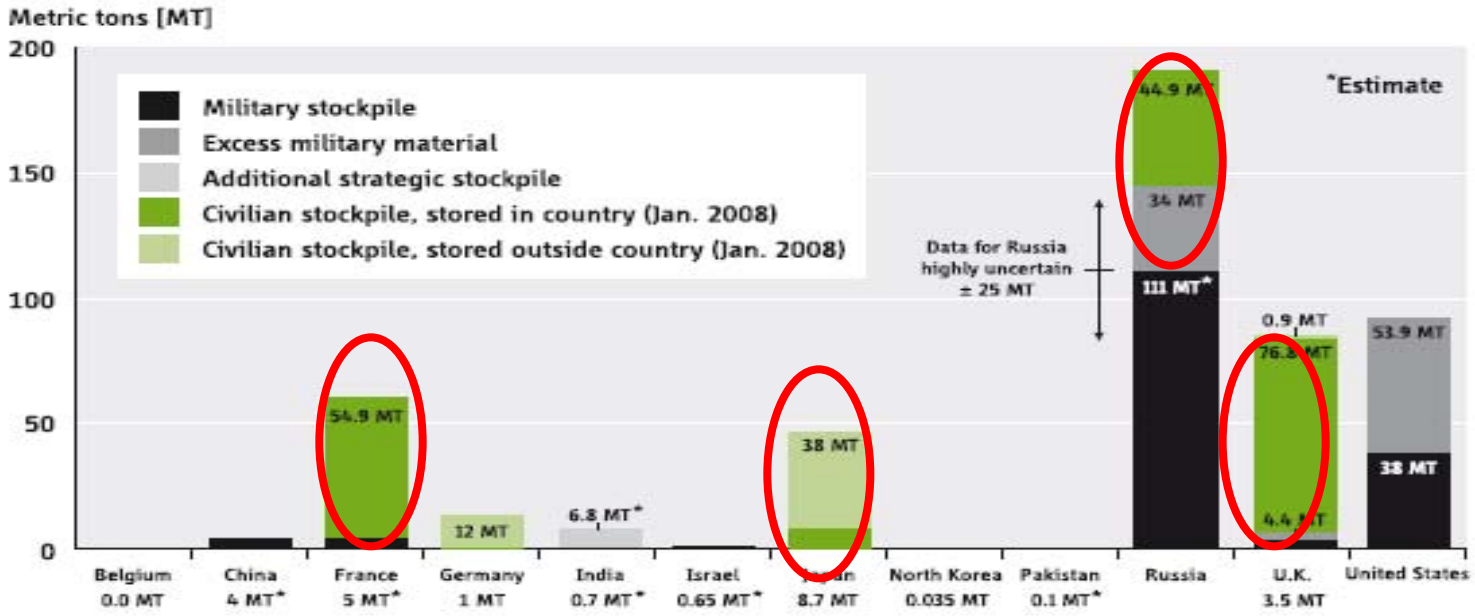

Figure 1.3. National stocks of separated plutonium. Civilian stocks are based on the most recent INFCIRC/549 declarations for January 2008 and are listed by ownership, not by current location. Weapon stocks are based on non-governmental estimates except for the United States and United Kingdom whose governments have made declarations. Uncertainties of the military stockpiles for China, France, India, Israel, Pakistan, and Russia are on the order of 20%. The plutonium India separated from spent heavy-water power-reactor fuel has been categorized by India as "strategic," and not to be placed under IAEA safeguards. Belgium holds 1.4 tons of foreign-owned plutonium, but has no stockpile of its own (Appendix 1C).

Source: IPFM (2009)

Civilian Pu Stockpile is increasing

- Russia, UK, France and Japan with reprocessing

	Belgium (Addendum 3)		France (Addendum 5)		Japan (Addendum 1)		Russia (Addendum 9)		United Kingdom (Addendum 8)		United States (Addendum 6)	
1996	2.7	n.d. ?	65.4	30.0 0.2	5.0	0.0 15.1	28.2	0.0 0.0	54.8	6.1 0.9	45.0	0.0 0.0
1997	2.8	n.d. 0.8	72.3	33.6 <0.05	5.0	0.0 19.1	29.2	0.0 0.0	60.1	6.1 0.9	45.0	0.0 0.0
1998	3.8	n.d. 1.0	75.9	35.6 <0.05	4.9	0.0 24.4	30.3	0.0 0.0	69.1	10.2 0.9	45.0	0.0 0.0
1999	3.9	n.d. 0.9	81.2	37.7 <0.05	5.2	0.0 27.6	32.0	0.0 0.0	72.5	11.8 0.9	45.0	0.0 0.0
2000	2.7	n.d. 0.6	82.7	38.5 <0.05	5.3	0.0 32.1	33.4	0.0 0.0	78.1	16.6 0.9	45.0	0.0 0.0
2001	2.9	n.d. 1.0	80.5	33.5 <0.05	5.6	0.0 32.4	35.2	0.0 0.0	82.4	17.1 0.9	45.0	0.0 0.0
2002	3.4	n.d. 0.4	79.9	32.0 <0.05	5.3	0.0 33.3	37.2	0.0 0.0	90.8	20.9 0.9	45.0	0.0 0.0
2003	3.5	n.d. 0.4	78.6	30.5 <0.05	5.4	0.0 35.2	38.2	0.0 0.0	96.2	22.5 0.9	45.0	0.0 0.0
2004	3.3	n.d. 0.4	78.5	29.7 <0.05	5.6	0.0 37.1	39.7	0.0 0.0	102.6	25.9 0.9	44.9	0.0 0.1
2005	2.8	n.d. 0.0	81.2	30.3 <0.05	5.9	0.0 37.9	41.2	0.0 0.0	104.9	26.5 0.9	45.0	0.0 0.0
2006	0.6	0.3 0.0	82.1	29.7 <0.05	6.7	0.0 38.0	42.4	0.0 0.0	106.9	26.5 0.9	44.9	0.0 0.0
2007	1.4	1.4 0.0	82.2	27.3 <0.05	8.7	0.0 37.9	44.9	0.0 0.0	108.0	26.8 0.9	53.9	0.0 0.0

Inventory held in country Foreign-owned (included in local inventory)
Stored outside the country (not included in local inventory), n.d. = not disclosed

Source:IPFM (2009)

Pu Stockpile Projection
(Japan vs Germany)

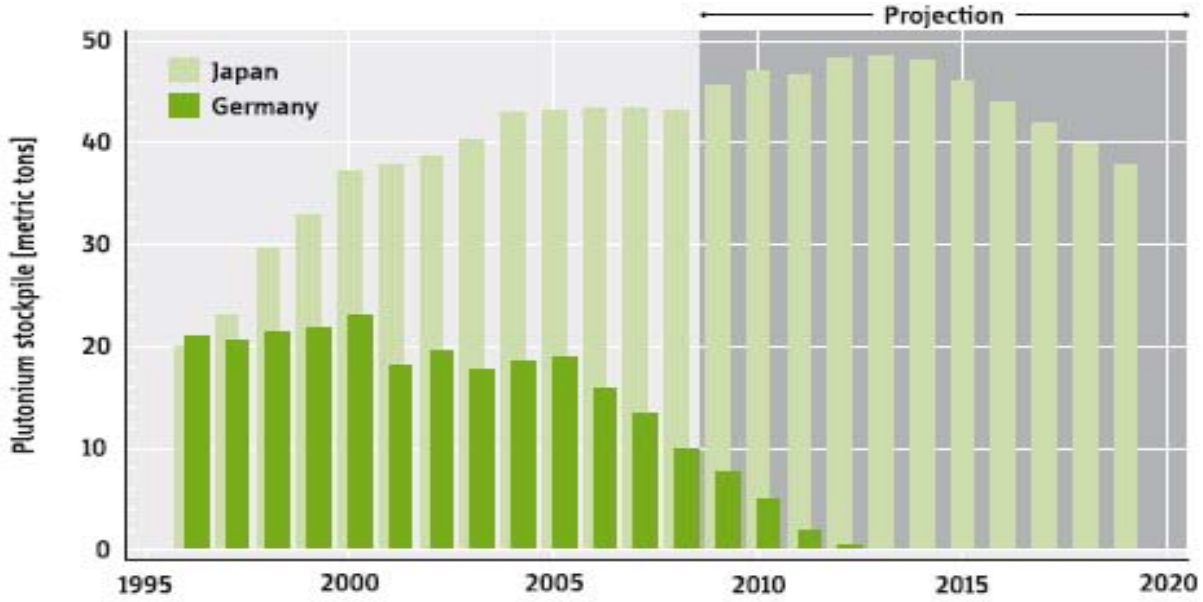

Figure 1.5. Stockpiles of separated civilian plutonium owned by Germany and Japan. Germany stopped shipping spent fuel for reprocessing (in France and the United Kingdom) in 2005. Since then, it has been able to gradually reduce its stockpile of separated plutonium from almost 20 tons to about 13 tons in 2008, and plans to consume the remaining material by the end of 2014. In contrast, if Japan's Rokkasho reprocessing plant operated at full capacity sometime, its plutonium stockpile would increase until the Rokkasho MOX fuel plant is completed.[73] Japan's reprocessing and MOX plants are both years behind schedule, however.

Source:IPFM (2009)

President Obama's Speech at Prague (April 5, 2009) - **Calling for new framework for civilian nuclear power**

- ” The threat of global nuclear war has gone down, but the risk of a nuclear attack has gone up.
  - " One nuclear weapon exploded in one city ..could kill hundreds of thousands of people. And no matter where it happens, there is no end to what the consequences may be – for our global safety, security, society, economy, and ultimately our survival.
- "And as a nuclear power – as the only nuclear power to have used a nuclear weapon – the United States has a moral responsibility to act. We cannot succeed in this endeavor alone, but we can lead it.”
- " ..we should build a new framework for civil nuclear cooperation, including an international fuel bank, so that countries can access peaceful power without increasing the risks of proliferation“

http://www.whitehouse.gov/the_press_office/Remarks-By-President-Barack-Obama-In-Prague-As-Delivered/

A Multilateral Approach?
No past proposals have been realized

- Baruch Plan: proposed an International Atomic Development Authority – 1946
- Atoms for Peace: speech to UNGA by US President Eisenhower – 1953– proposed an IAEA
- IAEA Statute (1956): Article III.B.2 and Article XII.A.5 provide for Agency control over excess special fissionable materials
- IAEA study project on regional nuclear fuel cycle centres (RNFC) –1975 to 1977
- Committee on International Plutonium Storage (IPS) – 1978 – 1982
- International Fuel Cycle Evaluation Programme (INFCE) – 1977 to 1980
- United Nations Conference for the Promotion of International Cooperation in the Peaceful Uses of Nuclear Energy (UNCPICPUNE) -1987
- Committee on Assurances of Supply (CAS) – 1980 to 1987
- International Symposium on Nuclear Fuel and Reactor Strategies:Adjusting to New Realities (1997)
- Technical, Economic and Institutional Aspects of Regional Spent Fuel Storage Facilities (RSFSF) – 2003 IAEA TecDoc

Why has MNA never been realized yet?

- Double Standards and In-equality
  - All proposals have been made by “Have” countries
  - “Have not” countries feel “unfair”
- Not enough transparency
  - Conditions for fuel assurance/access to technologies are not clear
  - Not enough incentives to give up technologies/facilities
- Lack of effective utilization of market mechanism
  - Could interfere (existing) “effective” market transactions
  - Government's intervention needs to be minimized
- Difficulties of siting spent fuel/waste facilities remain unchanged

Conditions for A Multilateral Approach?

- Universality
  - Discrimination between “have” and “have not” should be avoided
- Transparency
  - IAEA Additional Protocol or equivalent safeguards arrangements should be applied
  - Additional layer of “verification”
- Economic Viability
  - Should be consistent with global nuclear fuel market activities
  - Economic rationale should be clearly defined to support nuclear fuel cycle programs

A Proposal on Civilian Nuclear Power and Non-proliferation*

1. Reduction of "Surplus Weapons-Useable Materials"
2. Internationalization of Nuclear Fuel Cycle facilities and Establishment of Joint Stockpile
3. Voluntary Code of Conduct of the Nuclear Industry and Nuclear non-proliferation and disarmament Fund
4. Reexamination of Japan's nuclear fuel cycle programs and Research Initiative for Advanced Nuclear Power Systems without Weapons-Usable Materials
5. Adopting best practices in nuclear security through international cooperation

*Japan Cooperative Security Initiative, "10 Recommendations for Nuclear Disarmament and Non-proliferation based on A-MAD (Asian Mutually Assured Dependence)", September 2009. http://a-mad .org/

1. Reduction of "Surplus Weapons-Useable Materials"(1)

- Existing stockpile will be consumed first before further reprocessing
  - On-site dry cask storage is top priority for spent fuel management
- "No Surplus" principles should become a global norm
  - For enrichment and reprocessing service, "demand must be specified *before* supply"
  - Enrichment services will be supplied only when reactor order is confirmed
  - Reprocessing service will be supplied only when plutonium fuel order is confirmed
  - Users/suppliers will report its "supply/demand plan" annually to the IAEA
  - Surplus capacity will be adjusted by market mechanism, while shortage will be supplemented by joint stockpile

JAEC's "No Pu surplus policy"

- In August 2003, JAEC announced its new guideline for plutonium management
- Utilities are expected to submit **its plutonium usage plan annually *before* separation of plutonium**.
- Its plan is supposed to include the information on:

  (1) current plutonium stock

  (2) planned usage of plutonium (name of power plant, or site, insertion period)

  (3) amount of reprocessing (during that year)

  (4) usage of plutonium (during that year)

  (5) MOX contract plan and fabrication amount (during that year).

1.Reduction of "Surplus Weapons-Useable Materials"(2)

- International Plutonium Disposition Program(IPDP) should be established by Pu owners' countries
  - Utilities (owner of plutonium) can declare "excess" plutonium which will be exchanged with low enriched uranium (from stockpile) (1 tPu ~ 1GW reload of LEU)
  - Excess plutonium will be given to the Program and be disposed by commercial bid
    - most likely by MOX fuel and LWRs
    - Principle is "minimum cost, minimum transportation, minimum time"
  - Costs ($10millon~$100mill/tPu) will be shared by plutonium-owner countries

2. Internationalization of Nuclear Fuel Cycle facilities and Establishment of Joint Stockpile

- All fuel cycle facilities should be "internationalized" (international ownership) without exception.
  - Increase transparency and reduce number of facilities
  - "URENCO" as a model, with a treaty to have gov'tal oversight
- A country (or institution) has three options
  - (A) Own and operate its own facilities (with international participation)
  - (B) Only own the share of facilities (multinational facilities)
  - (C) No ownership and rely on international service
- Suppliers/Consumers establish joint stockpile of natural uranium and enriched uranium
  - (A) will pay the stockpile cost (~ $40 million for 1GWy LEU, $60 million for 1GWy fabricated fuel)
    - (A) also shall guarantee provision of emergency storage capacity for spent fuel from the fuel provided by it.
  - (C) has the top priority to access the stockpile

3.Voluntary Code of Conduct of the Nuclear Industry and Nuclear non-proliferation and disarmament Fund

- Global nuclear industry should adopt nuclear disarmament and non-proliferation principles such as:
  - Non participation in weapon activities
  - Non transfer of sensitive technologies
  - Best practice in safety and physical protection
- Adopting “social verification” system
  - Monitoring by civil society
  - Protection of “whistleblowers”

3.Voluntary Code of Conduct of the Nuclear Industry and Nuclear non-proliferation and disarmament Fund

- Japan should call on the countries possessing nuclear industry, working with private banks, to establish a "Nuclear Nonproliferation and Disarmament Fund" which can invest in the companies that observe the abovementioned three principles.
- The Fund shall provide support to the developing countries to contribute to capacity building for the observance of the three principles.

4.Reexamination of Japan's nuclear fuel cycle programs

- The nuclear fuel cycle policies of Japan are in a chaotic situation. This should be taken as an opportunity to conduct a fundamental review.
  - In particular, the Rokkasho reprocessing plant, which is out of operation now, is not needed from the viewpoint of plutonium demand.
  - Its future should be examined with the possibilities of either turning it into an international facility with expanded spent fuel storage capacity or shutting it down.
- Concerning the enrichment facility, if an increase of demand in Asia can be expected, its international competitiveness should be strengthened with the aim of internationalizing it

4. Research Initiative for Advanced Nuclear Power Systems without Weapons-Usable Materials

- As long term options, Japan can initiate research programs not involving sensitive nuclear materials
- Examples of such advanced system already under development in Japan
  - Uranium from seawater
  - Chemical enrichment process
  - Thorium MOX fuel for plutonium disposition
  - Small reactor with

5.Strengthening Nuclear Security Measures

- Japan should enhance its nuclear security measures aiming at the world-best standards and contribute to strengthening world-wide nuclear security measures
  - Adopting “best practices” of nuclear security measures through international collaboration
  - Taking a leadership in developing advanced technologies (such as nuclear forensics, ultra-sensors)
  - Improve domestic security measures such as:
    - Protection of radioactive materials in universities and hospitals
    - Enhance “security clearing measures” for all employees
    - Join international efforts such as World Institute for Nuclear Security (WINS)