Is the current non-proliferation regime adequate to deal with the ambivalence of nuclear technologies and materials?

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Development of nuclear technology since 1940s

Uranium enrichment:
HEU production for weapons

First **reactors**:
Plutonium production

Plutonium separation/reprocessing:
Plutonium for weapons

Uranium exploration & mining:
400 – 500,000 tons for weapons

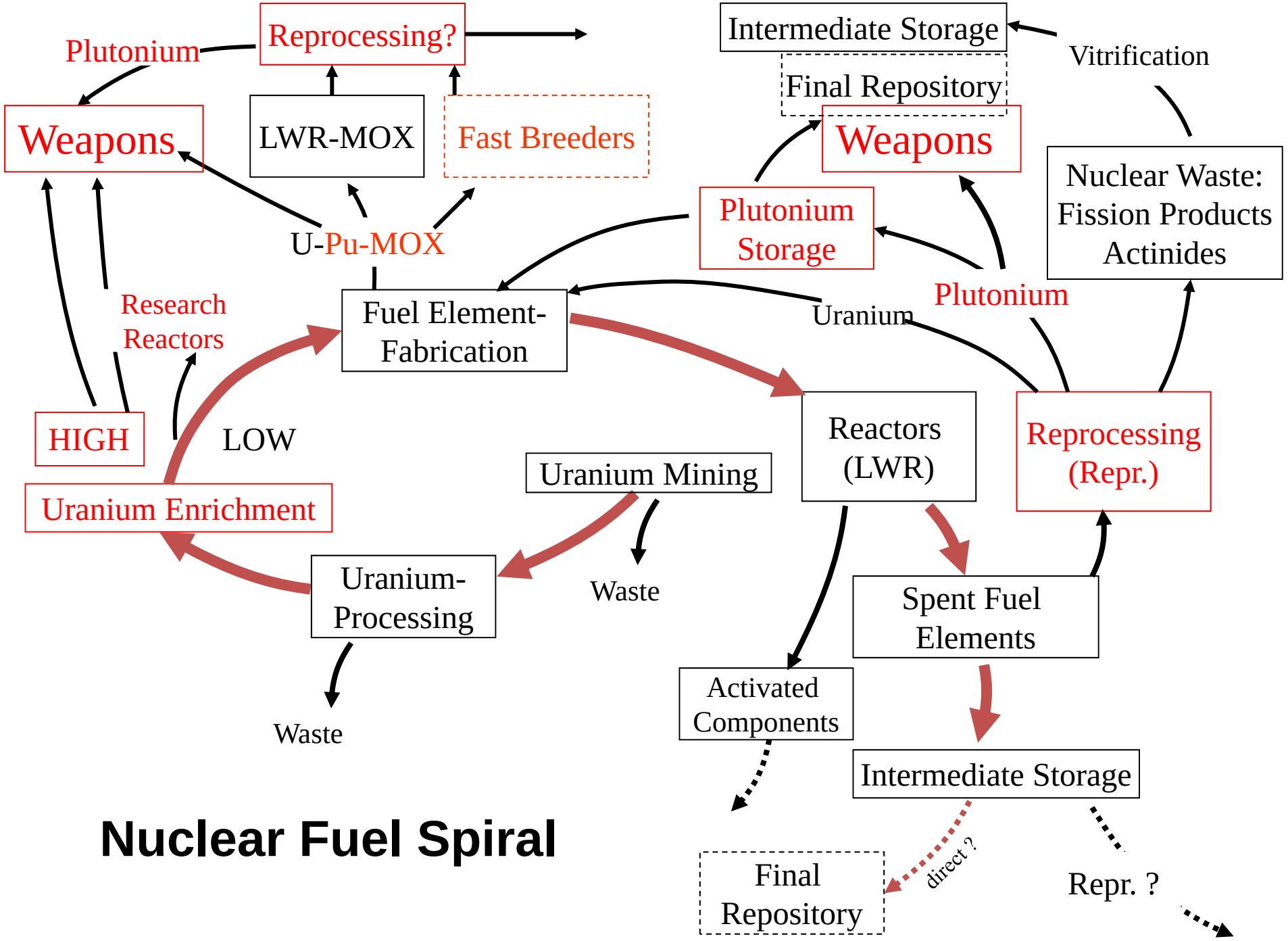
First **commercial reactor**:
Calder Hall 1956 provides plutonium
for the British weapons program

Resulting in **nuclear waste**

Development of nuclear technology since 1940s

Civilian nuclear era since 1955

Uranium enrichment:	
HEU production for weapons	fuel for power reactors fuel element manufacture
First **reactors**:	
Plutonium production	power reactors (today 31 countries) + ~ 30 countries: research reactors
Plutonium separation/reprocessing:	
Plutonium for weapons	Pu separated: > 250 tons in stock only partly use in MOX fuel (theoretically: ~ 40,000 weapons)
Uranium exploration & mining:	
400 – 500,000 tons for weapons	current U demand: ~ 70,000 tons/a
First **commercial reactor**:	
Calder Hall 1956 provides plutonium for the British weapons program	~ 250 kg Pu/ GWa in current LWRs
Resulting in **nuclear waste**	Interim storage of spent fuel



Nuclear Fuel Spiral

Material needed for a nuclear weapon (depending on know-how)

Highly Enriched Uranium (HEU): 10 – 50 kg
Plutonium: 3 – 6 kg
Tritium (in addition: boosting): 2 – 3 g

Sensitive technologies (strong indicator for proliferation risks)

uranium enrichment active or possible in 15 countries
plutonium reprocessing active or possible in 14 (?) countries
sufficient know-how (for one of the two): ~ 20 states

(Weaker indicator for nuclear proliferation risks:

31 countries with power reactors
~ 60 countries with research reactors**)**

Weaponization: neutron generators, ignition mechanism, …

Weapon and delivery system: bombers, ballistic missiles, submarines, …

Important example: Proliferation risk of centrifuge enrichment (I)

Gas ultra centrifuges for U-enrichment are especially fast,
effectively usable both for reactor-grade LEU & weapon-grade HEU,
and undetectable remotely from outside, and badly safeguardable!

Risks:

1. small facilities (several 1000 centrifuges or less) can produce significant HEU amounts over a year. This is esp. true for a not declared, additional facility optimized for HEU (based on the know-how of a declared facility)

2. military use of an existing facility after end of safeguards

3. diversion of HEU clandestinely produced in an declared facility, if safeguards fail

Important example: Proliferation risk of centrifuge enrichment (II)

→ Centrifuge enrichment is a proliferation-prone technology.
(by no means proliferation-resistant – Iran case illustrates it))

However, globally it is now the technology of choice.

There is no proliferation-resistant alternative under R&D.
(The only example, laser isotope separation is even worse.)

Nuclear era is marked by …

… **military roots** of important technology

… military-civilian **ambivalence** of nuclear technology and used nuclear materials (capability for dedicated **dual-use** programmes)

… military development programmes or **latent** military options under use of increasingly proliferated civilian technology („virtual NWS“)

… **proliferation tendency**: the club of nuclear powers could not be limited to the first three (U.S., SU, UK):

- 1960 France
- 1964 China
- 1967 Israel
- 1970er South Africa
- …India, Pakistan … North Korea …

Mohamed ElBaradei (then IAEA director general) about the danger of nuclear proliferation:

„Some estimates indicate that 40 countries or more now have the know-how to produce nuclear weapons. (…) We are relying primarily on the continued good intentions of these countries, which … could … be subject to rapid change.“

„We are dealing with almost as I call them virtual nuclear weapons states … Another 20 or 30 who have the capacity to develop nuclear weapons in a very short time span.“

„And under the current regime, there is nothing illicit for a non-nuclear state to conduct uranium-enrichment activities … or even to possess military-grade nuclear material.“

References: IAEA Conference 20 Sept. 2004, Reuters 16 Oct. 2006,
Interview in Le Monde 31 Oct 2003,

Nuclear Non-Proliferation Treaty (NPT) 1970

Article III

„Each non-nuclear-weapon State (…) undertakes to accept safeguards, as set forth in an agreement to be negotiated with the International Atomic Energy Agency (…) to preventing diversion of nuclear energy from peaceful uses to nuclear weapons (…)
Each State Party to the Treaty undertakes not to provide (…) fissionable material or equipment or material (…) to any non-nuclear-weapon State for peaceful purposes, unless (…) subject to safeguards (…).

… safeguards … in a manner designed to comply with Art. IV…

→ Since 1970 the International Atomic Energy Agency IAEA
(founded 1957 to promote nuclear energy)
has been entrusted with NPT related safeguards

- main task: „timely“ detection of a (possible) diversion of sensitive materials with high probability (means: accountancy of material balances, seals, cameras, inspector visits, measurements, …)

New capabilities of IAEA safeguards and verification to detect illicit activities after the Iraq case

Additional (Safeguards) Protocol 1997+ (IAEA-INFCIRC/540)

technically positive: environmental sampling and radiation measurement on-site;
(partly satellite monitoring); more obligatory reporting
about planned activities by the states

politically negative: privileges of the NWS perpetuated;
missing signatures or ratification by a number of states;
voluntary accede to the protocol

More would be possible, if major NWS (Nucl.Weap.States) could agree:

e.g. Wide Area Environmental Sampling (WAES)
to detect undeclared plutonium production

- radionuclides as indicators
- atmospheric transport models for localization of origin

Limits of IAEA-Safeguards (and Verification) I

- only declared facilities under surveillance
- detection of a (possible) diversion of sensitive materials only with high probability
- safeguards tend to be too late (post-festum)
- specific safeguard limits in „bulk-handling facilities“ (enrichment, reprocessing,…): material unaccounted for (MUF) >> 0
- also newly (to be) invented verification measures are technically limited
- ineffective in case of sub-national groups
- if sensitive know-how and technology available, military use and hide is possible !! (encouragement of clandestine activities ?)

Limits of IAEA-Safeguards (and Verification) II

→ More or less: safeguards can be seen only as "confidence building measures".

→ It would be misleading to consider the only existence of safeguards as a licence to work with sensitive proliferation-prone technologies and materials.

→ The detection of undeclared, clandestine activities (based on declared civilian know-how) is not probable.

Non Proliferation Treaty (NPT) 1970:

Article IV

„Nothing in this Treaty shall be interpreted as affecting the inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with Art. I and II of this Treaty.”

Nevertheless, over the last decades, additional measures,
not explicitly codified within he NPT, have been established,
like export control, etc.

Export control:

- Zanggers Committee („NPT Exporters Committee“): 35 members, since 1974 „trigger“ list valid for exports into NPT member states
- London Club („Nuclear Supplier Group“): today 46 members, since 1976 export rules (incl. transfers to non-members of the NPT)

Problems:

- Perception by a relevant number of non-aligned states of „developing“ world as policy of technological denial by the „haves“
- effectiveness in question: missing suppliers, indigenous developments, unequivocal rules?
- 2008 U.S.-India nuclear deal: NSG rules undermined (contradiction to exclusion of trade with non-members of NPT)

More cooperative or coercive non-proliferation measures

2003 Proliferation Security Initiative (Bush): interception of transfers probably related to weapons of mass destruction (currently ~ 90 states)

2003 Counter Proliferation: Iraq war (alleged Iraqi nuclear weapons programme)

2004 Global Threat Reduction Initiative (U.S.-Russia-IAEA): secure weapon-grade fissile material (HEU) originating from U.S. and Russia (currently ~ 90 states)

2004 G8 summit (Sea Island): one-year moratorium on new transfers of enrichment and reprocessing technology to newcomers (extended annually since then)

2005 International Convention for the Suppression of Acts of Nuclear Terrorism

2010 1st Nuclear Security Summit (47 states)

„Bush Proposal“

„The Nuclear Non-Proliferation Treaty ... has a loophole. (...) I propose a way to close the loophole. (...) The 40 nations of the Nuclear Supplier Group should refuse to sell enrichment and reprocessing equipment and technologies to any state that does not already possess full-scale functioning enrichment and reprocessing plants.“

George W. Bush, National Defense University Speech, 11 Feb. 2004

G8 Action Plan on Non-proliferation
(G8 Summit, Sea Island, 8-10 June, 2004)

„(…) we agree that it would be prudent not to inaugurate new initiatives involving transfer of enrichment and reprocessing equipment and technologies to additional states. We call on all states to adopt this strategy of prudence.”

Nuclear Non-Proliferation Treaty (NPT) 1970

Article VI

„Each of the Parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and to a treaty on gen. and complete disarmament under strict and effective international control."

Nuclear reality today:

- despite the old promises:
  no international talks on the elimination of nuclear weapons

- ~ 16,000 nuclear warheads still in the arsenals of 9 NWS, main part in Russia and U.S. (explosive force >> 100,000 Hiroshima equivalents)

- normal accident theory is not only applicable to nuclear reactors but also to nuclear weapons and their command & control systems

Defects and shortcomings of the NPT

- NPT sets a **double-standard**: NWS versus non-NWS
  (rights & obligations divided → unstable setting)
- NPT is part of legacy of **Cold War thinking**: remain status-quo of 5 NWS
- Its **universalization is impossible**:
  India, Pakistan (&Israel) cannot be forced to join the treaty.
- The NP-regime develops into a **dangerous multi-class system**.
- **No clear path to nuclear disarmament** down to zero.
- **Not the right remedy** to effectively **stop proliferation**.
- The NPT expresses the **nuclear euphoria of the 1960s**.
- **Accepts the civil-military ambivalence** of nuclear materials,
  research and technology as naturally inevitable.
- The **limits of safeguards** are serious.

Up to now, the NPT is important
but is more or less (and more and more) outdated.

Four- (or five-) class global nuclear order is emerging

1 **(responsible) 5 NWS**:
only serious obligation: do not fuel further spread of NW
disarmament, safeguards, etc. more or less voluntarily

- **(responsible) new NWS**: NPT precondition for nuclear trade discarded
de-facto acceptance as NWS

2 **(responsible) nuclear capable states** (“virtual nuclear weapon states”):
advanced nuclear programs including sensitive materials
& technology accepted

3 **(distrusted) nuclear user states**:
only import-dependent non-sensitive
technology & material usage is accepted and supported

4 **(irresponsible) nuclear ambitious states**:
denial of advanced nuclear programmes

Four- (or five-) class global nuclear order is emerging (II)

- global nuclear divide (“haves” versus “have-nots”) is actually multiplied
  (dangerous, pernicious & unstable)

- must lead to a coercive (violence-based), hierarchical global nuclear order:
  the nuclear „haves“ must be prepared to enforce the system
  by all possible means (using military force, in the end)

Conclusion

- The military-civilian ambivalence is inherent in nuclear technology and cannot be brushed away & and is a persistent danger to global security.

- Existence of safeguards should not be an excuse for welcoming usage of sensitive, proliferation-prone technology or material.

- Increasing the access to sensitive nuclear materials & technology by (growing) commercial nuclear programmes increases the danger of nuclear weapons proliferation.

- Inconsistency and limited effectiveness of today´s non-proliferation measures (safeguards, export control, …)

- The increasing global nuclear divide is dangerous & war-provoking (instead of support for a multi-class nuclear order we need equal rules for all states including appropriate control).

- The NP regime is risky in itself.

→ Renounce proliferation-prone nuclear technology and materials. Promote a more effective and just global nuclear order (NWC).