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***Nuclear Power and Proliferation risk***

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# Nuclear Power



## **Nuclear Power and Proliferation: A Paradox**

## A Paradox

- The common mode for nuclear power and armament is the need of special materials, enriched uranium or plutonium.
- A program for civilian use of nuclear power can be used to hide nuclear weapon developments and thus, in some cases, make easier the proliferation.
- But, a complete stop of civilian use of nuclear power will not suppress the proliferation risk, could even increase it.
- Therefore, the proliferation risk should not impede the development of nuclear energy for civilian applications.

## Where is the risk?

- Nuclear weapon development =  
physics + materials + technology.
- Physics is quite different for weapons and power production. It is impossible to stop knowledge spreading, at the best it can be delayed for sensitive parts.
- Special materials production is the overlap field of power and weapon programs.
- No overlap in the technology field. There too, knowledge protection is a way to delay the risk but, as a result of experience, it is well known that tightness is never complete.

## The Uranium Path (1)

- The special material is highly enriched uranium.
- No need for nuclear reactor or reprocessing. This path could be followed in a world free of nuclear power use for civilian purpose.
- Enrichment technology can be the same as for civilian applications but the level of enrichment is higher, which means a different process in the enrichment plant.
- Technologies in use or under development (centrifugation, laser...) are dual. Practical change of a civilian enrichment plant to produce weapon grade materials could be done in a rather short time.

# Enrichment Plant

**Uranium Enrichment**  
**A dual purpose risk**



## The Uranium Path (2)

- Safeguarding an existing plant to prevent a change of the process is easier than to detect a clandestine facility (it is part of the paradox).
- An economically viable plant could be sufficient to procure the necessary material for 50 to 100 reactors (1000 MWe). Thus, there is no need to built enrichment plant everywhere, assuming the procurement is guaranteed for all the users by a specific mechanism.
- Multiple ownership of plants is a way to reduce the risk associated with dangerous political decisions.
- In the longer term, the development of breeders should reduce the enrichment needs and therefore the risk.



## The Uranium Path (3)

- Without the need of economic viability, the centrifugation technology can be developed secretly using dual components.
- Often underestimated, the uranium path is the most dangerous precisely because it could be secretly developed without any other nuclear facility, in particular belonging to a civilian program.
- At present, the worldwide enrichment capacity for power programs is largely sufficient.
- There are some ambiguity in the NPT application. Obviously, an international consensus is necessary for the realization of new plants.



## The Plutonium Path (1)

- Here the special material is plutonium with a content of even isotopes as low as possible.
- The plutonium is coming from irradiation of natural or depleted uranium in power reactors. It means there is a possibility of using secretly some civilian power plants to produce the weapon plutonium.
- Problematic issue: plutonium is an unavoidable by-product of energy production in any kind of reactor using an uranium fuel.
- Some types of reactors are more difficult to safeguard than others (continuous loading, D<sub>2</sub>O, graphite, some research reactors). LWR are well designed to limit the risk.

## The Plutonium Path(2)

- Extracting plutonium from irradiated fuels is done in reprocessing plants. Till now, there is no difference in plants according to the final use of extracted materials.
- What to do with the plutonium coming from NPP?
- The US approach was to put everything (the spent fuel without reprocessing) in disposal; it will simplify the safeguarding in the short term but accumulate plutonium mines for later. Failure of Yucca Mountain.
- In the French approach, all the spent fuel is reprocessed and the plutonium is recycled through the use of MOX fuel. It requires a rigorous safeguarding of operations but then burning the plutonium suppress the risk.

# Reprocessing Plant



**Reprocessing:  
Make clear the distinction**

## The Plutonium Path(3)

- The US approach has been the most popular in the years 80-90, moving progressively from a final disposal to a long term storage (wait and see policy).
- Now, all the countries which are in the forefront of nuclear power development (China, India, Russia...) are engaged in a way more or less similar to the French approach, as already done by Japan.
- Other countries are still facing a strong US pressure against reprocessing that illustrates the necessity of new choices in the design of reprocessing-recycling facilities.

# Safeguards

- The Non Proliferation of Nuclear Weapons Treaty (NPT) was established in 1968 and signed by all the States minus three.
- An Additional Protocol was introduced in 1998 in order to enhance the international controls. Till now, only a third of the States have signed such a protocol.
- The IAEA has been mandated to manage international safeguards and it reports to the Security Council of the UNO when an important anomaly is detected or if a State fails to fulfill its commitments in a treaty.

## An Efficient System of Control

- Contrary to many concerns expressed in the years 60-70, the number of countries engaged in proliferation remains quite low. One reason is the efficiency of controls.
- Besides the three states which have not signed the NPT, North Korea is today the only country claiming officially its will to develop nuclear weapons.
- Detecting a clandestine program is not easy, mainly in countries without nuclear power facilities.
- A main difficulty: to enforce the respect of commitments taken through the signature of international treaties.

## Managing the Paradox

- There is no universal solution: Neither a complete or partial stop of civilian nuclear power nor an ambiguous development of this activity.
- Any nuclear activity implies a part of international responsibility.
- All the parties in such an activity should take clear commitments.
- For the States, it means signing treaties and joining international conventions.
- Recently, most of the nuclear industry has adopted a code of conduct (POC) with, in particular, the aim of avoiding competition leading to reduced safety or security.



## Conclusion

- To avoid proliferation of nuclear weapons remain a major goal.
- It should not limit the development of pacific use of nuclear power.
- The responsibility of States is fully engaged but it should be carried on in complete transparency to justify the necessary confidence of the international community.