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The Proliferation Challenge of the Nuclear Fuel Cycle in Non-Nuclear Weapon States

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Pierre Goldschmidt, IAEA Deputy Director General, Head of the Department of Safeguards

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IAEA Director General Statement

(https://www.iaea.org/sites/default/files/styles/hd_1920x1080/public/default_images/statement-default.jpg?itok=E1vf14LB)

Recent findings by the International Atomic Energy Agency (IAEA) that some nonnuclear-weapon States (NNWSs) party to the "Treaty on the Non-Proliferation of Nuclear Weapons" (NPT) had been able to conceal for two decades procurement, research and development, manufacturing and production activities related to uranium conversion and enrichment have raised new proliferation concerns² (/NewsCenter/Statements/DDGs/2004/goldschmidt26042004.html#ftn2). This has underscored the possibility that a NNWS that masters for instance centrifuge enrichment technology and constructs and operates an enrichment facility for peaceful purposes under IAEA full scope safeguards, would be in a position (i) to construct in parallel a similar undeclared facility at a concealed site or, (ii) if one day it so decided, to withdraw from the NPT (by giving the three month notice foreseen under Article X) and rapidly reconfigure the declared enrichment facility to produce weapons-grade enriched uranium.

In response, the IAEA Director General has highlighted these challenges to the international non-proliferation regime and proposed the introduction of measures to meet them³

(/NewsCenter/Statements/DDGs/2004/goldschmidt26042004.html#ftn3), including "limiting the processing of weapon-usable nuclear material in civilian nuclear programmes – as well as the production of new weapon-usable nuclear material through reprocessing and enrichment – by agreeing to restrict these operations exclusively to facilities under multinational⁴

(/NewsCenter/Statements/DDGs/2004/goldschmidt26042004.html#ftn4) control," and considering "multinational approaches to the management and disposal of spent fuel and radioactive waste."

In the 1970s and 1980s, a number of proposals and concepts were advanced and discussed⁵

(/NewsCenter/Statements/DDGs/2004/goldschmidt26042004.html#ftn5). These included such initiatives as:

- multilateral fuel cycle centres proposed for a limited number of States pooling their resources in a single centre to provide fuel cycle services;
- multinational spent fuel centres (as an alternative to reprocessing) and multinational storage of separated plutonium; and
- an international nuclear fuel authority to guarantee the supply of fuel for nuclear power plant to NNWSs that had renounced national reprocessing or enrichment facilities.

However, at the time, no consensus could be reached on any concrete proposal, partly because of over-supply of natural and enriched uranium, and partly because States were not prepared to give up national development and operation of such technologies.

Although multilateral approaches may bring added assurances that fuel cycle facilities would not be misused, it will be challenging to design an approach that prevents the host country access to the related sensitive technical know-how and even manufacturing capability.

Any solution would also need to take into account the necessity to maintain fair competition among suppliers of nuclear fuel and spent fuel management services as well as their customers' legitimate wish to have access to diversified sources of supply.

It may be difficult to find an equitable "one size fits all" solution that would be widely accepted. Therefore, in order to make some progress, it is suggested to approach the issue by addressing two opposite cases from the point of view of proliferation risk. The first case addresses States having been found in noncompliance with their safeguards agreements. The second considers the conditions deemed necessary for States with sensitive nuclear fuel cycle facilities to provide the greatest non-proliferation assurances.

States Found To Be In Non-compliance

For the sake of the present conceptual study and as a working hypothesis it will be assumed that a State found by the IAEA Board of Governors to be in noncompliance with its safeguards agreements⁶

(/NewsCenter/Statements/DDGs/2004/goldschmidt26042004.html#ftn6) would be prevented, for a given period of time, from developing, constructing or operating nuclear fuel cycle facilities⁷

(/NewsCenter/Statements/DDGs/2004/goldschmidt26042004.html#ftn7) and would be required to dismantle any existing such facilities under IAEA supervision. Such limitations in the State's fuel cycle activities could be the result of a decision by the United Nations Security Council (UNSC) (possibly under article VII of the UN Charter)⁸

(/NewsCenter/Statements/DDGs/2004/goldschmidt26042004.html#ftn8) or could

be agreed by the State found in non-compliance, without resorting to the UNSC, as part of a broad multinational agreement that could also include issues not directly related to nuclear non-proliferation (such as security guarantees).

However that State, once it is declared by the IAEA to have come into full compliance with its NPT obligations and related commitments as described below, would continue to be entitled to the benefits of nuclear energy and therefore of operating nuclear power plants for heat and/or electricity production within its borders.

In what follows, measures will be proposed which aim to provide sufficient assurances of fuel supply to operate a State's nuclear power plants while minimizing the possibility that the fuel could be used for a nuclear weapons programme, even if the State one day decided to withdraw from the NPT.

The first condition for supply of nuclear fuel to such a State (which will be referred to as the "recipient State") is that it has a comprehensive safeguards agreement (CSA) and an additional protocol (AP) in force and that the IAEA has drawn the conclusion that all nuclear material in that State had been placed under safeguards and remained in peaceful nuclear activities⁹ (/NewsCenter/Statements/DDGs/2004/goldschmidt26042004.html#ftn9).

Any "supplier State" party to the NPT (or group of such States) would then be in a position to offer to the recipient State, on a competitive basis, contracts for the delivery of fabricated fuel assemblies containing natural and/or low enriched uranium (e.g. up to 5% U-235). Under such an arrangement, the supplier State would be obliged to take back any spent fuel (after a specified minimum cooling time) for a storage period of at least 25 years. Ideally, this medium term storage would take place either in a Nuclear Weapon State (NWS) or in an agreed multinational storage facility located in a NNWS meeting the criteria detailed hereafter in the section relating to States providing the greatest non-proliferation guarantees.

The supplier State and the recipient State would have to negotiate bilaterally the terms and conditions of the fuel supply contract including its duration, the quantities of fuel involved, the pricing mechanism and the relevant fuel performance guarantees. As indicated above the contract would have two components, one relative to the supply of the fresh fuel assemblies and another one dealing with the spent fuel.

The following underlying contractual mechanism could be envisaged:

- The delivery of fresh fuel assemblies would most likely be guaranteed by the supplier State as long as (i) the IAEA is able to draw its annual conclusion of the absence of undeclared nuclear material and activities in the recipient State, and (ii) as long as that State complies with the obligation to return the spent fuel within the agreed time frame (e.g. within two or three years after unloading from the reactor core). Normally the full cost of the fresh fuel assemblies would be paid at the time of delivery.
- In addition, to further increase the guarantee of supply, it is conceivable that the IAEA could conclude long term agreements with all major uranium, conversion, enrichment and fuel fabrication producers whereby they would commit to reserve at all times a specified percentage of their production capacity to the IAEA. These capacity access rights would be exercised by the IAEA if and only if the supplier State fails to meet its contractual delivery obligations e.g. for political reasons, and provided the recipient State has met all its obligations under the contract (in particular with regard to the return of spent fuel) and under its safeguards agreements as well as any relevant UNSC resolutions or multilateral agreements (e.g. prohibiting the development of an indigenous nuclear fuel cycle).

 As is common in most countries, for each kwh produced by nuclear power plants a specified amount of money (often expressed in USD mills per kwh) would have to be paid into a dedicated fund in order to cover all future management, storage, conditioning and final disposal costs of the spent fuel.

In order to further strengthen the assurance that the contract will be honoured, it could include the following conditions.

An amount of x mills per kwh would have to be paid monthly by the recipient State into an escrow account as nuclear power is produced. The account could be managed by the IAEA (or another appropriate international organization, such as the IMF). This assessed millage would have three components: (i) to cover the cost of transporting the spent fuel (SF) out of the country and storing it (e.g. in dry containers) for a medium term period of 25 years or more, (ii) to cover further spent fuel transportation, storage and conditioning costs, and (iii) a component for final disposal costs in an appropriate geological repository.

These funds, held in escrow, would be provided to the State or entity that conducts each of these activities. For example, if the supplier State only stored the SF for say 25 years but later transferred it to an internationally managed regional SF conditioning and disposal facility, then the supplier State would receive only the component of the assessed millage and corresponding accrued interest for the medium term storage of each spent fuel element that it has taken back and stored.

The remainder of the fund and accrued interests would be paid to the operator of the regional conditioning and disposal facility once it takes ownership of the spent fuel.

There could be a case where the supplier State would accept to take back and store the spent fuel for 25 years or more, but would nevertheless reserve the right to send back to the recipient State an amount of vitrified (or otherwise appropriately conditioned) high level wastes (HLW) corresponding to the quantity (and toxicity) of the fission products contained in the spent fuel. The recipient State would have the obligation to take back the HLW and only then would be paid back the third component of the fund (and accrued interest) corresponding to the final disposal costs.

The delivery of fresh fuel assemblies would be suspended if the amount of assessed millage [x mills/kwh] was not paid monthly to the escrow account as required by the contract.

Because of the financial implications, the above mechanism should increase the likelihood that all parties will honour their commitments concerning the management of spent fuel.

 Although it is not foreseen that the IAEA would be a party to the contract, it should be required that it concurs with the contract before it can enter into force. This "concurrence" by the IAEA, similar to the concurrence required from the Euratom Supply Agency on all nuclear fuel supply contracts concluded by EU companies, would guarantee that the contract meets all the necessary conditions.

Any breach of the contract either by the supplier or the recipient State would be reported to the IAEA Board of Governors and, as the case may be, to the UNSC.

States Providing the Greatest Non-Proliferation Guarantees

It should be recognized that the greatest non-proliferation guarantees are provided by those States which demonstrate in practice, through full transparency, a clear commitment not to develop nuclear programmes for nonpeaceful purposes.

In order to limit the risk associated with the construction and operation by NNWSs of sensitive nuclear fuel cycle facilities such as uranium enrichment plants, these facilities should only be operated in States which provide the highest level of non-proliferation guarantees. It should be internationally recognized that such non-proliferation assurances can only be derived for States that have a CSA and an AP in force and for which the IAEA has drawn the conclusion (which needs to be reaffirmed annually) regarding the absence of undeclared nuclear material and activities in the State as a whole. As a further confidence building measure States could conclude with the IAEA appropriate bilateral agreements that would allow its inspectors and experts access rights to go anywhere, and privately interview anyone, at any time.

The international community could also agree that, as a matter of principle, no new nuclear fuel cycle facility should start operating with nuclear material unless a robust safeguards approach¹⁰ (/NewsCenter/Statements/DDGs/2004/goldschmidt26042004.html#ftn10) has

been agreed with the IAEA, and unless a Facility Attachment¹¹ (/NewsCenter/Statements/DDGs/2004/goldschmidt26042004.html#ftn11) has been concluded. For the sake of transparency the Board of Governors may find it advisable to request the IAEA Secretariat to report henceforth on any case where those conditions are not met.

In NNWSs, where such facilities are already in operation and processing nuclear material, it could become a policy that these States fulfil the above requirements within a reasonably short period of time.

Whether and under what conditions a multinational ownership and management of any such fuel cycle facilities would be beneficial from a non-proliferation point of view would have to be evaluated on a case by case basis.

It has been recognized for more than two decades that internationalizing the back-end of the nuclear fuel cycle by establishing first regional spent fuel storage centres and later on conditioning facilities and geological repositories is most likely the best solution from a technical, economical and non-proliferation point of view. In order to achieve that goal a number of legal and socio-political obstacles will need to be overcome. If the host country of such regional and multinational facilities is a NNWS, it would, as a minimum, have to meet the above mentioned conditions. What would happen if, at one point in time, the conclusion that there

is no undeclared nuclear material or activities in the State could no longer be drawn by the IAEA is a major issue that needs to be addressed. As has been suggested previously (e.g. in the reference cited in footnote 2), it would be advisable for the UNSC to consider what automatic international response could apply in such cases including that of a State withdrawing from the NPT.

Conclusion

The Director General of the IAEA has announced that he will soon appoint a group of experts to examine in depth the feasibility of multilateral approaches to nuclear fuel cycles. The study would be geared towards identifying how such approaches might be developed and implemented in such a way as to strengthen the international nuclear non-proliferation regime, thereby facilitating the contribution of the peaceful use of nuclear energy to the economic development of interested countries, and to attract the adherence from all countries that is necessary for successful implementation.

It is hoped that the ideas forwarded in this conceptual paper will contribute to such a study.

It is well known that the devil lies in the details and the contractual mechanisms proposed above will clearly need to be refined as appropriate. However, these proposals seem to indicate that solutions do exist to address the hopefully limited number of cases where States would be found in non-compliance with their safeguards agreements, while preserving the core principles of the NPT.

Practical solutions also exist that would diminish the risk that NNWSs would develop sensitive nuclear fuel cycle facilities under IAEA safeguards possibly with the long term objective of being in a position to produce weapons-grade nuclear material, if one day they decided to do so. Measures, such as those proposed in this conceptual study, even if not solving all the problems, appear to be better than the status-quo and if agreed upon could be put into practice without delay. That will require the determination and support of Member States and the IAEA Board of Governors. As once stated by Cardinal de Richelieu "politics is the art of making possible what is necessary".

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International Atomic Energy Agency

Vienna International Centre, PO Box 100 A-1400 Vienna, Austria Telephone: +43 (1) 2600-0, Facsimile +43 (1) 2600-7

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