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Agence internationale de l'énergie atomique

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Note by the Secretariat

Assurance of Supply

Information from the IAEA Secretariat with respect to the comments and questions of Member States

A. Introduction

1. Proposals on assurances of supply made or supported by Member States have been under discussion in the IAEA context for several years. The Secretariat provided an informal technical briefing to Member States on two such proposals on 28 May 2009.¹ The Board of Governors discussed these proposals in its meetings held on 18 June 2009 — the summary records of which are available in documents GOV/OR/1242 and 1243. In the discussions at the meetings of the Board of Governors in June, September and November 2009² on the various proposals on assurance of supply of LEU,

¹ Assurance of Supply: Proposal for the Establishment of an IAEA Low Enriched Uranium (LEU) Bank (GOV/2009/30), and Assurance of Supply: Russian Federation Initiative to Establish a Reserve of Low Enriched Uranium (LEU) for the Supply of LEU to the IAEA for its Member States (GOV/2009/31).

² The summary records of the September and November 2009 Board meetings are available in documents GOV/OR/1254 and 1256. The Board adopted resolution GOV/2009/81 on 27 November 2009, concerning the request of the Russian Federation regarding its initiative to establish a reserve of LEU for the supply of LEU to the IAEA for its Member States and inter alia authorized the Director General to conclude and subsequently implement the Agreement with the Russian Federation to establish such a reserve as contained in document GOV/2009/76.

Member States stressed the importance of properly addressing in a transparent manner the various technical, economic, legal and political considerations raised.

2. In order to facilitate further discussion among and consideration by Member States on the subject of assurance of supply, the IAEA Secretariat is presenting information in this document with respect to the comments and questions of Member States raised at the informal technical briefing and at the meetings of the Board of Governors in June, September and November 2009. Comments and questions from different Member States are followed by information provided by the Secretariat and have been consolidated below by theme for ease of reference. The information presented here reflects the Secretariat's current observations. The Secretariat will continue to take into consideration the evolving views of Member States on assurance of supply.

B. Comments and questions by Member States and information by the Secretariat

3. Some Member States noted that it is important that any proposal should be in accordance with the IAEA Statute and take into account the legal obligations of Member States and the principle of non-discrimination.

- Articles IX.A and IX.I of the IAEA Statute provide the Agency with the authority to carry out the activities that would be necessary to establish and operate an LEU bank. The proposal to establish an IAEA LEU bank is also compatible with Article III.A.1 of the Statute which provides for the Agency's focus on promoting the peaceful uses of nuclear energy and for it to "act as an intermediary for the purposes of securing the performance of services or the supplying of materials, equipment, or facilities by one member of the Agency for another."³
- The proposal for an IAEA LEU bank⁴ has been drafted in accordance with the provisions of the Statute and the IAEA LEU bank would be available to all Member States without discrimination in accordance with criteria established in advance by the Board.

4. Some Member States observed that concerns related to nuclear proliferation must not in any way restrict the inalienable right of all States to develop all aspects of nuclear science and technology for peaceful purposes, given in particular the relevance of nuclear science and technology for the sustainable socio-economic advance of developing nations, and that there should not be any attempts aimed at discouraging the pursuit of any peaceful nuclear technology on the grounds of its alleged 'sensitivity'.

- The Secretariat is fully aware of the broad expectation of Member States that the Agency, in line with its Statute, should encourage and assist research on, and development and practical application of, nuclear energy for peaceful uses throughout the world. The IAEA therefore would only be involved in assurance of supply mechanisms, such as, for example, an IAEA

³ Annex 1 to document, *Possible new Framework for the Utilization of Nuclear Energy: Options for Assurance of Supply of Nuclear Fuel* (GOV/2007/11), 13 June 2007, attached as Annex 1 to this Note.

⁴ GOV/2009/30.

LEU bank, that do not in any way restrict the right of all Member States to develop and use nuclear science and technology for peaceful purposes.

- The IAEA LEU bank proposal recognizes that the rights of Member States, including that of establishing or expanding their own production capacity in the nuclear fuel cycle, should remain intact and should not in any way be compromised or diminished by the establishment of international assurance of supply mechanisms. Having the right to receive LEU from the guaranteed supply mechanisms would not require a State giving up the right to establish or further develop a national fuel cycle.
- The consequences of a possible non-commercial disruption of a country's LEU supplies could be alleviated by the establishment of LEU reserves. It is reasonable to assume that governments, and intergovernmental organizations such as the IAEA, would act in such a way to reduce non-commercial barriers to starting nuclear power programmes and to facilitate continuing and future use of nuclear energy.
- With respect to the comment made by some Member States regarding the "alleged sensitive nature of enrichment and reprocessing technologies", which are technologies in the civilian nuclear fuel cycle that could be used to produce material for nuclear weapons, it may be recalled that inter alia these two technologies were identified as "sensitive technological areas" by the Board in the context of the application of safeguards in relation to the granting of technical cooperation by the IAEA.⁵

5. Some Member States noted that States in compliance with their safeguards obligations should have reliable access to fuel for nuclear power reactors at reasonable cost in accordance with the Statute and Article IV of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT).

- The Board of Governors has the authority to determine and approve the eligibility criteria that would govern the release of nuclear material from the IAEA LEU bank to any requesting Member State, as long as they are compatible with the provisions of the IAEA Statute (see paragraph 3 above). The Secretariat notes that Member States which are in compliance with their safeguards obligations would be eligible to receive nuclear material through the proposed assurance of supply mechanisms in accordance with the eligibility criteria approved in advance by the Board for the functioning of the supply mechanism.⁶

6. Some Member States enquired whether the LEU bank could be triggered if a Member State is under UN Security Council mandated sanctions.

- As noted above, the Board of Governors has the authority to determine and approve the eligibility criteria that would govern the release of the nuclear material from the IAEA LEU bank to any requesting Member State, as long as they are compatible with the provisions of the IAEA Statute (see paragraphs 3 and 5 above). A Member State against which the UN Security Council acting under Chapter VII of the UN Charter has imposed sanctions would

⁵ The Annex of the Revised Guiding Principles and General Operating Rules to Govern the Provision of Technical Assistance by the Agency approved by the Board of Governors on 21 February 1979 (INFCIRC/267) refers to: (a) uranium enrichment; (b) reprocessing of spent fuel; (c) production of heavy water; and (d) handling of plutonium, including manufacture of plutonium and mixed uranium/plutonium fuel, as "sensitive technological areas".

⁶ Article IX.J of the Statute inter alia provides that the "materials made available pursuant to this article shall be used as determined by the Board of Governors in accordance with the provisions of this Statute."

not be prevented from being supplied with LEU unless such sanctions specifically prohibit the provision of LEU for its relevant peaceful nuclear activities. It should be recalled, however, that the eligibility criteria approved in advance by the Board for the release of nuclear material from the bank will still apply.

7. Some Member States asked if the LEU bank could be used if a Member State is “blacklisted” by all countries having an enrichment facility, but still not under UN Security Council mandated sanctions.

- An IAEA LEU bank would be available for supply of LEU to Member States experiencing a non-commercial supply disruption in accordance with the eligibility criteria approved in advance by the Board for the functioning of the LEU bank.

8. Some Member States observed that the Agency should not lose its main focus on promoting the peaceful uses of nuclear science and technology, including national fuel cycle capabilities, through national capacity building and transfer of technology, and stated that any proposal which may contain any element that is not in accordance with the IAEA Statutes could not be accepted.

- The Agency’s function to act as an intermediary among its Member States is clearly set out in the Statute of the Agency – see Annex 1. The IAEA Statute provides the Agency with the authority to carry out the activities that would be necessary to establish and operate a LEU bank and/or reserve. The proposal for an IAEA LEU bank is compatible with the Agency’s focus on promoting the peaceful uses of nuclear energy as defined in the Statute.⁷

9. Some Member States observed that the proposal described in GOV/2009/30 does not address the supply of natural uranium, which fuels a number of reactors in the world.

- The reason for focusing on the supply assurance of LEU through an IAEA LEU bank is that the vast majority of nuclear power plants (NPPs) are light water reactors (LWRs) using LEU, while the number of reactors using natural uranium is relatively small.⁸ The inclusion of natural uranium in the LEU reserve, which is technically possible, could also be considered, if requested by Member States and the necessary funding is made available.

10. Some Member States said that from a technical point of view, none of the proposals provides a proper assurance of supply of nuclear fuel. Rather they merely create a backup mechanism to provide LEU when the supply of fuel is disrupted for non-commercial reasons. They noted that having guaranteed access to LEU will not help the recipient States because they require a supply of nuclear fuel assemblies to load into their power reactors and that in practical terms this would mean that it will be impossible at short notice to supply nuclear fuel where required through the proposed backup mechanisms, especially if the receiving State does not possess fuel fabrication plants. They also noted that another difficulty of a legal nature derives from the fact that fuel assemblies and their fabrication methods are normally proprietary technology belonging to the reactor manufacturer.

⁷ The proposal for an IAEA LEU bank is described in GOV/2009/30.

⁸ Data provided by the IAEA Department of Nuclear Energy shows that currently, 48 (11%) NPPs use natural uranium (44 pressurized heavy water reactors (PHWRs) plus 4 MAGNOX reactors) and 388 (89%) NPPs use low enriched uranium (92 boiling water reactors (BWRs), 2 fast breeder reactors (FBRs), 14 gas cooled reactors (GCRs), 16 graphite moderated light water cooled reactors (LWGRs) and 264 pressurized light water reactors (PWRs)). One PHWR operates with very slightly enriched uranium, i.e. 0.9% instead of 0.7% natural uranium.

- The Secretariat recognizes the concerns raised by Member States that none of the proposals presented so far provide an assurance of supply of nuclear fuel assemblies, which would be a more challenging and complex undertaking. The proposals initially have focused on assuring supply of LEU.⁹ In a follow-on step to the IAEA LEU bank, the Agency could look into mechanisms for providing assurance of fuel assembly fabrication, recognizing that the development of a full assurance supply mechanism necessarily would be a step-by-step process.¹⁰

11. Some Member States noted that the Secretariat should strictly adhere to the Rules Regarding the Acceptance of Voluntary Contributions as approved by the General Conference on 21 September 2001.

- If the Board approves the establishment of a bank, the formal acceptance of funds would be subject to the approval process set out in the Rules Regarding the Acceptance of Voluntary Contributions of Money to the Agency (GC(45)/RES/9). In strict adherence to this rule, funds transferred by Member States to the Secretariat for an IAEA LEU bank to date amount to approximately \$54 million. These funds have been deposited in a suspense account of the Agency and will remain there during the Board of Governors deliberations on this subject.
- It should also be noted that current Agency rules allow for acceptance of financial contributions from non-governmental organizations, and the Agency has accepted such contributions on a number of occasions.

12. Some Member States raised questions about the financial implications for the IAEA in establishing and operating the nuclear fuel assurance mechanisms, and whether the costs would be divided among the Member States.

- The startup costs for the IAEA LEU bank are to be funded by extrabudgetary pledges that currently exceed \$150 million. The amount of \$150 million should be sufficient to cover the costs of purchase and delivery of 60–80 tonnes of LEU (under 5% enrichment, in the form of UF₆) to the bank's location, as well as the cost and delivery of a corresponding number of storage cylinders (for UF₆) at prevailing market prices. While the startup costs and initial LEU costs could be covered as a one time contribution, funding of the recurring annual operating costs of the bank would need to be identified.
- Based on a preliminary assessment, the operating costs for storage, security, safety and for safeguarding the LEU could be expected to be modest, particularly if the bank would be located at an existing facility that is already storing this kind of material. If requested, a more detailed estimate could be made. However, such costs would depend on the arrangements to

⁹ It may be noted that fuel fabrication services are more widely dispersed than enrichment services. Currently there are 13 enrichment facilities in 9 countries versus 34 fabrication plants in 18 States. IAEA-TECDOC-1613 (Nuclear Fuel Cycle Information System, *A Directory of Nuclear Fuel Cycle Facilities*, 2009 Edition), Table 14, p. 55; Tables 17–22, pp. 55–56) – http://www-pub.iaea.org/MTCD/publications/PDF/te_1613_web.pdf.

¹⁰ For many of the currently operating BWRs and PWRs, alternative options for fuel fabrication already exist (Areva, GE-Hitachi and Westinghouse for BWRs and Areva, Mitsubishi and Westinghouse for PWRs, and Westinghouse for Russian VVER-440). Westinghouse is developing (technically developed but not licensed yet) the “VVAntage 6” fuel assembly for Russian designed VVER 1000 reactors and TVEL (Russian fuel fabricator) is developing (technically developed but also not licensed yet) the “TVS-Kvadrat” fuel assembly for Westinghouse and Areva designed reactors. Korea Nuclear Fuel is an emerging supplier of assemblies for several PWR designs. These developments indicate that already some industrial (technological) drivers exist for collaboration on fuel assemblies, which are being further developed (Vvantage, Kvadrat).

be concluded with the host country and upon the type of storage facility. When the LEU in the bank is transferred to a Member State, the costs would be paid by that State in accordance with a pricing formula, and the payments would be used to replenish the reserve.

- The mechanism for securing the recurring annual operating costs of the LEU bank needs further discussion.

13. Some Member States raised the question as to which are supposed to be the potential Member States that would make use of the nuclear fuel assurance mechanisms, and about how frequently these mechanisms would be used.

- Fuel assurance mechanisms, such as an IAEA LEU bank, are designed to be used rarely. They are an insurance and would be established and exist as a last resort supply option for a Member State which finds itself in circumstances where it needs to call on the bank.

14. Some Member States raised the question about whether the mechanisms would work if a supplier is bankrupt or if a Member State is bankrupt.

- The objective of establishing LEU reserves is to alleviate the consequences of possible non-commercial disruptions of a country's LEU supplies. Consequently, bankruptcy of the supplier would not be considered a factor.¹¹ The requesting Member State would have to purchase the LEU at the prevailing spot market price from the IAEA LEU bank, and the requisite funds would need to be deposited by the State in advance with the IAEA – thus, a bankrupt Member State that could not cover the cost of the LEU in advance would not be able to receive LEU from the IAEA bank.

15. Some Member States asked whether a Member State would be able to benefit from the mechanisms if it was able to identify alternative commercial suppliers, and whether the supply of LEU would be available for a first reactor core.

- As the IAEA LEU bank is intended to be a supply of last resort to IAEA Member States facing a supply disruption for non-commercial reasons, the requesting Member State would be expected to seek alternative commercial suppliers after experiencing the defined supply disruption and before applying to the IAEA for supply from the LEU bank. The mechanism could also be available in the event a Member State experiences a non-commercial disruption of supply for a first reactor core.

16. Some Member States raised the question whether the nuclear fuel assurance mechanisms would be considered as a means to reduce the risk of proliferation.

- The objective of the assurance of supply mechanisms is to supply LEU to IAEA Member States experiencing non-commercial disruptions of supply. This could lead to reducing non-commercial barriers to starting nuclear power programmes and facilitate the continuing and future use of nuclear energy by Member States. These mechanisms, such as an IAEA LEU bank, could also have as a consequence the strengthening of the nuclear non-proliferation regime by offering alternative sources of supply of LEU in instances of non-commercial

¹¹ See GOV/INF/2007/11, footnote 1, which states that disruptions of supply should be unrelated to technical or commercial considerations.

disruptions and thereby reducing the incentives to establish national enrichment facilities beyond market requirements to hedge against non-commercial disruptions.

17. Some Member States raised the question that if the bank were to cease to exist, would the respective Member States' safeguards obligations on the supplied material from the bank also cease, and whether there are plans for fall-back safeguards (i.e. bilateral or other safeguards).

- If the IAEA LEU bank were to cease to exist, the LEU supplied to a Member State, and any special fissionable material produced through its use including subsequent generations of special fissionable material produced therefrom, would remain under safeguards as long as it is relevant from a safeguards perspective as defined by the Agency, in accordance with the terms of the applicable safeguards provisions in the agreement concluded with the Member State by the Agency.
- National/bilateral (or so-called fall-back) safeguards are in the realm of Member States' national policies and not part of the Agency's safeguards system.

18. Some Member States asked whether the supplied LEU would be eligible for reprocessing, and if so, what the conditions would be that would allow reprocessing.

- For the development of the conditions of the use of LEU supplied to Member States from an IAEA LEU bank, the proposal follows other Project and Supply Agreements that the Board has approved on previous occasions. These Agreements allow, as standard practice, reprocessing of the supplied material only under conditions and in facilities acceptable to the Parties to the agreements.¹²

19. Some Member States asked about the criteria for the selection of the location of the IAEA LEU bank, and also about where it would be located.

- One or more Member States could offer to provide a location for the IAEA LEU bank at an existing nuclear facility, such as a conversion or fabrication plant, that already handles LEU. Furthermore, the bank should preferably be located in a place from where the LEU can be easily transported internationally. The IAEA would conclude a Host State Agreement with the Member State providing for all necessary licences and authorizations to enable the IAEA to import, store and export LEU from its bank. The IAEA would also conclude agreements with relevant neighbouring States guaranteeing the transit of the IAEA LEU, if required.
- Kazakhstan has circulated position papers (INFCIRC/782 and INFCIRC/753) noting the intention of the Republic of Kazakhstan to host an "international nuclear fuel bank" under IAEA auspices and to bear all of the corresponding financial and technical obligations associated with fuel storage.

20. Some Member States enquired about how the IAEA would acquire the LEU for the IAEA LEU bank, and what the conditions on the LEU suppliers would be.

- The IAEA would purchase the LEU from the existing commercial market based on a competitive tender process in accordance with the Agency's financial rules and regulations.

¹² See, for example, INFCIRC/695, Article II.5, page 2.

- For purposes of assurance of supply of LEU through or by the IAEA, it will be essential that suppliers provide LEU to the IAEA in the framework of the IAEA Statute and free of any additional national/international constraints.
- In accordance with the Statute, the necessary peaceful use, and safety and security obligations governing the supply of LEU to Member States by the IAEA through a nuclear fuel assurance mechanism would be regulated by the proposed eligibility and supply criteria. These criteria would be included in the relevant Agreements to be concluded between the IAEA and the Member State and would need to be approved in advance by the Board of Governors.

21. Some Member States raised the question of the reliability of the triggering mechanism under the proposals, and enquired whether the State that disrupts supplies could easily claim that any disruption was due to technical or commercial considerations, thereby blocking the possibility of resort to the suggested mechanisms within the framework of the IAEA. Furthermore, they enquired whether there can be any real guarantee that a State that has interrupted the commercial supply of fuel will not attempt to block the triggering of backup mechanisms within the IAEA.

- The circumstances of a supply disruption would be explained by the requesting Member State and it should be possible for the Director General to confirm the reasons for the supply disruption. The decision to supply LEU to a Member State from the IAEA LEU bank would be made by the Director General in accordance with the eligibility criteria approved in advance by the Board.¹³

22. Some Member States noted that participation in any nuclear fuel assurance mechanisms should be on a voluntary basis.

- The assurance of supply mechanism, such as an IAEA LEU bank, intends to provide an added layer of assurance that every country that wants nuclear energy has guaranteed access to a supply of LEU that would not be interrupted for political reasons. Member States would remain free to choose whether or not to make use of any supply mechanism.

23. Some Member States asked whether the LEU bank would undermine the existing commercial market.

- A description of the international nuclear fuel market is reproduced in Annex 2 of this document. Given the small size of the proposed IAEA LEU bank (60–80 tonnes of LEU), these small stocks of LEU are not expected to impact on the existing commercial market. The nuclear fuel market annually provides enriched uranium product to customers in quantities that are two orders of magnitude greater than the total of the LEU in the proposed IAEA stock for assurance of supply.¹⁴

24. Some Member States noted that the proposed eligibility criteria make access to the backup mechanisms conditional upon a Member State being one “with respect to which ... no specific report relating to safeguards implementation ... is under consideration by the Board of Governors”. They observed that this is not an acceptable or credible eligibility criterion, as there have been cases where specific safeguards reports were issued in response to allegations, and other cases where these reports

¹³ Described in GOV/2009/30.

¹⁴ The nuclear fuel market provides enriched uranium products in the amount of some 10 000 tonnes annually.

contained requests by the Board to Member States to take measures that exceed their legal obligations under their safeguards agreements.

- Based on the verification activities carried out by the Secretariat, when warranted, the Director General reports safeguards implementation issues regarding a State to the Board in an objective and impartial manner. In such instances, the Board would decide whether to consider the matter, and if necessary to call upon the State to take the necessary actions as required in order to enable the Agency to fulfil its safeguards obligations.
- The Board has the authority to request the inclusion of safeguards implementation issues that may be related to allegations in relation to the implementation of safeguards in a particular State on the agenda of its meetings and to remain seized of the matter. Furthermore, the Board has the authority to request States to take any necessary actions in respect of the fulfillment of their respective safeguards obligations.
- As regards reporting, the Director General is obligated to follow the provisions of the IAEA Statute and the relevant provisions of the various types of safeguards agreements. In practice, the Director General has reported to the Board on safeguards implementation matters based on information from the Agency's own sources and in those cases where information provided by third parties has been considered such information has been examined by the Agency in accordance with its practices.¹⁵
- As part of the eligibility criteria the proposal for an IAEA LEU bank suggests granting access to the LEU to those Members States with respect to which no specific report relating to safeguards implementation is under consideration by the Board of Governors. It should be noted, however, that the Board of Governors has the authority to determine and approve the eligibility criteria that would govern the release of the IAEA LEU bank to any requesting Member State.¹⁶

¹⁵ See, Press Statement, *IAEA Safeguards Reporting Process*, 28 August 2009: <http://www.iaea.org/NewsCenter/MediaAdvisory/2009/MA200918.html>.

¹⁶ As noted in footnote 6 above, Article IX.J of the Statute inter alia provides that the "materials made available pursuant to this article shall be used as determined by the Board of Governors in accordance with the provisions of this Statute." And, as stated in footnote 2 above, the Board adopted resolution GOV/2009/81 to establish an LEU reserve as contained in document GOV/2009/76 – in which the Agreement between the Russian Federation and the IAEA in its Article I.2 defines the eligibility criteria.

Annex 1: Relevant Provisions of the IAEA Statute¹⁷

1. The original concept for the establishment of an international atomic energy organization foresaw the receipt, custody and supply of nuclear fuel and also the acquisition and establishment of facilities, plants and equipment for the enrichment or fabrication of nuclear fuel as some of the principal functions of such an organization and embodied these principles in the Statute of the Agency.
2. The provisions of the Statute are sufficiently broad to allow the Agency: to establish its own stock of nuclear fuel purchased from or donated by Member States for supply to another Member State against payment of charges determined by the Board of Governors; to facilitate the supply of nuclear fuel from one Member State to another; and also to facilitate, inter alia, enrichment and fuel fabrication services by one Member State to another or to the Agency:
 - a) Under Article III of the Statute, the Agency is authorized to perform any operation, including acquiring nuclear fuel, services and equipment and establishing its own facilities and plants, in order to facilitate the practical application of nuclear energy for peaceful purposes.
 - b) Article IX of the Statute provides for Members States to make nuclear fuel available to the Agency, in quantities and on conditions to be agreed with the Agency. If the fuel is actually made available to the Agency, it could be stored either by the Member State concerned or in Agency depots and has to be used as determined by the Board of Governors. Accordingly, the use of the material cannot be tied to a specific project at the request of the supplier State. In storing materials in its possession, the Agency shall not allow concentration of large amounts of such materials in any one country or region of the world.
 - c) Article IX.I, in particular, requires the Agency to establish or acquire, as may be necessary, equipment and facilities for the receipt, storage and issue of materials. In this case, the Agency would be responsible for storing and protecting these materials, including safeguarding them and applying the adequate health and safety measures.
 - d) Article X provides that Members States may make services, equipment and facilities available to the Agency. No conditions as in Article IX are attached. Article XIII, however, foresees that the supplier State has to be reimbursed for the items furnished.
 - e) In establishing an assurance of supply framework under the auspices of the Agency (e.g. nuclear fuel supplied by or through the Agency) the Board of Governors should establish it as a project in terms of Article XI. If the framework involves fuel made available to the Agency, the Board of Governors must also determine in accordance with Article IX.J how such fuel is to be used.
 - f) In terms of Article XI.E, a number of criteria are prescribed for the establishment of a project, which are in addition to those additional non-proliferation criteria that the Board of Governors may deem relevant. They relate to: the usefulness of the project; the adequacy of plans, funds and technical personnel to assure the effective execution of the project; the adequacy of the health and safety standards for handling and storing the materials and for operating facilities; the equitable distribution of materials and resources available to the Agency; the inability of the requesting State to secure the necessary finances, materials, facilities, equipment and services (in this case specifically the ability of the requesting State to

¹⁷ GOV/INF/2007/11, Annex 1.

secure supply of LEU from elsewhere) and the special need of the under-developed areas of the world. These criteria are applied routinely in respect of Agency projects and there seems to be no need to add or modify them.

g) According to Articles XIV.E and XIV.F of the Statute, charges for nuclear fuel, services, equipment and facilities furnished have to be levied on a scale such that the revenues for the Agency are adequate to meet the expenses and costs incurred. These charges shall be placed in a general fund for use as determined by the Board and the General Conference, which would allow the replenishment of the fuel reserve.

3. The project approach for the assurance of supply framework can best be dealt with by considering the whole framework of assurance of supply as one single project with each request for the release of material being one element thereunder.

Annex 2: The International Nuclear Fuel Market¹⁸

1. The production of nuclear fuel includes several steps: purchase of natural uranium as U_3O_8 ; conversion to UF_6 ; enrichment (except for heavy water reactors); reconversion to UO_2 ; and manufacturing of fuel elements ready to be inserted in the reactors. The product of each step, up to and including reconversion, is a commodity that is essentially the same irrespective of supplier and that is thus interchangeable. Fuel manufacturing is highly technology-specific and is specially adapted to each reactor.

2. Traditionally, utilities have been involved in purchasing directly each step in the production chain. There are thus separate markets for natural uranium, conversion, enrichment and fuel manufacturing. Only in a few cases does the utility buy just the finished product, i.e. the manufactured fuel elements, including their content of enriched uranium, as a single final product. To hedge against the disruption of deliveries in any of the market segments, utilities normally diversify their choice of suppliers, having two or more suppliers in each segment, when possible. In addition, the manufacturers tend to assist each other in the event of a disruption, in order to ensure the smooth functioning of the deliveries of fuel.

3. In 2008, uranium was produced in 19 different countries, although just seven countries (Australia, Canada, Kazakhstan, Russian Federation, Namibia, Niger and Uzbekistan) accounted for approximately 90% of the world production, with Australia, Canada and Kazakhstan together accounting for 60%. The total production in 2008 was 44 000 tonnes, which was about 65% of the requirement for civilian reactors. The remaining 35% was met by secondary sources including civilian and military stockpiles, reprocessed uranium, and re-enriched depleted uranium. There are some uncertainties related to the uranium market in the medium term, due to limited information on available secondary supplies and on new uranium production centres. In the longer term, the production is expected to match demand. Uranium reserves are not expected to be the limiting factor for new production. Increasing exploration is expected to increase reserves substantially and to increase the number of countries in which uranium can be mined. Market uncertainty, improved global prospects for nuclear energy and the lingering effects of low mining investments have, in the recent past, led to a substantial rise in spot market prices. Most of the uranium, however, is purchased under long term contracts.

4. The uranium enrichment market is dependent on the demand for uranium as a fuel for nuclear power reactors. Enrichment services are sold as separative work units (SWU). The annual demand is roughly 40 million SWU, while the total world capacity is approximately 53 million SWU. There are four principal enrichment suppliers in the world (Areva, Tenex, Urenco and USEC) with enrichment facilities in France, Germany, the Netherlands, the Russian Federation, the United Kingdom and the United States of America. While enrichment services are normally supplied with the customer providing the natural uranium feed material, the enricher in some cases provides the feed material. The uranium enrichment industry is closely monitored by national governments and international agencies

¹⁸ Annex 2 to document, *Possible new Framework for the Utilization of Nuclear Energy: Options for Assurance of Supply of Nuclear Fuel* (GOV/2007/11), 13 June 2007 – updated to 2008 figures.

as a means to control the use of enriched uranium and its technology. The relative market shares of the enrichment companies have traditionally been closely linked to the domestic nuclear power market. With the deregulation of the electricity sector in many countries, the utilities have become more sensitive to the costs of enrichment and the security of supply. This has created an increasingly commercial approach in the enrichment market. Although, as with uranium, a spot market exist for enrichment (and enriched uranium), more than 95% of the services are provided by primary suppliers selling directly to utilities under multi-year contracts (typically 10 years in length). Two types of contracts can be distinguished: “requirements” and “fixed commitments.” In the “requirements” contracts, which are the most common, customers take delivery according to their need. In the “fixed commitments” contracts, the annual quantities are fixed from the start. In addition, secondary supplies in the enrichment market exist from liquidation of national or utility stockpiles and from the disposal of surplus military high enriched uranium (HEU) that is down blended to enrichment levels suitable for power reactors. In particular, the latter has strongly affected the market since the mid-1990s as material corresponding to approximately 6 million SWU/year has been down blended from Russian and US weapons material. This will continue through 2013. There are several plans for new enrichment capacity at the existing facilities to replace old facilities and provide additional capacity to match increasing demands.

5. As enrichment is carried out on uranium in the form of a gas (UF_6), it is necessary first to convert U_3O_8 to UF_6 . There are five main conversion companies: Cameco (Canada); COMURHEX (France); Rosatom (Russian Federation); Springfields (UK); and ConverDyn (USA). Conversion facilities are connected either to the uranium producer or to the enrichment company. The world capacity for conversion matches the demand and could be adapted to increasing demands. Conversion is also needed after enrichment from UF_6 to the UO_2 powder used for fuel manufacturing. This may be carried out at enrichment facilities or, alternatively, the fuel manufacturer may have its own conversion capacity for this step.

6. Fuel assembly manufacturing is the last step in the chain. The fuel assembly to be inserted in the reactor is a highly technologically specific product with significant intellectual property rights invested in and attached to it. A fuel assembly is also adapted not only to the specific reactor, but to the specific characteristics of the reactor; its design takes into account the fuel assemblies that are already in the reactor and its operating history. Moreover, as the fuel assembly in itself is a very important safety-related component that provides the first barrier to release of radioactivity from a reactor, each fuel type requires extensive licensing.

7. Fuel assemblies from different suppliers are thus not easily interchangeable. Nevertheless, a change of fuel suppliers is a common procedure. Many utilities change suppliers at regular intervals (perhaps every 5 years) in order to maintain competition, thereby ensuring that the best technology development and price are achieved, and to increase their security of supply by maintaining several possible suppliers. A change of supplier is, however, connected with an extensive licensing effort, sometimes requiring the insertion of lead test assemblies. Such a changeover will typically take between 2 and 5 years, depending on the preparedness of both the utility and the supplier. These changes would also presuppose the market availability of several manufacturers for the particular type of fuel required. This is the case for most, but not all fuel types. The main fuel manufacturers are also the main suppliers of nuclear power plants or closely connected to them. The largest fuel manufacturing capacity can be found in France, Germany, the Russian Federation and the USA, but

fuel manufacturing is carried out in at least seven other countries, often under licence from one of the main suppliers.¹⁹

8. Because the different steps in producing nuclear fuel take place at different locations, there is a need for transport between them. Each transport step requires approval by the national authorities concerned, export licences and in many cases also prior approval by the uranium supplier country.

9. Any expansion of nuclear power will require an expansion of other fuel cycle activities, including possibly bringing on line additional uranium enrichment and fuel fabrication capacity. Furthermore, the availability of fuel for nuclear power plants depends on the viability and access to the international market in nuclear fuel. However, the degree of expansion at any particular step in the fuel cycle will depend on national policy choices, for example between open and closed fuel cycle options.

10. As fuel supply is essential for the countries and utilities involved, several actions are normally undertaken to provide increased assurance at each link in the chain and to hedge against disruptions. The most straightforward action is to ensure a diversity of suppliers, as much as economically and technically possible. Additionally, a good balance is generally sought between long term and spot market contracts. Other approaches include the building up of national or utility strategic stockpiles of enriched as well as natural uranium and ensuring that a certain amount of surplus fabricated fuel elements are available at reactor sites. Storage of natural or enriched uranium in licensed transport containers is reasonably straightforward. The high energy content of enriched uranium makes the necessary storage volumes relatively small. Some countries have built their own fuel manufacturing capacity, often based on licences from the main fuel suppliers, to ensure deliveries to the national utilities. The spare capacity of these facilities has also been made available on the international market to the extent allowed by the licence providers.

11. The application of different hedging mechanisms differs from country to country and from time to time. The build-up of national or utility strategic stockpiles was rather common from the early days of nuclear power until the 1980s. With the development of a more open and competitive market in the different segments, and with the lowering of prices for uranium and enrichment in the 1990s, the size of the strategic stockpiles has been reduced in many countries. This is also true for the amount of surplus fabricated fuel stored at reactors. With current concerns about medium term supplies of uranium there is again a tendency to increase the stockpiles.

¹⁹ As previously stated in footnote 10 above, for many of the currently operating BWRs and PWRs, alternative options for fuel fabrication already exist (Areva, GE-Hitachi and Westinghouse for BWRs and Areva, Mitsubishi and Westinghouse for PWRs, and Westinghouse for Russian VVER-440). Westinghouse is developing (technically developed but not licensed yet) the “Vvantage 6” fuel assembly for Russian designed VVER 1000 reactors and TVEL (Russian fuel fabricator) is developing (technically developed but also not licensed yet) the “TVS-Kvadrat” fuel assembly for Westinghouse and Areva designed reactors. Korea Nuclear Fuel is an emerging supplier of assemblies for several PWR designs. These developments indicate that already some industrial (technological) drivers exist for collaboration on fuel assemblies, which are being further developed (Vvantage, Kvadrat)