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Nuclear power in the Arab world & the regionalization of the nuclear fuel cycle: an Egyptian perspective

The International Atomic Energy Agency's (IAEA) *Nuclear Technology Review* 2009 reported that there were 10 nuclear power plant construction starts in 2008 in China, Russia, and South Korea.[1] It seems that current expansion, as well as near-term and long-term growth prospects, remains strong in Asia. In Europe, there is mounting interest in the United Kingdom, Italy, Bulgaria, Finland, Switzerland, and Slovakia. In the United States, the Nuclear Regulatory Commission (NRC) approved 10 nuclear power uprates totaling 2,178 megawatts thermal (MWth). In Canada, two power reactor units are planned for Darlington. In 2007 and 2008, the IAEA introduced a new service providing integrated advice to countries considering the introduction of nuclear power. During that same period, the IAEA undertook 10 missions, to Belarus, Egypt, Georgia, Nigeria, the Philippines, Sudan, Thailand, and to members of the Gulf Cooperation Council (three times), to offer such advice.

The introduction of nuclear power on such a scale – dubbed by some as a nuclear renaissance – may double in the near future, raising the question of how many elements of the nuclear fuel cycle a country would be involved in. Does every country need its own nuclear fuel cycle? Or would it be more economical, with minimal risks of proliferation and an effective verification system, to include more countries in the radius of fuel cycle control? I believe those were the reasons that prompted Mohamed ElBaradei, Director General of the IAEA, to propose the creation of a multinational or regional nuclear fuel cycle in his 2003 article in *The Economist*. ElBaradei was in fact reviving previous interests in the internationalization of the nuclear fuel cycle. In his article, he identified three areas of vital importance: how to guarantee the supply of fuel for nuclear-generated electricity; how to set up one or more international repositories for spent nuclear fuel; and how to bring about multilateral oversight to sensitive parts of the front-end of the nuclear fuel cycle.

Nuclear Technology Review 2009 also reported that a number of Arab countries are interested in the introduction of nuclear power. A quick tour d'horizon of the Arab world, from east to west, reveals some facts and developments concerning nuclear technology and its affiliations in this vast area of the world, which constitutes 10.2 percent of the entire globe.[2]

Mohamed I. Shaker on the global nuclear future

Oman is interested in desalination energy options, possibly including nuclear energy. IAEA Director General ElBaradei visited the country in 2007. Kuwait, the United Arab Emirates (UAE), and Yemen had no nuclear infrastructure or regulatory authority up until recently, other than an Atomic Energy Committee or Department. The UAE, in anticipation of its investment in nuclear power, has adhered to the Additional Protocol attached to its safeguards agreement with the IAEA and has indicated its disinterest in uranium enrichment as well. The law decree (No. 6, 2009) promulgated by the UAE head of state on October 4, 2009, regulates the peaceful uses of nuclear energy within the state and adopts the basic elements included in the "Document on the General Policy of the State of the UAE in Assessing the Possibility of Developing a Peaceful Nuclear Power Program in the State," which was issued in April 2008. Accordingly, the law prohibits the development, establishment, or operation of any reprocessing or enrichment facilities within the UAE.

The Kingdom of Saudi Arabia has, since 1978, conducted several feasibility studies on utilizing nuclear power to desalinate seawater. The Saudis are world leaders in seawater desalination, but all such facilities are powered by petroleum- and gas-generated electricity. Saudi Arabia's only known previous involvement in nuclear applications is limited to experiments to produce radio isotopes using a tandetron accelerator and a cyclotron. Saudi Arabia, a party to the Nuclear Non-Proliferation Treaty (NPT), signed an IAEA safeguards agreement called the Small Quantities Protocol, which is intended for states with little or no nuclear activity and allows the kingdom to opt out of regular, intrusive inspections in exchange for a state declaration. As with Oman, ElBaradei visited Saudi Arabia to discuss the kingdom's needs. If Saudi Arabia were to invest in nuclear power, the kingdom may be asked to negotiate a new, more substantive international safeguards agreement with the IAEA.

In the Levant, Jordan is seriously interested in nuclear power and has signed a number of nuclear cooperation agreements with potential suppliers. It is also investing in exploration for uranium and in its extraction from phosphates.

Syria participated in a 2002 – 2006 IAEA study on the economic competitiveness of nuclear desalination. The Syrian elemental nuclear program includes a Chinese-supplied miniature reactor and plans for a larger research reactor to be sourced from Russia. Syria and Russia have also concluded negotiations on the construction of a nuclear power reactor coupled with a seawater desalination plant. An Israeli air raid on Syrian territory in September 2007 was allegedly motivated by the existence of nuclear equipment and/or material in a Syrian location, a possibility which is still under thorough investigation by the IAEA.

One of Lebanon's scientists had, up until recently, been the Director General of the Arab Atomic Energy Agency since 2001. Dr. Mahmoud Nasserldin is French-educated with a Ph.D. in nuclear physics from Grenoble University. As of 2009, he was succeeded by a Tunisian scientist, Dr. Abduel Maguied Magoub.

As for Iraq, we need not reiterate here the destruction and dismantlement of its nuclear apparatus before the war was launched against it in 2003, as a result of the work done by the two UN Security Council Committees, UNSCOM and UNMOVIC, in accordance with UN Security Council Resolution 687 of 1991.

Egypt has two research reactors at Inshas, northeast of the Delta. One of the reactors was acquired from Russia

in 1961, and the other, commissioned in 1997, was acquired from Argentina. Both produce radioisotopes for medical, industrial, and agricultural use. To operate these reactors, Egypt imports low-enriched uranium (LEU) from which it produces reactor fuel at its own fuel fabrication plant. Egypt also has medical facilities, accelerators, and other nuclear-related laboratories, including a hot cell laboratory.

Egypt nearly chose to construct its first nuclear power plant 20 years ago, but failed to do so in the aftermath of the Chernobyl accident in the Ukraine in 1986. After Egypt's ratification of the NPT in 1981, it negotiated a number of cooperation agreements with leading supplier states to begin the implementation of an ambitious nuclear power program. The long duration of most of these agreements makes them still valid. The great number of cooperation agreements should allow Egypt to diversify its sources in supply and types of equipment. After more than 20 years, Egypt's nuclear power project is being relaunched in the context of contributing to the energy mix in Egypt, for reasons and factors similar to those in other countries.

Egypt's decision in 1980 to invest in nuclear power came before its great discoveries of gas, which brought great relief to the energy sector and, more particularly, to the country's electricity needs. Gas was responsible for the uplift of Egyptian industries and other domestic needs – partly why Egypt did not hasten to rekindle its interest in nuclear power.

Today, Egypt relies mainly on natural gas and oil for electricity generation. In 2005 – 2006, Egypt consumed 17.3 million tons of oil and 541 billion cubic feet of natural gas. Only 12 percent of Egypt's electricity is generated by hydro power. Wind energy, currently at 230 MW capacity, generates only 1 percent of Egypt's electric power. In 2010, wind energy is expected to generate 3 percent of Egypt's total electric power. As for solar energy, Egypt is about to establish its first solar energy plant of 150 MW.

If Egypt were to invest in a nuclear power plant, with a capacity of 1,000 MW, this would save 1.78 million tons of oil, or 69.9 billion cubic feet of natural gas, per year. Over a period of 60 years, which is the average life span of new nuclear power plants, the savings in oil are expected to reach 106 million tons of oil, or 4.2 trillion cubic feet of natural gas. This would save Egypt the equivalent of 210 million tons of carbon dioxide. It is noteworthy that reserves of oil and gas are expected to be exhausted in 15 and 34 years, respectively. New discoveries in both sources of energy could extend the reserves by a few extra years. The average increase in energy demand for electricity in the last 10 years was 7 percent yearly. During 2006, the total demand for electric power was 18,160 MW, out of a total electricity-generation capacity of 21,300 MW. These figures should indicate the type of studies and comparative analyses that were undertaken to determine whether it is justifiable to add nuclear power to Egypt's energy mix. I am confident that similar studies are being carried out in other Arab countries.

The prospects for reviving the nuclear power program in Egypt are now clear. On October 29, 2007, Egyptian President Mubarak decided that Egypt would go ahead with nuclear power. Egypt will have to face up to its future electric energy needs in light of the short life span of its oil and gas resources, as well as the limitations on its hydro power (unless in cooperation with African states in the south, riparian of the River Nile, it can

double its hydro power sources). Egypt is in the process of promulgating laws regulating nuclear power, its safety and its security. A consultant, from Australia Parthons, has been chosen to assist in all phases of the program, including the preparation of tenders.

Egypt's immediate neighbor to the west, Libya, dismantled and turned over its enrichment equipment to the United States in 2004, and it has signed the Additional Protocol to its safeguards agreement with the IAEA. It has a 10 MW research reactor at Tajoura that is being converted to run on LEU (formerly it used highly enriched uranium). In March 2006, Libya signed an agreement with France to develop civilian nuclear power. French President Sarkozy and his government, which took power in 2007, have confirmed that orientation.

In Tunisia, the possibility of using nuclear as an alternative energy source to counter its limited natural gas resources has been studied since the early 1990s. At that time, Tunisia conducted a site survey and participated in an IAEA region-wide feasibility study of the use of nuclear energy for desalination in the North African states. In 2002, Tunisia undertook a more intensive nuclear desalination feasibility study with the French Atomic Energy Commission for the Skhira site in the south of the country. The study concluded that as long as gas prices remain constant, the nuclear option would not be economical for Tunisia. Yet it also concluded that in the future the country would experience electricity shortages unless new natural gas reserves were found. Tunisia has no nuclear infrastructure other than a National Center for Science and Nuclear Technology and a National Center for Radioprotection.

Tunisia is the host of the Arab Atomic Energy Agency, an Arab scientific organization and one of the Arab League subsidiary organizations with an independent identity. The Agency is concerned with peaceful uses of nuclear energy, including development and technological applications. The main role of the organization is to coordinate Arab states in peaceful applications of the atom, and to assist in research activities, manpower development, and technical and scientific information. It seeks to set up unified regulations for radiological protection and safe handling of radioactive materials, and to coordinate scientific and technical activities with concerned regional and international organizations. It supports and protects the patents in the peaceful uses of atomic energy, encourages Arab scientists in the field of nuclear sciences and technologies, and assists them in attending relevant Arab conferences.[3]

Algeria has a Chinese 15 MW heavy-water research reactor at Al Oussera; the reactor went critical in 1998. Algeria also possesses an Argentinean 1 MW research reactor that began producing isotopes in 1989, and also has a small fuel fabrication plant and rich deposits of uranium ore. Algeria is a leading candidate for nuclear power in the Arab world.

Finally, Morocco had a long-standing interest in nuclear power for seawater desalination. In the late 1990s, it carried out a feasibility study for a Chinese-built 10 MW demonstration plant at Tan-Tan, with IAEA technical assistance and financial backing from the European Union (EU). Later, Morocco studied the economics of coupling nuclear reactors with desalination systems at Agadir and Laayounne. To provide the infrastructure to help implement the program, Morocco has a nuclear research center and a radiation protection authority. In late October 2006, Morocco hosted a 12-country conference to discuss the necessary steps

to implement the Global Initiative to Combat Nuclear Terrorism, which was sponsored in July of the same year by the United States and Russia at the G8 Summit in St. Petersburg, Russia. The number of supporters of that initiative has dramatically increased since the conference.

Apart from sponsoring a number of studies, the Arab Atomic Energy Agency has generally been dormant, and its impact has not been felt in the Arab world or outside of the region. However, the 2007 Arab Summit of Riyadh was a turning point and perhaps a new lease on life for the Agency. At the Summit, the Council of the League of Arab States decided to undertake joint cooperative activities for the development of peaceful uses of nuclear energy and related technology in the Arab world, including a practical program devoted to applications in various fields, especially energy, water, medicine, agriculture, and industry. The Council requested that the Secretary-General of the League of Arab States form groups of experts and specialists, with the participation of the Arab Atomic Energy Agency, to consider ways and means for such cooperation to take place within an integrated Arab framework.

In Riyadh, attendees adopted a previous resolution inviting Arab countries to use or expand the use of nuclear technology for peaceful purposes for all fields of sustainable development, with due consideration of the diversity of their needs and of the fact that they were strictly observing provisions of all international treaties, conventions, and regulations that they have signed. Among the executive steps to be taken, the Summit provided support to the Arab Atomic Energy Agency, as the organ for joint Arab action in this field, and called upon Arab countries that have not yet joined the Agency to do so without delay, for their own benefit as well as that of joint Arab action in this field. The Summit requested that the Agency develop an Arab strategy for mastering nuclear sciences and technology for peaceful purposes by 2020.

The Riyadh Declaration Decisions struck a balance between peaceful nuclear ambitions for the Arab world and reaffirmation of the importance of clearing all weapons of mass destruction (WMD) from the region. The decisions moved away from double standards and selectiveness and warned against launching a dangerous and devastating nuclear arms race in the area. It was decided at the Summit to suspend the work of the Technical Committee, established in 1994 at the initiative of Arab countries, on the preparation of a draft treaty to establish a WMD-free, and especially nuclear-weapon-free, zone in the Middle East. The committee was suspended so that Arab policies followed during past decades could be assessed in light of current international conditions.

Over the last 13 years, the Technical Committee of the League of Arab States had been drafting a treaty to establish a WMD-free zone in the Middle East. The Arab League found no reason to make the draft text available, as it had not yet been approved by the League and as other parties outside the framework in which the draft was negotiated had not been involved or approached. The suspension of the work of the Arab League Technical Committee reflects frustration on the part of the Arab states because of the lack of implementation of the Middle East Resolution. The Resolution came out of the 1995 NPT Review and Extension Conference, sponsored by the three NPT depositary governments (the United Kingdom, the

United States, and Russia), and was put forward in conjunction with efforts to seek consensus on a decision to extend the NPT indefinitely. It also conferred on the nuclear-weapons states, as sponsors of the resolution, the responsibility to achieve universal adherence to the NPT, including by Israel and other states not party to the Treaty, and to establish the Middle East as a nuclear-weapon-free and WMD-free zone.

The clear message of the Riyadh Summit was that the Arab states would rather develop their peaceful nuclear activities in a Middle East completely free of WMD and in conformity with all the relevant international instruments they have adhered to. There would be no stability or security in the region in the presence of any nuclear-weapons capability, whether from Israel or from an Iranian potential capability. The Riyadh spirit prevailed as well at the Doha Summit, held in Qatar in March 2009, and underlined the importance of Arab cooperation and coordination in the nuclear field.

Will the Riyadh Summit be the basis for ongoing joint Arab action in the field of peaceful uses of nuclear energy? Will the success of the Summit give a boost to the Arab Atomic Energy Agency and lead to a regional or an Arab nuclear fuel cycle, fostering greater coordination and cooperation and, at the same time, ensuring regional control that could be effectively verified internationally?

Based on the tour d'horizon provided above, it is clear that Arab states would have the expertise, uranium ore deposits, research reactors, fuel fabrication skills on a small scale, accelerators, and other nuclear-related laboratories, including hot cell laboratories, necessary to develop an Arab nuclear fuel cycle. However, within the present international context and in light of policies imposed by the Nuclear Suppliers Group (NSG), Arab states, individually or collectively, would face difficulties in investing in and importing the so-called sensitive technologies: uranium enrichment and fuel reprocessing technologies. Iraq and Libya had dramatic experiences with regard to those technologies. The vehement opposition we are currently witnessing against the Iranian enrichment program is another signal that an Arab enrichment plant would not be tolerated, regardless of its location, even though enrichment is not prohibited under the NPT, and a number of non-nuclear-weapons states that are party to the NPT are investing in enrichment, including Germany, The Netherlands, Brazil, and more recently, Japan. How can the Arab states get around this dilemma in such an atmosphere? We must consider the possibilities in light of an IAEA expert group's 2005 report on multinational approaches to the nuclear fuel cycle.[4]

The regionalization of the nuclear fuel cycle raises a number of basic questions.[5]

Gradual buildup of a nuclear fuel cycle. The internationalization of the nuclear fuel cycle can only proceed in phases. Success achieved in the first phases may be an incentive to involve other stages and more actors. The IAEA, including the expert group mentioned above, tends to focus on the so-called sensitive parts of the nuclear fuel cycle – namely, uranium enrichment, reprocessing of spent fuel, and spent fuel disposal and storage. These are definitely important stages in the nuclear fuel cycle from the point of view of nonproliferation and supply, but other stages could be of great interest to a number of countries, such as uranium ore supply, fuel fabrication, and even supply of spare parts to nuclear power plants. Other stages could also

be included in a multilateral arrangement. At any rate, buildup of a regional nuclear fuel cycle in the Arab region could be expected to be slow and gradual. Restructuring the Arab Atomic Energy Agency to promote cooperation and coordination is expected to take a longer time.

The need for a supply mechanism. A supply mechanism is needed to address:

- The possible consequences of interruptions to nuclear fuel supply for political reasons; the risk of interruptions might dissuade countries from initiating or expanding nuclear power programs; and
- The vulnerabilities that create incentives for building new national enrichment and reprocessing capabilities.

A mechanism to assure the supply of nuclear fuel would be envisaged solely as a backup measure to the operation of the commercial market; states would make use of the mechanism only when supply was interrupted for political reasons. It would neither be a substitute for the existing commercial market in nuclear fuels nor would it deal with disruption of supply due to commercial, technical, or other nonpolitical reasons. If such a mechanism operated reliably, Arab countries might be relieved from looking for other alternatives (which I will say more about later). Could a renewed and bolstered Arab Atomic Energy Agency be entrusted with such a task?

The material to be assured. Existing proposals deal with supply assurance in different, complementary ways. Some proposals focus on assuring supply of natural uranium and LEU stocks, and still others focus on assurance of supply of nuclear fuel itself.[6] It has been asserted that there is also a complementary need for greater transparency in uranium markets, and that assured access to a broader range of nuclear reactor technology would be important to operators and countries seeking to reduce the risk of supply interruptions on political grounds. A number of Arab countries have made small-scale developments in fuel fabrication technologies (for example, Egypt and Algeria), and they may be more interested in assuring the supply of enriched uranium.

Modalities of assurance's mechanism. The possible modalities could include a virtual reserve of natural uranium and LEU based on binding contractual agreements for supply of such materials, plus parallel binding commitments/assurances of fuel fabrication services. A virtual reserve does not involve separate physical storage of natural uranium or LEU, but instead relies on availability from suppliers that have agreed to be part of the fuel assurance mechanism.

While an actual (physical) bank of natural uranium or LEU could be established, it was found impractical, for technical and economic reasons, to have an actual bank of nuclear fuel assemblies, given the different types of reactor designs and many variants of nuclear fuel required for them. A virtual reserve of Arab fabricated fuel would face the same problem, presupposing heavier investment in fuel fabrication by those Arab countries presently knowledgeable about this technology.

Conditions governing eligibility for benefiting from assurance mechanisms. Committing to nonproliferation would be considered a qualifying criterion. However, in accordance with the IAEA statute, an assurance mechanism would be available to all member states in a nondiscriminatory manner. For any mechanism, whether or not it involves a role for the IAEA, certain release criteria

would need to be defined and agreed upon, either by the IAEA Board of Governors or a supply consortium. Another aspect requiring further assessment is how best to ensure that the application of the release mechanism is demonstrably nonpolitical and based upon objective criteria.

If an Arab nuclear fuel cycle were to be established, it would also have to abide by IAEA standards of nondiscrimination as well as by nonproliferation criteria. An important issue here is the acceptability within the Arab world of the Additional Protocol to be attached to the safeguards agreement between the IAEA and the Arab states. Some have accepted the Protocol, including Libya and the UAE. Others have not done so yet, including Egypt. An Arab nuclear fuel cycle should aim for harmony on this matter.

Possible role(s) for the IAEA. Existing proposals envisage different roles for the IAEA, and there are still others that can be considered. The suggested roles range from IAEA administration or ownership of natural uranium or LEU stocks to administration of virtual stocks and associated parallel fuel fabrication commitments. The IAEA statute is sufficiently broad to allow the Agency to establish its own stocks of nuclear fuel purchased from, or donated by, member states for supply to another member state against charges determined by the IAEA Board; to facilitate the supply of nuclear fuel from one member state to another; and to facilitate, *inter alia*, the provision of enrichment and fuel fabrication services by one member state to another or to the IAEA. In this respect, a number of legal arrangements would be required, especially if the IAEA were to establish an actual bank of nuclear fuel.

The UN High-Level Panel on Threats, Challenges and Change, established by former UN Secretary-General Kofi Annan, produced the 2004 report *A More Secure World: Our Shared Responsibility*,[7] in which they urged that:

> Negotiations be engaged without delay and carried forward to an early conclusion on an arrangement, based on the existing provisions of Article III and IX of the IAEA Statute which would enable IAEA to act as a guarantor for the supply of fissile material to civilian nuclear users. Such an arrangement would need to put the Agency in a position to meet, through supplies it authorized, demands for nuclear fuel supply of low enriched uranium and for reprocessing of spent fuel at market rates and to provide a guarantee of uninterrupted supply of these services, as long as there was no breach of safeguards or inspection procedures at the facilities in question.

Privileging the IAEA as a guarantor of supply is due to the fact that the Agency's membership is much broader than that of the commercial consortium. Furthermore, the IAEA's track record, reputation, credibility, and relevant experience justify this reaction. However, one must take into consideration that those with permanent or semi-permanent seats on the Board of Governors are the most advanced countries in nuclear energy and also are the major supplier countries. They are also parties to the export control regimes that might not necessarily be favorable toward certain potential recipient states. In this case, the solution might be to democratize the export control regimes, especially the NSG. By offering universal admission to the regimes, suppliers and users could consult about guidelines that would be adopted for the export of nuclear equipment and material. At present, these guidelines are usually adopted without consultation with the user states. We must not assume that

seeking consultation would suffice as a remedy; a new democratic setup is badly needed.

The NSG practices and the domination of the IAEA Board by supplier countries may invite Arab countries to ponder whether their Arab Atomic Energy Agency could play the role of a guarantor of fuel supply in a regional context. Again, let us reiterate that the Agency would have to be restructured to play such a role.

The role of the nuclear industry. Consultations with the nuclear industry would be useful, particularly with the understanding that the nuclear industry would provide the required goods and services to support a supply assurance mechanism that does not have negative effects on the diversity and stability of the existing commercial market in nuclear fuels.

Other related issues. These issues pertain to how an assurance mechanism can be structured in a manner that would not result in a division – whether real or perceived – between nuclear fuel and nuclear reactor technology haves and have-nots. Also necessary is a structure that does not undermine existing multilateral, treaty-based nuclear nonproliferation norms of state sovereignty and rights. In this respect, it is important to reread Article IV of the NPT, which has encouraged parties to the Treaty to engage fully in cooperation on peaceful uses of nuclear energy. The Riyadh declaration and decisions are very much in line with the letter and spirit of Article IV of the NPT. Arab participants in a regional nuclear cycle would be equal partners sharing decisions together.

Aside from the basic questions raised by the possibility of a regional nuclear fuel cycle, there are also questions related specifically to the so-called sensitive technologies.

Uranium enrichment. In its 2005 report, the IAEA expert group noted that suppliers could provide additional supply assurances. Also, an international consortium of governments could step in to guarantee access to enrichment services, with suppliers simply being executive agents. This arrangement would be a kind of intergovernmental fuel bank.

There are also variations of the preceding option, including with the IAEA acting as the anchor of the arrangement. The IAEA would function as a kind of guarantor of supply to states in good standing, as described earlier. The IAEA might either hold title to the material supplied or, more likely, act as facilitator, with backup agreements between the Agency and supplier countries. In effect, the IAEA would establish a default mechanism only to be activated in instances when a normal supply contract had been broken down for reasons other than commercial.

As to multilateral nuclear arrangements that would take the form of a joint facility, the IAEA expert group pointed to the existence of two ready-made precedents, the Anglo-Dutch-German company Urenco and the French company EURODIF. The experience of Urenco, with its commercial-industrial management on the one hand and the governmental joint committee on the other, shows that the multinational or international concept can be made to work successfully. EURODIF has a successful multinational record as well. By enriching uranium only in France, instead of in three countries, as is the case with Urenco, EURODIF provides enriched uranium to its co-financing international partners, thus restricting all proliferation risks, diversion, clandestine parallel programs, breakout, and the spread of technology. Unlike

Urenco, EURODIF is known to have never been a manufacturer of enrichment equipment.

Is there any possibility of enlarging the two entities to accommodate more partners in the future and to make them more international than they are today in terms of financial contributions, management, or decision-making? Admitting Iran as a partner in EURODIF indicates that there was open-mindedness to the idea of accepting countries from other continents as partners. Can Arab countries benefit from this precedent, especially given that their regional nuclear fuel cycle would, in the present international context, most probably bypass enrichment, as earlier indicated? Bypassing enrichment, however, should not be construed as giving up the right to that activity, a right spelled out in the NPT.

There are national facilities for enriching uranium in other parts of the world, such as Japan and Brazil, and here, too, we can foresee that such national uranium enrichment facilities could one day be converted to multinational facilities providing services to regional neighbors and maybe beyond. By taking such steps, we would further internationalize essential parts of the nuclear fuel cycle. Also, Russian, German, American, and other offers to make enriched uranium available are of no less importance.

Reprocessing of nuclear spent fuel. The IAEA expert group noted that the present capabilities for reprocessing spent fuel from existing light water reactors and those currently under construction are sufficient for expected global demands in plutonium-recycled fuel during the coming two decades. Therefore, the expert group concluded that the objectives of supply assurances can be fulfilled to a large extent without new reprocessing facilities involving ownership. Currently, all reprocessing plants are, in essence, state-owned. An IAEA-broker arrangement could mean IAEA participation in the supervision of an international consortium for reprocessing services.

In the view of the IAEA expert group, converting a national facility to international ownership and management would involve the creation of a new international entity that would operate as a new competitor in the reprocessing market. An international entity would have the advantage of bringing together international expertise, but at the same time, it would include a nonproliferation disadvantage related to dissemination of know-how and to the return of the separated plutonium. Also, of the existing reprocessing facilities, all except two facilities (in Japan) are in nuclear-weapons states or in non-NPT states. In cases of conversion to international entities, appropriate safeguards would have to be introduced if they have not already been applied.

Because an Arab nuclear fuel cycle, in the present international context, is expected to bypass reprocessing (but without permanently giving up that right), it will have to rely on existing national facilities or converted international entities. The Arab countries may find in Japan (a heavy oil importer) a reliable partner.

The IAEA expert group believes that new joint facilities will not be needed for a long time, mainly because of the sufficient global reprocessing capacity.

Spent fuel disposal and storage. At present, there is no international mechanism for spent fuel disposal services; all undertakings are strictly national. The final disposal of spent fuel is thus a candidate for international approaches. The IAEA is encouraged to continue its effort in that direction.

Storage facilities for spent fuel are either in operation or being built in several countries. There is not yet an international market for services in this area, except for the readiness of the Russian Federation to receive Russian-supplied fuel and, possibly, other spent fuel. The storage of spent fuel is also a candidate for multilateral approaches, primarily at the regional level. Here, too, the IAEA is encouraged to continue investigation in that field.

Many political and public-acceptance issues will arise in connection with the import of nuclear materials to an existing repository. Public acceptance is already of crucial importance for setting up national repositories; it will be of even greater importance for multinational repository projects with nuclear waste and spent fuel coming from several countries.

The issue is of great sensitivity. Egypt had the experience of utterly rejecting an offer from Austria to send the waste from its aborted single reactor built outside Vienna. There was uproar in the Egyptian People's Assembly (Parliament) for even contemplating such a proposition. In light of that experience, it is highly unlikely that most Arab countries would host a multinational repository on their soil, unless they can identify a volunteer that could overcome internal difficulties or that guarantees public acceptance.

The internationalization of the nuclear fuel cycle is not a myth. As this paper indicates, internationalization in different forms can take place if political will exists, under conditions of nonproliferation and smooth cooperation. It can only be a gradual process in terms of both participants and the different stages of the nuclear fuel cycle, especially with regard to the so-called sensitive stages of the cycle: enrichment, reprocessing, and the disposal and storage of spent fuel. Most of the initiatives and proposals put forward are concerned with the supply mechanism. None has dwelt on the merits of a multinational or regional nuclear fuel cycle as suggested by the IAEA Director General. I have tried in this paper to advance a few ideas about a potential regional nuclear fuel cycle in the Arab region. The IAEA is well placed to encourage and to be involved in such an international endeavor. A first step to reduce the influence of the nuclear supplier states and their group would be to open up the group to the user states, to encourage ongoing dialogue for the benefit of both categories of states. This dialogue is missing now, and user states are often confronted with decisions made in their absence and without taking into consideration their essential needs and concerns. This new partnership should be institutionalized in a way that would guarantee new voices in the decision-making or in formulating guidelines for the export of nuclear materials and equipment.

The above situation may even lead to the formation of regional nuclear fuel cycles that would challenge the dominance of the NSG and would call into question the existence of the group in its present format. Following the Riyadh Summit, are we going to witness in the foreseeable future the emergence in the Arab region of an Arab Euratom, which could be a prelude to an Arab Union following the path that Europe has traveled since 1957?

As a first step, the Arab Atomic Energy Agency should be strengthened and restructured to play a pivotal role. The experiences of the Tlatelolco Treaty in Latin America and the Caribbean and the Argentine-Brazilian Agency for Accounting and Control of Nu-

clear Materials (ABAAC) should be instructive.

The most important element is that we must reach a stage where no supplier country alone can hamper or interrupt, for political reasons, a cooperative venture in the field of peaceful uses of nuclear energy. Our objective should be to protect the user states that have lived up to their international commitments and obligations and to allow them to continue unhindered in their peaceful nuclear activities.

Every individual state participating in an international or regional nuclear fuel cycle should feel that it has a say in the operation or the running of such an enterprise. This participatory aspect is just as important as the guarantee of supply.

Finally, and to sum up, regionalization or "Arabization" of the nuclear fuel cycle would have the following advantages:

- Economies of scale;
- Better guarantees of effective international control by the IAEA;
- Strengthened nonproliferation norms, because each party to the cycle would be checking on the others; and
- In the long run, better bridges between the developed and the less-developed countries in nuclear technology, thus maximizing equality among participants as much as possible and encouraging joint decision-making.

Closer Arab cooperation and coordination in the nuclear field could be the prelude to a sort of Arab Union. In Europe, the establishment of Euratom and the Steel and Coal Union led to the Common Market, the European Community, and, finally, the EU. We have much to learn from the European experience, which is a vivid example of how it is possible for our dreams to come true.

ENDNOTES

[1] IAEA Document Gov/2009/3, January 19, 2009.

[2] The following is based on a variety of sources, including Strategic Comments from the International Institute for Strategic Studies (IISS) (London, December 2006; http//www.iiss.org/index), with additions and comments by the author, especially with regard to Egypt.

[3] For more information, see http://www.aaea.org.tn.

[4] IAEA Document INFCIRC/1640, February 22, 2005. This part of the essay is based, after revisions and updates, on a previous article by the author entitled "The Internationalization of the Nuclear Fuel Cycle: An Arab Perspective" in the United Nations Institute for Disarmament Research's (UNIDIR) *Disarmament Forum*, issue two (2008).

[5] The following is based largely on Tariq Rauf's unpublished paper "New Framework for the Utilization of Nuclear Energy in the 21st Century: Assurances of Supply and Non-Proliferation."

[6] For existing proposals, see Yuri Yudin, "Multilateralization of the Nuclear Fuel Cycle: Assessing the Existing Proposals" (New York and Geneva, Switzerland: UNIDIR, 2009), 4.

[7] UN Document A/59/565, December 2, 2004.