IRAN'S MISSILE AND NUCLEAR CHALLENGE: A CONUNDRUM FOR RUSSIA

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The news of a uranium enrichment plant in Iran, which arrived in September 2002, has not only elicited the serious concern of the United States and Israel, but also came as an unpleasant surprise for Russia. IAEA Director-General Mohamed ElBaradei's visit to Iran in February 2003 confirmed the considerable progress Iran has made in constructing a centrifuge uranium enrichment plant. It has become obvious that Iran has moved considerably further in the development of nuclear power engineering than was thought earlier. If just one year ago Iran's nuclear fuel cycle seemed more virtual than real, given that nearly all stages in the cycle were absent, the information of recent months has made clear that it now has developed into a coherent whole.

The findings of this study, based on Iranian, American and Russian sources, do not claim to be completely accurate. However, they make it possible to gain some insight into the degree to which Iranian nuclear physics knowledge has progressed, the time required for the country to acquire the materials and technologies needed to create nuclear weapons, as well as the danger this may present for Russia. The paper also contains recommendations on how Russian policy towards Iran should be formulated in the given circumstances.

The Iranian Nuclear Fuel Cycle

Uranium Mines

Iran's first uranium mines were opened in 1985, in Yazd province.[1] Previously, it was thought that they covered an area of some 100-150 km^2, and contained reserves of approximately 5,000 tons (t) of low grade ore, with a grade of just 0.1% uranium.

Data from the Atomic Energy Organization of Iran (AEOI) that has recently become available indicate that uranium reserves are considerably smaller than estimated earlier, and total about 850 t, while the ore on average contains just 0.05% uranium (that is, 100 kg of ore yield just 50 g of uranium – the rest is dirt). According to estimates made by the IAEA in 2002, there are about 500 t of proved ore reserves, and about 900 more tons of probable reserves (with regard to which only rough estimates have been carried out).

At present, according to the AEOI, work is being conducted at two uranium deposits. The first is estimated to have some 785 t of uranium reserves, while the second has reserves of about 70 t. The first deposit occurs at a depth of 300-400 m. This, together with its low uranium content, will affect the cost of nuclear power plant fuel production. The IAEA estimates that this cost will be unacceptably high, exceeding current world prices by some three to five times. The cost of nuclear fuel from uranium mined at the second site, despite the relatively shallow depth of the deposit, will not be less expensive, given the miniscule quantity of reserves by the standards of nuclear power engineering. If Iran decides to use these proved uranium reserves for a nuclear power plant (NPP), one operating WWER-1000 reactor will completely use up the reserves in just six years.

At various times specialists from Argentina, Germany, Czechoslovakia, Hungary, and Russia have been employed in the investigation of Iran's uranium deposits. The greatest contribution was made by Chinese specialists, who were part of a joint working group in the early 1990s consisting of 600 Iranian and Chinese specialists working on rotation. At present there are 23 Iranian experts and 77 engineers and laborers doing preparatory work at the deposits. Before industrial exploitation of the mines begins, plans call for increasing the number of personnel to 233.[2]

Uranium Ore Processing Plant

Large-scale studies of the process whereby ore is separated from dirt (mechanical processing) were begun soon after the end of Iran-Iraq war. In 1989 Iran announced the signing of a contract worth $18 million with Argentina for the construction of a whole series of structures near the uranium deposits, including a plant for processing uranium ore. However, under pressure from the United States, the contract was voided three years later. In the mid-1990s, Russia prepared technical designs for the construction of a plant with the capacity to process 100-200 t of ore per year. However, the project was never realized. According to available data, after that date Chinese specialists assisted in the creation of an ore processing plant near the city of Ardakan; it is scheduled to be put into operation in 2005.

Taking into account the volume of uranium reserves (about 850 t), and also the AEOI estimate that after the mines begin industrial operation in 2005 it will take 17 years to exhaust their resources,[3] it is possible to conclude that, most likely, the planned ore processing plant is designed to obtain 50 t of natural uranium per year, while the preparation of fuel for one WWER-1000 reactor requires three times more.

"Yellowcake" Production Plant

In 1992 a pilot milling plant for the production of uranium concentrate ("yellowcake") was built at Saghand University's Hydrometallurgical Research Center, located in Yazd province, where the uranium deposits are found. The purpose of the pilot plant was the determination of the optimum parameters and technical characteristics for an industrial-scale yellowcake production plant. In 1995, according to AEOI information, the plant was reconstructed and considerably extended with the aid of a Russian institute. Simultaneously, a design for an industrial plant was developed. According to a February 2003 statement by Ali Akbar Salehi, Iran's representative to the IAEA, the yellowcake production plant located in Yazd province, not far from the uranium mines near the city of Ardakan, is ready.[4]

Uranium Conversion Plant

During the course of IAEA inspections in November 1996 at the Isfahan Nuclear Research Center, Iran informed the Agency of plans to construct a uranium conversion plant at the Center. The plans called for Chinese specialists to provide a facility for the conversion of uranium oxide (U_3O_8) into uranium hexafluoride (UF_6), which is a gaseous substance used in centrifuge enrichment. A year later the transaction was cancelled by the Chinese under pressure from the United States. In a letter to U.S. Secretary of State Madeleine Albright on 30 October 1997, China's Minister of Foreign Affairs Qian Qichen promised to end plant construction. However, technical documentation on the plant, including a blueprint, was probably transmitted to Iran, allowing Iranian specialists to independently finish building the facility. Later, in 1998, the two countries conducted negotiations regarding the delivery of hydrofluoric acid (HF), which is used in uranium conversion, to the Isfahan Nuclear Research Center.

According to a statement by Iranian vice president and AEOI head Gholamreza Aghazadeh, the plant was to begin operation in the summer of 2003. The commissioning of the plant opens a direct route for Iran to enrich uranium. Plans call for the latter to occur at a plant in Natanz (located in central Iran, 40 km from Kashan and 150 km from Isfahan).

Uranium Enrichment Plant

Iran's interest in centrifuge enrichment first became known in 1995, when Iran requested that the possible delivery of enrichment technology to Iran be added to the protocol of negotiations between Russian Minister of Atomic Energy Viktor N. Mikhailov and AEOI head Reza Amrollahi. Obviously, at the time Iranian specialists did this they were guided by the Russian-Chinese agreement on the construction of a centrifuge enrichment plant, signed three years earlier. After the Russian minister's return from Iran, Moscow made the unconditional decision to halt discussions on the centrifuge issue and conduct no further negotiations with Iran on the subject. At the same time, it cannot be excluded that Chinese specialists transmitted technical information on the Russian centrifuges, which began to operate in China in 1996. Other information suggests that the development of gaseous centrifuge technology in Iran was accomplished with the assistance of Pakistani specialists in the first half of the 1990s, and the aid of North Korean specialists during the second half of the decade.[5] In the latter case engineering may have been conducted in North Korea with the participation of Iranian specialists, and using Iranian funds. The two countries used this method for work on missiles. Iran financed the design of a new, modified version of the *Scud-B* missile in North Korea on the condition that a significant number would be delivered to it.[6] The fact that information about the presence of centrifuge enrichment programs in North Korea and Iran appeared at approximately the same time – in October and December 2002, respectively – is quite suggestive.

According to IAEA Director-General Mohamed ElBaradei, who visited the uranium enrichment plant under construction in Natanz, the pilot centrifuge enrichment plant is nearly ready for operation.[7] At that time, according to the IAEA inspectors' data, about 160 centrifuges were operational and there were components for another 1,000. In all, according to press releases, 5,000 centrifuges are planned for the facility by 2005.[8] At the same time, according to some estimates, the production of enough nuclear fuel for seven 1,000-megawatt (MW) power units[9] requires ten times more;[10] that is, the planned number of centrifuges will not be enough for the operation of even one Russian WWER reactor.

During the course of a year, these 5,000 centrifuges will presumably be able to produce enough highly enriched uranium for not more than two nuclear explosive devices, which, given the United States' "close attention to the site" and the fact that the plant will be put under IAEA safeguards, makes its use for these purposes unlikely, since a shift of half of the facility's capacity from peaceful to military purposes under the circumstances is improbable. According to experts, one could conceal on average up to 1% of the nuclear material under IAEA monitoring under the terms of the safeguards agreement based on INFCIRC/153, [11] from which it follows that the possibility of concealing from international inspectors nuclear materials of sufficient volume to create one explosive device would require the presence of 250,000 centrifuges, while the Natanz complex is large enough for about 50,000 centrifuges.

Iran's centrifuges most likely are built out of aluminum alloy. It is possible that a Russian consignment of this high-strength material, which was sent in the beginning of 2001 for aircraft production, was used for the centrifuges. The production of aluminum centrifuges is quite simple, but they are the least productive in the industry. More advanced centrifuges are made from titanium alloys or alloyed steel, while the most recent (sixth) generation of centrifuges are made of fiberglass reinforced with graphite threads. An examination of Iran's sources of materials for centrifuge construction should also mention the March 1998 detention on the Azerbaijani-Iranian border of a consignment of 22 tons of alloyed steel, which certain persons were attempting to illegally export to Iran. The steel had come from Russia and was transiting Azerbaijan on the way to Iran.

The enrichment plant, which is being actively built in Natanz, is apparently supposed to become an industrial-scale uranium enrichment facility. The plant under construction is partially underground and has, according to media reports, 2-3 meter thick walls, which Iranian specialists believe should be able to protect it in the event of a preventive strike.

Fuel Fabrication Plant

At present there are a series of laboratories for the study and production of nuclear fuel at the Isfahan Nuclear Research Center. One of them, according to the AEOI, is producing experimental fuel for WWER reactors.[12] According to the same source, the construction of an industrial-scale fuel fabrication facility is already planned. There is no reliable information about the location or stage of construction; however, the facility will probably be located near Isfahan.

Fuel Element Cladding Production Plant

In the mid-1990s, China promised to build a plant to make zirconium pipes in Isfahan. These pipes are used to fabricate cladding to encase nuclear fuel rods. When China promised the United States that it would cease cooperation with Iran in the missile and nuclear spheres, it said its specialists nevertheless would complete construction of the zirconium production facility in Isfahan.[13] The plant was originally scheduled to be finished by the end of 1999. However, as of May 2003 construction was continuing, but was close to completion.[14]

Even the most preliminary survey of nuclear fuel cycle facilities completed or under construction in Iran indicates that the nation has made considerable progress in the creation of a complete nuclear fuel cycle. According to current estimates, if all of the planned facilities (see Table 1) are brought into industrial use Iran will be able independently to produce NPP fuel by 2005. At present the only aspect of the closed fuel cycle about which there is no information concerns the location where a spent nuclear fuel (SNF) reprocessing facility might be constructed.

TABLE 1. *Iran's Nuclear Fuel Cycle Enterprises*

Facility	Location	Stage
Uranium mines	Ardakan, 200 km from Isfahan	Bore-hole drilling has begun. The beginning of operations is planned for 2005
Ore processing plant	Ardakan	May begin operation in 2005
Yellowcake production plant	Ardakan	Ready for operation
Uranium conversion plant	Isfahan	The beginning of operations is planned for summer 2003.
Uranium enrichment plant	Natanz, 150 km from Isfahan	A pilot cascade may begin operations in the near future.
Fuel fabrication plant	Isfahan (presumably)	There is no information on this facility. However, a research laboratory in Isfahan is already producing experimental fuel.
Fuel element cladding production plant	Isfahan	Plant construction is nearing completion.

There are, however, a large number of contradictions between the technical characteristics of the nuclear facilities that have been constructed, or the construction of which is nearly complete, and the declared goals of Iran's nuclear energy development program.

1. *When brought into operation, the uranium mines and ore processing plant will only be able to provide one third of the uranium needed for a WWER-1000 reactor.*

2. *If the problem of insufficient ore processing capacity is solved and Iran decides to use its own uranium ore for NPP fuel, one WWER-1000 reactor will use up proved uranium reserves in six years.*

3. *The planned capacity of the gas centrifuge uranium enrichment plant is not enough to produce fuel for even one WWER reactor.*

Thus, the productivity of the facilities under construction are not only incapable of satisfying Iran's demands for nuclear fuel in the long term (plans call for the construction of seven 1,000 MW reactors by 2021), but even in the short term, when a single WWER-1000 reactor will come online at Bushehr. This raises a question regarding the aims of creating these nuclear fuel cycle facilities if they are not going to be used for energy production, and the nuclear fuel that they create costs some three to five times more than the average world price. Another question concerns the justification for a heavy water production plant, now under construction in Arak, since Iran only has one research reactor, located at the Isfahan Nuclear Research Center, that uses heavy water, and very little at that. The construction of Canadian CANDU reactors in Iran in the near future is very unlikely, despite Iran's interest in them.

It is well known that for two decades Iran has been trying to acquire a heavy water reactor, and that this is the type of reactor most suitable for the production of weapons-grade plutonium. In the mid-1980s, the construction of a 10 MW heavy water-moderated Indian research reactor was considered. In the early 1990s, Iran acquired a heavy-water reactor from China of near-zero capacity, which was not suitable for plutonium production, but which made it possible to simulate the operation of a large-scale heavy-water reactor. In the second half of the 1990s, AEOI conducted negotiations regarding the purchase of a heavy-water research reactor (according to some sources, a 40 MW reactor) from Russia. Iran's original argument for the construction of this type of reactor, that Iran was not interested in the development or purchase of enrichment technologies and therefore wished to purchase a heavy-water reactor, cannot be taken seriously given the on-going construction of an enrichment plant at Natanz.

There are several possible explanations for this sort of contradiction between Iran's stated nuclear power development aims and the facilities currently under construction.

The first is that Iran does not plan to create a large-scale closed nuclear fuel cycle, which would ensure the self-sufficiency of the country through the operation of seven 7,000 MW nuclear power reactors. In this case the active development of the nuclear industry aims at the acquisition of technology and high-technology equipment without the creation of industrial-scale uranium production, uranium conversion, and the fabrication of nuclear fuel for NPPs.

The renunciation of industrial nuclear plant construction, particularly of facilities of proliferation concern like a uranium enrichment plant, could be an attractive bargaining chip, primarily with the United States, on the "North Korean model." Repayment for the renunciation of an enrichment complex could consist of removing the one-sided American sanctions against Iran, developing valuable trade and economic cooperation, including large investments in the Iranian economy, and providing Iran access to peaceful nuclear technology. By imitating the creation of a closed nuclear fuel cycle, the present government of reformers is simultaneously pursuing domestic political goals. Given the current fragile balance between moderate and hard-line forces in the country, moderate Iranian leaders may be able to use successes in this high-tech branch to strengthen their position among the population at large. It is no accident that the main Iranian reformer, President Mohammad Khatami, announced the results achieved in the nuclear sphere on the anniversary of the Islamic revolution. Minatom estimates favor this last explanation. In the words of Deputy Minister of Atomic Energy Valery Govorukhin, the Iranian statement regarding the beginning of uranium deposit exploitation "is, most likely, political in nature, since it cannot be reinforced by the country's technological and financial capabilities."[15] At the same time, the goal of increasing the country's status in the region can be pursued.

The second explanation is that the country is developing nuclear technologies in order to acquire the technical capabilities to build nuclear weapons. If this is the case, Iran could go quite far without violating its international obligations. In particular, Iran has the right to produce highly enriched uranium and generate, separate and store weapons-grade plutonium under IAEA supervision. In this scenario, Iran would be able to obtain the technical and material ability to build a nuclear weapon just several months after having accumulated sufficient quantities of weapons-grade nuclear materials. The political decision to use the accumulated reserves of nuclear materials for the creation of a nuclear weapon might be made if Iranian-American relations worsen further and the United States prepares for an operation to overthrow the current regime in Iran, or as a result of the U.S. or Israeli bombing of Iranian nuclear facilities; that is, if scenarios that the present U.S. administration has not excluded are realized.

The fact that Iran's nuclear fuel cycle facilities, from the uranium mines to the uranium enrichment plant, are concentrated around Isfahan (within a radius of 200 km) further supports this second explanation. Launchers for the *Scud-B, Scud-C,* and *Shehab-3* attack missiles, which have a range of 300 to 1,300 km, are located in the same region.[16]

The study of open source information, primarily from the AEOI, poses a whole series of questions regarding the aims of nuclear energy development. These questions demand answers from Iranian experts. The first question is where and for what purposes will the ore, which is soon to be mined near Ardakan, be used? Its use for nuclear fuel production is extremely uneconomical.

The second question is for which reactors will the fuel at the plant in Isfahan be produced? As indicated above, the planned nuclear fuel cycle facilities cannot produce the quantity of fuel needed for even one power unit at Bushehr. In addition, Iran's representatives themselves have stressed that Russia will supply the fuel for the Bushehr NPP.[17]

The third question is where will the heavy water that will be produced in the Arak plant be used?

Iranian specialists will answer many of these questions if Iran signs the Additional Protocol. At least, it obligates them to do so.

Strengthening IAEA Safeguards In Iran

For several years, in parallel with its development of nuclear technologies, Iran has repeatedly come out in support of strengthening IAEA safeguards. Proposals for the strengthening of these safeguards include the signing of the IAEA's Additional Protocol and the broadening of technical collaboration between member states and the Agency itself. Iran's position is that both must be realized simultaneously, in order to raise the level of confidence between member states and the IAEA and increase the transparency of member states' nuclear power programs on the one hand, and contribute to the development of nuclear power engineering in these countries on the other. The maintenance of a balance between the IAEA's roles of "controller" and "assistant" is a necessary condition for strengthening the safeguards regime. Further, Iran takes the position that there must be a proportional increase in the funding of Agency technical assistance programs along with the strengthening of safeguards.

One more issue that Iran regards as crucial when considering how to strengthen IAEA safeguards is the need for a nondiscriminatory approach to nuclear power engineering cooperation, as well as the nondiscriminatory and uniform application of the Additional Protocol to the nuclear facilities of all countries, including nuclear-weapons states, and also of those countries that are not parties to full-scope IAEA safeguards, including Israel first and foremost. In Iran's opinion, the question of the universality of the safeguard system, and of the nonproliferation regime as a whole, is one of the major problems standing in the way of strengthening the IAEA.

For several years Iran has spoken out in favor of strengthening safeguards, but at the same time held back from signing the IAEA Additional Protocol.

The question of Iran's signing the Additional Protocol was one of the central issues during the visit of IAEA representatives to Iran in February 2003. According to Agency Director-General ElBaradei, "Iran has developed a fuel cycle program sophisticated enough to warrant that the IAEA obtain as much authority and as much information with respect to Iranian nuclear research, as possible."

However, during his visit to Tehran he was not able to persuade Iran's representatives to sign the protocol. AEOI head Aghazadeh said that too few countries had signed the protocol. Earlier, Iran's representatives had announced that Iran would be neither the first nor the last in the region to join the Additional Protocol.[18] At the time, Aghazadeh said that the Iranian program "will be under the oversight of the IAEA, but we will leave the road open to the Additional Protocol in the future."[19]

Russia has consistently raised the question of Iran's signing the Additional Protocol during the course of bilateral talks. For instance, Russian Deputy Foreign Minister Georgy Mamedov indicated the necessity of Iran's joining the Additional Protocol as soon as possible in his meeting with Gholamreza Shafei, Iran's ambassador to Russia, on April 14, 2003.[20] The importance of strengthening IAEA safeguards also were emphasized in the joint statement by Russian Foreign Minister Igor Ivanov and Iranian Foreign Minister Kamal Kharazi on March 12, 2003.[21]

It is indicative that Iran's reservations regarding the Additional Protocol are no longer fundamental in nature. The question that remains concerns the preferences the country will obtain from its signature. Thus, according to Iranian Foreign Ministry spokesman Hamidreza Assefi, "many countries want Teheran to sign this document, and we are ready to conduct negotiations in this area. However, it is necessary to clarify the benefits that Iran will receive."[22] It is very much likely that Iran will have signed the Additional

Protocol prior to the IAEA General Conference meeting in September 2003, but it is very unlikely that Iran will ratify the Protocol soon.

During his visit to Iran, ElBaradei was able to make some progress with respect to Iran's preliminarily informing the Agency about its plans to construct new nuclear plants. AEOI representatives agreed to declare their facilities at an earlier stage.

In accordance with the Subsidiary Arrangement to the Agreement with the IAEA for the Application of Safeguards, to which Iran acceded in 1974, time limits were established within which the Agency had to be given information regarding new installations. Iran was obligated to provide such information not less than 180 days prior to the introduction of nuclear material into the installation. Thus, from a formal point of view, Iran's construction of an enrichment complex in Natanz does not violate the country's obligations to the Agency, since nuclear materials have not yet been delivered to the plant, and preliminary information regarding plans to build the plant were sent to the IAEA in August 2002, or more than six months ago. However, during the February 24-26, 1992 session of the IAEA Board of Governors, a number of other measures for strengthening safeguards were examined besides the Additional Protocol. In part, the decision was made that member states should inform the Agency about new installations as soon as a decision regarding their construction is made. Until recently Iran did not adhere to this Board of Governors decision. The change of the Iranian position on this issue achieved during ElBaradei's visit to Tehran should be recognized as an important breakthrough that will strengthen IAEA safeguards in Iran.

If Iran signs the IAEA Additional Protocol, according to Article 2.a.(x) of the Model Additional Protocol, within 180 days from the moment the Protocol enters into force Iran will have to present an expanded declaration to the Agency that contains its "general plans for the succeeding ten-year period relevant to the development of the nuclear fuel cycle (including planned nuclear fuel cycle-related research and development activities) when approved by the appropriate competent authorities."

Iran's Missile Capability

Along with the development of nuclear technologies, Iran has paid particular attention to the acquisition of a missile capability. Iran's missile industry is one of its most dynamically developing branches, to which it has dedicated large funds and numbers of technical personnel. The current presence of thousands of American troops in the region, beyond doubt, is a serious stimulus for Tehran's acceleration of its missile development program. Iran is surrounded by land borders on all sides: American bases are located in Saudi Arabia, Iraq, Turkey, Pakistan, and Afghanistan, and the American presence in two others Iranian neighbors, Azerbaijan and Turkmenistan, has been strengthened. Under the circumstances, Iran has been forced to search for a counterweight to the American presence in the region. A missile capability is the only way for Iran to restrain the United States, which possesses an incomparably large conventional military capability.

At present the armed forces of Iran have about 40 launchers for theater missiles, including *Scud-B* and *Scud-C* ballistic missiles.

The *Scud-B* ballistic missile, which was developed and produced in the USSR, is a mobile system with a guided theater missile that entered service in 1987. The launcher is mounted on a Chinese tractor, and can be moved at a rate of 60 km/h.

The *Scud-C* ballistic missile was developed in North Korea with Chinese technical support and entered service in 1992. It too is a guided missile used with a mobile launcher mounted on a Chinese tractor. In peacetime these mobile launchers are on standby alert at operational bases, while in times of war they are at launch readiness, and are periodically exchanged.

The capabilities of the *Scud-B* and *Scud-C* ballistic missiles found in Iran's arsenal are presented in Table 2.

TABLE 2. The Tactical and Technical Characteristics of Iranian Missiles

Characteristics	***Scud-B***	***Scud-C***
Maximum range, km	300	550
Payload, kg	1,000	700
Accuracy, m	450	1,000

Missile payload can be something other than conventional explosives.

Together with its medium-range missiles, Iran has tactical ballistic missile complexes, including the *Luna-M*, *Nazeat-10* and *Okhab*.

The *Luna-M* ballistic missile was developed and produced in the USSR in the beginning of the 1970s, and is a ground-based mobile unit, with a maximum range of 65 km. It is capable of delivering a conventional 420 kg high explosive warhead this distance.

The *Nazeat-10* ballistic missile was developed in Iran with the technical assistance of China, but is produced in Iran. Plans call for it to be mounted on a mobile ground-based complex. It has a range of 150 km and a conventional 250 kg high explosive warhead.

The *Okhab* ballistic missile was also developed in Iran with the technical assistance of China and is mounted on a similar mobile ground-based tactical complex. It has a range of 34 km and a warhead weighing up to 170 kg equipped with conventional high explosives.

On July 15, 2000 a successful test of an Iranian *Shehab-3* missile was carried out, testifying to the country's ability to manufacture ballistic missiles. This was the missile's second flight test. The first test, which took place in July 1998, ended with the explosion of the missile during the test. The *Shehab-3* is a single-stage ballistic missile, capable of carrying a 1 t warhead a maximum range of 1,300 km. The missile has an impact accuracy of about 2 km. In the opinion of a number of experts, this missile was developed on the basis of *Scud-C* technologies and the North Korean *Nodong* missile. With this range the missile is able to strike almost all regions of the Middle East, including Israel, and also some regions of Russia, depending on the launch site. The launchers of Iran's forward-based missiles are located in Isfahan and near Hamadan.

The appearance of the *Shehab-3* missile in Iran's arsenal indicates a qualitative change in the threat not only for Israel, but also for Russia. The missile's range already allows it to strike Russia's southern regions, in which more than 20 million people live, including the provinces of Volgograd and Astrakhan. Iran's missile capabilities are presented in Figure 2.

At present Iran is working on increasing the range of the *Shehab-3* ballistic missile. This may involve the use of more powerful accelerators or a reduction in payload mass. It may be technically ready for deployment by 2005, and will be a multiple-stage missile.

In addition, Iran is working on the development of the *Shehab-4* missile, with a range of 2000 km and a heavier warhead, capable of carrying a biological or even nuclear payload. There are reports that Iran is attempting to acquire China's *M-9* missile technology.

Iran is also conducting work on the development of the *Shehab-5* missile, which will act as a medium-range intercontinental ballistic missile (ICBM), with a range on the order of 4000 km.

By 2005 Iran also plans to develop:

- Theater missiles based on *M-11* technology, with Chinese assistance, that have a range of 300 km and a conventional 800 kg warhead;
- *Zelzal-2* theater missiles, with the technical assistance of North Korea, that have a range of 200 km and a conventional 600 kg warhead.

In 2005, when its nuclear fuel cycle facilities become operational, Iran's armed forces will include: 16-20 launchers with 80-100 *Nazeat* missiles; 40-60 launchers with 200-300 tactical *Okhab* missiles; as well as 24 launchers with 150-180 *Scud-B* theater missiles; and 4-6 launchers with 10-20 *Shehab-3* missiles.

In the more distant future, in 2010, Iran may have up to 16-20 *Shehab-3* launchers. In addition, Iran plans to develop a promising IRBM that uses technology from the North Korean *Taepodong-2* IRBM by 2010. It will be launched from a stationary ground-based missile complex, and will have a range of 4000 km and a 2000 kg warhead. Plans call for a separable warhead that can carry either a conventional or, possibly, a chemical payload.

Iran's missile program is characterized not only by a rapid increase in the number of delivery vehicles, but also by their qualitative development. While the first tactical missiles, the *Luna-M*, *Nazeat*, and *Okhab*, were unguided and inaccurate, the *Scud*, *Shehab*, and *Zelzal* class missiles, and the promising IRBM, will have substantially higher performance characteristics.

Thus, *Scud-B* and *Scud-C* missiles have a considerably larger launch weight and payload mass, as well as increased accuracy, hitting a target through the use of an inertial guidance system. These missile complexes have the option of remote control, monitoring and launching, including remote retargeting of launchers through the use of launching and mobile command post equipment. Retargeting takes 15 minutes. Preparation and pre-launch operation time has been substantially reduced. The time needed for a repeat launch has been reduced to 1-2 hours.

As far as the promising IRBM is concerned, along with a separable warhead, this missile possesses greater accuracy due to an inertial guidance system. Its increased range (up to 4000 km) and warhead mass (up to 2000 kg) makes it possible to deliver strikes on facilities at a significant distance from missile bases.

Recommendations for Russia

The above estimates indicate that by 2006, one year after the enrichment complex at Natanz has become operational, Iran will have acquired the technical capability to join the club of states that possess nuclear missile capabilities. Under these circumstances, questions regarding Russia's position on further cooperation with Iran in the nuclear and other spheres, and what actions Russia should undertake to decrease the possible negative consequences of Iran's development of its nuclear industry, are unavoidable.

Russia should tie the continuation of cooperation with Iran in the nuclear sphere to the country's signing and ratification of the IAEA Additional Protocol. Russian representatives, conducting negotiations with Iran on various ways to improve cooperation, including in the peaceful use of nuclear energy, invariably raise the question of the nation's accession to the Additional Protocol. Russia is experienced in conducting "critical" dialogues with Iran. In 1995, when the Nuclear Non-Proliferation Treaty was extended, Russia was able to convince Iran not to block an indefinite extension in exchange for the continuation of cooperation at Bushehr. Under the current circumstances, Russia must stiffen its position on Iran's accession to the Additional Protocol and directly link further cooperation in the field of nuclear power engineering to the resolution of this question. If Tehran signs and ratifies the Additional Protocol, Russia will most likely face serious competition on the Iranian NPP market; however, economic and political expenses could prove far higher, if Iran continues to remain outside the protocol.

During negotiations with AEOI representatives, Russia should strictly adhere to the position defined by Minister of Atomic Energy Aleksandr Rumyantsev and later confirmed by President Vladimir Putin regarding the return of SNF from the Bushehr NPP to Russia. Negotiations over the details of the protocol on the return of SNF have been going on a long time; however, to date no agreement has been signed. In August 2002, there were statements to the effect that the protocol on SNF return would be signed in September or October. After Rumyantsev's visit to Iran in December of the same year, they said they would be ready to sign the protocol within a month. However, it remains unsigned.

The most likely reason for the protracted negotiations is the search for mutually acceptable provisions governing the procedure for SNF storage in Iran and the time frame for its removal. It is well known that Russia, under pressure from the United States and Israel, wants to reduce this period to the minimum required from a technological point of view. Normally this means a three-year period of SNF storage in cooling ponds near the NPP.

In case the Iran SNF return procedure is agreed upon within a shorter time, it is evident that the US must bear expenses for manufacturing of special “thicker” containers for safe transport of SNF to Russia and, possibly, provide Russia with technological support in solving this issue. According to certain information, Minatom of Russia and the US Department of Energy have been already conducting consultations on this problem.

Russia need not phase out the construction of light-water power reactors in Iran. WWER-1000 reactors cannot be used for the creation of nuclear weapons. The only case in world history of the creation and testing of a warhead with a payload of nuclear power-derived plutonium was in 1962. It took 15 years of experiments and 62 full-scale tests for the United States to create and successfully test a nuclear warhead from plutonium that was isolated from SNF from the British Magnox reactor. However, this reactor is loaded with natural uranium, which makes the isotopic composition of the resulting plutonium considerably more similar to weapons-grade plutonium than plutonium from a light-water reactor. In Iran, even taking into account the considerable progress this country has made in the field of nuclear power engineering in recent years, similar technical capabilities are absent.

For Russia, the economic desirability of building an NPP in Iran is obvious. The total cost of building one power unit is more than $1 billion. About 300 Russian enterprises participated in the construction of the Bushehr NPP. According to some estimates, the contract to complete the nuclear reactor in Iran created about 20,000 jobs. The contract to produce components for the Bushehr NPP is providing 70% of the work for the firm Izhorskiye Zavody, and resulted in a four-fold increase in average wages at the plant in 2002 alone, while the state budget received 3.5 times more in taxes.

Russia must also pay special attention to the control of exports from domestic enterprises that manufacture products and services of proliferation concern, and also to scientific research centers that have scientific and technical secrets in the nuclear and missile sphere.

In the past, Iran has repeatedly attempted to acquire illegally high-tech equipment that can, in part, be used for creating weapons of mass destruction and means of their delivery. In 1997-98, Russia’s Federal Security Bureau (FSB) curbed a whole series of attempts to bypass the export control system and acquire missile technologies, including missile engine and guidance system components. There is information about Russian (and

Ukrainian) experts – former employees of government-owned missile and aircraft building enterprises and left today without work and money for a decent living who go to Iran as tourists where they participate in research and development related to missiles. In January 1999, the leadership of the Scientific Research and Design Institute of Energy Technologies (NIKIET) curbed the unsanctioned contact of several institute employees with Iranian specialists. In addition to this, in December 2001, FSB Director Nikolai Patrushev stated that there had been increasingly frequent discoveries of people employed in Russian government bodies and the "power" ministries (those ministries with troops at their command, such as the Ministries of Defense and Interior as well as the FSB) "taking the initiative" and attempting to establish criminal contacts with the special services of other countries, including Iran.

Russia should be more active in the official level discussions of Iran's missile and nuclear dossier in the bilateral working group format Russia-USA and Russia-EU.

It is obvious that Russia, the United States, and EU cannot independently check the development of Iran's nuclear and missile programs. The problem of the absence of hard information on the Iranian nuclear fuel cycle was noted by Russian Minister of Atomic Energy Aleksandr Rumyantsev. The isolation of Iran and, as a result, the shortage of information about domestic developments there, has a negative effect on the entire international security system.

The international organizations that are trying to monitor the situation, including the IAEA, face the same difficulties. It is therefore no surprise that high-ranking IAEA representatives are interested in any information about the Iranian nuclear program that is received from Iran itself. Thus, a high-ranking IAEA representative, who accompanied ElBaradei on the trip to Iran in February 2003, asked the PIR Center for a transcript of a press conference dedicated to the Iranian nuclear program that was held immediately after PIR Center Director Vladimir Orlov visited Iran.

Bilateral Russian-American working groups on nonproliferation and export control issues had already existed, but were abolished at the initiative of the United States upon the arrival of the Bush administration.

In order to effectively carry out this task, we must first increase mutual confidence. To date, the United States has considered the transmission of confidential Russian information to it as its due, and used information thus obtained exclusively in its own national interests, often to the detriment of Russia's. Thus, in 1997, soon after the Russian Federation Security Council gave the United States a list of Russian organizations suspected of missile technology cooperation, the Americans imposed unilateral sanctions on them. After the confidential transfer of the names of two Russian missile specialists suspected of making an unsanctioned trip to Iran, one of the largest American newspapers published an expanded interview with one of these "heroes."

One of the issues the bilateral commissions should address is the sources providing sensitive technologies to Iran. Where is the technology coming from? There is a whole series of suspect countries that can be listed as the most active "proliferators." These include Pakistan, North Korea, and China. In order to develop certain nuclear technologies, Iran may have followed its own "missile" example, whereby the country financed the development of a new, modified model of the *Scud-B* missile in North Korea on the condition that a significant quantity be delivered to Iran.

There is also evidence that Iran's missile and nuclear programs use the technologies and support of Western firms. "We have this information, and we are ready to provide it to our partners," President Putin stated in one of his addresses. According to Minatom of Russia and the US Department of Energy top officials' statements, the centrifuge technologies could get to Iran from Europe. In particular, they might have been owned by the German-British-Dutch Consortium *URENCO*. U.S. Assistant Secretary of State John Wolf, too, has recognized the existence of a problem with the leakage of technologies from the United States to Iran.

Multilateral consultations on Iran's missile and nuclear programs have already been under way at the non-governmental level.

However, *at the present time there are no good reasons making it worthwhile for Russia to harm its trade and economic relations with Iran,* in spite of tempting proposals from the United States. The promises of the United States to compensate for Russia's losses in the Iranian market thus far are only promises. Will money really flow into Russia, if it forgoes collaboration with Iran? This is far from certain. Many remember the story in the Ukraine, when in March 1998 Kiev officially rejected participation in the Bushehr project in exchange for American promises to compensate for these losses in the form of an increase in assistance to Ukraine's energy sector and the placement of American orders at Kharkov's Turboatom enterprise. This was the enterprise that was supposed to build the turbines for the Iranian NPP. After Ukraine's refusal to participate in the Bushehr project, the Americans soon forgot their promises, and as a result the enterprise lost $5.1 million dollars (the sum spent on the development of the turbine.) In total, as a result of nonparticipation in the Bushehr project, Turboatom failed to earn about $40 million. Ukraine waited for compensation from the United States for four years, and then, during Iranian President Khatami's visit to Kiev, agreed to renew cooperation in the nuclear sphere. In the beginning of 2003, 40% of the construction occurring at Bushehr NPP was being done by Ukrainian specialists.

On the eve of the May 2002 presidential summit in Moscow, Richard Pearl, the head of the Council for Defense Policy at the U.S. Department of Defense, proposed erasing the debts Russia inherited from the USSR in exchange for its refusal to cooperate with Iran in the nuclear sphere. Since Russia's obligations to the United States for Soviet debt total about $3 billion, this proposal alone can hardly interest Moscow: the cost of one reactor is about $1 billion, and Iran plans to build seven.

Moreover, *it would be wise to devote attention to broadening economic cooperation with Iran, in order to overcome the negative consequences of a decrease in the level of confidence between the two countries* caused by the release of information about the construction of sensitive nuclear facilities in Iran as well as the intensification of Russian-American cooperation.

It is no accident that the Russian foreign policy concept views Iran as one of its main partners in the Moslem world. The partnership with Iran is in many respects the solution to the problems of radical Islamic movements in the Caucasus. For Russia, in which more than 20 million Muslims live, the support of its antiterrorist actions in Chechnya by a power as authoritative in the Islamic world as Iran is quite valuable. Tehran's position played a positive role in the solution of the Tajik problem and the regulation of the Karabakh conflict. Nor should one forget the positive role Iran played in opposing the spread of Wahhabism from Afghanistan to neighboring countries. Thus the retention of a partnership with Iran for the long term and the development of trade and economic ties are both extremely important for Russia.

From 1995 through 2002, commodity turnover between the two countries grew by five times and reached the $1 billion mark. However, the trade increase was essentially caused by revenue from large-scale projects, including the expansion of thermoelectric power stations built with the technical assistance of the USSR in Isfahan and Akhvaz, and the construction of the nuclear power plant in Bushehr. Russian military equipment deliveries, defrosted after the December 1995 signing of an intergovernmental protocol on the regulation of mutual financial obligations, increased the trade volume as well. Today these sources are practically exhausted, but contracts for new large-scale projects, including a construction contract for a second power unit at Bushehr, have not been signed.

Nor is it worth rejecting cooperation in the sphere of conventional defensive armaments. Today Iran is the third most important buyer of Russian weapons after India and China, despite the fact that Russia manifests serious restraint in its sale of military equipment, supplying only a small portion of the arms in which Tehran has indicated its interest. First of all, these are armaments that do not present a potential threat to Russia and cannot be used by international terrorists. These contracts, as in the past, are extremely important for Russian defense enterprises. Thus, the recent agreement to supply Iran with 300 BMP-2 infantry fighting vehicles at a cost of about $60 million is a virtual "life buoy" for the Kurganmashzavod factory, which finished 2001 with losses of approximately $7 million and continued to suffer losses in 2002.

After the military operation by the United States and Great Britain in Iraq, Iranian leaders will presumably think about the need for large-scale purchases of more high-tech Russian armaments, and for increased funding for these purchases. In this case Russia should exercise restraint, in part in order not to aggravate relations with the United States, which sees the strengthening of Iran's military power as a threat to its national interests. According to Russian President Putin, relations with Iran are unique, in that we "need to calculate the security concerns of the world community. We, as a country that is a member of the UN Security Council and the G8, must consider these concerns, but [...] not forget our national interests."

It would be best for Russia to adhere to a very pragmatic approach vis-à-vis Iran, developing mutually beneficial commercial and military ties. At the same time, Russia should strive to understand the fears of Western countries regarding domestic political developments in Iran, particularly given the fragile political balance in the country and the results of the February 2003 elections of people's representatives to city and local Islamic councils, in which for the first time in six years the supporters of President Khatami were defeated. The future relations of the two countries should be characterized by "alert cooperation."

Footnotes

[1] According to AEOI President Reza Amrollahi, smaller uranium deposits have also been discovered in the provinces of Isfahan, Azerbaijan, Khorasan, and Sistan-Baluchestan.

[2] Official Atomic Energy Organization of Iran website, http://www.aeoi.org.ir.

[3] These calculations are given on the official Atomic Energy Organization of Iran website, http://www.aeoi.org.ir.

[4] "Achieving Nuclear Fuel Production Technology in Iran, a Great Scientific Achievement: Official," IRNA, February 11, 2003.

[5] Michael Eisenstadt, "Iran's Nuclear Program: Gathering Dust Or Gaining Steam?" *Policywatch,* February 3, 2003.

[6] Vladimir Dvorkin and Aleksandr Shcherbakov, "North Korean Missile Dreams," *Voprosy Bezopasnosti*, No. 2 (March 2003).

[7] Ian Traynor, "UN alarm at Iran's nuclear programme," *Guardian*, March 18, 2003.

[8] Joby Warrick and Glenn Kessler, "Iran's Nuclear Program Speeds Ahead," *Washington Post*, March 10, 2003.

[9] Iran's nuclear power engineering development plans call for the construction of seven 1,000 MW power units by 2021.

[10] David Albright and Corey Hinderstein, "The Iranian Gas Centrifuge Uranium Enrichment Plant at Natanz:
Drawing from Commercial Satellite Images," paper published by the Institute for Science and International Security (ISIS), March 14, 2003.

[11] "A New Post-Cold War Challenge: the Propagation of Weapons of Mass Destruction," unclassified Russian Foreign Intelligence Service Report, 1993.

[12] Official Atomic Energy Organization of Iran website, http://www.aeoi.org.ir.

[13] "Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 January Through 30 June 1999," http://www.nti.org/db/china/engdocs/cia0200.htm.

[14] Paul Hughes, "Iran Says Its Enriched Uranium Plant Under Way," *Reuters*, February 10, 2003.

[15] German Solomatin, "Russia's Minatom: Iran Does Not Have the Capability to Produce Its Own Uranium-fuel Cycle," ITAR-TASS, 11 February 2003.

[16] Vladimir Dvorkin, "Status and Prospects for Missile Development in *Third World* Countries in the Period Up to 2015," *Yadernyy Kontrol*, No. 1 (January-February) 2002, p. 44.

[17] "Iran Seeks Nuclear Know-how, not Atomic Weapons," IRNA, February 10, 2003.

[18] As of March 25, 2003, the Additional Protocol had been signed by 69 states, the Board of Governors had approved Additional Protocols with 78 states, and the Additional Protocol had already entered into force in 30 states, including just one Middle Eastern country – Jordan.

[19] Azadeh Moaveni, "Iran Pledges Transparency in Its Nuclear Development," *Los Angeles Times*, February 23, 2003.

[20] Sergey Kozhukhar and Nikita Krasnikov, "Georgy Mamedov Indicated the Importance of Iran's Signing the Additional Protocol to the IAEA Safeguards Agreement as Soon as Possible," ITAR-TASS, March 14, 2003.

[21] Joint Russian-Iranian Statement, Information and Press Department, Russian Ministry of Foreign Affairs, www.mid.ru, March 12, 2003.

[22] "Iran Ready for IAEA Safeguards," *Kommersant*, March 17, 2003.