Containing the Iranian Nuclear Crisis: The Useful Precedent of a Fuel Swap

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Abstract:

The nuclear fuel swap that was proposed by the USA in October 2009, accepted by Iran, then rejected, and finally accepted again under conditions rejected by the West, was never a solution to the nuclear crisis. Tangential to the main issues, the deal offered only a temporary respite from the threat posed by Iran's sensitive nuclear programs. Intended as a confidence-building measure, the deal has only sown more suspicion, and the attempt in May 2010 by Brazil and Turkey to renew the agreement served to widen the circle of distrust. Yet the precedent of sending Iranian enriched uranium out of the country and thereby reducing its stockpile still holds promise. The question is whether or not Iran is determined to have a nuclear-weapons capability. Even if it is, containment and deterrence policies may help to keep that capability latent, but unrestricted growth of Iran's enrichment program could still trigger military action.

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Key Words

Iran, nuclear, proliferation, uranium enrichment, fuel swap.

Iran's Need for Reactor Fuel Creates an Opening[1]

Ever since the Iranian nuclear crisis began on a date that might be fixed as 14 August 2002, when an Iranian dissident group revealed the existence of nuclear facilities under construction at Natanz and Arak that Iran had been keeping secret- earnest negotiators, mediators and outside analysts have sought a solution that would give the world confidence that the nuclear program would not be used for weapons purposes. To date, all attempts have failed.

The most recent set of diplomatic attempts have centered on a side issue that was sparked by Iran's June 2009 request to the International Atomic Energy Agency (IAEA) for assistance in obtaining replacement fuel for the Tehran Research Reactor (TRR). The TRR is a small facility primarily used for various research activities. Iran wants to use it to produce radioisotopes to treat

an estimated 850,000 cancer patients per year and said the TRR would run out of fuel in late 2010. But finding an international supplier for the fuel was no simple proposition, for both political and technical reasons. Only two countries produce this kind of reactor fuel; Argentina and France. In 1993, Argentina supplied the current fuel load, after the reactor was converted from its former use of 93% highly enriched uranium (HEU) fuel to run on fuel that is enriched to 19.75%, just below the 20% level that arbitrarily distinguishes HEU from low enriched uranium (LEU). The conversion of the reactor and Argentina's provision of the 115 kg fuel load was supported by the United States in line with its interest in reducing proliferation risks by eliminating the need for such high levels of enrichment.[2]

Washington has been discouraging most other nuclear commerce with Iran, however, and the TRR has a chequered history. Notwithstanding its civilian purposes, it was also used between 1988 and 1992 for illicit experiments in plutonium separation, although this was not revealed until several years later.[3] Given the international concern about Iran's nuclear program, Argentina had little interest in potentially causing a problem with the US by offering reactor fuel to Iran. Moreover, Argentina has its own political issues with Iran, given that nation's alleged role in the 1984 bombing of a Jewish centre in Buenos Aires that resulted in 85 deaths. An Iranian intelligence officer wanted by Interpol over the bombing, Ahmad Vahidi, was appointed Iranian defense minister in August 2009. It would appear that Iran made little effort to persuade Argentina to supply a fuel reload.

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President Mahmoud Ahmadinejad farcically suggested that America itself could provide the fuel reload.[4] The US does not produce this kind of reactor fuel and even if it did, both legal restrictions and political realities would make this impossible. Most of the world's research reactor fuel is produced in France. Cerca, a subsidiary of nuclear-energy company Areva, manufactures several kinds of research reactor fuel as a sideline to its production of fuel for nuclear power plants. But the French government is even more strident in its opposition to Iran's nuclear program than is the United States and was not disposed to approve a TRR fuel sale either, even though it had no legal prohibitions against doing so.

Iran thus had every reason to expect that its request to the IAEA for assistance in obtaining TRR fuel would not be acted upon. It seems very likely that the request was a political ploy, in order to claim an excuse for producing 20% enriched uranium on its own, as indeed it went on to do.[5] But this

claimed justification is false, since Iran had no means of turning the LEU into TRR fuel and as of September 2011 still did not. It would not be beyond Iran's technological capabilities to produce the fuel. Indeed, Iran has told the IAEA that equipment for one stage of the production process would be installed at the Uranium Conversion Facility in Esfahan in November 2010.[6] The head of the Atomic Energy Organization of Iran (AEOI), Ali Akbar Salehi, said on 31 August 2010 that Iran would produce fuel for the TRR in one year, a deadline that has come and gone. This prediction was exaggerated from the start. Under standard safety practices, any fuel not previously certified must be tested for an extended period of time before it is used. Any production of useable fuel by Iran would thus take several years and not be ready until well after the current TRR fuel load is projected to run out. Mohammad Ghannadi, AEOI vice president, acknowledged the time problem in December 2009 when he said: "We could enrich the fuel ourselves, but there would be technical problems. Also, we'd never make it on time to help our patients".[7]

The Original Fuel Swap Plan

In the fall of 2009, Washington called Iran's bluff by proposing what soon came to be known as a "fuel swap", although more accurately it should be called a "fuel for LEU swap". Under the proposal, fuel plates for TRR use in making medical radioisotopes would be provided, if Iran first supplied the LEU that would be used to make the fuel. The plan was for Iran to export to Russia 1,200 kg of the 1,600 kg that it had produced as of October 2009. This amount, when further enriched to 19.75% and processed into fuel pellets and then clad, can provide three reactor loads of TRR fuel. Coincidentally (or perhaps not), 1,200 kg of 3.5% LEU is approximately the amount needed to produce enough weapons-grade HEU (25kg) for a single bomb.

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The fuel swap plan was significant as a confidence-building measure and offered important benefits to both sides. By reducing Iran's stockpile below the level necessary to produce a nuclear weapon, Iran would have retained only as much LEU as it possessed in August 2008. This would have provided diplomatic breathing space for negotiations on a longer-term solution. More importantly, it would establish the principle that Iranian uranium could be enriched outside of Iran, setting an important precedent.

A one-time export of LEU is peripheral to the main problem presented by Iran's uranium enrichment program: namely, the capability it gives Iran to

produce fissile material for nuclear weapons should it chose to do so. The NPT does not prohibit enrichment or plutonium reprocessing, which is the other path to an atomic bomb, but any country that pursues these technologies without a clear economic justification will invariably raise proliferation concerns. In Iran's case, there is very little economic justification for enrichment. Unless a country has at least 10 nuclear reactors to fuel, economies of scale make it much more economical to purchase fuel on the international marketplace. Iran's only nuclear power reactor, at Bushehr, did not even come on line until September 2011 and Russia has promised a lifetime supply of fuel. Countries with extensive uranium resources might have an economic justification to produce LEU to add value to their uranium ore exports, but Iran is not blessed by nature in this regard. Its known uranium reserves are insufficient for the sale of nuclear power it plans. In light of this shortfall in uranium ore, Iran's claim that it needs to enrich uranium in order to be self sufficient is also false.

Given this economic illogic, the history of concealment and IAEA safeguards violations, and the many military links to Iran's nuclear program, including strong evidence of weapons development work at least until 2003 if not later, the Western countries have had every reason to demand that Iran cease enrichment. On the other side, however, the right to uranium enrichment has become a national pre-occupation and is seen as a *sine qua non* of sovereignty. Given the nationalism that has come to pervade the issue, it is difficult to envision a timely solution to the crisis that would involve Iran retreating and foregoing enrichment.

Former IAEA Director General Hans Blix has suggested that foregoing enrichment could be possible as part of a wider regional deal to eschew fissile material production in all countries of the Middle East.[8] This would require Israel to give up the plutonium reprocessing that underpins its presumed nuclear weapons program. The establishment of such a zone is a worthy ideal, and could serve as an intermediary step toward a Middle East zone free of weapons of mass destruction. Given the time it would take for conditions to emerge that would allow for negotiations to ensue on a fissile material free zone, however, it is more practical for the time being to consider limitations on Iranian enrichment to reduce the proliferation risks. This can be done by increasing scrutiny by the IAEA, including but not limited to Iranian acceptance of the Additional Protocol, and by reducing the potential for Iran to divert LEU to weapons use. Shipping LEU out of the country on a continual basis for further processing elsewhere is one way of reducing the diversion risk. An agreement whereby such exports kept Iran's LEU stockpile below the amount needed for one weapon would be ideal.[9]

Envisioning such a future agreement, American officials sincerely saw the swap as a way to begin to build trust.

Anticipating that it would be the first tangible success of Obama's nine-month engagement policy, they hoped that a breakthrough here could lead to constructive dialogue on a range of other issues. IAEA Director-General Mohamed El Baradei reflected this optimism when, at the end of negotiations in Vienna on 21 October 2009, he said: "I very much hope that people see the big picture, see that this agreement could open the way for a complete normalization of relations between Iran and the international community".[10]

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The plan also offered strong benefits for Iran. In addition to keeping the research reactor operating, the plan was a way to show that its LEU really was being used for the civilian nuclear purposes it proclaimed, even if what came back to Iran was not actually its own uranium, which some think is contaminated with heavy metals, but cleaner uranium substituted by Russia or France along the way. The deal thus offered Iran a way to legitimize its enrichment program, a goal Tehran had long sought. In fact, this implicit legitimization is one reason why France, the UK, and, above all, Israel were skeptical about the deal. They saw a one-time fuel-swap as being of little value and were unenthusiastic about the amendments that would have been required to UN Security Council resolutions forbidding Iranian export of LEU. Given Washington's keenness for the deal, however, the allies went along with it.

France's lack of enthusiasm for the deal was exacerbated by Washington's choreography in first consulting with Moscow, which served US interests in rebuilding ties on that front but insulted its allies. Because Russia does not produce the type of fuel required by the TRR, France's help was essential, and it was prevailed upon to allow Cerca to produce the fuel. France's reluctant agreement came with a strict condition: Iran would have to export the 1,200 kg in one batch and do so by the end of 2009. Any delay in the export would reduce the significance of exporting a fixed amount of LEU if Iran in the meantime continued to add to the stockpile, which it of course continued to do. At the production rate of about 120 kg per month, Iran would be able to replenish the 1,200 kg in 10 months. Setting an early deadline for Iran to export the LEU, however, meant that it would not receive any TRR fuel until a year later, the time it would take Cerca to manufacture each load of fuel, since this niche product is reactor-specific and is not kept on the shelf.

Iran tentatively agreed to the basic outline of this proposal when Supreme National Security Council Secretary Saeed Jalili met with US Under Secretary of State William Burns in Geneva on 1 October in the context of a larger

meeting chaired by EU foreign-policy chief Javier Solana, accompanied by representatives of the P5+1 (the United States, the United Kingdom, Russia, China, France and Germany). In his tête-à-tête with Burns, Jalili agreed that the US proposal could be the basis for a deal, the details of which should be negotiated by a lower-level working group. All the parties, including Iran, then agreed to the statement Solana read at the end of the session, including the following line:

> In consultations with the IAEA and on the margins of today's meeting, it was agreed in principle that low enriched uranium produced in Iran would be transported to third countries for further enrichment and fabrication into fuel assemblies for the Tehran Research Reactor, which produces isotopes for medical applications.[11]

Iranian Domestic Opposition

Although Jalili had the backing of Ahmadinejad to agree to this wording, Iranian support for the Geneva deal was weak from the beginning. When officials from the IAEA, France, Russia, the United States and Iran met in Vienna on 19 October to hash out the details, Iran's ambassador to the IAEA, Ali Asghar Soltanieh, quickly backed away from the outlines of the deal. He insisted that any exchange of LEU for TRR fuel would have to be simultaneous, and that the LEU would be parceled out in stages. This would have meant that Iran would not part with any of its LEU for the year's time it would take to produce a fuel load, by which time its stockpile would presumably have grown by another weapon's worth of LEU. As a confidence-building measure, such a deal held no appeal to any of Iran's negotiating partners. As US Ambassador to the IAEA Glyn Davies later put it, "Iran wants the international community to use some other country's uranium for TRR fuel while Iran keeps its own uranium for a possible weapons option. How does that increase confidence?"[12]

In Vienna, the parties agreed after three days of hard negotiations to a formulation that El Baradei then put forward in his name. Although few details were publicized, the deal was largely the same as the original plan agreed to in Geneva, under which Iran committed to exporting the bulk of its enriched uranium stockpile to Russia for further enrichment and then processing into fuel rods. Left unspecified was when the fuel assemblies would be sent to Iran. In a separate side deal with Iran, Washington reportedly agreed to supply safety equipment for the Tehran reactor, contingent on agreement over the LEU export deal.[13] The United States, Russia and France immediately accepted El Baradei's proposal, while Iran said it was considering it "in a favorable light", but needed time to provide a response.[14]

The details agreed to in Vienna ran into immediate trouble in Tehran, where the deal was rejected by Ahmadinejad's rivals across the political spectrum. Majlis Speaker Ali Larijani, who as Iran's previous nuclear negotiator had

repeatedly been vetoed by hardliners when he sought small elements of tactical flexibility, found revenge by castigating the Geneva plan as a Western deception. His opposition was enough to tilt the naturally suspicious Supreme Leader, Ayatollah Ali Khamenei, against the deal. Reformist presidential candidate Mir Hossein Mousavi similarly opposed it, as did conservative presidential candidate Mohsen Rezai, secretary of the Expediency Council, who said that Iran should retain 1,100 kg of its stockpile in order to maintain negotiating leverage.[15] This figure is suspiciously close to the amount necessary to produce a nuclear weapon. Conservative parliamentarian Hesmatollah Falahatpisheh said any export of Iranian LEU should be conditioned on ending the economic sanctions on Iran, particularly those affecting its ability to import raw uranium.[16]

Over the next few months Iran avoided a formal answer to El Baradei but offered several permutations of its counter-proposal for a series of simultaneous exchanges of LEU for TRR fuel. To explain why Iran had retreated from the outlines agreed in Geneva and elaborated upon in Vienna, Foreign Minister Manouchehr Mottaki blamed the Western press for focusing on the purpose of the deal: "We said we are in agreement on the principles of the proposal, but suddenly the Western media announced that 1,200 kilograms of uranium would be leaving Iran to delay the construction of a nuclear bomb."[17] Iran knew all along, of course, that Washington's purpose was to make it impossible for Iran to be able to produce a nuclear weapon in the short term. The reason for walking away from what was agreed in Vienna thus appeared to be domestic politics. Ahmadinejad's rivals had condemned him for being willing to give up the LEU and for linking it with the issue of the TRR fuel.

On 2 January 2010, Iran gave the other parties a month to respond to its counter-proposal, after which it said it would produce 20% enriched uranium on its own. Iran's insistence on simultaneity was briefly dropped when Ahmadinejad in a February 2 television interview said there could be a four to five month delay between LEU export and receipt of the fuel. That the hard-line president should be the only public figure in Tehran to support the Geneva deal may seem counter-intuitive but Ahmadinejad had political reasons. His political rivals, by the same token, did not want to see him capture the prize of rapprochement with the US. Because the fuel could not be produced in the four to five month period Ahmadinejad suggested, his January statement may have been an artfully constructed show of flexibility that he knew would not be persuasive to the West. In any case, his concession was immediately met by another hail of domestic opposition and was not repeated by him or any other Iranian leader. In fact, in reporting the remarks, the headline on his own website said "Gradual exchange of fuel is not

possible", and the official transcript of his interview omitted the reference to a four to five month delay.[18]

Iran Raises the Stakes

Iran exacerbated the situation on February 9 when it began enrichment to 20% at a newly installed 164-machine cascade at the above-ground, pilot fuel-enrichment plant (PFEP) at Natanz. It might be argued that by beginning 20% enrichment, Tehran was seeking to force acceptance of its counter-proposal for a simultaneous exchange. But there were more important motivations for the move.

On one dimension, there was a political rationale. Ahmadinejad's announcement on 11 February of successful 20% enrichment served as the rallying cry for his speech to the nation on the anniversary of the Iranian Revolution. In their rush to enable Ahmadinejad to announce the achievement on the anniversary, the operators at Natanz began to feed low-enriched UF_6 into the cascade before IAEA inspectors arrived, contrary to Tehran's promise to the agency. The operators also violated Article 45 of Iran's safeguards agreement with the IAEA, which calls for notice of major changes "sufficiently in advance for the safeguards procedures to be adjusted".[19] When notified on 8 February that the higher-level enrichment would commence, the IAEA asked Iran to wait until inspectors could adjust their monitoring procedures and obtain further details about the enrichment plan. Iran's decision to begin the higher-level enrichment without waiting for the IAEA to adjust procedures triggered an unusually prompt secretariat report to agency members, expressing concern about the lack of advance notice about the move.

There was also a strategic reason to enrich to 20%. Doing so puts Iran on the cusp of producing weapons-usable HEU. The move exacerbated concern that Iran's intention is to move closer to being able to produce a nuclear weapon. By starting with 20% product of this quantity, Iran would be able to further enrich to weapons grade in a short period of time. Although 20% seems a long way from the 90% level of enrichment that is considered weapons grade, the vast majority of the effort required to enrich natural uranium to weapons grade has already been expended by the 20% level. In fact, 72% of the effort to produce weapons-grade uranium is accomplished by the time the product is enriched to 3.5%. By the time the uranium is enriched to 20%, nine-tenths of the effort to reach weapons grade has been expended. Having sought to justify enriching to 20% for the sake of TRR fuel, Iran could try to justify going to 63% as a means of producing the targets required for the production of medical radioisotopes at the reactor; in fact, Iran has already claimed it may need to do so.[20] It could even speciously claim a need to produce 90% HEU for the most effective functioning of these targets.[21]

Production of enriched uranium at any of these higher levels would complicate IAEA detection of clandestine HEU production because Iran could claim that any environmental samples showing signs of higher enrichment were due to contamination by the activity connected with claimed TRR fuel or target production.

The involvement of Turkey, Brazil and others in seeking to revive the fuel swap was not warmly welcomed in Western capitals.

In March 2010 Iran said it was willing to put 1,200 kg of LEU under IAEA seal on Kish Island, and to allow it to be exported upon receipt of the equivalent amount of TRR fuel.[22] Tehran's offer to put the uranium under seal at Kish was presumably intended as a guarantee against further enrichment, which Iran would soon go on to do regardless. However, as long as the LEU remained on Iranian territory, whether under IAEA seal or not, it would be susceptible to seizure and diversion to weapons use. In 2003, North Korea did just that with the plutonium-bearing spent fuel that was under IAEA seal there, and Iran itself forced the IAEA to break seals on nuclear equipment when it decided to undo the 2003 and 2004 suspension agreements with France, Germany and the UK (the E3).

Although Iran's negotiating partners held to the principles of the Geneva/Vienna deal, they were not inflexible about the details. Russian Deputy Foreign Minister Sergei Ryabkov visited Tehran in early November to sound out possibilities, but came away empty handed and irritated at Iran's suggestion that Russia could not be trusted to uphold its part of the Geneva bargain. From a non-proliferation perspective, it did not much matter where Iran's LEU went, so long as it left Iranian territory. It could be placed in escrow in any mutually acceptable third country. Turkey offered its territory, as did Japan and Brazil. To satisfy Iranian complaints that past broken agreements had left the country skeptical about TRR fuel being provided unless the exchange were simultaneous, the IAEA agreed to take formal custody of the LEU, the other parties agreed to a legally binding supply agreement, and the United States offered substantial political assurances.[23]

The Tehran Joint Declaration by Iran, Turkey and Brazil

The involvement of Turkey, Brazil and others in seeking to revive the fuel swap was not warmly welcomed in Western capitals. Iran's efforts to find other negotiating partners were seen as an obvious ploy to sidetrack the growing momentum for tough UN sanctions. The discussions were also expected to be futile; Iran was considered unlikely to meet the conditions that would be

necessary for a fuel swap to be mutually beneficial. Obama told Turkish Prime Minister Recep Tayyip Erdoğan and Brazilian President Luiz Inácio Lula da Silva as much in a meeting at the Nuclear Security Summit in Washington in April 2010. In a follow-up letter to Lula on April 20 that was later leaked, Obama emphasized that for a fuel swap to work, Iran would have to export the stated amount of LEU to a third country before it received (in one year's time) the TRR fuel. During this time, the LEU could be placed under IAEA "escrow", Obama said.[24]

To the surprise of Western leaders, in a 17 May meeting with the foreign ministers of Turkey and Brazil, Iran dropped the insistence on a simultaneous exchange on Iranian soil. This time the "Joint Declaration by Iran, Turkey and Brazil on Nuclear Fuel" had the support of the rest of the regime. The agreement seemed to encompass everything Obama had asked for in his letter. As the Brazilian and Turkish negotiators emphasized afterwards, Iran had agreed on quantity, place and time of the transfer.[25] El Baradei said it seemed as though the West could not take yes for an answer.[26]

Given the intense political opposition that Ahmadinejad faced when he first seemed ready to go along with a sequential exchange of LEU for TRR fuel and the similar outburst when he suggested in February that an exchange need not be simultaneous, it is curious that no political attacks at all were mounted against the deal struck with Brazil and Turkey on 17 May that went back to the sequential exchange. In the months between October and May, any number of defenders of Iran, both inside and outside the country, had insisted that as a matter of national pride any exchange absolutely had to be simultaneous. There was also insistence, albeit with less consistency, on the principle that any exchange had to take place on Iranian soil.

Why then did the matter of the principle of a simultaneous exchange on Iranian soil evaporate once Brazil and Turkey joined the negotiations? There are several explanations. The most obvious is that Khamenei weighed in early with his support. Once the Supreme Leader had pronounced himself on the matter, there was no political room for disagreement. But why then did the cautious Khamenei, who has always been so distrustful of making a deal with the West, support a deal that was based on Obama's proposal from the previous fall. Here the explanations are more complex.

Firstly, the immediate negative reaction from the White House to the Tehran Declaration made it look very good in Iranian eyes. By contrast, the positive Western media reaction to the Geneva deal the previous October made Iranians naturally suspicious, as reflected in Mottaki's comment, noted above, about why Iran withdrew its support for the deal in October. For any deal to work, it will have to be seen as a mutual win-win solution, but the distrust that pervades Iran's relations with the West has solidified into zero-sum-game thinking.

Secondly, by offering Iran a new set of negotiating partners outside the ranks of the West and the nuclear weapons states, Brazil and Turkey gave Iran a face-saving way to make what otherwise seemed to be an unacceptable concession. The Iranian leadership and the domestic media played up the fact that these two important nations broke with the Western consensus, even voting against the looming next Security Council sanctions resolution. Breaking off Brazil and Turkey from the Western group was treated as a positive breakthrough in Iran's diplomacy.

Thirdly, Iran was on the verge of being penalized by new Security Council sanctions designed for the first time to extract a real cost. Iran sought negotiations with Brazil and Turkey in the first place in order to persuade Russia and China to hold off on sanctions to allow diplomacy more time. Only when China and Russia decided to join the P-5 in a draft sanctions resolution did Iran give up its insistence on a simultaneous exchange and strike the deal with Brazil and Turkey, although by then it was too late to forestall the new sanctions round.

Fourthly, by May Iran was in a stronger strategic position. It could export 1,200 kg of LEU and still have another 1,200kg left. Rezai's demand in October that Iran retain what amounted to a weapon's worth was now met. In fact, the longer it would take to initiate a fuel swap, the stronger Iran's position would be. As of October 2010, for example, 1,200 kg constituted only 40% of Iran LEU stockpile, which by then totaled 3,000 kg.

Finally, Brazil and Turkey were willing to sign off on a deal that was much better for Iran than what the US, France and Russia had been demanding. From the perspective of Western capitals, these newcomers to the negotiating arena with Iran were taken to the cleaners by the wily Persians. Although Lula and Erdoğan persuaded Iran to accept the principle of a delayed fuel exchange, in almost every other aspect of the deal, the "fine print" gave the advantage to Iran. In particular, the "Tehran Joint Declaration" was silent about Iran enriching to higher levels. When Iran insisted the same day that it would continue to enrich to 20%, there was no chance of the deal being accepted by any Western capital, nor even by Moscow or Beijing. The P5+1 could hardly agree to legitimize enrichment in Iran without a limit on the level and the disposition (through export) of the accumulated 20% product enriched to date.

Other problems with the Joint Declaration included its faulty timelines: no set date for export of the LEU and an impossible one-year deadline for delivery of all TRR fuel. If this (impossible) condition was not met, the agreement gave Iran the right to demand the return of the LEU, which in any case would remain its property while in Turkey. Moreover, the deal did not specify what would become of the LEU after Iran received fuel for the TRR.

The concessions by Brazil and Turkey in the 17 May 2010 deal were all the more egregious because on their own, these two nations cannot deliver on the Tehran Declaration. They possess none of the assets that Iran seeks- neither the ability to produce fuel for the TRR nor the power to lift sanctions or to grant security guarantees. Nor can these middle powers by themselves accord Iran a right to enrichment, despite words to this effect in the Tehran Declaration.

A Fuel Swap is Still Worthwhile

One other problem with the "Tehran Joint Declaration" is that Iran did not say it was willing to meet with the P5+1 to discuss concerns about its nuclear program. Ahmadinejad has said that future talks must involve a greater variety of countries and that parties must both confirm that they seek friendship with Iran and pronounce themselves on Israel's alleged nuclear arsenal. Iran repeatedly put off talks. When discussions finally were held in December and January, Iran was not willing to talk about its nuclear program. On 29 August 2011, Fereydoun Abbasi, head of the Iranian Atomic Energy Organization, said Iran was no longer interested in a nuclear fuel swap of any kind.

If Abbasi's rejection is not Iran's final position and fuel swap negotiations every do resume, they would have to be done by parties that can deliver. It would also make sense to include Turkey, which is an important regional player and can play a useful role as an intermediary and as a venue for Iranian LEU to be placed in custody. A renegotiated deal should increase the amount of LEU to be exported, ideally to leave less than one weapon's worth in Iran, and must also dispose of the stockpile and production of 20% enriched uranium. The issues involving timelines, ownership and return rights must also be addressed.

If these problems can be fixed, it still makes sense to strike a deal over the TRR fuel in order to set a precedent for capping Iran's stockpile of LEU. This, and enhanced verification measures, could make the difference between war and peace. Otherwise, the larger the stockpile, the closer Iran will come to being able to break out of the NPT with a sizable nuclear deterrent. If Iran did not care about the international reaction, the approximately 4,500 kg of 3.5% LEU in its stockpile as of August 2011 could be theoretically further enriched to 90% to produce fissile materiarl for at least two nuclear weapons. There are some technical challenges in producing HEU at this level, but it will be easier for Iran to overcome these challenges now that it has the experience of enriching to 20%. Having just one or two weapons' worth of enriched uranium would not be enough to make it worthwhile for Iran in any strategic sense to go for broke and withdraw from the NPT. In North Korea's case, after it expelled inspectors and broke out of the NPT in 2002-

2003 it was able to reprocess enough weapons-grade plutonium for six to eight nuclear weapons. The cases of Iran and North Korea are very different, of course, and it is impossible to determine at what point, if ever, in terms of bomb-making potential, Iran might think it worthwhile to break out of the NPT. What may matter more is how outside countries, particularly Israel, view Iran's weapons' potential.

Despite all the downside risks and negative consequences of military action, Israel is likely to want to take matters into its own hands if diplomatic efforts to stop Iran from acquiring nuclear weapons fail. The deeply held view in Israel is that a nuclear-armed Iran is unacceptable and must be prevented by any means necessary. Whether those means include military action will depend, inter alia, on how close Iran comes to crossing the line between weapons capability- which Iran arguably already has- and weapons production.

Iran's leaders are unlikely to take the obvious step of crossing the line between capability and weapons production such as by withdrawing from the NPT, expelling inspectors, or testing a weapon. But they might be tempted to gear up to cross the line by resuming weapons development in ways that would be observable only through intelligence collection. Judgments about the strength of the intelligence would be an important factor in deciding whether to initiate a pre-emptive military attack. They may also be tempted to get as close as possible to a weapons capability by continuing to stockpile LEU and produce 20% enriched uranium. The more LEU and the higher its concentration, the less time it would take Iran to further enrich a weapon's worth of HEU. Iran's ability to produce just one weapon should not by itself be a tripwire. But Iran's adversaries cannot allow the LEU stockpile to grow too large, to the point where Tehran could calculate that a NPT break-out was worthwhile. Just how large the stockpile could grow before Iran's adversaries would feel compelled to take action to destroy it is unclear, but Israel's threshold is undoubtedly lower than that of the United States.

The deeply held view in Israel is that a nuclear-armed Iran is unacceptable and must be prevented by any means necessary.

The West does not want Iran to have the capability to produce a nuclear weapon. Iran's determination not to part with the bulk of its LEU strongly suggests the opposite intention. Apparently, Iran sees the LEU as a security hedge. A misjudgment about how large the hedge will be allowed to grow could well trigger the very attack that the nuclear program may have been intended to forestall.

Endnotes

1 Portions of this paper draw on the author's article on "Iran: The Fragile Promise of the Fuel-Swap Plan", *Survival*, Vol.52, No. 3 (June–July 2010), pp. 67–94.

2 In theory, a bomb could be made using 20% HEU, but it would be impractically large, weighing at least 400kg. Weapons designers prefer to use HEU enriched to over 90%, which is considered weapons grade.

3 IAEA, "Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran: Report by the Director General", GOV/2003/75, 10 November 2003, pp. 26–28.

4 "Ahmadinejad: Iran Ready to Buy N. Fuel from US", *Fars News Agency*, at http://english.farsnews.com/newstext.php?nn=8807151645 [last visited 13 October 2010].

5 Iran commonly refers to the enrichment level as 20%, which is the rounded-up figure (from 19.75%) used throughout much of the rest of this article.

6 IAEA, "Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran: Report by the Director General", GOV/2010/46, 6 September 2010, p. 7; The equipment is for the conversion of 20% enriched UF_6 to U_3O_8.

7 Thomas Erdbrink and William Branigan, "In Iran, Nuclear Issue is also a Medical One", *Washington Post*, 20 December 2009.

8 See, Weapons of Mass Destruction Commission, *Weapons of Terror: Freeing the World of Nuclear, Biological and Chemical Arms,* (June 2006), p. 72.

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