Bulletin of the Atomic Scientists

ANALYSIS (/FEATURE-TYPE/ANALYSIS)
21 JANUARY 2014

A nuclear energy program that benefits the Iranian people

Siegfried S. Hecker, Abbas Milani

The election of President Hassan Rouhani and external economic pressure brought about the breakthrough interim nuclear deal with Iran that went into effect this week. A long-term resolution of the Iranian nuclear standoff, however, will require both Iran and the world's major powers to alter past approaches.

Iran must move beyond its false nationalism and the misguided notion that uranium enrichment is the *sine qua non* of peaceful nuclear energy. Iran's centrifuge program has actually produced embarrassingly little peaceful nuclear benefit, while making other countries rightfully suspect it of developing a nuclear weapon.

At the same time, Iran's negotiating partners—the five permanent members of the UN Security Council plus Germany, or P5 + 1—must be more sensitive to the proud history of the Iranian nation. Although external pressure and more technical barriers will remain necessary to prevent Tehran from exercising a nuclear weapon option, the P5+1 should not isolate the country, but offer to incorporate it into the international nuclear energy community by helping it build a viable civilian program.

Such an embrace might be possible if Iran decides not to follow in the footsteps of North Korea, but to adopt instead a model for civilian nuclear development similar to the one South Korea has successfully pursued. Over the past three decades, South Korea has become one of the world's most advanced and successful nuclear energy vendors (http://cisac.stanford.edu/news/south_korea_has_made_huge_strides_by_focusing_on_middle_of_fuel_cycle_20131205/) by focusing development on the economically profitable parts of the nuclear fuel cycle—reactor component fabrication, fuel fabrication, and reactor construction—while eschewing the proliferation-sensitive steps of uranium enrichment and spent-fuel reprocessing.

In his speech at the United Nations, President Rouhani acknowledged that other nations could have legitimate concerns about Iran's nuclear program. That admission opens up the possibility for objective debate within Iran on the economic and technical costs of its current nuclear trajectory. We believe that such a debate—which should include business leaders, intellectuals, and a broad spectrum of civic groups—is crucial if Iran is to realize the enormous benefits that could flow from the fundamental changes we propose for its nuclear program.

Iran's nuclear weapon option. The 1946 Report on the International Control of Atomic Energy (often called the Acheson-Lilienthal report (http://fissilematerials.org/library/ach46.pdf), after its primary authors) concluded that the pursuit of nuclear technologies for both peaceful purposes and the bomb are, during much of their respective courses, interchangeable and interdependent. Many countries have since used the inherent duality of nuclear technologies to clandestinely pursue the bomb under the guise of peaceful nuclear energy programs. The list includes not only the usual suspects—Iraq, Libya, North Korea, Syria, South Africa, Pakistan, India, and Israel—but also Japan, South Korea, and Taiwan.

(/bio/siegfried-s-hecker)
SIEGFRIED S. HECKER (/BIO/SIEGFRIED-S-HECKER)
Siegfried Hecker is a senior fellow and affiliated faculty member at Stanford University's Center for International Security and Cooperation (CISAC) and the Freeman Spogli Institute for...
More (/bio/siegfried-s-hecker)
SUBSCRIBE (/BIO/287/FEED)

ABBAS MILANI (/BIO/ABBAS-MILANI)
Abbas Milani (http://abbasmilani.stanford.edu/) is the Hamid and Christina Moghadam Director of Iranian Studies at Stanford University and a co-director of the Iran Democracy Project...
More (/bio/abbas-milani)
SUBSCRIBE (/BIO/6811/FEED)

The Shah of Iran launched a major commercial nuclear program in the early 1970s, making it the Iranian government's biggest non-oil investment. He also explored the military possibilities of nuclear power, ostensibly through cooperation with Israel and South Africa. Although his weapon ambitions were severely constrained by Washington arm-twisting, the Shah secretly kept the option open (http://www.foreignpolicy.com/articles/2010/12/29/the_shahs_atomic_dreams), telling the head of Iran's nuclear program that he wanted to be able to build a bomb quickly if anyone in the neighborhood did so.

Ayatollah Khomeini summarily brought the entire nuclear program to a grinding halt when he came to power in 1979. The covert re-launch of the program a few years later focused on acquiring uranium centrifuge technologies through the proliferation networks established by European businessmen and Pakistan's purveyor of nuclear technologies, A.Q. Khan. In its resurrected program, Iran's new partner was Russia rather than Germany, which had originally contracted to construct the Bushehr reactor. In the early 2000s, Iran's massive covert program was uncovered, raising suspicions that the country was seeking nuclear weapons. Eventually, Tehran's contention that its nuclear activities were strictly peaceful did not even satisfy Russia, the main partner in its nuclear effort, and the UN Security Council adopted a series of increasingly crippling economic sanctions.

The sanctions did not stop Iran's centrifuge program. During the past 10 years, Iran has enriched uranium so it contains 3 percent to 5 percent uranium 235, the appropriate level for light-water reactor fuel, and also achieved the 19.75 percent level needed for research reactor fuel. With its current stock of enriched uranium and its existing equipment, Iran can, in a breakout scenario, make enough highly enriched uranium (90 percent uranium 235) for a nuclear bomb in a matter of months or even weeks.

In such a scenario, Iran would still have to weaponize this highly enriched uranium—that is, it would need to craft a bomb and the means to deliver it. Iran likely has the necessary capabilities to build a simple bomb deliverable by plane, boat, or van. But bombs must be miniaturized to be delivered by missile. Iran has an expanding missile-development program. The intermittent missile-related threats made by Islamic Revolutionary Guard Corps commanders against Israel, the United States, and Iran's neighbors make the program a concern. Still, Iran would need a number of years of research, development, and testing before it could have a reliable, missile-deliverable nuclear warhead.

The terms of the interim agreement will temporarily prevent Tehran from moving closer to a potential breakout scenario. Upcoming negotiations will aim to erect additional technical barriers. Negotiators will limit enrichment levels, the number and sophistication of centrifuges, and the types of fuel and level of completion for the Arak reactor, and they will seek to preclude reprocessing of its spent fuel. These measures will be necessary to delay a potential breakout, but they will not be sufficient to alleviate concerns about the ultimate goals of the Iranian program.

Indeed, external pressure, export controls, and technical barriers were not sufficient to keep Israel, South Africa, Pakistan, India, or North Korea from the bomb. These countries demonstrated that a sufficiently determined nation with moderate technical and industrial capabilities can build the bomb.

But other countries with such capabilities—particularly South Korea—have achieved enormous progress in commercial nuclear energy production and reaped large economic benefits by eschewing uranium enrichment and other aspects of the nuclear fuel cycle that are most closely connected to nuclear weapons production. Iran could go down a similar path—but only if it engages in genuine internal debate that acknowledges just how costly its nuclear program has been to date.

An embarrassing record of nuclear energy production. Over a period of decades, Iran has portrayed its nuclear enrichment program as a symbol of national honor. It has hidden from citizens the fact that it also maintains an important military nuclear option. This conception of the nuclear program has shaped Iranian decisions that have resulted in an embarrassing, unproductive, and costly civilian nuclear program. After 50 years, Iran has very little to show for its nuclear pursuit.

Iran has one commercial nuclear reactor, only partially ready for electricity production, at Bushehr. This nuclear plant has been supplied entirely by Russia, with little or no technology transfer and even less actual electrical energy production. The fuel for that reactor will be supplied by Russia with limited Iranian technical contributions.

The Tehran research reactor, used primarily for medical isotope production, was supplied by the United States in 1967 and is on its last legs. The reactor at Arak is not of modern design and appears not well suited for its purported task of medical isotope production.

Iran's pride and joy, the uranium centrifuge program, can enrich in one year only as much uranium as the European consortium Urenco can produce in about five hours. A ten-fold increase in Iran's centrifuge capacity would be required to enrich enough uranium to fuel its Bushehr reactor alone. And no matter how many more centrifuges Iran installs, it can never become self-sufficient in nuclear fuel production; it does not possess the uranium ore reserves required for a large-scale nuclear energy program.

The direct costs of Iran's nuclear pursuits have been enormous. The indirect costs of keeping the nuclear weapons option open are even more staggering. Lost economic opportunities—from oil and gas market share to the corruption begot by the covert nature of much of the nuclear program and the regime's attempt to circumvent increasingly tightened sanctions—run into the tens of billions of dollars. Other indirect costs are more difficult to quantify, but significant. Economic sanctions and internal politics have created a major brain drain, as the educated flee the country, and Iran has one of the world's highest rates of heroin and opium addiction. Meanwhile, sanctions have made it impossible for Iranian students to study abroad in cutting-edge scientific fields.

The results have been similarly poor for other countries that have seriously pursued nuclear weapons under an ostensibly peaceful umbrella. None of these countries produces a significant fraction of its electricity from nuclear power. India has had the most success in the commercial nuclear sector, but it is only a shadow of what it could have been, if the country had not pursued the bomb. North Korea is a particularly telling example: More than 50 years of nuclear pursuit have netted it the equivalent of just 23 days of a modern nuclear reactor's electricity production.

A new path for nuclear energy in Iran. We propose that Tehran re-examine its energy options. As it does so, it may find

that it makes little economic sense to pursue nuclear power. It may also conclude that a small nuclear power program is desired, in which case it can simply purchase one or two additional reactors from Russia, under the same contractual arrangement as for the Bushehr reactor. Such agreements require no domestic enrichment or reprocessing of the spent fuel.

If, as we expect, driven by national pride and a quest for prestige, Tehran decides to pursue a substantial indigenous nuclear power and research program, then it should be convinced—not coerced—to follow the path South Korea took some 30 years ago. South Korea and Japan found that an economically viable nuclear electricity program is incompatible with military nuclear pursuits.

South Korea struck close business alliances with established reactor and equipment vendors from the United States, Canada, France, and Japan. It was able to negotiate full technology-transfer agreements to simultaneously launch the essential components of a nuclear industry. This approach put nuclear electricity on the grid quickly, and allowed South Korean industrial corporations to come up to speed in reactor component manufacturing, reactor construction, other plant equipment manufacturing, and fuel fabrication. It became integrated into the global nuclear community, rather than isolated from it.

Establishing the industrial capacity for these ventures had significant beneficial spin-offs to other key South Korean industries. A telling indicator of the economic rationality of this option can be found in one stunning fact: Iran and South Korea were comparable in terms of their industrial and economic power in the 1970s, but today South Korea is an economic giant, while Iran, in spite of windfalls in oil revenue in the last decade—amounting to close to $700 billion—has an economy that is on the verge of collapse.

Today, South Korea is one of the leading nuclear power plant vendors in the world. It has expanded its domestic nuclear capacity with its own version of modern light-water reactors. It is now fully independent in nuclear reactor design and construction technology, in the manufacture of nuclear fuel for all its reactors, and in their safe and economic operation.

South Korea won the lucrative bid to construct four modern 1,400 megawatt-electric nuclear plants in the United Arab Emirates, and it is supplying the steel pressure vessels and other components for two US reactors being constructed on the East Coast. South Korea first collaborated on and then developed its own research and medical-isotope-production reactor, the high-flux advanced neutron application reactor, or HANARO. It is now building a version of this reactor in Jordan.

South Korea achieved this success in the nuclear energy field without domestic uranium enrichment. It chose to focus its efforts in the middle of the nuclear fuel cycle—that is, on fuel fabrication, reactor components, and reactor construction, all of which are economically beneficial and raise few proliferation concerns. It found enrichment services readily supplied on the global marketplace by many countries. In fact, there exists today a glut of enrichment supply worldwide, resulting in depressed prices. South Korea, like Iran, will continue to depend on the international market for uranium, because it also lacks sufficient domestic uranium ore.

For the Arak reactor, current negotiations focus on technical changes that would reduce the potential risk that it could be used to produce plutonium for nuclear weapons. In keeping with the spirit of incorporating Iran into the international community, we propose that it instead cooperate with other countries that sell and build reactors, optimizing the Arak reactor design for medical and research applications. Iran could then operate this facility with participation by the international community, consistent with current global practice. For example, an Argentina-built reactor has operated in Australia for the past six years in this mode, and the reactor South Korea is building in Jordan will have international participation. Such an arrangement would bring Iran into a cooperative rather than confrontational relationship with the IAEA.

For Iran, the lesson of the South Korean experience is clear: Tehran should decide to abandon its enrichment efforts because the costs—technological, economic, and political—are not worth the price of keeping the nuclear weapon option open. Iran should focus instead on developing the middle of the fuel cycle as the honorable and best economic path to a successful, internationally acceptable, and peaceful nuclear program. For this to happen, the international community must of course provide reliable access to uranium and enrichment services. And Tehran must provide the requisite transparency by implementing the IAEA's Additional Protocol to assuage the international community's concern that it might return to the nuclear weapon option.

Such a decision, we believe, must be internally, not externally, driven. With the involvement of the Iranian business and scientific communities, and a national debate that engages and does not stigmatize or isolate those advocating a rational and prudent nuclear-development paradigm, Iran will recognize the enormous costs and scant returns its previous approach has begotten. Rouhani's election clearly indicated that a majority of the Iranians who helped elect him—*and* a large number of people around Ayatollah Khamenei, who allowed the votes to actually be counted—have come to realize that the status quo is untenable.

Overcoming the inevitable obstacles. We realize that the approach we advocate faces many obstacles. First, both sides of the Iranian nuclear negotiations will have to observe the terms of the interim deal as they work to negotiate a long-term deal. The trust required for a balanced and lasting deal will take time to develop. Iranian hard-liners' insistence on retaining uranium enrichment will need to be exposed for what it is—an option for nuclear weapons, but a dismal failure for civilian applications. Hard-liners in the West and in Israel will oppose all terms that allow Iran to keep any nuclear program, claiming that it gives Iran breakout potential. That opposition will have to be overcome, and above all, military intervention by Israel must be prevented.

The reality is that the capabilities Iran has developed, though meager for commercial nuclear power, are sufficient to give it breakout potential, regardless of the nature of its future nuclear program. Even if Iran eliminates all its centrifuges, it will not unlearn how to reconstruct them. The best hope is to make the civilian path we have outlined so appealing—and then successful—that Tehran will not want to risk the political and economic consequences of that success by returning to a military path. That is precisely the lesson learned from the South Korean and Japanese nuclear experiences. Seoul would not sacrifice its nuclear industry or Samsung's international reach to develop a nuclear bomb.

Only a truly peaceful nuclear program—one that forfeits the false promises of a weapons hedge and the empty bravura of an enrichment program falsely promoted as an indispensible ingredient of national pride and technological savvy—can bring Iran the prosperity and innovation it deserves.

7 comments

Jonathan Katz • 17 hours ago
There is a distinction between having a right and exercising it. For example, the world can accept Iran's right to enrich uranium for peaceful purposes, while Iran accepts an indefinite moratorium on the exercise of that right, monitored according to the IAEA Additional Protocol, and the world provides fuel for Bushehr so Iran has no need to exercise its right.

Javed Mir • 3 days ago
--breakout potential.--

Now this point seems irreversible so best way is to release their frozen funds and recognize the Iranian nation at par with others with the expectations that they will not use that monster of destruction for hegemony.

tms5510 • 3 days ago
you don't get it. It is Iran's right. No matter if economically useful or not Iran will continue to exercise its sovereign rights.

Leif_Ericson → tms5510 • 2 days ago
The authors aren't saying that Iran doesn't have the right to enrich. They are saying that it is not in Iran's best interest to enrich. There's a difference.

RobGoldston • 4 days ago
How do you incorporate into your argument South Korea's current request to the U.S. for permission to engage in fuel cycle activities under its 123 agreement? And Brazil's ongoing involvement in enrichment? Iran is not close to being in a position to compete in the international nuclear market. It seems to me that the West should offer Iran, inter alia, combined cycle gas turbine plants to although them to make extremely cheap electricity, with no dependence on foreign sources. Throw in some tech transfer so they can manufacture these themselves (like China's deal on nuclear power) and this would be great for their economy.

HC • 4 days ago
You are right to point out that this decision must be internally driven - has this article been translated into Farsi and directed at Iranian audiences?

no use. Iranian are determined on their rights. The way Iranian see this is not based on economy. During the past 2 centuries Iran has been dealt unfairly and based on double standards. Iran will not accept anything short of equal partnership which includes all rights other countries have.

Reply • Share ›