The opening of the nuclear " fuel reserve " at the International Uranium Enrichment Center in remote Siberian Russia in December 2010 is a milestone in nuclear nonproliferation efforts. The fuel reserve is a preliminary step to establishing an IAEA "fuel bank". The fuel bank concept in theory is designed to offer assurances to developing countries that they can rely upon reactor fuel suppliers without fear of being subject to political manipulation. The fuel bank is designed to function as an IEAE-supervised facility committed to serving as a disinterested guarantor of fuel supplies for nuclear power reactors. The rationale of guaranteeing nuclear fuel supplies is that it would discourage a country from experiencing any necessity to embark on "nuclear self-reliance" by developing indigenous uranium enrichment capabilities. While creating an indigenous enrichment capability would allow a country to fuel its own nuclear power stations with low enriched uranium (LEU) as well as service other peaceful applications, it would nevertheless put countries closer to the increasingly difficult to define threshold between peaceful uses and weapons applications. Any action that would move countries away from this threshold would have the effect of promoting nuclear nonproliferation and could contribute to nuclear disarmament. The fuel bank idea, consequently, plays an important intermediate role in the broadly-supported, two-pronged goal of promoting nuclear power and nuclear science while simultaneously reining in tendencies that would lead to nuclear proliferation.

The fuel bank concept has significant international support but by no means enjoys universal agreement. Nor is there even a consensus about what a fuel bank implies in terms of implementation in practice. For some supporters, the fuel bank's principal benefit is that it will serve as a mechanism to discourage countries already engaged in nuclear fuel enrichment from continuing along this path by offering them a form of political insurance: the fuel bank assures them access to a commercially priced and fully reliable option enabling them to procure nuclear fuel provided by existing suppliers. Iran is a country that fits into this category. Iran is an energy-rich country whose drive to gain mastery over the full nuclear fuel cycle raises the specter of blurring lines between the peaceful uses of nuclear technology and the applicability of those technologies to nuclear armaments. A fuel bank will make it possible for Iran to be assured of access to nuclear fuel at the same terms as any other country complying with the provisions of the principal international convention on nuclear nonproliferation, the Nuclear Non-Proliferation Treaty (NPT). The functioning of a fuel bank would thus give developing countries such as Iran a civil nuclear option, removing any rationale that might drive the country to a uranium enrichment program out of economic or scientific expediency. Yet Iranian President Mahmoud Ahmadinejad has made it clear that the present Iranian government leadership has no intention of reversing Iran's uranium enrichment program . The Iranian response to the fuel bank concept raises new questions about the practicality of offering options for mutually beneficial negotiations to parties that are adamantly opposed to any measures that limit nuclear ambitions.

The essence of the fuel bank idea is that it will be useful in stemming the proliferation of uranium enrichment technology and know-how. More generally the concern applies not only to uranium enrichment but more generally to a way to more systematically securitize the "full fuel cycle." The full fuel cycle refers to the production of reactor fuel through enrichment, the use of fuel in reactors, and finally the disposition of spent-fuel either through long-term storage or through reprocessing and recycling through the fuel cycle. The "front-end" processes include production, conversion and fuel fabrication, while the "back-end" processes include disposition

and reprocessing.

The idea of a fuel bank

The idea of the nuclear fuel bank is not new. When Dwight Eisenhower presented the “Atoms for Peace” plan to the UN General Assembly in 1953 he called on all countries to support the distribution of the benefits of nuclear technology but to resolutely oppose the spread of nuclear weapons. He called upon countries to commit to the goal of eliminating nuclear weapons as an instrument of war. Eisenhower’s Atoms for Peace plan was based on what he thought could be maintained as a clear distinction between the beneficial uses and the armaments-related uses of nuclear science. Eisenhower also called upon countries with the capacity to produce fissile materials to cooperate in sequestering in a repository these materials under international control.

The idea of a fissile materials repository soon resulted in a stalemate. No nuclear weapon possessing country was prepared to relinquish its control over fissile materials until the others had first done so. The idea of disarmament froze in the pattern of arms control. But the idea of international cooperation over low enriched fissile materials designed for power reactors or other applications in science, medicine, or agriculture remained on the agenda in the form of a fuel bank.

Eisenhower also proposed the establishment of an international agency with two parallel missions. He proposed the establishment of an international agency that would simultaneously promote the promulgation of nuclear science for peaceful means and at the same time would work to curb the further development, production, storage and deployment of nuclear armaments. This idea was carried forward in the establishment of the IAEA. Since its founding in 1957 within the framework of the UN, the IAEA has pursued the goals of the Atoms for Peace program. The IAEA has promoted knowledge regarding nuclear science, particularly in the use of nuclear medicine and in applications in industry, agriculture and materials science. Following the enactment of the Non-Proliferation Treaty in 1970, the IAEA refocused to become the leading global institution implementing legal nuclear conventions.

The IAEA has carried out a watchdog capacity to sound an alarm in the event of violations of international conventions. It is has not exercised a mandate to intervene. For many years since its inception, the IAEA basically carried out an accounting function. It focused on tracking and tabulating nuclear materials and know-how. Following revelations of a clandestine nuclear weapons program in Iraq in the wake of the first Gulf War, the IAEA was called upon to go beyond the passive monitoring function to more actively investigate whether countries were living up to international commitments not to use nuclear science to cloak efforts designed to develop nuclear weapons. The IAEA’s “Additional Protocol commitments” officially adopted in 1997 expanded the IAEA’s accounting functions to what may be called “detective” functions. But the IAEA functions do not extend beyond that point. The IAEA is not a police organization. It does not have the ability to enforce sanctions.

A fuel bank in practice

The IAEA fuel bank concept is still evolving. But even in its present form it is a bold step for the nuclear oversight agency. Despite broad international support for the fuel bank idea, it is still

unclear how it will be realized in practice. The IAEA presently does not have the capacity independently to provide a storage facility for nuclear reactor fuel. As a result, the IAEA fuel bank will be an extension of some national fuel bank, organized under international contractual arrangements or some new storage facility with a special international status. On December 2, 2010 the IAEA Board of Governors approved the IAEA fuel bank concept. Accordingly, the new fuel bank may be variously interpreted. First, it might imply an “extraterritorial” physical location as a fuel repository existing on an area that enjoys much the same status as an Embassy. Second, it may imply a physical location on the territory of a “third party state” widely construed as neutral. Third, it may imply essentially contractual relationships between the IAEA and other countries or existing commercial low enriched-uranium (LEU) suppliers. Contractual relationships may be sufficient to provide assurances regarding protection against intervention designed to disrupt nuclear fuel supplies for political purposes. The Russian International Uranium Enrichment Center fits in this category.

Establishing the fuel bank gives the IAEA the capacity to provide access to fuel supplies for conventional light water reactors at “market prices” in the event of a political dispute between LEU suppliers and consumers. The fuel bank is a limited, stop-gap measure designed to deter countries from pursuing go-it-alone nuclear policies. The fuel bank does not provide broad and privileged access to uranium supplies. Moreover, the bank can be used only in extraordinary circumstances and only provide specific amounts of nuclear fuel at market prices and only subject to stringent IAEA oversight and monitoring conditions. These are clearly circumstances in which the fuel bank is unlikely to ever be used. If it is not used, it is not expected that there will be a direct consumer benefit of the fuel bank.

The fuel bank’s two real benefits, therefore, are indirect. One is psychological. The fuel bank can offer psychological assurance to developing countries that reliance upon nuclear energy for electric power generation would not put them in a position where access to fuel supplies at some future point could be manipulated for political purposes. The other main benefit is diplomatic. The fuel bank also offers a disincentive to smaller countries to discourage them from investing in the costly and hazardous business of uranium enrichment only for nuclear self-sufficiency. Any smaller country undertaking the costs and risks involved in developing uranium enrichment technology—which holds a proliferation risk for the entire international community—can be assured that this is an unnecessary expense.

Just shortly after the IAEA announced approval of the fuel bank concept, the Russian international fuel reserve formally opened its doors. The Russian fuel reserve had already been operating on a national level, having been established on the basis of the institutional knowledge of refocused Soviet-era nuclear facilities. The Russian fuel reserve is a new legal entity under the ownership and management of an international consortium led by Russia but also including Kazakhstan, Ukraine and Armenia. The fuel bank is located on the previous territory of the Angarsk Electro-Chemical Combine in the city of Angarsk near Lake Irkutsk in eastern Siberia. The Russian government’s state-controlled oversight agency, Rosatom, has announced it intends to expand the facility into a 120-ton low enriched uranium (LEU) reserve that can serve as a last-instance supplier to IAEA Member States. Russia’s rapidly expanding fuel bank concept piggybacks on Russia’s

state-owned and strategically-focused nuclear power industry.

Nuclear reactor fuel and uranium enrichment

When the NPT came into force in 1970, it expressly stated the two-pronged goal of advancing science while curbing weapons. The NPT states the “benefits of peaceful applications of nuclear technology…should be available for peaceful purposes to all Parties to the Treaty.” The NPT specifies that the IAEA has the right to implement safeguards to prevent the diversion of fissionable nuclear materials for weapons purposes. But the NPT also provides signatory countries with the assurance of the inviolability of peaceful activities. NPT Article for the “free use” doctrine, states that “Nothing in this Treaty shall be interpreted as affecting the inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes.” This assurance assumes that the distinction between peaceful and weapons-related purposes can be easily made. That assumption is becoming increasingly tenuous. Rapidly changing nuclear technology is changing the way that this distinction can be maintained in policy and practice. The fissile materials that can be used for nuclear explosives are Uranium isotope 235 (U 235) and Plutonium isotope 239 (Pu 239). Plutonium is a synthetic element in the sense that it does not exist in nature except in trace elements. It is a product of the uranium fission process. The critical mass of fissile material that can sustain a nuclear chain reaction depends on the purity of the isotope and the density and shape of the fissile material. It also depends on the effectiveness of the surrounding envelope of materials that contain and reflect the fission process.

All nuclear explosives begin with uranium. Uranium found in nature consists largely of two isotopes, U235 and U238. Natural uranium typically contains 0.7% of the U235 isotope. The difference in mass makes it possible to separate the lighter from the heavier uranium—to increase the relative proportion of U235 by isotope separation, or “enriching”. The technology which isotopically separates at a limited level to produce low enriched uranium (LEU) is the same as that which produces high enriched uranium (HEW).

The path to nuclear weapons is through uranium, but the first stop is usually by using the plutonium that is produced in uranium fission. Some nuclear power reactors, for example the Canadian-designed Candu and the British Magnox reactors, use naturally occurring U238 as fuel. Most reactor designs, however, make use of light water reactors reactors (LWRs), using low enriched uranium (LEU) where the proportion of the U235 isotope has been increased to between 3% and 5%. High enriched uranium (HEU) is above 80% U235.

Conventional water, or light water, consists of H20. Water includes two atoms of Hydrogen (Protium) and one atom of Oxygen. Heavy water, deuterium oxide, is formed from Deuterium and Oxygen, D20. Heavy water is used in certain types of nuclear reactors because it acts as a neutron moderator, slowing down neutrons in such a way that they facilitate self-sustaining fission reaction in naturally occurring, that is unenriched, U238. The CANDU reactor design, named as an abbreviation of "CANada Deuterium Uranium", is a heavy water reactor. Light water may also act as a neutron moderator, but because light water absorbs more neutrons

than heavy water, reactors using light water must use enriched uranium rather than natural uranium. Heavy water reactors are more efficient at producing, or breeding, Pu239 than a comparable light-water reactor. For this reason, heavy water reactors present greater nuclear proliferation concerns. The production of Pu239 is a relatively rapid and inexpensive route to amassing the fissionable materials for use as a nuclear explosive. Chemical separation of Pu239 from spent fuel is easier than isotopic separation to produce enriched U235. Heavy water moderated research reactors or specifically-built Pu239 breeder reactors have been used for this purpose.

The fissile materials' extraction process is conducted in a number of phases, first separating actinide by-products and then separating the U235 and Pu239 from one another. The closest, easiest path to nuclear explosives is through plutonium separation. But the reprocessing and separation of spent reactor-fuel to extract plutonium would be easier to detect than would be a small-scale clandestine uranium-enrichment facility using centrifuge technology.

Eisenhower's distinction in the "Atoms for Peace" proposal made both scientific and political sense in the early 1950s. In the early days of nuclear science, the US enriched uranium through expensive, energy-intensive and physically large facilities such as Oak Ridge's Y-12 electromagnetic enrichment facility and the K-25 gaseous diffusion facility. At the time, the K-25 facility was the largest building in the world. In those days uranium enrichment was a highly visible and relatively easily monitored process. The original pledge to share technology with the rest of the world made sense in 1953 when the developed countries were decades ahead in scientific progress. Today uranium enrichment technology is fundamentally different. It is increasingly easy to acquire, increasingly easy to conceal, and increasingly easy to transfer uranium enrichment technology. The "right" to research, develop and produce nuclear materials is increasingly difficult to distinguish from an effort to divert nuclear materials unless a wholly new era of international transparency is brought into being.

The idea of a fuel bank to depoliticize access to LEU is one element in promoting greater transparency. After many years of discussion of the idea of a safe reserve of fuel beginning with the Atoms for Peace plan, the idea gained greater support after the end of the Cold War. In January 2006 the idea of a fuel bank was picked up by then Russian President Vladimir Putin. Russia's legacy infrastructure from the Soviet period was undergoing reconstruction. Russia was emerging as the world's largest producer of commercial LEU and the idea of gaining the prestige of being the world's LEU supplier of last resort fit right into the Kremlin's effort to reinvent its strategic industries and improve its global image at the same time. Western diplomats were less than enthusiastic for the Russian proposal at first because they were focused on restraining new nuclear dual use technology.

Russia's role as a supplier of equipment and services for the construction of Iran's civil nuclear power facility at Bushehr in southern Iran had raised questions in the minds of many Western observers who feared that Russia might be playing both sides of the deal—calling for restraint with Iran's nuclear programs while at the same time cashing in on the transfer of technology to Iran. But the idea of a fuel bank was seen by some as a means to buttress the distinction between peaceful and weapons-related technologies. A proposal by the philanthropist businessman Warren Buffet in September 2006 to pledge matching funds of $50M brought

forward other supporters of the idea. Other donors chipped in, exceeding the target of $150M autumn 2010. Only after a lengthy period of dissension among the IAEA members, with considerable dissension led by the Indian delegation, did the idea of a fuel bank win unanimous approval in December 2010.

The package of "reset" agreements between the Russian and American governments endorses the fuel bank concept, but many practical implementation issues are still under discussion. The US Department of Energy and the state corporation Rosatom have concluded a series of specific steps devoted to reducing the amount of fissile material and redirecting enrichment technology to LEU purposes. The agreements on US-Russia civil nuclear cooperation commit both countries to "both a Russian international nuclear fuel bank and an IAEA fuel bank that provide incentives for other nations not to acquire sensitive uranium enrichment technology."

Will the nuclear fuel bank disabuse Iran of its nuclear ambitions?

Iran is a major oil and gas producer and ranks among the world's leading countries in terms of proved hydrocarbon reserves. The goal to become a major nuclear power producer is consistent with Iran's aspirations to become a major regional actor. Iran's role as a major energy producer and exporter, on the one hand, and Iran's role as a major figure throughout the Middle East, on the other hand, is inseparable. Power is fungible. Iran's greater influence in manipulating energy markets can be directly translated into greater political influence throughout the region. But the key to Iran's uranium enrichment program is not the influence of an economic power throughout the region, but the stature and weight that is projected in the minds of the Middle East. Iran's chief diplomat Manouchehr Mottaki, before he was replaced last December as Ministry of Foreign Affairs and replaced by Ali Akbar Salehi, the former head of the Iranian Atomic Agency, frequently asserted Iran's "inalienable" right to conduct its nuclear activities beyond the reach of the oversight capacity of the IAEA.

Enriched uranium is not equal to nuclear armaments, but the steps to devising deployable nuclear armaments for Iranian scientists is by not the greatest challenge. Iran has enough direct experience with other forms of weapons of mass destruction from its eight-year long war of attrition with Iraq to know that chemical weapons and biological weapons are easily produced and deployed but are not easily translated into military success on the field. These weapons are not influential instruments of threat-based diplomacy. Fulsome objections by Iranian diplomats and leaders that they are not interested in developing nuclear weapons should not in any case be believed. Similar pronouncements by Pakistani diplomats preceded the detonation of Pakistan's nuclear devices in 1998, and these statements were not followed by any retractions or apologies after the fact, let alone reversal of policy. If Iran succeeds in producing enough

highly enriched uranium, it can be expected to follow with an announcement that it has joined the ranks of nuclear powers.

The danger of “breakaway technology”, with dual-use application being more easily concealed than in the past, is likely to focus increasing international attention on Iran’s nuclear programs. On the basis of documented violations of international fissile materials safeguards and responding to warnings that Iran was attempting to develop a surreptitious nuclear weapons program, the UN Security Council has passed a series of resolutions directing Iran to halt uranium enrichment. In July 2006 the UN Security Council issued a resolution (UNSCR 1696) demanding that Iran suspend uranium enrichment and charged the IAEA, the International Atomic Energy Agency, with monitoring and oversight of Iran’s enrichment activities. In December 2006 the UN Security Council issued a second, more pointed resolution (UNSCR 1737) demanding that Iran suspend all uranium enrichment and imposing sanctions pending cessation. In February 2007 the IAEA reported that Iran had failed to comply with a number of measures including the demand to stop uranium enrichment. In March 2007 the UN Security Council issued yet another resolution (UNSCR 1747) again demanding cessation of uranium enrichment and imposing yet greater sanctions. Iran’s Foreign Minister, Manouchehr Mottaki, rejected the UN resolution as “illegitimate,” claiming that Iran’s nuclear program was peaceful and therefore outside the UN’s jurisdiction. In March 2008 the UN Security Council adopted yet another resolution (UNSCR 1803) reaffirming resolution 1737 in calling for Iran to suspend enrichment activity and imposing a more extensive complex of economic sanctions. In June 2010 the UN Security Council adopted the most extensive resolution (UNSCR 1929), demanding Iran suspend uranium enrichment and imposing the most extensive economic sanctions.

UN Security Council permanent members are united on the goal of preventing Iran from developing nuclear armaments, but there have been significant differences among the countries on how to achieve that goal. Some Security Council members, while claiming that nuclear non-proliferation should be headed off, continue to think that Iran can be dissuaded from continuing on its risky course and compensated by inducements of greater trade, inclusion in the international community, and the absolution of its international pariah status. The most tough-minded of the soft-power promoters, Russia and China, have insisted that in present circumstances preventative intervention is both premature and precipitous, and that diplomatic measures must be given time to work. These veto-wielding members of the UN Security Council have agreed that the goal is to achieve an outcome of Iran without nuclear armaments, but have disagreed on the measures. Russian officials are opposed to the development of nuclear weapons in Iran as well as to the enrichment of uranium by Iran. As Russian Foreign Minister Sergei Lavrov summed it in the early stages of negotiations, “We think that there is no economic rationale for Iran to continue with a program of uranium enrichment. We will convince the Iranians that the cessation of that program will be valuable to Iran itself because it will bring them to the negotiating table.”

Others are skeptical of the view that “soft-power” diplomatic pressure can induce Iran to abandon pursuit of full fuel cycle capacities. If Iran is permitted to continue on the course of amassing enriched uranium, even in the absence of a declared nuclear weapons program, it will change the political terrain of the Middle East and Central Asia. If Iran manages to amass a stockpile of highly enriched uranium it will be within steps of a nuclear weapon. This situation alone, with or without the existence of a “nuclear weapons program”, will transform the political terrain in the Middle East. What may be more important than the timeline is the fact that there are significant decision points ahead. An Iranian nuclear weapon may be thought of by its designers and by Iran’s political leaders as an instrument of deterrence. They may anticipate that it will provide them with protection from foreign threat. But the logic of nuclear deterrence is robust only when there are two contestants. Deterrence erodes with the emergence each new nuclear weapon-empowered state. The post-MAD world can be expected to be much more volatile and much more unstable than the MAD one.

It is this situation which has moved France’s Nicolas Sarkozy to summarize the situation by saying that it is increasingly edging toward a choice: the world will be faced with “an Iranian bomb or the bombing of Iran.”
More bluntly,
Alan Kuperman
has argued in the pages of The New York Times, “We have reached the point where air strikes are the only plausible option with any prospect of preventing Iran’s acquisition of nuclear weapons."

The fuel bank concept remains an important diplomatic alternative. The paradoxical reality is that if the fuel bank idea works in practice, it is unlikely that any country would use it. The fuel bank is an insurance policy against political manipulation and, by simply existing, prevents any advantage in a country or group of countries trying to exert control through political extortion.

Gregory Gleason is Professor at the University of New Mexico and the George C. Marshall European Center for Security Studies. The views expressed here do not represent those of the Marshall Center, the US Department of Defense or the US Government .