

NUCLEAR ISLANDS

International Leasing of Nuclear Fuel Cycle Sites to Provide Enduring Assurance of Peaceful Use

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Current International Atomic Energy Agency safeguards do not provide adequate protection against the diversion to military use of materials or technology from certain types of sensitive nuclear fuel cycle facilities. In view of highly enriched uranium's relatively greater ease of use as a nuclear explosive material than plutonium and the significant diseconomies of commercial spent fuel reprocessing, this article focuses on the need for improved international controls over uranium enrichment facilities as the proximate justification for creation of an International Nuclear Fuel Cycle Association (INFCA). In principle, the proposal is equally applicable to alleviating the proliferation concerns provoked by nuclear fuel reprocessing plants and other sensitive nuclear fuel cycle facilities. The INFCA would provide significantly increased nonproliferation assurance to its member states and the wider international community by holding long-term leasehold contracts to operate secure restricted zones containing such sensitive nuclear facilities.

KEYWORDS: Nuclear fuel cycle; nuclear energy; international controls; highly enriched uranium

At the dawn of the atomic age, the leaders of American industry and science who prepared the famous "Acheson-Lilienthal Report" on international control of atomic energy clearly perceived that "the development of atomic energy for peaceful purposes and the development of atomic energy for bombs are in much of their course interchangeable and interdependent."¹ They were therefore convinced that "if the production of fissionable materials by national governments (or by private organizations under their control) is permitted, systems of inspection cannot by themselves be made 'effective safeguards . . . to protect complying states against the hazards of violations and evasions.'"² Over the ensuing decades, this clarity of view has not sufficiently informed national and international policies. Such "intrinsicly dangerous activities" have spread among nations under the very type of inspection that the report foresaw would be inadequate to the task, engendering the very "rivalries and fears" among nations that the report warned against. As world politics slowly but steadily emerge from a communist-capitalist divide enforced by nuclear deterrence, the prospect of developing a credible system of cooperative international control for security against atomic warfare can be considered anew. It is high time to view the proliferation problem with fresh eyes,

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as Robert Oppenheimer and his colleagues did in 1946 in the Acheson-Lilienthal Report. With global nuclear energy growth likely as a response to climate change, the development of a substantially improved control regime takes on special urgency.

The overall weakness of the current international safeguards regime stems not only from its inability to ensure timely warning of a diversion from existing bulk-handling facilities of a significant quantity (SQ) of fissile material, as defined by the International Atomic Energy Agency (IAEA), but also from other serious proliferation concerns.³ These include:

- The “legal withdrawal” scenario. Under Article X of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), with three months’ notice a state can legally withdraw from the NPT and its IAEA safeguards agreement “if it decides that extraordinary events . . . have jeopardized the supreme interests of its country.”⁴ It can then proceed to divert to military purposes enrichment technology and enriched materials previously declared for peaceful use.
- The “breakout” scenario. A state can abruptly (and thus “illegally”) abandon the NPT—having made secret preparations in advance—and within days or weeks become a nuclear weapon power. The timing depends on the type and extent of nuclear weapons-usable materials and technology it has already accumulated under cover of a peaceful nuclear fuel cycle program and on the technical progress achieved in a parallel weaponization program nominally devoted to unconstrained research, development, and testing of conventional munitions and inherently “dual-capable” delivery systems.
- The NPT-compliant “virtual weapon state.” Without leaving the NPT, a state can exploit to the fullest its “inalienable right” under Article IV to “develop research, production and use of nuclear energy for peaceful purposes without discrimination” and its right “to participate in the fullest possible exchange of equipment, materials, and scientific and technological information for the peaceful uses of nuclear energy,” and thereby acquire the principal elements of a nuclear weapons capability.
- Small, undeclared facilities. Some types of uranium enrichment facilities, such as small gas centrifuge and laser enrichment plants, have the potential to be hidden from inspectors and national technical means of surveillance for a considerable period, potentially long enough to produce a quantity of highly enriched uranium (HEU) sufficient to fuel a nuclear explosive device.
- Covert technology acquisition and production. National civil enrichment programs can provide cover for the importation and domestic manufacture of enrichment technology for military purposes.
- Low confidence or untimely capability for detecting diversion. The amounts of HEU and plutonium needed to make a nuclear weapon with a militarily useful yield are actually several times smaller than the IAEA’s currently designated SQ values for these materials, thus making even more difficult the agency’s ability to detect diversion of “weapon quantities” of these materials from large bulk-handling facilities, such as commercial-scale enrichment or reprocessing plants.⁵

- An under-appreciated barrier to global elimination of nuclear weapon stockpiles. Left unattended, the persistence and spread of isotopic enrichment and spent fuel reprocessing facilities, under purely national forms of control and revocable peaceful use safeguards, will place a floor under nuclear arms reductions by the known nuclear powers and foster a proliferation of uneconomic nuclear fuel cycle facilities in non-nuclear weapon states to “hedge against my neighbor’s hedge.”

Measured against these proliferation concerns—and what is required to allay them while also enabling progress toward a world without nuclear weapons—current reform efforts seem poised to deliver only modest improvements in the perceived durability of nuclear peaceful use commitments. These improvements are mainly limited to: (1) enhancing material accounting, control, containment, and surveillance measures; (2) increasing the frequency of IAEA inspections; (3) encouraging states to adopt the Additional Protocol, which permits IAEA inspections of sites not previously declared as civil nuclear facilities; and (4) providing political assurances and backup multilateral supply mechanisms to ensure an uninterrupted flow of enriched fuel for peaceful uses to non-nuclear weapon states that refrain from constructing indigenous sensitive nuclear fuel cycle facilities.

To address directly the international security concerns that accompany continued national acquisition of sensitive nuclear fuel cycle facilities, we propose the establishment of an INFCA as a major supplement to current IAEA safeguards to close the gaps noted above in the global nonproliferation and nuclear disarmament regime. We have employed the following criteria to guide the design of an INFCA:

- The INFCA must be able to fill the international security gap arising from the NPT’s legal right of withdrawal with three months’ notice, and from the inherent possibilities of clandestinely prepared “breakouts” from the treaty that would not be detected by the current set of IAEA safeguards in time for the UN Security Council or other multilateral security bodies to take effective preventive actions.
- The INFCA’s mission would be achieved by endowing the association with the minimum powers needed to guarantee exclusively peaceful use of civil nuclear fuel cycle facilities for the entire period of their construction, operation, and decommissioning. Countries and existing multilateral consortia would not be asked to give up their “inalienable right” under Article IV of the NPT to own and operate the full range of peaceful nuclear facilities when such activities are conducted “in conformity with Articles I and II of this Treaty.” Instead, all countries already in, or desiring to participate in, the global nuclear fuel services market as either supplier or customer would voluntarily agree to exercise that right only pursuant to uniform, nondiscriminatory leasehold contracts and protocols with the INFCA and the IAEA that would ensure conformity with Articles I and II of the treaty.
- The INFCA control regime should be universally applied to all civil enrichment activities (and could be expanded to include other sensitive fuel cycle activities, like reprocessing) in nuclear weapon and non-nuclear weapon states alike. The

INFCA would meet this objective principally by ensuring that all such activities occur within “internationally secured leased areas” (ISLAs) where the association would exercise certain specified privileges and immunities, pursuant to an irrevocable lease that would terminate only upon final decommissioning of the facility. While there are a number of options for defining the scope of a country’s INFCA obligation, up to and including the equivalent of an indefinite ban on any future production of fissile materials for use in weapons for countries not otherwise bound by an NPT obligation, implementation of INFCA need not await international agreement on a Fissile Material Cutoff Treaty.

- Any country joining the INFCA as a supplier to and/or consumer of civil nuclear fuel services from the global market should be required to undertake binding long-term contractual and protocol obligations not to establish, operate, supply, or purchase services from enrichment or reprocessing facilities unless these are located within an INFCA-ISLA. In other words, these arrangements would require rigid adherence to an “either you’re in, or you’re out” principle for accessing the legitimate commercial fuel services marketplace. Nuclear suppliers outside of the INFCA could not transact nuclear business with customers inside it, and nuclear suppliers inside the INFCA could not transact nuclear business with other suppliers who remained outside it, or with any customer from a state that has failed to put into effect an IAEA Additional Protocol providing for inspection of undeclared sites. Consistent with Article IV of the NPT, these additional peaceful use obligations would apply “without discrimination” to all states that have or might acquire sensitive nuclear fuel cycle facilities and would be designed solely to ensure that the “use of nuclear energy for peaceful purposes” remains “in conformity with [the basic nonproliferation obligations in] Articles I and II of this Treaty.”⁶
- The ISLA contract with a member nation should stipulate that the consequence of violating the contractual terms would be the immediate shutdown of the fuel cycle facilities located within the ISLA and suspension of the nation’s membership in the INFCA, which, given widespread acceptance of the arrangement, would be tantamount to that country’s exclusion from the legitimate global nuclear fuel services market. Ratification of an INFCA leasehold contract would require collateral acceptance of the IAEA’s Additional Protocol.
- In accord with Article IV of the NPT, the regime should be completely non-discriminatory in its application of safeguards and security requirements. In nuclear weapon and non-nuclear weapon states alike, there would be one universal set of technically adequate standards for nuclear material accountancy, frequency of inspections, portal-perimeter monitoring, physical security, and the like, with the INFCA afforded unfettered discretion to upgrade particular controls—such as anti-intrusion defenses—at particular sites as the evolving needs of its nonproliferation assurance mission dictate. In its early stages, the INFCA would pass muster for “political discrimination” by having several nuclear weapon states take the lead in placing their uranium enrichment facilities within ISLAs controlled by the new international association.

- In accord with Article III of the NPT, the proposed improvements should complement and reinforce the role and effectiveness of the IAEA's international safeguards system. Primary responsibility for safeguards implementation and material balance assessments would remain with the IAEA, with the INFCA's role directed to: ensuring IAEA access to a member facility, monitoring observance of agreed operating parameters for a plant (such as feed and product inventory ceilings, enrichment levels, and the amount and type of nuclear material and equipment moving into and out of the plant site), and enforcing a partial or complete stand-down of facility operations in the event of unexplained safeguards discrepancies or external/insider threats to facility security.
- The proposed improvements should not impede the normal functioning of the international commercial marketplace for nuclear fuel services. The existing commercial market in nuclear fuel cycle services has a long record of reliable supply to financially qualified buyers who remain in compliance with their safeguards obligations. Concerns about capricious and politically motivated cutoffs of enriched uranium fuel supply are not substantiated by the historical record, and complaints to this effect are really indirect assertions of the "right" of all NPT parties to "participate in the fullest possible exchange" of peaceful nuclear technology, including inherently dual-use enrichment and reprocessing capabilities.
- Existing ownership and management arrangements for currently operating bona fide commercial facilities should be disturbed as little as possible, but the new association should have authority to set fundamental ownership and management qualification criteria that are directly related to its nonproliferation assurance mission; for example, it could bar ownership or operation of an enrichment (or reprocessing) facility by military or internal security organizations, or bar the involvement in the enterprise of persons known to have engaged in safeguards violations or made false statements to the IAEA.
- Primary responsibility for safe operations and environmental compliance should rest with the operating company and a member nation's relevant regulatory authorities. The INFCA's operational role in this respect would be limited to facilitating access by legitimate national or international environment, safety, and health authorities; to denying entry into the international zone by unauthorized persons; and to promptly reporting any knowledge of unsafe conditions or harmful discharges to the relevant national and international regulatory bodies. The INFCA's authority could be invoked in these areas only when lapses threaten the performance of the association's nonproliferation assurance mission.
- The cost of INFCA operations should be considered an inherent cost of continuing to exploit nuclear energy for peaceful purposes and entirely recovered in the cost of nuclear fuel through a modest tariff on enrichment services. This tariff is justified because an INFCA-like entity is required to reduce the risks of peaceful nuclear commerce to a level conducive to the maintenance of international peace and security.

With these criteria in mind, we believe the best way forward is to ensure the irreversible peaceful use of isotopic enrichment facilities—followed by other sensitive fuel cycle facilities—by establishing an administratively independent international association that would acquire, on behalf of all its member states, long-term contractual lease-rights over the geographic sites where uranium enrichment activities are conducted. These lease rights would endure for the entire life cycle of the facilities at the site, including the period of their decommissioning. This arrangement erects a significant barrier against using a plant originally constructed for peaceful civil purposes to support production of nuclear weapons.

Any unilateral attempt by a member state or sub-national party to modify the terms of the lease, or wrest physical control of the ISLA from the INFCA prior to the lease's stated expiration, would be stipulated in advance as constituting an unambiguous threat to international peace and security, triggering a set of pre-authorized security responses at the site and an automatic referral to the UN Security Council. If a member state attempted to take control of an INFCA-secured site by force, it would obviously constitute the unilateral abrogation of an enforceable legal contract. The member state's access to the legitimate international market for nuclear fuel services would immediately be cut off, including deliveries against existing contracts, and harmed parties could immediately seek redress and compensation—including forfeiture of member state assets held overseas—in national and international courts. Commercial contracts between INFCA members would specifically provide for the collection of monetary damages from any member that defaults on the terms of its ISLA leasehold contract with the association.

To be clear, the association would not take over any functions of the IAEA. Rather, INFCA would ensure the IAEA's immediate, unimpeded, and continuous access (when necessary) to sensitive fuel cycle facilities subject to IAEA safeguards, while INFCA's long-term site presence, extending over the full operating life and decommissioning period of an enrichment facility, would represent both a state's strong political commitment to future peaceful use of the facility and a very significant deterrent to its future abuse in a nuclear weapons program. The risk of clandestine off-site production would be reduced by the member's mandatory collateral acceptance of the IAEA's Additional Protocol, providing for the inspection of undeclared sites, and by the linkage of a country's total nonproliferation performance to its prospective or continued membership in the INFCA.

The INFCA's leasehold on the sites of enrichment and other sensitive fuel cycle activities need not inhibit national, multinational, or private ownership arrangements, or commercially viable operation of the enrichment facilities located within such an internationally secured site. By creating a voluntary "nonproliferation assurance" association of nuclear fuel cycle service providers, uranium producers, and nuclear fuel consumers—for which the price of admission is a tangible, long-term, and irreversible peaceful use commitment guaranteed by the on-site presence and authority of an international association with strict rules and the capacity to enforce them—INFCA would directly link a country's continuing access to peaceful nuclear cooperation and trade to its long-term nonproliferation performance.

A New Proposal to Address an Ongoing Problem

Credible technical and political concerns persist regarding whether current IAEA safeguards meet the fundamental standard of ensuring “timely warning” of the diversion from uranium enrichment plants of nuclear materials for military purposes. Timely warning requires that the interval between the diversion of safeguarded material and its detection by the IAEA be brief enough that measures can be taken to prevent the government or organization concerned from further enriching the material and converting it into a nuclear explosive device.

It appears unlikely that the problems of treaty breakout, undeclared facilities, and covert acquisition and manufacture of sensitive nuclear fuel cycle technologies can be resolved satisfactorily without implementing at least some form of international institutional control over the sites where such national activities currently occur or may be conducted in the future. Numerous proposals have been made by governments, the nuclear industry, international organizations, and experts to strengthen international safeguards and security over uranium enrichment and nuclear fuel reprocessing, while also assuring an enriched uranium fuel supply.⁷ In two recent papers, Pierre Goldschmidt, former deputy director general and head of the Department of Safeguards at the IAEA, has made several useful recommendations to strengthen safeguards over uranium enrichment and other nuclear activities.⁸ An excellent survey of twelve recent multilateral approaches has also been made by Yury Yudin of the UN Institute for Disarmament Research (UNIDIR).⁹

In what follows we propose a detailed outline of a new international structure designed to substantially improve the international community’s ability to ensure the long-term peaceful use of uranium enrichment plants and related facilities, while making it more difficult and politically costly for states to misuse the technology. While going beyond the reach of current proposals to “reform” and “strengthen” the international safeguards system, our proposal nonetheless falls well short of long-standing but enduringly unattainable proposals for “international ownership and control” of the entire nuclear fuel cycle. We have sought to identify a middle ground that provides the added margin of security the world so clearly needs without invoking visionary schemes that the world is not yet ready to adopt.

A political weakness of several of the proposals for strengthening safeguards over enrichment activities is that their proposed application discriminates between nuclear weapon states and non-nuclear weapon states, or between states that currently have enrichment plants and those that do not, or requires significant changes in existing commercial arrangements. The proposal described herein is designed to apply universally without discriminating between nuclear weapon states and non-nuclear weapon states. It also seeks to preserve the existing commercial structure for providing enrichment services without placing onerous or undue restrictions on commercial firms that provide these services. In due course, it could be expanded to include other sensitive nuclear fuel cycle activities, such as commercial spent fuel reprocessing, whenever such activities begin to show a glimmer of commercial viability, and non-nuclear weapon states (beyond Japan) advance proposals to build and operate such facilities.

Central Elements of the Proposal

The central element of our proposal is the establishment of an International Nuclear Fuel Cycle Association that would be an independent organization alongside the IAEA, with a status similar to the IAEA; that is, the INFCA would not be part of the UN Secretariat but would be obligated by a formal agreement defining its relationship to the United Nations to report at least annually to the UN General Assembly regarding nuclear fuel cycle activities bearing on the continued maintenance of international peace and security. The INFCA would certify the initial configuration for peaceful use and the continuing operation of all uranium enrichment enterprises (and later other sensitive fuel cycle activities, such as reprocessing) in countries that seek to supply nuclear fuel cycle services to the global marketplace or receive services from it. The INFCA would enclose these activities within Internationally Secured Leased Areas (or ISLAs, which happens to be the Spanish word for "islands," fortuitously capturing the concept). The ISLAs would be leased by the association for the duration of construction, operation, and decommissioning of the sensitive fuel cycle facility, and the INFCA would provide continuous close monitoring and nonproliferation assurance for all such fuel cycle activities that come within its purview.

In the case of enrichment activities, for example, the INFCA's on-site presence would provide an uninterrupted capability for making recurring certifications that the enrichment activities of its members have not, are not, and cannot (in their existing configuration) be used directly for, or contribute enriched product to, the production of fissile materials for nuclear weapons without triggering an unambiguous, timely, high-confidence advance warning of such illegal activity. Issuance of such a warning would in turn lead to an immediate set of prescribed INFCA security responses at the site and immediate referral to the UN Security Council. The INFCA's purview would apply equally to enrichment activities in nuclear weapon and non-nuclear weapon states, including facilities not currently covered under existing IAEA or European Atomic Energy Community (Euratom) safeguards.

In short, the INFCA's prescribed authorities and immunities within the leased zone and continuous presence on the site are intended to enable improved performance of four key nonproliferation functions:

- The first concerns the IAEA's normally *retrospective* safeguards function: to more accurately determine what has actually occurred within a prescribed interval at the enrichment facility and detect any diversions or anomalies in relation to a country's or an enterprise's legal obligations under the NPT and relevant agreements with the IAEA and INFCA.
- The second function is to provide a safeguards capability with a better *predictive* component. Countries want to know not only what potential adversaries have already done that might be eroding their commitment to peaceful nuclear uses, but also what they might be *capable* of doing within a given time period and what the totality of the evidence suggests they are *intending* to do. Just as the IAEA reviews new plant blueprints and recommends design changes to improve safeguards, the INFCA and the IAEA would jointly exert similar authority over the physical configuration of future enrichment plants to enhance confidence in their

exclusively peaceful use for the production of low-enriched material. With a continuous on-site presence, INFCA would certify and monitor proposed modifications to the facility to ensure that these are constrained technically to the production of low-enriched material and remain limited to exclusively peaceful purposes.

- The third function is essentially a *deterrent* one. Embedding peaceful use enrichment facilities within a secure location leased to an international association with a charter from the international community to provide increased nonproliferation assurance considerably ups the ante for any government considering diverting or reclaiming such facilities for nuclear weapons use.
- The fourth function involves *enforcement*. To be responsive to situations in which a national government (or an agency or group within a government) chooses to violate its nonproliferation obligations, or the nominally responsible government appears on the verge of losing control over the security perimeter of the leased zone—or even the country as a whole—the INFCA’s founding statute and lease contracts would establish the necessary standing authorities to quickly mitigate the security and proliferation risks. Such specified predetermined responses could range from halting material flows in and out of the plant to, in an extreme case, physically disabling it, thereby significantly increasing the “conversion time” to weapons for the at-risk material and increasing the time available to the UN Security Council to mount an effective response.

The role of the IAEA would be strengthened, not diminished, by the creation of an INFCA. The IAEA would continue to establish safeguards requirements and conduct safeguards inspections, but under the INFCA arrangement it would have easier—indeed assured—access to all facilities located within INFCA-leased areas and an enhanced ability to monitor such facilities and to compel changes in operations where a facility or operator is not in compliance with IAEA safeguards. The INFCA likewise would have its own rigorous set of requirements regarding permissible civil facility configurations, enrichment levels and capacities, allowable feedstock and product inventories, and security arrangements that would need to be met to sustain member and wider international confidence in the INFCA’s nonproliferation assurance program.

The contractual and protocol arrangements between the INFCA and the member states establishing the ISLAs would be specifically designed to yield prompt resolution on matters in dispute, with compliance ambiguities resolved in favor of the precautionary principle: an activity that remains unexplained or murky within the context of an exclusively peaceful nuclear program will be treated as suspect, and immediate actions will be taken to curtail or terminate relevant fuel cycle activities until the matter is cleared up. This approach will prevent the type of prolonged standoff that has occurred between the IAEA and Iran, or earlier between the IAEA and North Korea, regarding swift and full compliance with safeguards obligations.

The INFCA will thus require its membership to run a very tight fuel cycle ship, including adoption of best available control technologies in all the covered facilities. This will lead to a general upgrading of operational standards among all members of the

association, including some nuclear weapon states not known for adherence to such careful control practices in the past.

Within the leased zone, the INFCA would possess stipulated and clearly delineated authority to monitor the facility in a manner that provides credible nonproliferation assurance, but it would normally have no responsibilities for day-to-day operations, operational safety, environmental protection, finance, or administration of the facility *unless* failure to properly execute these activities had a direct bearing on maintaining nonproliferation assurance—for example, failure to pay or train guards, failure to maintain detection equipment, or improper storage of hazardous materials in a manner that poses an explosion risk to agency personnel or accountability of safeguarded material.

We recognize that our concept of a continuous international monitoring and security presence, with carefully delimited powers to ascertain, certify, and ensure compliance with a clear set of nonproliferation and security requirements (but otherwise not interfering with the commercial and operational aspects of the uranium enrichment business) falls well short of “international ownership and control” of the uranium enrichment stage, much less the nuclear fuel cycle as a whole, as called for in some other proposals. This less-than-“visionary” approach is deliberate.

We are seeking to tread the fine line between political-institutional overreaching on the one hand and technical ineffectiveness on the other. Thus we seek institutional innovations only to the extent needed to achieve a high level of nonproliferation assurance. Like others, however, we see such arrangements as the beginning—not the end—of efforts to build the international frameworks and confidence required for a transition to a world without nuclear weapons.

There are several considerations that need to be addressed regarding any new structure for ensuring the exclusively peaceful use of nuclear fuel cycle activities, including:

- creation of an INFCA and its relationship to the IAEA;
- scope and timing of certification activities with respect to enrichment and other stages of the complete nuclear fuel cycle;
- international control and management structure of the INFCA;
- certification authority of the INFCA;
- enforcement of the terms of INFCA leasehold agreements;
- facility ownership and operations;
- liability;
- customer supply;
- component manufacturing, testing, and supply;
- IAEA safeguards;
- physical security;
- health, safety, and waste management; and
- INFCA financing and economic issues.

In the balance of this article, we address each of these considerations in turn. We offer recommendations but recognize these issues would be the subject of more extensive development and negotiation.

The Creation of an INFCA and the Role of the IAEA

To ensure the continuing credibility and independence of IAEA safeguards, the INFCA would be established as a separate, freestanding international association of states with industries that either provide nuclear fuel services or are major consumers of them, operating in parallel with the IAEA. The INFCA would have its own founding statute, ratified by its members, and an agreement, endorsed by the UN General Assembly, establishing the terms of its cooperation with and obligations to the United Nations. A similar agreement would define its relationship to the IAEA and set the terms of cooperation between the two organizations.

Alternatively, some observers have suggested that the INFCA could be established on a provisional basis as a semiautonomous group within the IAEA. Were this done initially, it could possibly make this proposal easier to achieve and speed its implementation. However, unless this were seen as a steppingstone to freestanding association status, it could weaken the long-term effectiveness of the INFCA by encumbering it with some of the procedural weaknesses and long-standing political fault lines associated with the current structure of the IAEA. It could also lead to confusion between the traditional materials accounting and inspection roles of the IAEA and the targeted institutional on-site presence and security mission of the INFCA as proposed here, which is complementary to but different from the IAEA's long-standing safeguards mission.

A major purpose of the INFCA is to provide an additional layer of nonproliferation assurance, *beyond that hitherto achievable within the terms of the NPT and the current safeguards system*, for certain types of sensitive nuclear fuel cycle facilities, so a new international body focused on this particular mission makes sense. Nonetheless, there would need to be a close working relationship between the new fuel cycle association and the IAEA, as a new protocol to existing safeguards agreements with the IAEA covering fuel cycle facilities would be the principal legal mechanism by which countries consent to provide this additional layer of nonproliferation assurance.

The relationship of the INFCA to the United Nations would be similar to that of the IAEA as described in the October 1959 IAEA information circular, "The Texts of the Agency's Agreements with the United Nations."¹⁰ The INFCA would have periodic—at least annual—reporting requirements to the UN General Assembly, and, like the IAEA, the obligation to submit reports to the Security Council "whenever, in connection with the activities of the Agency, questions within the competence of the Council arise."¹¹ INFCA's responsibility to the IAEA would be to ensure swift access by IAEA staff to sensitive fuel cycle facilities located within its secure leased areas, facilitate IAEA (or Euratom) monitoring activities, and take prompt and effective action when facilities are not in compliance with safeguards or security requirements by, for example, restricting or terminating the flow of materials into and out of the site, or, in an extreme case, imposing a complete shutdown.

States joining the INFCA would have to ratify and implement a new "Additional Protocol on Sensitive Nuclear Facilities" (AP-SNF) to existing safeguards agreements between the IAEA and its member states. Under an AP-SNF, member states would agree to nonproliferation assurance arrangements, which are described in greater detail below.

States that have not agreed to the AP-SNF *and* the existing Additional Protocol providing for IAEA inspections of undeclared sites would not be eligible to receive fuel cycle services from those states that have agreed to the AP-SNF. Similarly, states that adhere to the AP-SNF agree not to accept fuel cycle services from any state that has not agreed to it and the Additional Protocol. If a core group of key suppliers commits to this scheme, this would provide a strong incentive for all states that have enrichment plants and uranium-fueled reactors to ratify the AP-SNF.

Uranium enrichment services are now dominated by a few commercial and mostly state-owned enterprises, namely: EURODIF (services marketed by Areva); URENCO; Rosatom (foreign services marketed by TENEX); and the recently privatized U.S. Enrichment Corporation (USEC). These enterprises have large uranium enrichment plants located in the United States, France, United Kingdom, Netherlands, Germany, and Russia. These six major enrichment supplier countries—joined by Canada, Australia, and Kazakhstan, the three largest uranium suppliers—would be key players in any initial effort to implement this proposal. From a global political perspective, a key leadership role might be provided by leading non-nuclear weapon states with nuclear fuel cycle programs, such as Brazil, Japan, and South Korea.

The establishment of the INFCA would occur through the negotiation of a separate founding statute that would enter into force when signed and ratified by a specified number of original members. Countries joining the INFCA after its entry into force would accede to the statute by depositing their instruments of ratification with the UN secretary-general.

Countries ratifying the statute would be considered candidate members of the association and would not be entitled to the nuclear fuel service benefits and privileges of full membership until they signed and ratified the necessary protocols and ISLA contracts giving full force and effect to the operation of the association's nonproliferation assurance mechanism with respect to all their current and proposed sensitive nuclear facilities. The full cooperation of the IAEA would be required to qualify candidate members for full INFCA membership, as protocols to existing safeguards agreements would be one of the primary legal means of implementing the INFCA nonproliferation assurance mechanism.

Scope and Timing

As noted, INFCA's first mission would be to bring within its jurisdiction all uranium enrichment activities, including those not covered under existing IAEA safeguards. This could be followed, or even accompanied in certain cases, by extending its jurisdiction to cover:

- spent fuel reprocessing facilities, separated plutonium storage sites, and mixed oxide fuel fabrication plants;
- uranium conversion activities between the production of uranium concentrate (triuranium octoxide) and safeguarded fuel fabrication plants;

- any other intermediate product storage sites that, in the view of the association, pose a state-sponsored diversion or breach-of-physical-security issue; and
- sensitive fuel cycle research and development activities.

International Management Structure of the INFCA

The association's founding statute would establish the specific criteria and selection procedures for membership in the INFCA Board of Directors, requirements for all members for becoming and remaining members in good standing, and procedures for the removal of board members who fail to uphold these standards.¹² An Executive Committee would nominate, and the INFCA Board would approve, the senior officers of INFCA. We suggest for consideration the following governing structure of the INFCA Board and its Executive Committee.

The director general of the IAEA (or a designated representative) would have a permanent seat on the INFCA Board and on its Executive Committee but could not simultaneously be an executive officer of the association, and he or she would cast a vote only when needed to break a tie. The INFCA Board would have responsibility for establishing and amending INFCA policies and procedures.

The UN secretary-general and the IAEA director general would solicit nominations from governments and civil society organizations and then jointly propose a candidate for INFCA Board chair, whose selection would require confirmation by a three-fifths majority of the Executive Committee and the full INFCA Board. The chairperson would hold a voting seat apart from any membership that his or her home state might enjoy.

The Executive Committee would nominate (and the full INFCA Board would approve) selection of INFCA's executive director for operations, who would be the head of the INFCA staff. The chair and executive director for operations would be responsible for negotiating the terms of INFCA/member-nation contracts that cover the leasing of locations containing sensitive nuclear facilities, which would require ratification by the Executive Committee.

Each member state or (consortium of states) of the IAEA that has: a) commercial enrichment facilities that supply at least 1 million kilograms separative work units (SWU) per year to the commercial market; and/or b) sufficient commercial nuclear power reactors that together utilize 3 million kilograms SWU per year, would be provisionally entitled to membership on the INFCA Board and Executive Committee. Using these SWU production/consumption criteria, France, the URENCO consortium countries (Germany, Netherlands, and the United Kingdom), Japan, Russia, the United States, and China would hold the initial seats on the Executive Committee. These "SWU Criteria Members" would continue to hold the seats as long as they met the criteria. In the interest of maintaining geographic balance and equity, the URENCO consortium countries might reasonably consent to hold a joint seat on the Executive Committee that they would rotate among themselves, making a total of six quasi-permanent executive committee seats, while maintaining their individual seats on the full INFCA Board.

In addition to the INFCA chairman, the IAEA director general, and the initial eight SWU Criteria Members, a reasonable proposal for constituting the remainder of the

full INFCA Board would be to allocate seats to the ten additional countries that have some type of national fuel cycle facility under IAEA safeguards—Argentina, Belgium, Brazil, Canada, India, Iran, South Korea, Romania, Spain, and Sweden (the “Facility Criterion Members”)—plus the largest suppliers of uranium (i.e., more than 3,000 metric tons of uranium per year) to the world market not already included on the preceding two lists—Australia, Kazakhstan, Namibia, and Niger (the “Uranium Criterion Members”).

To address the predictable objection that a board thus constituted would not adequately represent the interests of smaller nuclear fuel customer nations that have refrained from developing sensitive nuclear fuel cycle facilities, seven additional regional rotating seats on the INFCA Board could be reserved for current and future nuclear fuel-consuming countries (the “Nuclear Customer Criterion Members”) that, within their respective regions, depend most significantly on imported nuclear fuel and are not otherwise represented on the INFCA Board. Accordingly, additional board seats would be allocated to countries representing the European Union, Eurasia (outside the European Union), Middle East/North Africa, sub-Saharan Africa, South Asia, East Asia, and Latin America.

If this proposal were adopted, one could expect in the near term to see the following dozen fuel-importing countries in the pool for the remaining seven rotating seats on the INFCA Board: Bulgaria, Czech Republic, Finland, Hungary, Lithuania, Mexico, Slovakia, Slovenia, South Africa, Switzerland, Taiwan, and Ukraine. Other countries would be eligible to join this pool when their fraction of nuclear generation to total electrical output (as measured in kilowatt hours) surpassed some agreed threshold, calibrated to reflect the extent of nuclear power development in their respective regions (e.g., 5 percent in Latin America, versus 30 percent in Europe). Counting the seats held by the INFCA chairman and the IAEA director general, this arrangement would yield a manageable initial governing board for the association of thirty-one members.

The members of the INFCA Board who were not SWU Criteria Members of the Executive Committee would be entitled to elect three of their number to fill rotating four-year slots on the Executive Committee, yielding an initial Executive Committee of eleven people (comprised of six SWU Criteria seats, three “at large” rotating seats, the INFCA chairman, and the IAEA director general, with the director general casting a deciding vote only on matters that are evenly divided within the Executive Committee). The size and composition of the board would evolve slowly over time as countries joined or departed the ranks of the four criteria groupings or moved from one group to another.

The INFCA’s Certification Authority

The member states’ nuclear regulatory authorities would continue to exercise licensing authority over uranium enrichment activities. Ongoing certification by the INFCA would be limited to a determination of whether facilities have been designed and constructed and are being operated in compliance with INFCA requirements as set forth in: its founding statute; INFCA cooperation agreements with the IAEA; the Additional Protocol

on Sensitive Nuclear Fuel Cycle Facilities (AP-SNF) that each member state would accede to; and the leasing contract(s) between the association and the relevant state agency or private entity that holds title to the land on which a sensitive nuclear fuel cycle facility is located.

The INFCA would certify existing and new uranium enrichment and reprocessing facilities that are placed within its jurisdiction and must, by design, be covered by ISLA contracts. Whether some or all of the other types of fuel cycle facilities potentially within its purview (such as fuel fabrication and uranium conversion plants) would likewise require enclosure within ISLAs, or merely rigorous international certification and improved safeguards, could be left to the discretion of the INFCA Board or its Executive Committee, based on the professional recommendations of its staff and the recommendations received from participating governments.

The INFCA-member contracts, and specific facility attachments thereto, would set forth basic threshold requirements related to ownership, operations, safeguards, physical security, and observance of existing international standards and conventions for protecting environment, safety, and health.¹³ The agreements would also specify limits on:

- enrichment level—for example, uranium-235 concentrations would be limited to levels under 20 percent, depending on customer requirements;
- plant capacity and configuration; and
- inventories of feed materials and enriched product stored at the site or other intermediate storage sites if these are specifically permitted by the terms of the INFCA-member agreement.

From a purely technical and economic perspective, global demand for uranium enrichment services could readily be met for the next several decades by upgrading technology and expanding capacity at existing uranium enrichment and conversion plants. Nonetheless, additional countries may wish to enter the enrichment market by constructing new facilities, possibly using new and more efficient technologies, or for reasons that are unrelated to ensuring security of fuel supply, such as a uranium-exporting nation (e.g., Australia or Canada) desiring to add value to its exports of uranium concentrate.

Before the INFCA could render a judgment on formal requests from a member state to certify a proposed new enrichment facility or expansion of an existing plant, the association staff, in consultation with the relevant staff of the IAEA, would prepare a “Nonproliferation Impact Statement” analyzing, among other things: the proposed civil purpose and economic rationale for the facility in light of other available sources of supply; the local and regional security environment for the facility; potential proliferation risks and impacts of the facility; and reasonable alternatives to it that might also satisfy its proposed legitimate purpose and need. This analysis would inform the INFCA’s preliminary assessment on whether or not it could reasonably provide nonproliferation assurance for the facility once constructed.

An initial INFCA determination that it could not provide such assurance could be met in one of four ways by the requesting country:

- (1) It could abandon the proposal and continue to rely on the international market.
- (2) It could modify the project's design in ways that are responsive to the INFCA's expressed concerns.
- (3) It could defer the proposal, if the INFCA had assessed it as technically and/or economically premature within the context and likely trajectory of the requestor's civil nuclear energy program.
- (4) It could reject the preliminary INFCA judgment and press ahead with the project, but without any certainty that the INFCA would ultimately consent to cover it with a nonproliferation assurance contract, thus risking exclusion from the legitimate international nuclear fuel services marketplace and a likely INFCA determination that the facility operating without such a contract represents an imminent threat to international peace and security.

While the INFCA itself would not have any direct environmental and safety oversight or enforcement authority, INFCA staff would have a binding fiduciary obligation to report any observed environmental abuses or safety concerns to the cognizant environmental, nuclear safety, public health, or occupational health and safety authorities of the member state and relevant international bodies.

The INFCA would also require that any formal request for certification be accompanied by an environmental impact statement, prepared by the appropriate national nuclear licensing or environmental protection agency of the member government, demonstrating facility compliance with all applicable international and national standards for radiation facility protection, nuclear security, radioactive and hazardous waste disposal, groundwater protection, and any other environmental requirements that apply to the facility under domestic or international law. (This document could assess environmental impacts with reference to national standards that were more but not less protective than prevailing international standards for the same parameter.) The INFCA would have no formal authority to review the adequacy of or demand changes in this document but would consider its findings and conclusions as part of any decision to certify a facility.

The Executive Committee would be responsible for reviewing and making recommendations to the full INFCA Board regarding any member-country request conveyed by the staff (with or without a staff recommendation) requesting INFCA certification for construction and operation of a new sensitive nuclear fuel cycle facility, and a three-fifths majority vote of the full board would be required to grant the certification. Since sensitive nuclear facilities are a matter of global security interest, it is only fitting that a robust majority of the INFCA membership has the final say on the matter.

Rejection of any certification request from a member in good standing would be "without prejudice" to the member returning at some later date to re-file its request. Countries still bent on exercising their full "rights" under the NPT, and not willing to take "no" or "wait a while" for an answer from a peer group of other nuclear states, could do so, but only at the cost of forfeiting their membership in the INFCA and the benefits it provides.

Long-Term “Nonproliferation Assurance” Contracts and Establishment of Internationally Secured Leased Areas

The INFCA would have the mandate and authority to enter into long-term contracts with its member states to create ISLAs. The INFCA would enter into such agreements with each state hosting or planning to host uranium enrichment (and, in due course, other fuel cycle facilities), for the purpose of establishing the operational parameters, portal-perimeter security, and other arrangements necessary to maintain a high degree of nonproliferation assurance regarding both the use of the facility and the nuclear energy activities of the country as a whole. Until such time as the covered nuclear facilities have been decommissioned, the INFCA-member lease contracts would confer on the association specified rights over all government or private reservations of land where uranium enrichment or spent fuel reprocessing facilities exist, or where new facilities are under construction.¹⁴

The INFCA’s leasehold rights over the ISLA would remain in force even if the state chose to withdraw from the NPT or its safeguards agreement with the IAEA, further curtailing whatever submerged motivations may exist to acquire nuclear fuel cycle facilities as part of a quiet dual-investment, national security hedging strategy, leading potentially to nuclear weapons acquisition at some later date. In short, a nation’s major investments in civil nuclear fuel cycle facilities would not be recoverable for later use in a weapons program without a major, unavoidable confrontation with the international community, as embodied by the INFCA and the IAEA and backed by the UN Security Council. While obviously not insurmountable, this is fairly high bar to such future “breakout.”

Under an AP-SNF, association members would cede any possibility of creating, converting, or utilizing any fuel cycle facility within the ISLA for nuclear explosive purposes for the entire period of construction, operation, and decommissioning of the facility, but their state-owned or commercial nuclear suppliers would continue to manage and operate the facilities located within the leased zone.

Safeguards and an IAEA-INFCA Agreement

The IAEA would retain responsibility for establishing safeguards requirements, conducting safeguards inspections, and enforcing the terms of safeguards agreements. The IAEA would prepare an IAEA-INFCA Agreement. This agreement would set forth the steps that the INFCA must take in the event that the IAEA finds that any state or INFCA-certified facility is not in compliance with an IAEA-state safeguards agreement. For example, the INFCA’s authority and obligations in this connection could include the following hierarchy of options: a) limiting the flow of materials into and out of the site; b) limiting personnel access to the site; c) shutting down any facility the IAEA deems not in compliance; d) taking operational control of materials and or equipment at the site; or in an extreme case, e) rendering the plant temporarily or permanently inoperable by disabling or destroying critical equipment.

The IAEA-INFCA Agreement would provide the IAEA with unimpeded access to the site for the purposes of monitoring and enforcing IAEA safeguards and provide the IAEA with the authority to establish independent monitoring of materials, equipment, and personnel entering and leaving the site.

Physical Security

We propose that the responsibility for day-to-day physical security at the facility level within an ISLA would continue to be the responsibility of the operating commercial entity or state-owned enterprises, as overseen by the regulatory and nuclear security authorities of the host government—as it is today. However, countries that today are accustomed to securing both military and declared civilian nuclear sites with the same internal security forces (or perhaps different guard forces that report to the same military command) would have to definitively alter this practice by developing entirely separate civil plant security forces that report to a strictly civilian nuclear energy agency or state corporation that has sole responsibility for the operational control of the facility. The INFCA, under its member state agreements, would be ceded the authority to establish, at or inside the ISLA's actual geographic external boundary, whatever access controls and procedures are necessary for the INFCA to carry out its monitoring and security tasks and to assist the IAEA in carrying out its tasks.

One way that this might work would be as follows. Consider the demanding case of large multi-unit facilities on large reservations. The member state would commit to ensuring the day-to-day physical integrity of a security-fenced outer perimeter and buffer zone surrounding the actual ISLA. On the inner edge of this buffer zone, the INFCA would establish its own highly automated and remotely monitored inner security barrier enclosing the ISLA, which would encompass the sensitive fuel cycle facility, all associated feed and product storage facilities, and other critical support and waste processing facilities.

Ingress and egress would be exclusively through one or more portals controlled at all times by INFCA security and technical monitoring personnel. Shipments of feed materials in (and product or waste materials out) would be allowed only at designated portals at designated times, using designated standard types of canisters and equipment to facilitate accurate monitoring. Individual security perimeters and access controls at individual facilities and highly secured areas within the zone would be the responsibility of the individual commercial enrichment and conversion enterprises, which would continue to operate under private, state, or multinational ownership, much as they do today. INFCA personnel with special clearances would have unfettered right of access to all inner security areas to conduct inspections.

While the day-to-day responsibilities for site and fissile material security would be shared, as outlined above, countries with sensitive nuclear fuel cycle facilities that join the INFCA would do so with the full understanding that a major purpose of the association is to improve international confidence in the security of the site and fissile materials in times

of severe stress, such as war, civil unrest, mutiny, terrorist assault, or breakdown in the duly constituted organs of government. In such times, the INFCA's executive director and board chairman could exercise INFCA's inherent authority to prevent the misuse or loss of sensitive materials and equipment held within the ISLA by supplementing, replacing, or taking command of all the security forces at the site.

In acceding to the INFCA statute, members would commit to never launch military attacks against facilities within an ISLA as long as INFCA's control perimeter remained secure and inviolate. Member states would further commit to supplying on short notice, when called upon by the INFCA's executive director, an agreed number of reserve security forces that have been specially trained for this type of mission to reinforce INFCA site security personnel.

Such "emergency security responses" (ESRs) undertaken by the Executive Director would require explicit extension, modification, or cancellation by a majority of the INFCA Executive Committee within fifteen days, and similar consideration by the full INFCA Board within thirty days. But an ESR request originating with or endorsed by the director general of the IAEA in response to evidence of a safeguards violation could not be reversed by the INFCA Executive Committee, and terminating such an ESR would require a three-fifths majority vote of the INFCA Board. In other words, the "default setting" of the system would favor and empower immediate responsive action, rather than inaction, as is the case today.

A provision of the INFCA Member Agreement would also provide that in the event of war, civil strife, or credible warning of a terrorist threat to the facility, the Executive Committee of the INFCA Board could also call upon the security forces of the United Nations, or any state or group of states represented on the INFCA Board, to provide trained security personnel to bolster the security of an INFCA site.

Enforcement of INFCA Agreements

One of the glaring weaknesses in the current safeguards regime is the lack of enforcement and the seemingly endless debate within the IAEA and the United Nations about what kind of sanctions to apply in the event that a state is not in compliance with its IAEA safeguards obligations. Under this proposal, the member state and secure leased-area agreements would include predetermined provisions and limitations on the activities of the facility and the member state in the event of noncompliance with IAEA safeguards or INFCA's certification requirements.

The executive director and Executive Committee of the INFCA Board would have immediate responsibility for enforcing the conditions of the INFCA agreements and any IAEA safeguards agreements referenced in the INFCA agreement with the member state. As outlined above for site security, in response to evidence of safeguards noncompliance the executive director would be granted the short-term discretionary authority to restrict or end the flow of materials and equipment to and from any facility within an ISLA and to immobilize or impound the materials, equipment, records, and other assets at any covered

site. The Executive Committee would be required to consider and act upon the matter within fifteen days, and the full INFCA Board within thirty days.

In the event of severe cases of noncompliance, amounting to open defiance of a member state's agreements with the association, the Executive Committee would have the authority to call upon the United Nations, or any state or states represented on the INFCA Board, to provide additional security forces if needed to enforce INFCA's certification requirements. In the case of less-than-severe disagreements or non-imminent threats, the association would be obligated to take due care not to cause damage to the facility while resolution of the problem is under review. But when circumstances warrant, under its facility attachment with the private, national, or multinational operating company, the association would have the inherent authority to shut down or disable a member facility if a loss of control over the association's site perimeter appeared imminent or a member state remained in open defiance of its obligations under the INFCA-state agreement.

We believe the territorial leasing requirement and other aspects of this proposal will significantly reduce the likelihood that any member state (or political-military element within a state) would attempt to break out of the international safeguards regime and use its fuel cycle facilities for weapons purposes. The INFCA-Site Owner Lease Agreement would give rise to binding legal obligations that are independent of a state's NPT and IAEA obligations. So, even if the state withdrew from the NPT and terminated its IAEA safeguards agreement, it would still be legally bound by its lease agreement with the INFCA, a UN-affiliated international association. More importantly, the cooperative and non-discriminatory nature of the association—and the assured market access it provides to all members in good standing—offers significant economic incentives not to rock the boat with proliferative behavior.

We recognize that some states, at least initially, would seek to limit the enforcement authority provided to the INFCA in its statute. The degree of enforcement authority granted to the INFCA ultimately boils down to a trade-off between an individual state's desire to reserve ultimate control over sensitive fuel cycle facilities in order to preserve a military security hedge and its desire to live in a global and regional security environment that is significantly less vulnerable to NPT breakout, undeclared nuclear activities, and covert acquisition and manufacture of fissile material production equipment.

Facility Ownership and Operations

Productive capital assets at the enrichment and conversion sites would be owned by commercial entities, including private, state-owned, quasi-governmental, and multinational enterprises. The company or companies currently responsible for operating enrichment and conversion facilities would have to meet the INFCA's certification requirements. Similarly, new enrichment facilities built and operated by commercial entities would have to conform to the INFCA's certification requirements. The leasing arrangement would resemble the operation of enrichment plants by USEC, the

“privatized” U.S. enrichment enterprise spun off from the U.S. Department of Energy in the 1990s, on sites that are still owned by the U.S. government. The difference is that the plants would be located within secure, international leasehold sites under the long-term control of the INFCA, rather than on real estate exclusively controlled by national governments or private entities.

Over time, the cooperative association structure would lend itself to furthering licensed production ventures and multinational partnerships in new fuel cycle enterprises, and the INFCA’s certification requirements for new facilities could state a preference for such arrangements over purely national forms of ownership.

Liability

The AP-SNF and the INFCA-State Lease Agreements would absolve the INFCA of any commercial, environmental, or personal injury liabilities associated with the INFCA leasehold on the site. In effect, under our proposal, the apportionment of liability under existing national laws and international conventions would remain unchanged, and the operating nuclear companies or consortia (or their state shareholders) would remain the financially responsible parties.

Customer Supply

Customers would order fuel cycle services from facility operators, just as they do today. The INFCA would have the ultimate responsibility and obligation to insure that all financially solvent members who are in full compliance with their IAEA safeguards and INFCA agreements would have available to them sources for obtaining uranium concentrate and conversion, enrichment, and fuel fabrication services. The INFCA could be granted standby authority (including access to a bridge financing mechanism) to be used as necessary in the event of a breakdown in commercial supply arrangements to facilitate—or in the extreme case to overtly direct—the delivery of fuel cycle services to customers from member enrichment facility operators and/or fuel fabricators.

The INFCA would have no obligation, however, to provide a country resorting to such a standby mechanism with *subsidized* access to fuel cycle services. Security of supply would be guaranteed at fair world market prices. While nuclear fuel is normally a fairly small component in the overall delivered cost of nuclear power, this technology is an inherently costly way to boil water to generate electricity, and the purpose of the INFCA would *not* be to encourage the spread of nuclear power by subsidizing or otherwise disguising its true cost.

The INFCA would take over responsibility for managing existing and proposed buffer stocks—so-called “fuel banks”—of enriched product in the form of uranium oxide. Consequently, it is unlikely that the INFCA’s standby authority would ever need to be exercised, except possibly in the case of a disruption of fuel fabrication services to a customer otherwise in good standing.

Component Manufacturing, Testing, and Supply

The INFCA would be granted authority to maintain a list of critical uranium enrichment components, materials, and dual-use equipment. Only manufacturers certified by the INFCA would be permitted to produce selected critical components for member state facilities. The INFCA would certify existing and new facilities that manufacture and test critical sensitive facility components. Manufacturing and testing such components without a valid INFCA certification would represent a serious breach of a country's INFCA obligations. Brokerage and resale of non-certified components by INFCA members would be prohibited.

An even more secure option would be to require that all purchase orders for items on a short list of critical enabling enrichment components be placed through an INFCA clearinghouse. Manufacturers would also be required to notify the INFCA every time they received orders for or shipped such critical components ostensibly for uses other than uranium enrichment. The INFCA would maintain a secure registry and would thus be aware of every such legitimate purchase order, shipment, and delivery. End-users would notify the INFCA's registry when and where they took delivery of a given batch of sensitive nuclear components. Each unit in a batch of sensitive components would be assigned a unique and difficult-to-replicate "tag" indicating the location and date of production, status as an INFCA-licensed product, and the intended customer facility for which it was produced.

Critical components not bearing this tag could not be used in any new INFCA-licensed facility or facility expansion, and the discovery of a tagged product in an uncertified facility could subject the producer to immediate suspension of certification and potentially permanent exclusion from the legitimate commercial marketplace while INFCA investigated how the diversion occurred. The objective of this system is to sharply differentiate between the legitimate and black markets for sensitive fuel cycle technology, in order to extinguish the latter. The incremental costs of this tightly regulated supply system—a necessary cost of reducing the proliferation risk of nuclear power generation—would be rolled into the association's tariffs levied on SWUs and thus ultimately reflected in the downstream retail cost of nuclear electricity.

Health, Safety, Waste Management, and Supply Chain Certification

The INFCA's initial mission would be narrowly defined—providing significantly improved and durable "nonproliferation assurance." At some later date, consideration could be given as to whether the INFCA's role should be expanded to include responsibilities for establishing and strengthening baseline international health, safety, environmental, and waste management/disposal criteria and requirements at facilities under the INFCA's purview and throughout the nuclear fuel supply chain. The INFCA's role also could be expanded to include responsibility for enforcing these international standards.

The eventual extension of the INFCA's authority into this realm would have the virtue of ensuring that competition in the future nuclear fuel supply chain is based on the

comparative efficiency and environmental compatibility of mining and processing technologies and operations, and not on a “race to the bottom” propelled by exploiting national differences in environment, safety, and health standards or enforcement.

Member states would retain the discretion to establish more (but not less) protective health, safety, environmental, and waste management standards and the right to enforce facility compliance with these more protective standards. The INFCA would facilitate access by member-nation regulators to examine environment, safety, and health records and make independent environmental measurements within the site security boundary.

Association Financing and Economic Issues

The INFCA would establish a schedule of tariffs on enrichment services sufficient to cover the full cost of its operations. Since the SWU-cost represents a small fraction of the levelized, fully amortized cost of nuclear-generated electricity, these tariffs would not adversely affect the economic viability of nuclear power.

At current SWU prices, a modest tariff of perhaps 5 percent tacked on to the market price of an SWU would yield on the order of \$250 million per year to fund INFCA operations. Because every enrichment market participant would pay these costs, there should be no adverse market impact on an enrichment enterprise’s comparative market position due to the imposition of this tariff. A similar fee could be assessed on each metric ton of heavy metal entering a reprocessing plant or on each kilogram of separated fissile material product that emerges at the other end.

An alternative would be for the INFCA to establish an annual fee to cover the cost of its activities at each facility or class of facilities under its purview. A new member state joining the INFCA would be assessed an initial fee to cover the startup costs of launching nonproliferation assurance operations in its national territory. These funds could be drawn from bloated national military budgets now devoted almost entirely to nuclear deterrent and other military responses to the proliferation problem.

The INFCA would require similar surcharges on other stages of the fuel cycle as they are brought within its purview. The intent is for the INFCA to be self-sustaining, based on the premise that its costs are a legitimate and necessary part of managing the risks associated with using the nuclear fuel cycle; these costs deserve to be reflected in the retail cost of nuclear-supplied electricity. Detailing of member government laboratory experts for rotating tours with the association, and other types of in-kind contributions, could obviously supplement its budget but would not be expected to play a major part in overall funding.

Conclusion

We believe the proposal set out here directly addresses the strategic nuclear security concerns of states in ways that other proposals offered to date do not, and does so in a

way that minimizes discrimination in the treatment afforded nuclear weapon versus non-nuclear weapon states. Other proposals do not seek to remedy weaknesses in the enforcement of IAEA safeguards requirements or to substantially diminish both NPT breakout risk and the nuclear arms elimination barrier represented by the existing stock of nationally controlled sensitive nuclear fuel cycle facilities in both nuclear weapon and non-nuclear weapon states.

That said, it is also worth noting that this proposal does not conflict with most other proposals, which largely concern the creation of an international fuel bank and various schemes for “multilateralizing” the ownership and operation of nuclear fuel cycle facilities. These proposals are briefly reviewed in Appendix A below. Appendix B attempts to summarize the application of our proposal to the “hard case” of Iran without presuming that what we propose would, in practical political terms, be any more successful than what has already been tried.

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NOTES

1. “A Report on the International Control of Atomic Energy,” March 16, 1946, p. 11, <www.fissilematerials.org/ipfm/site_down/ach46.pdf>.
2. Ibid.
3. For a summary of technical inadequacies in the current international safeguards system, see Christopher E. Paine, Thomas B. Cochran, and Robert S. Norris, “Technical Realities Confronting Transition to a Nuclear Weapon Free World,” in *Background Papers* (Canberra: Canberra Commission on the Elimination of Nuclear Weapons, 1996), p. 109.
4. Treaty on the Non-Proliferation of Nuclear Weapons, July 1, 1968, Article X.
5. See Thomas B. Cochran and Christopher E. Paine, “The Amount of Plutonium and Highly-Enriched Uranium Needed for Pure Fission Weapons,” Natural Resources Defense Council, Nuclear Weapons Databook monograph series, April 13, 1995, <docs.nrdc.org/nuclear/files/nuc_04139501a_144.pdf>.
6. The International Commission on Nuclear Non-Proliferation and Disarmament noted in its November 2009 report that “any new binding international norm stipulating that sensitive fuel cycle activities must be conducted exclusively in the context of a multilateral arrangement and no longer as a national undertaking, would amount to a reinterpretation of Article IV of the NPT and the right specified therein for each party to pursue their own national programs. Such a reinterpretation might not be entirely impossible, but would likely only be agreed in the context of a broader negotiation in which all existing facilities, wherever located, in nuclear weapons states or elsewhere, would need to be subsumed unto the new arrangement. Any new restrictions on independent national operations would need to apply to all, including non-NPT, nuclear armed states as well as to non-nuclear-weapon states, thus bringing them to the same level of obligation as the latter.” We have sought to satisfy this criterion in the design of this proposal. See Gareth Evans and Yoriko Kawaguchi, “Eliminating Nuclear Threats: A Practical Agenda for Global Policymakers,” International Commission on Nuclear Non-Proliferation and

Disarmament, 2009, p. 144, <www.icnnd.org/reference/reports/ent/contents.html>. While we believe protections sufficient to ensure that peaceful nuclear cooperation does not undermine the basic nonproliferation obligations of the NPT (Articles I and II) are explicitly required by the plain language of Article IV and common sense notions of legal interpretation—i.e., ancillary or collateral rights should not be construed in such a way as to undermine or defeat the fundamental purpose of a statute, and therefore no legal “reinterpretation” is necessary—we note that our proposal represents a fusion of national and multilateral approaches that would not deny the “right” of countries to their “own national programs,” but would rather make these subject to a form of multilateral, nondiscriminatory collective supervision in which all countries with such national facilities would be both eligible and strongly encouraged, but not required, to take part. The consequence of declining to provide this added layer of cooperative nonproliferation assurance would represent not the loss of a national “right” to pursue peaceful nuclear technology under existing IAEA safeguards, but rather the *exercise of the inherent right of other nations* not to cooperate in the nuclear sphere with a country that elects not to provide such added assurance that sensitive nuclear fuel cycle activities are indeed conducted “in conformity with Articles I and II of this Treaty.” Similarly, the “right to *participate* in the fullest possible exchange” of technology for the peaceful uses of nuclear energy under Article IV does not give any individual nation an unqualified right to dictate the terms of its participation in such exchanges with other NPT parties, without regard to their views regarding what “peaceful” nuclear fuel cycle arrangements are “possible” and yet still “in conformity with” the treaty’s basic obligations. In short, any enhanced nonproliferation assurance arrangement will likely have to encompass both national and multilateral nuclear enterprises—as both already exist—but do so in a way that makes non-membership a possibility but by no means cost-free to those who would opt out of the voluntary arrangement. Maintaining a future “right” or “option” to misuse peacefully acquired nuclear facilities in a future nuclear weapons program would come at a price, hopefully a steep one.

7. See Appendix A for a discussion of other proposals that involve some form of international control of various stages of the nuclear fuel cycle.
8. See Pierre Goldschmidt, “Concrete Steps to Improve the Nonproliferation Regime,” Carnegie Endowment for International Peace, Nonproliferation Paper no. 100, April 2009; and Pierre Goldschmidt, “Multilateral Nuclear Fuel Supply Guarantees and Spent Fuel Management: What are the Priorities?” *Daedalus* 139 (Winter 2010), pp. 7–19. The American Academy of Arts and Sciences (AAAS) has continued the discussion in a recent booklet that focuses primarily on the back end of the nuclear fuel cycle. See Charles McCombie et al., “Multinational Approaches to the Nuclear Fuel Cycle,” AAAS, 2010.
9. Yury Yudin, *Multilateralization of the Nuclear Fuel Cycle: Assessing the Existing Proposals* (Geneva: United Nations Publications, 2009). Yudin has since expanded on his earlier analysis in *Multilateralization of the Nuclear Fuel Cycle: The Need To Build Trust* (Geneva: United Nations Publications, 2010). This new analysis is more a survey of the political obstacles facing a more effective regime than an attempt to formulate a specific solution to the NPT’s conundrum of peacefully proliferating the inherent technical capacities for treaty breakout and future weaponization. Nonetheless, Yudin concludes, “The majority of NPT states parties recognize the risks arising from the proliferation of these technologies and diversion or misuse of nuclear materials, but many find it difficult to accept arrangements that would codify a ‘two-tier’ system, where some states are entitled to certain nuclear fuel cycle technologies, and others are not” (p. 54). We believe Yudin is correct on this point, and yet it also follows that if a more effective arrangement could be found that did *not* “codify,” in Yudin’s phrase, “a new discriminatory system of ‘haves’ and ‘have nots,’” there might be a chance for a political consensus to emerge in support of it. This article represents our attempt to formulate such an effective but “nondiscriminatory” arrangement.
10. IAEA, “The Texts of the Agency’s Agreements with the United Nations,” INFCIRC/11, October 30, 1959, <www.iaea.org/Publications/Documents/Infircs/Others/infirc11.pdf>.
11. *Ibid.*, p. 3.
12. Given the vital nonproliferation assurance mission of the association, and the importance of countries attaining and adhering to certain required standards and practices before enjoying the full benefits of peaceful cooperation and trade in nuclear fuel services, not all countries that fit the nuclear facility or power generation criteria for membership may qualify immediately for full membership because of their possible failure, in the view of the secretary-general, to conduct their activities “in accordance

with the Purposes and Principles of the United Nations Charter, and in conformity with the establishment of safeguarded worldwide disarmament and in conformity with any international agreements entered into pursuant to such policies." See IAEA, INFCIRC/11, Article 1, Principles, para. 4. Such members would be classified as "candidate members" of INFCA until all the requirements of the necessary protocols and contracts with the association had been met and had entered into full force and effect.

13. For example, to help ensure future peaceful uses, these agreements could preclude ownership or operation of enrichment plants by military establishments or other bodies with national defense functions.
14. This would be similar to the "Multilateral Enrichment Sanctuary Project" under the German proposal. See Appendix A of this paper for a brief description and references.

Appendix A: Selected Previous and Current Proposals for International Control of the Nuclear Fuel Cycle

"Acheson-Lilienthal Plan" of 1946. The scheme proposed in the preceding article differs substantially from prior proposals for "international control," but the general concept of "internationalizing" various stages (or indeed all of the nuclear fuel cycle) has a long history, stretching back to the original so-called Acheson-Lilienthal Plan of 1946 for comprehensive international control of the intrinsically "dangerous activities" of atomic energy, including an international monopoly on uranium mining and enrichment.¹ Reading this insightful document today is humbling, not only for the clear view it provides of the road not taken, but also because it stands as eloquent testimony to the fact that the fundamental dimensions of the nuclear nonproliferation problem were grasped accurately and early in the nuclear age, and that there is little that is really new in the field of nuclear nonproliferation, despite all the ink that has been spilled on it. What is new is that modern surveillance and communications technologies have created a more transparent world than in 1946, possibly allowing for the adoption of "international control" concepts that are less politically demanding than international ownership and control of the entire fuel cycle.

U.S. Nuclear Non-Proliferation Act of 1978. Although little remembered today, Section 104 of the U.S. Nuclear Non-Proliferation Act of 1978 [22 U.S.C. § 3223 (a)] remains legally binding in the United States and actually directs the president to:

institute prompt discussions with other nations and groups of nations . . . with a view toward the timely establishment of binding international undertakings providing for:

- (1) The establishment of an international nuclear fuel authority (INFA) with responsibility for providing agreed upon fuel services and allocating agreed upon quantities of fuel resources to ensure fuel supply on reasonable terms in accordance with agreements between INFA and supplier and recipient nations;
- (2) a set of conditions . . . under which international fuel assurances under INFA auspices will be provided to recipient nations, including conditions which will ensure that the transferred materials will not be used for nuclear explosive devices;

- (3) . . . feasible and environmentally sound approaches for the siting, development, and management under effective international auspices and inspection of facilities for the provision of nuclear fuel services, including the storage of special nuclear material;
- (4) the establishment of repositories for the storage of spent nuclear reactor fuel under effective international auspices and inspection;
- (5) the establishment of arrangements under which nations placing spent fuel in such repositories would receive appropriate compensation for the energy content of such spent fuel if recovery of such energy content is deemed necessary or desirable; and
- (6) sanctions for violation of the provisions of or for abrogation of such binding international undertakings.ⁱⁱ

In negotiating such "binding international undertakings," Sec. 104 directs that the president "seek to ensure that the benefits of such undertakings are available to non-nuclear-weapon states only if such states accept IAEA safeguards on all their peaceful nuclear activities, do not manufacture or otherwise acquire any nuclear explosive device, do not establish any new enrichment or reprocessing facilities under their de facto or de jure control, and place any such existing facilities under effective international auspices and inspection."

International Nuclear Fuel Agency proposal, 1983. In view of the particular proliferation threat posed by the spread of multiple and relatively compact uranium enrichment technologies under purely national auspices, an extensive 1983 analysis by four technical experts affiliated with the Stockholm International Peace Research Institute (SIPRI) concluded that "the enrichment industry should be internationalized, possibly along the lines of an international nuclear fuel agency (INFA)."ⁱⁱⁱ

The experts proposed that "all national enrichment facilities should be brought under the authority of this agency, which would own and operate them in response to national demands for enrichment services." Such an agency would be responsible for "the production, distribution, and safeguarding of enriched uranium." In their scheme, "all research and development on uranium enrichment should be conducted by INFA," further development of proliferation-prone centrifuge and laser enrichment techniques would be terminated, no new national enrichment facilities would be built, INFA membership would be required for the receipt of nuclear fuel services and would not be subject to a withdrawal provision, INFA would have "the power to enact sanctions against states that either violate their agreements or withdraw from the agency, and "technical and administrative aspects of safeguards on enrichment facilities should be improved substantially."^{iv}

U.S. Security Assistance Act of 2008. Section 422 of this bill (which was reported by the Committee on Foreign Relations to the full Senate on September 24, 2008 but did not become law) would have required the president to report to Congress regarding "establishment of an international nuclear fuel authority." The bill highlights Senate interest in some of the same issues considered in this paper:

- (a) Report Required—Not later than 180 days after the date of enactment of this Act, the President shall submit to the appropriate congressional committees a report detailing the feasibility of establishing an International Nuclear Fuel Authority (INFA) as called for in section 104 (a)(1) of the Nuclear Non-Proliferation Act of 1978 (22 U.S.C. § 3223(a)(1)).
- (b) Content—Without regard to any previous reports submitted under section 104 (a)(1) of the Nuclear Non-Proliferation Act of 1978 (22 U.S.C. § 3223), the report required under subsection (a) shall evaluate, with respect to the feasibility of the establishment of the International Nuclear Fuel Authority, the following:
- (1) United States laws and regulations that could be affected by the establishment of an INFA.
 - (2) What the cost to the United States Government could be of establishing an INFA.
 - (3) Potential locations for the INFA.
 - (4) The potential for creating a fuel supply bank under the control of the INFA.
 - (5) Nuclear materials that should be placed within the control of the INFA, including which nuclear activities should be carried out by the INFA for the production of nuclear fuel or for use as fuel.
 - (6) Whether the INFA should provide nuclear fuel services to recipient countries.
 - (7) Whether a multilateral supply mechanism, such as the INFA, is, in the judgment of the President, superior to bilateral mechanism for nuclear fuel supply.
 - (8) How such an international organization should operate to preserve freedom of markets in nuclear fuel and avoid undue interference in the efficient operation of the international nuclear fuel market.
 - (9) The degree and extent to which such a multilateral supply mechanism should be under the control of, or a subordinate organization within, the IAEA, including whether establishing such an INFA would be superior or preferable to allowing the IAEA, pursuant to Article IX of the Statute of the IAEA, to become an international broker of nuclear fuel and nuclear fuel services, including with respect to an examination of the costs to IAEA Member States of effectively carrying out clauses (1) through (4) of paragraph (H) of such Article.
 - (10) The likely receptivity of the major countries involved in the supply of nuclear fuel and nuclear services to the creation of a multilateral supply mechanism such as the INFA or one under the IAEA.^v

Current international proposals. Seven of the twelve proposals compared in Yury Yudin’s review for the UN Institute for Disarmament Research address nuclear fuel supply assurance.^{vi} These include:

- a September 2005 U.S. proposal for a reserve of nuclear fuel;
- a May 2006 World Nuclear Association proposal;
- a June 2006 concept for a “Multinational Mechanism for Reliable Access to Nuclear Fuel,” proposed by France, Germany, the Netherlands, Russia, the United Kingdom, and the United States;
- a September 2006 proposal by Japan for “IAEA Standby Arrangements”;
- the Nuclear Threat Initiative’s September 2006 proposal for an “IAEA Fuel Bank”;

- the United Kingdom's September 2006 "Enrichment Bond Proposal," now called the "Nuclear Fuel Assurance Proposal"; and
- the June 2007 Nuclear Fuel Cycle "non-paper" by the European Union.

Many experienced observers do not believe that fuel assurance is a serious issue for anyone, save those who have enmeshed themselves in a serious, unresolved IAEA safeguards problem. But if it *were* a serious issue, having access to enriched uranium hexafluoride or enriched uranium oxide would not completely resolve it because the customer still needs assured access to a fuel fabrication supplier, if not also a uranium conversion facility.

Under the proposal presented in the preceding article, the INFCA is the ultimate guarantor of nuclear fuel services to all members in good standing who are in compliance with IAEA safeguards and have sufficient good credit to arrange payment for the services. Moreover, any of the fuel assurance proposals could be incorporated readily into our proposal by having the INFCA manage the fuel bank and/or fuel assurance activities.

Other proposals reviewed by Yudin lack the universality and/or non-discriminatory aspects of the INFCA proposal:

- Russia's January 2006 "Global Nuclear Power Infrastructure" proposal envisions creating a system of international centers for front- and back-end nuclear fuel cycle facilities under the control of the IAEA. In May 2007, Russia proposed the Russian International Uranium Enrichment Center at Angarsk. These proposals do not address existing or future national enrichment and conversion facilities that do not become international enrichment centers. In any case, the Angarsk Electrolysis Chemical Complex and similar centers could easily be incorporated into the INFCA proposal, although the centers would fall under the purview of INFCA rather than the IAEA.
- In February 2006, under the George W. Bush administration, the United States proposed the "Global Nuclear Energy Partnership" (GNEP). The GNEP program as previously conceived has been terminated by the Obama administration. The program is now known as the International Framework for Nuclear Energy Cooperation, although closed fuel cycle research and development will continue, and the cooperative diplomatic elements of GNEP related to assurance of fuel supply have been retained and may even be expanded.
- The May 2007 Multilateral Enrichment Sanctuary Project (MESP) proposal from Germany is an earlier proposal that somewhat resembles our own. The MESP would be a multilateral enrichment facility established by a group of interested states on an extra-territorial basis in a member state and supervised by the IAEA but owned and operated by a multinational commercial consortium.^{vii} However, we believe we have strengthened the German proposal by expanding the sanctuary concept to apply to all enrichment plant sites, both existing and proposed, and by shifting supervision of non-safeguards issues—including new defenses against breakout—from the IAEA to a smaller, independent, and potentially more agile body, the INFCA.
- In May 2009, Austria submitted a working paper to the IAEA on "Multilateralisation of the Nuclear Fuel Cycle: Increasing Transparency and Sustainable

Security.”^{viii} While representing only a vague sketch of an international process—led by the IAEA—for transitioning to full multilateralization as the long-term remedy for the ongoing NPT withdrawal/breakout threat, the working paper correctly identified the nature of the problem, which cannot be said of many other state proposals:

Because of its inherent dangers, nuclear technology continues to represent the potentially most destructive threat to global security. Every expansion in the use of nuclear power leads to the spread of fuel cycle services, thus increasing the risk of misuse for non-peaceful purposes, whether by States or non-State actors. The anticipated rise in demand for fuel cycle services, as well as the associated risks of weapon proliferation, nuclear terrorism, illicit trafficking, and accidents involving radioactive materials requires new frameworks for reducing the threat of misuse—or careless use—of nuclear energy.

As we strive for the complete elimination of nuclear weapons, and as this goal begins to see reflection in the official policies of nuclear-weapon States, the need for a long-term vision to address nonproliferation concerns gains increasing urgency. Given the mutually reinforcing nature of disarmament and non-proliferation efforts, it is vital to ensure that any progress towards disarmament of nuclear weapons is not hindered in any way by concerns over non-proliferation.^{ix}

The envisioned future end-state of the Austrian proposal would ultimately ban ownership and operation of nuclear fuel cycle facilities under solely national auspices, but the specific institutional mechanisms and political-economic incentives for getting to this result remain obscure (a gap we have sought to remedy in our present proposal). The transition process outlined by Austria would begin by the IAEA assuming a comprehensive role for ensuring global transparency of all activities affecting the nuclear fuel cycle, by maintaining what amounts to a near-real-time data base on all nuclear facilities, activities, and transactions from the uranium mine to the spent fuel repository.

In parallel to this decision to establish a “cradle to grave” information system, the IAEA would be granted “the mandate to act as a mandatory virtual broker in all transactions related to the nuclear fuel cycle. The virtual broker arrangements would apply to all transactions involving source or fissionable materials—regardless of the stage of processing—as well as fuel cycle services such as uranium conversion, uranium enrichment, reprocessing, and disposal and storage of spent fuel and other radioactive waste.”^x As a virtual broker, the IAEA would not take physical possession or legal title of the nuclear materials or services in question, but would oversee the course of each transaction via its database and maintain the readiness to match suppliers and customers in the event of market failures unrelated to NPT or safeguards compliance issues, resorting to its own “fuel bank” if necessary.

The stage of actual “multilateralization” is the fuzziest part of the Austrian proposal: “As regards existing national facilities, incentives should be provided to encourage broader involvement by interested States, for instance by permitting them to become

shareholders, influence strategic decisions at the facilities in question, and share profits and responsibilities.^{xi} This approach neglects the fact that some nuclear fuel cycle facilities, such as fuel fabrication and conversion plants, are privately owned, while others are owned or operated by quasi-private state corporations. In either case, the incentive for sharing significant fractional ownership with foreign governments is unclear. The proposal also envisions the creation of new regional multilateral fuel cycle facilities, along the lines of the German MESP proposal. The IAEA “would have a role to play in certifying” such regional facilities, “in order to guarantee high standards of safety and security,” but the threat posed by the NPT’s withdrawal clause is not explicitly dealt with.

Unfortunately, the Austrian proposal then does an about-face—undermining any possibility of achieving a transformational leap in international confidence any time soon—by declaring: “In order to avoid any potential conflict with Article IV of the NPT, participation in a multilateral or regional fuel cycle facility would not require a State formally to forgo the right to development of national facilities, but it is expected that the incentive to develop national facilities would be greatly diminished, particularly as confidence grows over time in the ability of a regional facility to satisfy all fuel and fuel service demands.”^{xii} The proposal also argues that the “involvement of multiple partners would act as a barrier to ‘break out’ from civil nuclear energy programmes to nuclear weapon programmes,” but it seems this argument really only applies to the host nation’s future misuse of the shared facility, and not to its foreign partners, who would not be so constrained, and might even technologically advance their own national fuel cycle (and weapons) options by “participating” in such a facility. Without a parallel commitment to forego independent national fuel cycle facilities as the price of “multilateral” peaceful nuclear cooperation, the Austrian proposal, while well intended, appears insignificant from a strategic security perspective, especially in the near term, when more effective arrangements are urgently needed.

According to the Austrian proposal, “at the end of the process, all fuel cycle facilities worldwide would be under multilateral control,” but the actual “control” concept is never elaborated and seems to be implicitly equated with “shared ownership,” which could in some cases actually dilute the effectiveness of security and technology controls. “IAEA verification would become more efficient and less costly, as a number of facilities could be expected to shut-down, leading to a more limited number of larger facilities, just as many as global demand requires.”^{xiii} The vision appears to be of a few large interstate nuclear enterprises that somehow coexist and compete fairly with private free markets in other forms of energy supply.

In the final step, “a legally binding international instrument would limit the production or reprocessing of all nuclear material for civilian nuclear programmes to facilities under multilateral control,” while a parallel agreement on a “Verifiable Fissile Material Cut-Off Treaty would ensure that production of nuclear material for strategic nuclear programmes would also be halted at this stage, if not earlier, allowing strategic facilities to be converted to civilian use under multilateral control, or closed-down.”^{xiv} Unfortunately, by postponing the critical commitment to forego national fuel cycle facilities until the very last stage, and providing no meaningful improvement in interim

nonproliferation assurance arrangements, the Austrian proposal is unlikely to engender significant progress, despite its inclusion of some worthwhile elements.

NOTES

- i. "A Report on the International Control of Atomic Energy," March 16, 1946, <www.fissilematerials.org/ipfm/site_down/ach46.pdf>.
- ii. U.S. Code, Title 22, Sec. 3223(a), <codes.lp.findlaw.com/uscode/22/47/I/3223>.
- iii. Allan S. Krass et al., *Uranium Enrichment and Nuclear Weapons Proliferation* (New York: Taylor & Francis Ltd., 1983), p. 88, <books.sipri.org/product_info?c_product_id=286>.
- iv. *Ibid.*, pp. 79, 88–91, 207.
- v. U.S. Congress, Security Assistance Act of 2008, 110th Cong., 2nd sess., S.3563, Sec. 422, <www.govtrack.us/congress/billtext.xpd?bill=s110-3563>.
- vi. Yury Yudin, *Multilateralization of the Nuclear Fuel Cycle: Assessing the Existing Proposals* (Geneva: United Nations Publications, 2009).
- vii. The MESP is tenth of the twelve proposals reviewed by Yudin in *Multilateralization of the Nuclear Fuel Cycle: Assessing the Existing Proposals*, p. 18. This proposal is also discussed in detail on pp. 46–48 and in Appendix D, "MESP Details." For the original text and revisions of the German proposal, see IAEA, "Communication Received from the Resident Representative of Germany to the IAEA with Regard to the German Proposal on the Multilateralization of the Nuclear Fuel Cycle," INFCIRC/704, May 4, 2007, <www.auswaertiges-amt.de/diplo/de/Aussenpolitik/Themen/Abruestung/Downloads/MESP-Zirkularnote704.pdf>; IAEA, "Communication Date 30 May 2008 Received from the Permanent Mission of the Federal Republic of Germany to the Agency with Regard to the German Proposal for a Multilateral Enrichment Sanctuary Project," INFCIRC/727, May 30, 2008, <www.auswaertiges-amt.de/diplo/en/Aussenpolitik/Themen/Abruestung/Downloads/MESP-Zirkularnote727.pdf>; IAEA, "Communication Dated 22 September 2008 Received from the Permanent Mission of Germany to the Agency Regarding the German Proposal on a Multilateral Enrichment Sanctuary Project," INFCIRC/735, September 25, 2008, <www.auswaertiges-amt.de/diplo/en/Aussenpolitik/Themen/Abruestung/Downloads/MESP-Zirkularnote735.pdf>.
- viii. IAEA, "Communication Dated 26 May 2009 Received from the Permanent Mission of Austria to the Agency Enclosing a Working Paper Regarding Multilateralisation of the Nuclear Fuel Cycle," INFCIRC/755, June 2, 2009, <www.iaea.org/Publications/Documents/Infircs/2009/infirc755.pdf>.
- ix. *Ibid.*, p. 1.
- x. *Ibid.*, pp. 4–5.
- xi. *Ibid.*, p. 5.
- xii. *Ibid.*
- xiii. *Ibid.*, p. 6.
- xiv. *Ibid.*

Appendix B: Relevance of the Present Proposal to Resolving the Iran Crisis

In commenting on early drafts of our proposal, some experts remarked that it did not adequately address current developments in Iran, or would simply allow Iran to continue to expand its enrichment facility at Natanz while the proposal is debated and developed. We do not suggest that our proposal by itself would or could "solve" all the tangled dimensions of the Iranian enrichment issue, particularly the historical IAEA safeguards compliance issues that Iran has so far refused to clear up. Rather, we are looking beyond Iran to strengthen the nonproliferation regime so the Iran issue is not repeated. Nonetheless, we note that acceptance and implementation of our proposal by Iran would require the following:

- (1) Implementation of the IAEA Additional Protocol and conclusion of an Additional Protocol on Sensitive Nuclear Fuel Cycle Facilities (AP-SNF) with the security and inspection arrangements described in this paper.
- (2) A cap on the enrichment level, facility capacity, and amount of LEU product and feed material stored on-site that would better protect IAEA timely warning objectives, and either:
 - a) prompt export to a foreign fuel fabricator, or;
 - b) INFCA-licensed and secured storage under IAEA safeguards at another site, remote from Natanz, of any excess low-enriched uranium (LEU) hexafluoride—allowance for such a site would be at the discretion of the INFCA and only in response to a legitimate commercial fuel-cycle need, such as the eventual startup of an LEU fabrication facility within the country.ⁱ
- (3) A “nonproliferation assurance” lease of the Natanz (and any other enrichment) site to INFCA until these facilities are decommissioned, with clearly defined and inviolate rights and privileges within the leased area conveyed to the association for the lifetime of the facility.
- (4) Formal certification of the Natanz operation by INFCA, with a continuous on-site presence, complete access to every aspect of the operation by INFCA personnel, and the regulatory discretion to shut it down, take possession of, or even disable the equipment in the event any irregularities or unsafe or insecure conditions were detected at the plant, or in the event of evidence of Iranian noncompliance with other aspects of its and IAEA safeguards and NPT obligations that in the view of the INFCA merits such steps.
- (5) Declaration and closure within Iran of any other enrichment technology or production facility—such as the recently disclosed Fordow Fuel Enrichment Plant under construction near Qom—lacking international certification, which would be within the INFCA’s discretion to grant or deny.
- (6) To address the residual breakout threat involving the supply of natural uranium fuel to the heavy water reactor under construction in Arak (which in principle could produce weapons plutonium in a breakout scenario), the conversion facility at Isfahan could be placed within a leased area simultaneously with the creation of the ISLA for the Natanz plant.
- (7) Going forward, the use in the Natanz facility of only INFCA-certified parts; Iran’s reliance on clandestine supply networks would be terminated, and compliance would be ascertained through intrusive inspections.
- (8) An INFCA founding statute and an agreement between the association and the United Nations, approved by the General Assembly, that would provide for direct referral of serious breaches of Iran’s AP-SNF to the UN Security Council, with INFCA’s Executive Committee, in consultation with the director general of the IAEA, jointly determining what constitutes a serious breach meriting immediate referral.

The above measures collectively would substantially reduce the proliferation risk. Whether this reduction would be a sufficient basis on which to resolve the current impasse

with Iran, whether Iran is likely to accept and faithfully implement such a proposal, and whether Israel could derive sufficient security assurance from it, are of course matters for debate and perhaps resolution in further detailed agreements tailored to the specifics of the Iranian situation.

At the very least, with the INFCA in effect, Russia and all other member countries would be compelled to cease nuclear trade and assistance to Iran and isolate it from the international market, forcing it to pursue, like North Korea, a path of highly uneconomic and technologically limited autarchy in the nuclear sphere until it met not only IAEA but also the more demanding INFCA requirements. What Iran would get out the deal would be vindication of its "right" under the NPT to own and operate an enrichment plant, but only under circumstances ensuring that its practical implementation of this right under Article IV will remain "in conformity with Articles I and II of this Treaty."

The INFCA would have inherent powers and discretion to mitigate, or even further reduce to very low levels, the risks posed by Iran's enrichment program and other national programs that are likely to follow. Once established, the INFCA would have inherent powers to certify the design, construction, and operation of new enrichment facilities in countries and at proposed sites that the association as a whole deems suitable and appropriate. The INFCA could develop sound objective criteria, relating to a member state's internal security, regional security environment, political stability, transparency of governance, and economic viability of its domestic fuel cycle program, which would make it extremely unlikely that other individual countries in the Middle East would replicate Iran's path anytime soon.

NOTES

- i. Regarding (2)(b): we note that this partial solution, which we first advanced in a paper presented in Tehran in April 2006, is now part of the current discussions to resolve Iran's dispute with the UN Security Council over its enrichment program and undeclared nuclear activities. See Thomas B. Cochran and Christopher E. Paine, "Ensuring the Peaceful Use of Iran's Uranium Enrichment Capability," paper presented at the Pugwash Conferences Workshop held in collaboration with the Center for Strategic Research, Tehran, Iran, April 24–25, 2006, <www.pugwash.org/reports/rc/me/tehran2006/Cochran-paper.pdf>.