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TECHNICAL NEGOTIATIONS IN A POLITICAL ENVIRONMENT
Why the Hexapartite Safeguards Project Succeeded

J. Christian Kessler

Despite a political environment fraught with core policy differences, between 1979 and 1983, six governments and two international safeguards directorates—the International Atomic Energy Agency and the Euratom Safeguards Directorate—negotiated an agreement to preserve the core verification principles behind the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). At first, even agreement to talk was in doubt. Other governments questioned US motives; they wondered whether US motives in promoting the International Nuclear Fuel Cycle Evaluation had been to evaluate or to prevent non-nuclear weapon states from deploying uranium enrichment and spent fuel reprocessing technologies. In addition, Germany and Japan disagreed with the United States on whether NPT safeguards were to address undeclared materials or activities. Notwithstanding this environment, the participants reached agreement first to negotiate, and then on specific technical measures, even when the approach implied a policy consensus where none existed. At the conclusion, agreement was reached on specific technical measures for safeguards at gas centrifuge uranium enrichment plants, and all participating states, including two nuclear weapon states, made diplomatic commitments to adopt this approach for current and future centrifuge plants. This article examines the factors that facilitated agreement and considers what lessons can be learned for future efforts to solve complex technical issues in a politically charged environment and in the absence of complete agreement even on the objectives to be realized.

KEYWORDS: Safeguards; highly enriched uranium; gas centrifuge; Treaty on the Non-Proliferation of Nuclear Weapons; International Atomic Energy Agency; Euratom; URENCO

US policy makers today are involved in a number of complex negotiations with foreign partners over nuclear trade, clandestine nuclear activities, nuclear weapon developments, and other proliferation-related issues. Some of the most significant among these negotiations involve highly technical issues whose resolution will likely have profound policy implications on US and international security. Policy makers involved in these negotiations can benefit from an examination of similar attempts that resulted in successful resolution of highly complex technical and policy issues. One such case occurred when the International Atomic Energy Agency (IAEA) and a number of parties to

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the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) confronted the challenge of implementing international safeguards on a new and complex—and hence largely unfamiliar—nuclear technology.[1]

The Centrifuge Dilemma

In the late 1970s, a number of states were developing and deploying a new and more efficient uranium enrichment technology, gas centrifuges. While two of these states—the United States and the United Kingdom—were nuclear weapon states (NWS) under the NPT, the others were not. The Netherlands and (as it was then) West Germany were working with the United Kingdom in a consortium known as URENCO to develop one technology to be deployed by all three partners. Japan was developing its own different centrifuge enrichment technology. Australia was seriously considering whether to adopt an enrichment technology in order to export enriched uranium for power reactor fuel instead of only exporting uranium ore concentrate. At the time, the IAEA had never applied safeguards, whether under the Statute regime (INFCIRC/66, "The Agency's Safeguard System") or the nascent NPT regime (INFCIRC/153, "The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons"), to any uranium enrichment activity. Before the NPT, uranium enrichment plants only existed in a few states and were not considered a technology that might be transferred and thereby made subject to IAEA safeguards. Now it became clear that the new plants in the Netherlands, West Germany, and Japan would have to be under NPT safeguards, that the technology was very sensitive for both commercial and nuclear weapon proliferation reasons, and that such safeguards must not jeopardize technical and proprietary information. How to accomplish this was profoundly uncertain.

At that time, the NPT had only recently come into force, and many issues related to Article III verification procedures were still strongly contentious. Many non-nuclear weapon states (NNWS) were deeply concerned that full-scope safeguards would place their industries at a significant disadvantage with respect to competitors in the NWS. These concerns involved both economic costs and risks to proprietary information. While the NPT entered into force in March 1970, such concerns meant that West Germany only ratified it in May 1975, and Japan not until June 1976. Moreover, whether the IAEA or the European Atomic Energy Community (Euratom) would have the primary safeguards role within the European Communities was a contentious issue through the first half of the 1970s, and the NPT safeguards agreement between the IAEA and Euratom on behalf of the NNWS of the European Communities only entered into force in 1977.[2]

As though issues of how to implement the safeguards provisions of Article III were not problem enough, Japan and the leading nuclear states in Europe felt that the very legitimacy of their nuclear industries was being challenged by policy decisions in the United States. President Gerald Ford's administration focused on the risk of nuclear weapon proliferation, and President Jimmy Carter had recently won election by, among other things, taking an even stronger stance regarding nuclear proliferation. Congress had

just adopted stringent new requirements for US nuclear cooperation in the Nuclear Nonproliferation Act of 1978, and President Carter had initiated an international discussion of the role of nuclear power in weapon proliferation in the International Nuclear Fuel Cycle Evaluation (INFCE) initiative. As former senior IAEA official David Fischer aptly phrased it, the debate was on "non-proliferation through co-operation versus non-proliferation through denial."[3]

In this atmosphere, six governments (the United States, the United Kingdom, West Germany, the Netherlands, Japan, and Australia), together with two international safeguards directorates (the IAEA and Euratom), met between 1979 and 1983 to find a safeguards approach based on NPT safeguards principles and acceptable to all participants when measured against several criteria: providing effective international (or multilateral) safeguards, protecting what was recognized to be a very proliferation-sensitive technology, and protecting proprietary information so as not to place plants in NNWS at a commercial disadvantage. This effort was entitled the Hexapartite Safeguards Project, or HSP.

Given the deep divisions over nuclear nonproliferation policy issues, how would it be possible to find common ground on the technical measures to be applied to gas centrifuge plants? The six participating governments held strongly differing views on the legal rights and obligations of the IAEA in verifying states' NPT obligations (specifically, whether NPT safeguards were to confirm the absence of undeclared materials or activities in addition to confirming national declarations). In addition, the URENCO partners, Japan, and the United States each had indigenously developed centrifuge enrichment technologies that differed in key respects, and held differing views on the safeguards measures that may be necessary and practical. Nonetheless, in 1983, the HSP reached agreement on a safeguards approach known as Limited-Frequency Unannounced Access (LFUA). This approach was then promptly implemented at the three URENCO facilities, as well in Japan's facility and at the US Gas Centrifuge Enrichment Plant (GCEP) at Portsmouth, Ohio, which was still under construction. As with any agreement negotiated among governments, the LFUA approach was a product of the political climate of the time.

The United States and other governments face similar technical/policy and international negotiating challenges today, and it would behoove policy makers to understand how to approach a complex, technical negotiation fraught with policy implications and conducted in a contentious political environment in order to increase the chances of success. The HSP process may provide some useful lessons. The article begins with some background on the domestic context in which this process was initiated, before turning to the HSP process itself and the factors that provided the basis for agreement, first to conduct such a project, and then on the technical measures that were judged to meet safeguards objectives.

Laying the Foundations—Early Concerns on Uranium Enrichment

Early in Richard Nixon's administration, concerns developed over activities associated with the development and expansion of nuclear capabilities worldwide.[4] These included concerns about the quantities of highly enriched uranium (HEU) exported as part of the Atoms for Peace program to fuel research reactors, about plans to build power reactors

fueled by HEU, and particularly about the growing interest among NNWS in developing their own uranium enrichment capabilities. In September 1970, President Nixon ordered his Intelligence Board—with participation by the departments of State, Defense, the Atomic Energy Commission (AEC), and the Office of Science and Technology Policy—to review "whether a need continues for the classification of uranium enrichment technologies," addressing specifically both the "gaseous diffusion process and the gas centrifuge process."[5] Five months later, he ordered a review of US "policies and programs on peaceful applications of atomic energy," to discuss "national security issues posed by interchange [sic] of nuclear technologies and equipment," and specifically to whether "[c]onsidering probable expansion of future worldwide peaceful application, are current bilateral and multilateral safeguard arrangements adequate to prevent deliberate diversions of special nuclear material?"[6] Then, in March 1972, Nixon asked for a study on "transfers to other countries of highly enriched uranium for the fueling of power reactors."[7]

These studies led to three presidential directives, known individually as a National Security Decision Memorandum (NSDM). The first, in October 1973, established a policy of case-by-case review "without an a priori presumption of supply" for transfers of HEU fuel for foreign nuclear power reactors, or "precondition" that fuel fabrication or spent fuel reprocessing take place in the United States.[8] Emphasizing the security and foreign policy sensitivities of the issue, the directive required the AEC to seek State Department views prior to making any "formal or informal commitment" regarding HEU supply, and to refer any such proposal to the president (but noting that the European Communities had been informed that their requests for HEU would receive "sympathetic consideration"). This directive also requested an

> action program … for diplomatic and other steps the U.S. can consider taking with other nations, and in particular other supplier nations, with regard to the security, non-proliferation, political, and economic aspects associated with the increasing growth and dissemination of nuclear power industries, with particular focus on potential problems associated with highly enriched uranium.[9]

Expectations of significant growth in demand for enrichment services were further reflected in a second memorandum six months later, directing the United States to "take a neutral posture toward Soviet sale of enrichment services" but to consult with allies "to ascertain the necessity and feasibility of establishing some limit to those purchases to avoid significant dependence on Soviet supply."[10]

In June 1974, President Nixon signed a third NSDM approving consultations "with other countries—particularly present or potential suppliers of materials, technology and equipment— … outlining steps the United States could take with other nations concerning the problems associated with the increased availability of weapons usable materials from the growth and dissemination of nuclear power industries."[11] In particular, the president ordered that

> The initial consultations should emphasize but not necessarily be limited to the need for: (1) establishing agreed international guidelines, preferably based on U.S. practice, to ensure that physical security of weapons usable and highly toxic materials whether internationally transferred or indigenously produced; (2) reaching some common principles regarding the supply of sensitive enrichment technology or equipment;

> (3) avoiding or applying [sic] stricter terms for supply in situations where special hazards could be present; and (4) encouraging, where appropriate, multinational enrichment, fuel fabrication and reprocessing facilities.

This directive was the basis for the United States initiating what became the London Suppliers Club, and, eventually, the Nuclear Suppliers Group.[12] While subsequent interpretations of the origins of the Nuclear Suppliers Group have cast it in terms of a response to India's 1974 "Smiling Buddha" nuclear test, it is notable that the chain of presidential study and then decision directives was primarily in the context of foreign demand for, or production of, highly enriched uranium. There is no reference in this chain of directives to India's May 18, 1974 test of a "peaceful nuclear explosive" at Pokhran.[13]

Thus, by the end of the Nixon administration, the United States had already conducted an intelligence-based evaluation of what elements of gas centrifuge enrichment technology should be kept secret by the United States, and had started multilateral discussions on controlling enrichment technology and equipment, albeit in the context of controlling all technology and equipment essential to civil nuclear power.

Laying the Foundations—Context for the Initiative

In the 1976 presidential election, Jimmy Carter sought to give even greater emphasis to nuclear weapon proliferation concerns than had former President Nixon or then-President Ford.[14] Among President Carter's first major foreign policy initiatives was creation of the INFCE, which began with an organizing conference in Washington, DC, in October 1977.[15] INFCE began to focus international attention on the proliferation potential inherent in uranium enrichment technologies, the need for rigorous international safeguards on uranium enrichment plants, and the need to create a culture of multilateral discussions in which the technical and policy aspects of such issues could be addressed with a view toward practical solutions.[16]

While INFCE's formal purpose was to evaluate nuclear fuel cycle alternatives in terms of their proliferation and economic characteristics, it was clear from the domestic US debate that for many, including the Carter administration, the real US objective was to restrict NNWS from developing or building uranium enrichment or spent fuel reprocessing plants. This objective was quite clearly indicated in the new amendments to the Atomic Energy Act, that is, in the Nuclear Non-Proliferation Act of 1978.

But even as INFCE was considering long-term approaches to reduce the threat of nuclear weapon proliferation, such as placing uranium enrichment and spent fuel reprocessing facilities under some form of multilateral (if not explicitly international) control and operation, uranium enrichment facilities were being built and beginning to operate in NNWS. The need for a rigorous and effective safeguards approach the IAEA could use at existing and planned national gas centrifuge enrichment plants was becoming urgent.

The Dutch URENCO plant in Almelo (capable of 100,000 separative work units or SWUs, a standard measure of capacity for all uranium enrichment technologies) had been under IAEA safeguards since 1978 (following the 1977 entry-into-force of the Euratom-IAEA safeguards agreement), although the plant had been in commercial

operation since 1973.[17] The West German URENCO facility at Gronau was still operating as a test and development facility but was believed to be conducting pilot enrichment activities using uranium; a first 1.8 million SWU production cascade at Gronau was slated to start in a few years. Japan was building a pilot enrichment plant at Ningyo Toge, and developmental activities using uranium in a test cascade were imminent, if not already underway. While the safeguards issue might be finessed for a while at the research facilities, the Dutch commercial plant and the soon-to-be completed German and Japanese plants confronted the IAEA with fundamental questions of how to apply the required safeguards.

Meanwhile, the Dutch, West German, and Japanese governments were confronted with fundamental issues of how to meet their NPT obligations (and for the Netherlands and Germany, how to meet their Treaty of Rome obligations to Euratom) while protecting the technology. The ad hoc safeguards measures being implemented at the Dutch plant and the Japanese developmental facility did not permit inspector access to the cascades or access to detailed design information.[18] In the judgment of most safeguards experts at the time, the existing ad hoc safeguards did not provide an adequate technical basis to permit the IAEA to meet its verification obligations.[19]

Meanwhile, as US and British concerns about safeguards for uranium enrichment plants were growing, some factors that would facilitate efforts to address these concerns were developing. In 1967, both the United States and the United Kingdom had offered to place some of their civil nuclear facilities under IAEA safeguards as an incentive to NNWS during negotiation of the NPT. The US–IAEA Safeguards Agreement was approved by the IAEA Board of Governors in September 1976, and signed in 1977.[20] The United Kingdom's Voluntary Offer Safeguards Agreement entered into force in August 1978. Britain's URENCO gas centrifuge plant was already in operation at Capenhurst, and with the US decision to include the Department of Energy's GCEP, then under construction at Portsmouth, Ohio, on the US eligible facilities list, both the United States and the United Kingdom had facilities to which any agreed centrifuge enrichment plant safeguards approach would apply.[21]

That the United States and the United Kingdom agreed to include their plants was especially significant. They were placing their proliferation-sensitive technology and commercially-sensitive process information at risk to the same degree as such information at gas centrifuge plants in NNWS. Whatever safeguards approach would be adopted in negotiations with the IAEA, the two NWS pressing for comprehensive and effective international safeguards on centrifuge enrichment plants could commit to run the same risks that they were expecting (or demanding) of others.

The urgent need for a credible and effective safeguards approach for gas centrifuge enrichment plants was clear; the credibility of the NPT depended on it, as did he credibility of US nonproliferation policy. With most of the nuclear world—both the policy and the technical/commercial communities—absorbed in INFCE, the question was, in a way, "how will we find this credible and effective safeguards approach when few understand the technology and the issue is politically divisive?"

The HSP Initiative—Getting the US Government Organized

Before taking the question to allies, it was necessary to develop agreement within the US government that an international safeguards approach for GCEPs (and especially for the US plant) was even possible. Several major steps in this direction had already been made. The early 1970s intelligence analysis had studied the degree to which sensitive information could be discerned from certain inspection or intelligence activities, including activities inside the plant and sampling conducted outside the plant perimeter.[22] The technical information requiring special protection had been determined and classified as Restricted Data. This information was distinct from other information that was commercially sensitive but not sensitive from a technology transfer point of view. Second, the United States had made the policy decision to make GCEPs eligible for IAEA safeguards under the US Voluntary Offer Safeguards Agreement. The question that had not been seriously addressed, much less resolved, was how to implement these decisions in practice.

The decision to permit the IAEA to implement international safeguards on GCEP was however quite controversial within the Department of Energy. The original decision had been made at the under secretary level, with no role for, or buy-in from, the operational levels of the career service.[23] Within the State Department and the Arms Control and Disarmament Agency, senior career officials had not only participated in, but had largely guided, the policy process. Studies of possible safeguards activities appropriate for a centrifuge enrichment plant had been performed, but neither a thorough analysis nor interagency agreement had been developed on what specific activities by an international inspectorate would be acceptable. Nor was there a sense of trust among key personnel in the different executive branch agencies that, in the negotiations, the United States would not sacrifice either the objective of effective safeguards or the protection of proliferation sensitive technical information. This initial lack of trust would prove crucial to the final outcome.[24] An important early step was to establish a shared understanding among key personnel in the different executive branch agencies about how the United States would pursue any negotiations with either the IAEA or with other partners.

This process of building trust and common purpose was helped by the fact that the key senior official in each agency was also that agency's representative on the US negotiating team. Nonetheless, this sense of trust and shared policy objective was, to an important degree, only reached at the same time that the United States was taking steps to initiate the multilateral process.[25] While officials in the various agencies differed somewhat in how they prioritized safeguards effectiveness and technology protection, all agreed that both were necessary; all agreed that it was a question of finding the best balance; and for that, the United States needed to work with other technology holders as well as the IAEA.[26] We shall see that the multilateral process only became possible as other governments came to realize the United States was looking for a solution, not seeking to sell one.

The HSP Initiative—Building International Agreement to Proceed

The multilateral process began with bilateral consultations between the United States and the United Kingdom, which shared many of the US concerns. The British were, at the time,

particularly concerned about the level of access that Euratom Safeguards Directorate (ESD) inspectors had in URENCO plants and the implications for protecting technical information.[27] ESD inspectors had URENCO security clearances and were permitted access to cascade halls. To maintain the credibility of Euratom safeguards, the inspectors at URENCO plants were not nationals of the three URENCO countries, so centrifuge technology was being shared with inspectors from other Euratom states. The United Kingdom was also concerned about duplication of effort by the two inspectorates, and would later use such concerns as the vehicle by which to address the overall question of inspector access to centrifuge technology.[28]

In late autumn 1978, the United States organized a first meeting of HSP participants in Tokyo. In addition to the United States and the United Kingdom, the other URENCO partners—the Netherlands and West Germany—were invited, as was Japan. The fact that Australia was considering whether to acquire its own uranium enrichment capability provided a basis for inviting Australia into the group. As a NNWS with strong nonproliferation credentials but no indigenous technology to protect, Australia was seen as playing a neutral and balancing role. Also invited were both the IAEA Department of Safeguards and the ESD.

It is important to note that, in 1978, not only was gas centrifuge enrichment technology still a new technology under development in each state (except Australia), but so were national understandings of what technical information was considered proliferation sensitive and what information would be considered commercially sensitive (valuable mainly to competitors and customers). Moreover, multilateral controls on the transfer of nuclear-related information also were a recent development. The Zangger Committee had published its first "Trigger List" of "equipment or material especially designed or prepared for the processing, use or production of special fissile material" in September 1974.[29] That list largely dealt with all uranium enrichment technologies as a single conceptual category. It did not even differentiate gas centrifuge technology from diffusion barrier technology or any other enrichment technology. As the list was a public document, even identifying specific equipment was considered too sensitive for disclosure, whether to the public or to international safeguards inspectors. The first multilateral dual-use list of items and technologies was more than a decade away, and the concept of "deemed exports" remained nascent, even in US or British thinking.

While all invited governments agreed to participate in the Tokyo meeting, agreement to actually join a technical negotiation to develop a common safeguards approach had not been reached. The Dutch were prepared to do so, but West Germany continued to have reservations, and Japan was essentially waiting to see the German position before it made its own decision. Germany (and Japan) held strongly that the IAEA's NPT verification responsibilities under Article III were adequately met with facility-level nuclear materials accountancy. Their view was that the negotiations leading to agreement on INFCIRC/153 had established that the IAEA was only responsible for verifying national declarations of nuclear materials. The IAEA's responsibilities did not extend to searching for possible misuse of the facility through undeclared activities. Confirming only declared feed and declared withdrawals ("perimeter safeguards") could

be accomplished with facility accountancy supported by containment and surveillance measures outside the cascade halls. In this view, detecting reconfiguration of the cascades for the purpose of undeclared production of HEU was outside the purview of NPT safeguards, and detecting recycling of low enriched uranium to produce HEU was to be addressed strictly by accountancy measures outside the cascade halls.[30]

Notwithstanding having heard the United States' explanation as to why a multilateral process was needed, and apparently not disagreeing in principle, German suspicions remained. German officials wondered whether the US agenda was really limited to developing an agreed safeguards approach for centrifuge enrichment plants, or whether there was a larger political objective. Their concerns were not just about disagreements over whether the IAEA's safeguards responsibilities extended beyond confirming nuclear materials declarations. Both Germany and Japan were suspicious that the United States wanted to roll back their respective uranium enrichment programs and perhaps prevent both enrichment and reprocessing in NNWS.[31]

Getting Germany to agree to participate beyond the first meeting and engage in a multilateral process examining technical safeguards approaches for centrifuge enrichment plants required extensive informal diplomacy and personal "off-the-record" conversations between delegation heads. By developing a sense of personal trust between the delegation heads, German suspicions about ulterior motives were assuaged and the German delegation was convinced that for the United States the real topic in this case was how to meet the potentially conflicting requirements for credible and effective safeguards and protecting technology.[32] Once Germany agreed to participate in the process, Japan did also.

The HSP Initiative—Organizing the Work

To guide their work, the participants agreed that the goal of the HSP was to develop "an adequate basis of technical experience and information which could be used by the IAEA, Euratom, and the State involved in their evaluation of the various safeguards approaches and the possible development of arrangements for the direct implementation of an effective and efficient safeguards approach to specific plants." Participants agreed that "the technical objective … was to facilitate the application of effective and efficient safeguards" at gas centrifuge enrichment plants.[33] By this description, the goal and "technical objective" of HSP were about a process, and an agreed informational foundation. It did not, at this point, include the objective of formal agreement to develop one specific safeguards approach—one set of technical measures—that all participants would agree together to implement in their respective plants or inspection activities.

Once agreement to conduct this exercise had been established, the issue became how to organize the work. The resulting decision provides valuable insight into which issues governments considered most important or most difficult. At the second meeting, participants agreed to establish four working groups:

1. Facility characteristics;
2. Containment and surveillance;

3. Nuclear materials accountancy; and
4. Safeguards strategies "including different degrees of access to cascade areas."[34]

As the HSP conducted its work, the first three working groups developed the technical foundation, the common sense of purpose, and the trust that underpinned the work of the fourth working group.

However, even two years into the process, there was still strong disagreement among governments about fundamentals. These disagreements about safeguards objectives are manifested in a paper written by the three US principals and presented at the 1982 Institute of Nuclear Materials Management annual meeting.[35] In discussing the authors' "Views on International Safeguards at Uranium Enrichment Plants," the paper stated a series of "shoulds." These normative objectives addressed diversion target quantities to be detected, timeliness of detection, probabilities of detection, and probabilities of a false positive. The paper concluded with a section emphasizing the essential nature of making comprehensive design information available to the inspectors, and verification of that information as a key inspection function. The paper also spoke directly to concerns being addressed in the first three working groups, specifically:

- Safeguards effectiveness;
- Risk of technology compromise;
- Facility access;
- Resources required by the IAEA; and
- Costs to the host country.[36]

By implication, this US paper laid out both an agenda for HSP and a program of engineering work to develop specific measures, including techniques and types of instruments. While the "shoulds" stated in this paper reflected US views, they proved also to reflect a growing consensus within each of the HSP working groups. As technical experts in the working groups examined in detail the issues of technology exposure risks and safeguards effectiveness with respect to specific containment and surveillance measures and specific nuclear materials accountancy measures in terms of the different centrifuge technologies, a common understanding of what the safeguards technology "menu" looked like emerged. It was this shared understanding of the "menu"—the strengths and weaknesses of different measures—that facilitated the work of the fourth subgroup, charged to assess the respective advantages of a non-access approach and a LFUA approach. It was in this subgroup that technical consensus on the LFUA approach was reached.[37]

While some participants continued to hold the view that NPT safeguards objectives could be met with an approach that did not include access to the cascade halls for either design verification or other purposes, the experts reached technical consensus on an approach that included those measures. This LFUA approach was then adopted by the plenary, along with commitments by each government and the two safeguards inspectorates to utilize this approach at all existing and planned gas centrifuge plants in the participating states. Thus, agreement was reached on a specific "required" safeguards approach, the objective that had appeared to be "a step too far" when the process began three years earlier.

What Factors Led to Success?

It is important to recognize that the HSP took place in a very different political environment than exists today: controversies regarding specifics of legal rights and obligations fought during negotiating the NPT and then INFCIRC/153 were not only recent, but not entirely resolved. Technical safeguards concepts and the methods and instrumentation available to achieve inspection objectives were at relatively early stages of development. Centrifuge enrichment technologies and plant control systems were in sufficiently late stages of development to permit moving to deployment, but they remained incomplete and relatively simple by modern standards. All these factors created great uncertainties, but at the same time they afforded flexibilities that would not have otherwise existed.

That the United States would subject its gas centrifuge enrichment plant to the same safeguards approach as the plants of all other participants was key for several reasons. In large part, the US willingness to place a highly classified and commercially important technology at the same risks and costs as demanded of others persuaded the NNWS to come to the US initiative, rather than work out their own, separate agreements. It was equally important that the United States came to the table with an experience-based definition of the problem that others could accept, but without a precooked definition of the solution. There was, in fact, no agreement among different agencies within the US delegation as to what the solution would look like, although there was agreement on certain general principles that permitted the United States to guide the multilateral discussions. The other participants knew that the United States did not have a specific safeguards approach worked out in advance. They could see that the United States was genuinely seeking to develop a shared approach, not sell a predefined solution.

Another significant factor for HSP's success was the ability to concentrate on technical issues. Even some of the contentious policy issues were handled during the HSP process from an essentially technical perspective. There was significant political level exhaustion in all the participating states at the end of a decade that started with negotiation of the NPT, then INFIRC/153, the Nuclear Suppliers Group, and finally INFCE.[38] The lattermost started two years before, but overlapped with HSP. Given the contentious technical, policy, and political issues considered in INFCE, it had essentially consumed all the policy disagreement energy and permitted the HSP to proceed quietly in the hands of mid-level officials as a technical process. Equally importantly, all the participating governments chose, for their own separate reasons, to handle it that way. Once the Germans and Japanese agreed to participate, there was a shared sense of purpose and desire to bring a success to participants' respective leadership, rather than to engage those senior policy makers in the process itself.

Much of the detailed examination of technical issues was virtually new. HSP participants could not—and did not have to—fall back on previously established agreements reached in other fora. Neither the Zangger Committee nor the NSG had gone beyond treating uranium enrichment as a broad category of technologies. At the same time, all governments participating in HSP had participated in both the Zangger Committee and NSG discussions. This meant that, while the foundations for a technical

consensus on the issues that HSP needed to resolve were extremely sparse, all HSP participants started from a common sense of the issue, and agreed on the value of a multilateral discussion, if not approach.

The question of whether to include the ESD in the HSP appears to have been surprisingly uncontroversial. Certainly, it was necessary from the perspective of the URENCO partners. However, during this period, the IAEA Department of Safeguards and the ESD were in a significant struggle over whether ESD was an "international" safeguards inspectorate, equivalent to the IAEA or to the subordinate State System of Accounting and Control for Euratom member states.[39] As it turned out, this controversy was largely kept outside the HSP. In practice, it appeared that the two safeguards inspectorates rather valued having a colleague in the room, and they tended to approach issues from much the same perspective, in spite of the struggles between them taking place in other fora.[40] In fact, ESD tended to take a rather passive role in much of the discussion, particularly on technical issues, deferring to URENCO as a "technology holder" or to the IAEA. Whether guidance from political levels or decisions made by senior participants directed this more passive stance is not known, but ESD's tendency to be supportive of the IAEA on technical safeguards questions and avoid reference to the political issues between them played a strong role in the negotiations being conducted as a "technology holder" versus safeguards inspectorate dynamic. The URENCO governments also approached the negotiations from this perspective.

Conclusion

The HSP was created to solve a particularly thorny problem. Creating the HSP was itself a very thorny problem. In both cases, a key factor was a shared sense of the political necessity of solving the problem; the credibility of the NPT required that the IAEA apply safeguards to these plants, and those safeguards had to bear technical as well as political scrutiny. The safeguards approach the IAEA would implement at NNWS centrifuge plants had to be transparent enough to provide assurances that it was technically sound. Politically, it was necessary that there be no sense that one state—whether NNWS or NWS—had cut a better deal in terms of burdens on commercial competition. Ultimately, the six governments and two safeguards directorates had too much at stake to permit failure.

In such a situation, with failure not an option and with profound political tensions and suspicions among participants, one would expect that senior political officials in each government would insist on leading the process and being chief negotiators. Whether the decision, or willingness, in all six governments to delegate this effort to career officers was driven by fatigue over the previous decade of difficult negotiations or by recognition that the issues were so technical that it was best that senior political officials "did not notice" the negotiations, permitting those who understood the substance and constituted a technical community to handle the negotiations was crucial.

The pre-existing disagreements at to what the specific objectives of IAEA safeguards should be, and thus just what IAEA (and Euratom) inspectors were responsible for verifying, were only partially resolved through HSP. In key respects, the policy differences on safeguards objectives were finessed rather than addressed in the technical measures adopted. Concerns for the protection of proprietary information were also significant. In

large part, concerns for protecting commercially sensitive information were subsumed under concerns for protecting the technologies. The technology holders were at relatively early stages of developing and implementing their respective technologies, and they considered any aspect of technology that might lead to a more cost-effective enrichment process to be commercially sensitive.

Ironically, the issue of costs to industry of implementing the approach, which had been a major issue in negotiating INFCIRC/153 and was very much in the minds of all participants, was not a decisive factor. It was, of course, the reason the United States and the United Kingdom had each made a Safeguards Voluntary Offer, and included their respective gas centrifuge enrichment plants in that Offer. The costs of different implementation strategies were important only in choosing among measures in formulating the final LFUA approach.

Today, many of the technical issues that would enter into such a negotiation are already largely determined. Determinations as to what equipment and technologies are sensitive from a proliferation perspective are well-established. The scope and objectives of IAEA safeguards are now well-established. While this might be seen to make a negotiation similar to HSP more straightforward, that is not necessarily the case. That consensus did not exist at the time of HSP made the process more complicated; the lack of pre-existing, authoritative determinations of key questions meant that these issues could be addressed in the specific context of centrifuge enrichment plant safeguards, and that disagreement was not a challenge to established authority. Any future efforts will be facilitated to the extent that all participants agree with pre-existing determinations on sensitive information and technology established, for example, in multilateral control lists. Likewise, to the extent that some participants in such a future negotiation disagree with any of those pre-existing determinations (perhaps their government did not participate in the original determination), the work of that new effort will be more difficult.

The HSP originated out of the need to solve a problem that everyone agreed had to be solved. All the participants had too much at stake, whether in the credibility of the NPT or in demonstrating that uranium enrichment technology could be trusted to responsible NNWS. Some policy-level disagreements made the process more difficult. On the other hand, the absence of pre-existing policy-level agreement on many technical issues may have facilitated negotiation of an agreement. Leaving the negotiations to career officials expert in those technical issues—rather than senior political officials with little expertise but careers and policies to protect—was crucial. Equally important was unanimous agreement on the problem, and that no delegation entered the process committed to a specific solution.

Today the policies, methods, and technologies relevant to a comparable problem for which an HSP-like approach might be considered are likely to be well-established, although only formulated and agreed to by the established players. Success will be more difficult with the inclusion of governments new to the issue or emerging as significant players and which did not participate in the original decision process. Similarly, with these more highly charged questions (challenging what is considered to be well-established by some participants) and without previous, competing political level debates, it will be

harder for all governments to delegate national leads to career experts. It may be very hard to keep the question, and hence an HSP-like process, below the political horizon.

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NOTES

1. In addition to the case examined here—safeguards for gas centrifuge uranium enrichment plants—safeguards approaches for spent fuel reprocessing plants and light water power reactors provide examples. However, the policy versus technical issues created greater tension in the centrifuge plant case than in the others.
2. See David Fischer, "International Safeguards," in Jozef Glodblat, ed., *Safeguarding the Atom: A Critical Appraisal* (Stockholm: Stockholm International Peace Research Institute, 1985), pp. 70–73, for a discussion of the issues debated at the time. The European Communities (also known as the European Community) consisted of three international organizations: the European Coal and Steel Community, the European Economic Community, and the European Atomic Energy Community.
3. See Fischer, "International Safeguards," pp. 104–105.
4. I am particularly indebted to former State Department official John Boright and former Oak Ridge National Laboratory official and scientific advisor to the US HSP delegation David Swindle for their descriptions of the activities they participated in during the early and mid-1970s. Their guidance and insight was essential to researching and writing this section.
5. National Security Council, National Security Study Memorandum 101, "Review of Security Requirements regarding Uranium Enrichment Technology," September 14, 1970, Nixon Presidential Library and Museum, <http://nixon.archives.gov/virtuallibrary/documents/nssm/nssm_101.pdf>.
6. National Security Council, National Security Study Memorandum 120, "United States Policy on Peaceful Applications of Atomic Energy," February 19, 1971, Nixon Presidential Library and Museum, <http://nixon.archives.gov/virtuallibrary/documents/nssm/nssm_120.pdf>.
7. National Security Council, National Security Study Memorandum 150, "U.S. Policy on Transfer of Highly Enriched Uranium," March 13, 1972, Nixon Presidential Library and Museum, <http://nixon.archives.gov/virtuallibrary/documents/nssm/nssm_150.pdf>. However, this review was not to "affect the transfer requested by EURATOM" for the German high temperature reactor prototype power plant.
8. National Security Council, National Security Decision Memorandum 235, "NSSM 150, United States Policy on Transfer of Highly Enriched Uranium for Fueling Power Reactors," October 4, 1973. Nixon Presidential Library and Museum, <http://nixon.archives.gov/virtuallibrary/documents/nsdm/nsdm_235.pdf>.
9. Ibid.
10. National Security Council, National Security Decision Memorandum 250, "U.S. Policy Toward Purchase of Soviet Uranium Enrichment Services," March 29, 1974, Nixon Presidential Library and Museum, <http://nixon.archives.gov/virtuallibrary/documents/nsdm/nsdm_250.pdf>

11. National Security Council, National Security Decision Memorandum 255, "Security and Other Aspects of the Growth and Dissemination of Nuclear Power Industries," June 3, 1974, Nixon Presidential Library and Museum, <http://nixon.archives.gov/virtuallibrary/documents/nsdm/nsdm_255.pdf>. The President also mandated "prompt study" of a possible convention on physical security.
12. John Boright, former senior State Department official, principal in creating the HSP, telephone interview with author, October 22, 2010.
13. The only reference to an Indian nuclear test in any released Nixon administration NSDM or NSSM is in NSSM 156 ("Indian Nuclear Developments," July 5, 1972) ordering study of the "likely impacts of a possible test on the policies and actions of India's neighbors in South Asia" and the "likely political, military, and economic implications for India's other policies and programs." See National Security Council, National Security Study Memorandum 156, "Indian Nuclear Developments," July 5, 1972, Nixon Presidential Library and Museum, <http://nixon.archives.gov/virtuallibrary/documents/nssm/nssm_156.pdf>
14. This is certainly the popular perception, both at the time and today. However, President Ford was the first to make a significant nuclear nonproliferation statement: "I have concluded that the reprocessing with recycling of plutonium should not proceed unless there is sound reason to conclude that the world community can effectively overcome the associated risks of proliferation." Gerald R. Ford, "Statement on Nuclear Policy," October 28, 1976, The American Presidency Project, <www.presidency.ucsb.edu/ws/?pid=6561>. I thank Michael Rosenthal for providing this insight.
15. R. Skjöldebrand, "The International Nuclear Fuel Cycle Evaluation—INFCE," *IAEA Bulletin*, 22/2 (1981), p. 30, <www.iaea.org/Publications/Magazines/Bulletin/Bull222/22204883033.pdf>.
16. Michael D. Rosenthal, retired Arms Control and Disarmament Agency official and senior advisor to the United States HSP delegation, telephone interview with author, October 19, 2010.
17. Appendix H—World Enrichment Plants, table adapted and updated from Nuclear Engineering International, *World Nuclear Industry Handbook 2006* (Nuclear Engineering International, 2006), <http://tinyurl.com/kolf4lf>.
18. D.W. Swindle, Jr., and L. E. Wheeler, "An Overview of Enrichment Plant Safeguards," Paper for presentation at the American Institute of Chemical Engineers Winter 1982 National Meeting, February 28–March 3, 1982, Orlando, Florida, <www.osti.gov/bridge/servlets/purl/5859084-o9L9Xs/>.
19. Boright, telephone interview with author, October 22, 2010. Also David W. Swindle, Jr., former Oak Ridge National Laboratory official and scientific advisor to the United States HSP delegation, telephone interview with author, October 21, 2010.
20. The Agreement between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States entered into force in December 1980, following Senate advice and consent to ratification.
21. On the US commitment, see H.G. Handyside, "Statement for the Senate Committee on Foreign Relations on the U.S./IAEA Safeguards Agreement," June 22, 1979, quoted in Swindle, Jr. and Wheeler, "An Overview of Enrichment Plant Safeguards."
22. Rosenthal, telephone interview with author and Swindle, telephone interview with author.
23. Joerg H. Menzel, retired Arms Control and Disarmament Agency senior official and head of United States HSP delegation, telephone interview with author, October 27, 2010.
24. Ibid.
25. Ibid. While this trust was, to a necessary degree, established early in the HSP process, it was still fragile and incomplete in the mid-1980s as the United States and the IAEA negotiated a Facility Attachment specifying specific technical methods for the Department of Energy's Portsmouth, Ohio plant.
26. Michael Rosenthal, e-mail correspondence with author, December 13 2010.
27. Ibid.
28. Menzel, telephone interview with author and Swindle, telephone interview with author.
29. Zangger Committee, Information Circular 209, "Communications Received from Members regarding the Export of Nuclear Material and of Certain Categories of Equipment and Other Material," September 3, 1974. The original 1974 entry concerning uranium enrichment technologies read in its entirety: "2.5.1. Equipment, other than analytical instruments, especially designed or prepared for the separation of isotopes of uranium," and the Annex expansion read simply: "Equipment, other than analytical instruments, especially designed or prepared for the separation of isotopes of

uranium' includes each of the major items of equipment especially designed or prepared for the separation process." The December 1977 updates to the Trigger List, INFCIRC/209/Mod.1, stated that, "Such items include: … gas centrifuge assemblies, corrosion resistant to UF6." It was not until 1984, following conclusion of the HSP, that specific gas centrifuge components were added to the Trigger List.

30. Rosenthal, telephone interview with author and Menzel telephone interview with author.
31. Rosenthal telephone interview with author.
32. Menzel telephone interview with author.
33. Joerg H. Menzel, ed. (authored by the Hexapartite Safeguards Project), "Safeguards Approach for Gas Centrifuge Type Enrichment Plants," *Journal of the Institute for Nuclear Materials Management* 12 (Winter 1983), p. 31.
34. Menzel, "Safeguards Approach for Gas Centrifuge Type Enrichment Plants," p. 31.
35. Joerg H. Menzel, John P. Boright, and Leonard M. Brenner, "Views on International Safeguards at Uranium Enrichment Plants," *Journal of the Institute for Nuclear Materials Management* 9 (Summer 1980), pp. 60–64.
36. Ibid., p. 62.
37. Menzel, "Safeguards Approach for Gas Centrifuge Type Enrichment Plants," p. 31.
38. Boright, telephone interview with author.
39. At that time, the concept of a Regional System of Accounting and Control had not been developed. Even the concept for a State System of Accounting and Control was relatively nascent. I thank an anonymous reviewer for identifying this question.
40. Author's personal observation as a member of the US delegation to the HSP negotiations, 1982–83.