

In the last few years, international arms control and disarmament discussions have often been focussed on the safeguarding and management of plutonium and highly-enriched uranium (HEU) released from the dismantling of nuclear weapons. At the same time, the international community has given less attention to highly-fissionable materials (HFMs) in the civilian fuel cycle. Nevertheless, the accumulation and transportation of plutonium, and the development of the plutonium fuel cycle in several countries raise a number of concerns for nonproliferation.

Since 1992, a small group of countries engaged in nuclear activities involving plutonium and HEU has met regularly, but informally, to discuss ways in which the management of these HFMs could be made safer, more secure, and more transparent. This article analyzes the accomplishments and shortfalls of those negotiations, and suggests steps towards the international safeguarding and management of plutonium and other HFMs.

## THE BACKGROUND

Why are discussions specifically on civilian plutonium and HEU management taking place now? After all, many people would say that HFMs are carefully supervised in most countries. The operators of nuclear facilities spend enormous sums of money to protect HFMs against diversion and accidents. In non-nuclear weapon states (NNWS) parties to the nuclear Non-Proliferation Treaty (NPT), HFMs are subject to international safeguards to verify that they are not diverted to proscribed uses. Moreover, the exports of fissile materials are covered by the rules of the Nuclear Suppliers Group (NSG) that require full-scope safeguards as a condition of supply. Furthermore, many suppliers (for instance, major uranium producers such as the United States, Canada, and Australia) require that the use by their clients of exported nuclear materials and technology be subject to the supplier's prior approval. Therefore, nonproliferation

rules and practices cover most plutonium and HEU related activities in Europe and Japan that involve materials and technology originating from these regions, or from the United States, Canada and Australia.

Still, concern about better plutonium and HEU management is widespread among the public and in many governments. The main sources of this renewed concern are: 1) the surplus accumulation of large quantities of separated plutonium, as a result of nuclear arms reductions and civilian reprocessing; 2)

the difficulties in fast reactor programs, which cause a slowdown in the burning off of plutonium; 3) opposition to the maritime transportation of plutonium; and 4) the safety and physical security of fissionable materials in the former Soviet Union.

These issues—as well as some national and local incidents and controversies—have increased public sensitivity to the dangers presented by the plutonium fuel cycle, and its potential role in the proliferation of nuclear weapons. Worries about a potential “plutonium glut” and a possible black market in plutonium are important issues on the current nonproliferation agenda.

Plutonium, the choice ingredient for nuclear weapons, exists in large quantities, mostly in the spent fuel of major nuclear power users. A part of this spent fuel is reprocessed in civilian facilities in France, England, and Russia, and the recovered plutonium can be used alone for fuelling fast reactors, or can be blended with uranium in mixed-oxide (MOX) fuels for fuelling conventional reactors. The storage and transportation of the growing stockpile of separated plutonium constitute safety and security problems, since plutonium is an environmental, health, and proliferation risk.

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# VIEWPOINT: OPTIONS FOR THE MANAGEMENT OF HIGHLY-FISSIONABLE CIVILIAN MATERIALS

by Jean-François Rioux<sup>1</sup>

Disposal problems are one troubling aspect of plutonium. While HEU can be blended with natural or depleted uranium to make low-enriched uranium (LEU) to fuel conventional power reactors, plutonium-based MOX fuels currently cannot be extensively used in reactors, and there are not enough fast reactors to burn the plutonium stockpile. In any case, MOX is so expensive, as compared to LEU, that its wide use in power generation is out of the question for several decades.<sup>2</sup> As a result, separated plutonium is piling up, and there are no short-term prospects for its extensive use as fuel. Only Japan has a large program for plutonium utilization, but it will be a decade before it reaches full capacity.<sup>3</sup>

According to many analysts, another major problem is that the management of plutonium is not transparent enough. Safeguards reports from the International Atomic Energy Agency (IAEA) remain confidential and, in any case, do not monitor stockpiles of nuclear materials. Furthermore, mainly for commercial reasons, operators generally do not like to divulge their holdings of spent fuel, waste, and separated plutonium. As a result, we have only a general idea of the vast stockpiles of plutonium held by advanced nuclear power users.<sup>4</sup> Small discrepancies are very significant in this area, because in the most advanced weapon designs, little more than two kilograms (kgs) of weapons-grade plutonium can be used to make a nuclear bomb.<sup>5</sup> The May 1994 incident at Tokai-Mura, Japan, where nearly 70 kgs of plutonium oxide were found to have gradually accumulated in glove boxes without being retrieved, illustrates the importance of keeping accurate and open accounts of plutonium holdings.<sup>6</sup>

Facts and incidents involving plutonium, duly recorded by advocacy organizations and parliamentarians, often embarrass governments and nuclear operators. The nuclear industry is especially vulnerable on the plutonium issue, which, besides the aforementioned aspects, is characterized by other contentious topics, such as the safety of plutonium transit, the dubious economics of reprocessing, and the health effects of reprocessing.

Currently, there is not much that the international community can do to prevent the on-going accumulation of plutonium. Suppliers could exert some leverage but, as a rule, prefer to avoid confrontation on plutonium cycle activities. In practice, rather than questioning the reprocessing campaigns, stockpiling, and transfers of plutonium by their clients, suppliers usually simply demand to be notified and provide rubber-stamp

approval. After all, in a buyers' market such as the nuclear industry, most suppliers are vulnerable to retaliation by their clients. Furthermore, quarrels over nuclear matters can very well lead to problems in other fields.

## HFM MANAGEMENT OPTIONS

The ideal solution<sup>7</sup> to the concerns about plutonium and HEU stockpiling would be to take advantage of Article XII.A.5. of the IAEA Statute which: 1) incorporates the right of the Agency to approve methods of reprocessing; 2) requires that special fissionable materials be used for peaceful purposes under IAEA safeguards; and 3) stipulates that fissionable materials in excess of the needs of members be deposited with the Agency and returned to members when they need them.

Article XII is the basis for the International Plutonium Storage (IPS) plans much discussed in the 1970s and early 1980s. At that time, the problem was that countries developing a plutonium cycle strongly opposed IPS, which led to major confrontations between the United States—the main supporter of this idea — and Western Europe and Japan. The concept of IPS has been retained as an option in the IAEA and in international talks, such as NPT review conferences, but remains a nonstarter with many governments.<sup>8</sup>

Currently, the main alternative to IPS is International Plutonium Management (IPM). A Dutch paper, widely distributed at the IAEA in the summer of 1993, outlined the following four basic options for the international management of plutonium:<sup>9</sup>

1) *Joint management between suppliers and users.* This is the *status quo* option. In most current nuclear relations, states intending to reprocess spent fuel or transfer or burn plutonium must acquire prior consent from their suppliers. Some form of reporting by the user provides the suppliers with confirmation of authorized use.

2) *Joint management under the IAEA umbrella.* In this model, the IAEA would be consulted and would provide nonbinding advice on the desirability of particular plutonium cycle activities.

3) *Dual-key system.* In this scenario, the IAEA would hold a right of veto on national plutonium cycle activities.

4) *IAEA plutonium management under the Statute provisions.* This is the full IPS model, where the IAEA would be physically in charge of plutonium stockpiles.

While the Dutch concluded that the *status quo* option was not advisable, they maintained that options three and four would encounter too much opposition from the advanced plutonium users, and should not be actively pursued. Therefore, they suggested model two as the best target in plutonium negotiations.

An IAEA document distributed in the winter of 1994 enumerated a number of options open for strengthening provisions for health and safety, physical protection, and peaceful uses of plutonium and HEU.<sup>10</sup> On the peaceful uses aspects, the document identifies 12 options, ranging from basic transparency measures to the IPS scheme. Those of particular interest include:

- the possibility of states submitting their national program for peaceful uses of HEU and plutonium to a peer group, possibly organized by the IAEA, for review or approval;

- the possibility of storing excess fissile materials in special national depositories;

- the elaboration of some conditions for the withdrawal from storage;

- a commitment to reducing stockpiles of fissile materials; and

- the foreswearing of any further production of HEU or plutonium, except for specified usages.

The IAEA document identifies four forms that the legal framework for improved assurances on the safe, secure, and peaceful use of special fissionable materials could take: 1) unilateral undertakings; 2) an NSG-type agreement; 3) bilateral agreements between states and the IAEA; 4) a multilateral treaty open either to states involved in plutonium and HEU, or to all states.

## CURRENT DISCUSSIONS

In 1992, the Director General of the IAEA invited the United States, Russia, China, France, Great Britain, Japan, and Germany to informal talks on means to improve confidence in plutonium and HEU programs. The first meeting was held in Vienna in December of 1992, and was followed by another meeting in the fall of 1993. Since then, the IAEA has ceased to act as a host, and is represented as an observer. Discussions have since been held among a larger group, including the original seven countries, plus Belgium and Switzerland.<sup>11</sup> In these one-day meetings, scheduled to correspond with meetings of the Board of Governors of the IAEA, the participants discuss informally (some participants have likened the process to “brain-storming”

sessions), and do not circulate much written material. No official summary has been written.

Until now, the discussions have been dominated by concerns about the management of plutonium and have stressed the principle of transparency. In a winter 1994 paper, the Japanese elaborated on the idea of transparency in the management of plutonium.<sup>12</sup> Under their proposal, countries holding plutonium (and/or HEU, presumably) would register their inventories with the IAEA and would store their surplus at designated storage facilities. These surplus stocks would be completely under national control, which should not be confused with international facilities under IPS models. The plutonium holders would report all withdrawals from these stores, but the materials loaded in reactors or blended in MOX would no longer be subject to the transparency regime (since they would instead be covered by the safeguards regime). The Japanese identified three ways in which their plan could be implemented: 1) through a multilateral treaty; 2) through bilateral arrangements with the IAEA; or 3) through unilateral declarations under common guidelines. For reasons of practicality, the Japanese favor option three, which is the model of the NSG. To keep track of fissile materials, a new secretariat would be created in the IAEA and financed by voluntary contributions.<sup>13</sup>

Despite concentration on the seemingly noncontroversial issue of transparency, not much progress has been reported in the HFMs management discussions. In 1994, the participants, partly motivated by the NPT deadline, hoped to complete their discussions before the end of the year. Now, however, hopes of a rapid resolution are dim, since there are still a few notable obstacles in the way of an agreement.

First, defining “surplus” or “excess” plutonium is a major problem attendant to any international plutonium management or transparency scheme. During 1977 to 1979, there was a similar controversy about definitions in the International Fuel Cycle Evaluation study. The commonly discussed definition of “surplus” is material that is not going to be used in the fuel cycle in the near future. In the Vienna discussions, for instance, the Japanese indicated that they would consider “surplus” any plutonium the holder does not plan to use within five years. Evidently, this kind of time limit is not very popular with the operators, who worry that they would have to declare most of their materials as excess and deposit them in special sites. This would increase costs and create delays for any retrieval of plutonium, when

clients order more plutonium fuel, or want to modify their fuels' compositions. Therefore, France and Great Britain are likely to oppose a strict definition of surplus. However, if the time limit is too long (10 or 15 years, for example), only insignificant quantities of surplus holdings will be reported, and our knowledge of fissile materials holdings will not improve much.

A major source of differences in the group is over the question of general principles. The Japanese are satisfied with increased transparency as the major objective of the discussions. The United States, however, has advanced two other principles. The first is an equilibrium between supply and demand of plutonium. This implies that plutonium should be separated only for use in power reactors in the short term, and that states should agree not to stockpile without such a purpose. The second is limiting and reducing stockpiles of plutonium. This principle adds the idea that states should get rid of their plutonium if they are not using it. In sum, the United States seem to favor an agreement that would specify limits on plutonium accumulation, separate surplus from mainline plutonium, and provide a measure of international supervision.

The issue, then, is to set up either a simple transparency agreement, or a limitation regime. In other words, should plutonium cycle countries simply unilaterally implement some transparency measures in an informal, NSG-type grouping, or should they also aim at a commitment to limit and reduce plutonium stockpiles? The first option — the Japanese model — is the most likely to be implemented, simply because major reprocessors and plutonium users are not prepared to see other countries and the IAEA oversee, and possibly impede, their plutonium management.<sup>14</sup>

What would be the value of such a basic transparency agreement? Obviously, it would have some advantages for participating countries. Openness and good will would improve the reputation of plutonium cycle countries. They might more easily “sell” to their domestic constituents their plutonium related activities. This is considered by many to be Japan's primary motivation for participating in these negotiations.<sup>15</sup>

But, more importantly, would there be advantages for nonproliferation? Certainly, although they would be modest. Greater transparency about the size and location of plutonium stockpiles would improve our knowledge of civilian nuclear programs of participating countries and could be used to identify and prevent, where possible, risky decisions in plutonium manage-

ment. More specifically, such an agreement would also improve our knowledge of the stockpiles in participating nuclear weapons states (NWS). Finally, a transparency agreement would be especially useful if non-NPT countries were included. Chances are that non-NPT countries would be more inclined to sign a transparency agreement than join a more ambitious plutonium management scheme.

Nevertheless, nothing in a transparency agreement could prevent implementation of risky decisions about plutonium stockpiling and use. Better control of plutonium management would require measures other than transparency. Obviously, IPS or a “double-key” system would provide more security, but such measures are unlikely to be implemented. As suggested by the Dutch paper, the answer—or, at least, a first step—might be for states to express unilateral commitments on the principle of separate storage of excess plutonium, accepting an advisory role for the IAEA.

## THE ROLE OF THE UNITED STATES

The United States wants more than transparency and, reportedly, has signified to its partners in the group that it has agreed to discuss transparency as a first step towards an improved plutonium management system. The most logical next step would be to discuss limitation and supervision principles. It is not clear, however, whether all other partners are interested in further discussions, or can agree on the substance of an eventual second round.<sup>16</sup>

The leverage of the United States in nuclear matters is still considerable. For instance, the Americans can effectively disrupt plutonium cycle activities by threatening to use their prior consent veto on the plutonium related activities of Japan involving U.S. material or technology, and by stalling negotiations on a U.S.-EURATOM treaty. However, the United States will probably neither want nor need to go that far. Washington should make clear that its participation in a transparency agreement is absolutely conditional on a second round of talks devoted to multilateral plutonium management. The plutonium users may well be influenced by that position, knowing that the non-participation of the United States—the major opponent of the plutonium fuel cycle—would weaken the legitimacy of a transparency agreement, and may even result in it being portrayed as a cynical self-serving arrangement by plutonium cycle countries, a conclusion that would give am-

munition to the anti-nuclear opposition. The plutonium users also know that there is strong support in the United States in favor of a total ban on fissile materials, and that failure in plutonium transparency negotiations would increase this lobby's influence in Washington. In sum, it is arguably in the long-term interest of plutonium cycle countries to reach an agreement that extends beyond basic transparency and tackles concrete management issues.

The problem for the United States will be to decide what to do if its partners show no sign of conforming to any American wishes, either in the current or in a subsequent round of discussions. The United States is the only power that can pressure others to start negotiations on a more ambitious fissionable materials management program, despite the risks it entails for the conclusion of a limited plutonium transparency agreement. Should Washington accept a weak transparency regime devised by the commercial users of plutonium, or pull the plug on plutonium management negotiations? American decisionmakers may calculate that quarrelling over the plutonium issue can harm other national and global interests, and that a weak agreement is better than no agreement at all. However, several factors now favor a stronger agreement on the management of HFMs, namely: difficulties in the plutonium cycle; the need to strengthen the NPT; the negotiation of other nuclear arms control treaties (i.e. the "cut-off" agreement and Comprehensive Test Ban Treaty); and possible clashes between the United States and its allies on plutonium issues.

#### **A "HIGHLY-FISSILE MATERIALS CHARTER"?**

A basic transparency agreement is not the only option regarding the control of civilian HFMs. Rules on the safe and secure management of HFMs could be embodied in a charter that would clearly spell out the rights and duties of states regarding civilian HFMs (including spent fuel holdings) and provide for supervision by international agencies. The United States could eventually develop and propose an agreement along the following lines.

In its preamble, a HFM charter could include two basic commitments: a pledge to uphold the principle of nuclear nonproliferation and a pledge to ensure the safety, physical security, and non-diversion of all HFMs in a country's possession.

The core of the HFM charter would incorporate three

articles. First, there would be the requirement to participate in a system of declarations of the size and location of national holdings of HFMs (the transparency measure included in the original Japanese proposal). This system would be administered and verified through the IAEA. Second, state parties would acknowledge that the IAEA must be consulted by suppliers and customers in the management of HFMs, and that its advice should be an integral part of decisionmaking about the management of HFMs. This was the option favored by the 1993 Dutch document. It would not impose IAEA preferences on states, but would force them to carefully consider their plutonium management decisions, in view of the IAEA evaluation. Third, the HFM charter would include a general commitment to safely reduce plutonium stockpiles, either by burning, transmuting, final disposal and/or any other option or options that will eventually be deemed acceptable for safety and security reasons by the General Conference of the IAEA. This would not force states to get rid of their plutonium or to stop production, but could act as an incentive to dispose of surplus plutonium and to halt excessive production.

The HFM Charter could also contain some supplementary undertakings, three of which can be identified at this time: 1) a commitment to collaborate in the investigation and prosecution of individuals and organizations involved in the transnational smuggling of HFMs; 2) the obligation to participate in the existing IAEA system of voluntary declarations on transfers of nuclear materials and technology; and 3) an agreement to apply NSG-type conditions of supply for any transfers of nuclear materials and technologies and related non-nuclear technologies.

#### **CONCLUSION**

Improving the transparency of plutonium holdings is a worthy goal. A transparency agreement could take the form of a NSG-type arrangement among the main plutonium users and owners. However, it should be only the first step leading to the establishment of wider and stronger norms for the safe and secure management of HFMs, with increased involvement by the IAEA. This is the spirit in which transparency should be adopted and presented to the international community.

Multilateral HFM management should preferably materialize in an international legal charter, opened to many signatures, that would give the IAEA some re-

sponsibility in overseeing plutonium management. After years of following the limited objectives of the Vienna informal talks, it will eventually be time to expand the agenda and look towards more ambitious goals for multilateral HFM management. A HFM Charter could usefully complement the NPT and the cut-off treaty and aid the safe and secure management of plutonium and HEU.

the participants of the informal Vienna talks agreed to set up a technical working group to propose options for a transparency regime. The technical group has reported to the participants in March 1995, but the contents of their recommendations have been kept secret.

<sup>15</sup> Recently, to demonstrate their commitment to transparency, the Japanese have unilaterally disclosed the size of their plutonium stockpile. See *Nucleonics Week*, December 1, 1994, pp. 13-14.

<sup>16</sup> Moreover, assuming that they accept further negotiations, the plutonium cycle countries may also want to sidetrack plutonium discussions to other topics, such as: the emerging plutonium cycle countries, the unsafeguarded plutonium cycle countries, or the strengthening and streamlining of IAEA safeguards applied to the plutonium cycle. Obviously, there is no shortage of topics, and it must be hoped that the United States and its supporters will soon make clear their objective for the second round of negotiations.

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<sup>2</sup> There is plenty of natural uranium on the market, and many enrichment facilities. Furthermore, LEU made with HEU from dismantled Russian nuclear weapons is going to be sold at bargain prices.

<sup>3</sup> In its 1994 long-term nuclear policy plan, the Japanese Atomic Energy Agency has postponed to the early 2000s the start up of three crucial elements of its plutonium use program: the reprocessing plant and the fuel fabrication plant at Rokkasho-mura, and the Ohma advanced thermal reactor (*Nucleonics Week*, May 26, 1994, pp. 10-11).

<sup>4</sup> Our only comprehensive open source is David Albright, Frans Berkhout, and William Walker, *World Inventory of Plutonium and Highly Enriched Uranium, 1992* (London: SIPRI-Oxford University Press, 1993).

<sup>5</sup> Frank Barnaby, "Types of Nuclear Weapons", in Barnaby, ed., *Plutonium and Security: The Military Aspects of the Plutonium Economy* (London: Macmillan, 1992) pp. 264-280.

<sup>6</sup> *Nucleonics Week*, May 12, 1994, pp. 5-6; International Atomic Energy Agency, Press Release, "Japanese Material Under Full Safeguards," PR 94/23, 25 May 1994.

<sup>7</sup> This discussion deliberately excludes the option advocated by some interest groups of completely banning the production and use of HFMs. This option is precluded by strong opposition in most nuclear power countries.

<sup>8</sup> An argument in favor of the application of Article XII can be found in Laurence Scheinman and David A. V. Fischer, "Managing the Coming Glut of Nuclear Materials," *Arms Control Today* (March 1992), pp. 7-12.

<sup>9</sup> "International Plutonium Management," Netherlands discussion paper, July 20, 1993.

<sup>10</sup> International Atomic Energy Agency, *Non-Paper on International Arrangements for Plutonium and Highly Enriched Uranium: A Discussion Paper on Additional Confidence Building Measures in Relation to Plutonium and Highly Enriched Uranium* (Vienna: IAEA, November 1993).

<sup>11</sup> Germany had proposed inviting some threshold states (such as India, Pakistan, and Israel) to the discussions, but that was opposed by the United States and several other participants. At one point, the United States suggested (outside the meetings) inviting Canada and Australia, countries that do not sustain a plutonium fuel cycle, but that are important in the uranium trade and—in the case of Canada—in the nuclear industry. This suggestion was opposed by Germany and others.

<sup>12</sup> "International Framework on Enhanced Transparency of the Use of Plutonium," Japanese draft paper dated February 17, 1994. For earlier indications of Japanese policy, see *Nucleonics Week*, September 30, 1993, p. 3.

<sup>13</sup> Since 1994, proposals from countries other than Japan reportedly have been considered, and parts of the Japanese proposal have not been discussed (for example, the issue of a new secretariat). However, the Japanese proposal is the only one that has been made public, and has strongly influenced the discussions.

<sup>14</sup> We may have a more detailed proposal about how a plutonium transparency system could work later in 1995. In their December 1994 meeting,