

# **A Japanese-Russian Agreement to Establish a Nuclear Facility for MOX Fabrication and Spent Fuel Storage in the Russian Far East**

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## **Issues to be addressed**

This concept is intended to address three key problems:

- There is an urgent need to reduce stockpiles of excess weapons plutonium in both the United States and Russia, but no method of funding the cost of disposition of Russian excess weapons plutonium has yet been agreed to. The September 1998 joint statement of Presidents Clinton and Yeltsin concerning plutonium disposition commits in principle to eliminate 50 tons of weapons plutonium per side, but this commitment cannot be implemented until a detailed agreement is negotiated which must include a financing mechanism. G-8 efforts to develop a strategy for financing a Russian disposition program have thus far not shown signs of moving toward a successful outcome, despite the interest of many of the member states to contribute to global disarmament. Meanwhile, there is also a need to disposition highly-enriched uranium (HEU) from dismantled Russian warheads beyond the quantities covered under the existing U.S.-Russian HEU purchase agreement.
- There are critical spent fuel storage problems in East Asia, which can create safety, proliferation and energy security problems. In Japan, for example, electric utilities are running out of storage space for spent nuclear fuel, and are searching for approaches to providing additional storage capacity. This results in part from the fact that the Rokkasho-mura reprocessing plant that the utilities are building has been delayed. Utilities in South Korea and Taiwan are also running out of spent fuel storage space and are having difficulty gaining public acceptance for building additional storage capacity. This has led to offers by foreign reprocessing companies to reprocess their spent fuel, even though the utilities in South Korea and Taiwan do not need the plutonium that would result. The United States has been unwilling to consent to these countries reprocessing of U.S.-origin material out of concern that it could increase proliferation risks in the region.
- Russia must defuel and decommission numerous obsolete nuclear submarines (including many moored in or near the Sea of Japan) and needs storage facilities for this spent naval fuel.

In addition, Japan and Russia are seeking cooperative projects to help ease the path to achieving a peace treaty by the year 2000; the Russian Far East is in need of additional economic development and hard-currency investment; the nations of East Asia, including Japan and Russia, have been discussing the need for increased regional nuclear cooperation, to ensure nuclear safety, nonproliferation, and appropriate waste management; and the recent nuclear testing in South Asia has heightened concern over the proliferation of nuclear weapons and the problems posed by today's growing stockpiles of weapons-usable separated plutonium, both military and civilian.

This proposal is intended as an option to help address all of these concerns.

### **The proposal**

The concept, in essence, is a Japanese-Russian government-to-government agreement (with support from additional partners as desired by the principal two), to build a large MOX fabrication plant and international spent fuel storage facility in the Russian Far East. The facility would address the global security imperative of weapons-plutonium disposition while in parallel providing much-needed storage capacity for spent nuclear fuel from both commercial power and naval propulsion reactors. Japanese and Russian industry would cooperate in the construction of these facilities. As a major world economic power with the largest commercial nuclear program in the region, and as a country with strong non-proliferation credentials and a high historic interest in nuclear disarmament, Japan may wish to play the kind of significant role in the disposition of Russian weapons plutonium that this proposal would entail.

The entire nuclear facility in the Russian Far East would be under international safeguards, and the two parties (and others) would cooperate to ensure that it had the highest attainable standards of security and accounting for the nuclear material. Further, the parties might agree on additional international approaches to ensure that the facility met the highest standards of safety, security, and transparency. Indeed, a larger international group, including the United States and European countries, might be asked to be involved, particularly in ensuring internationally approved approaches for safety, security, and safeguards.

If acceptable terms could be agreed between the Japanese government and Japanese private electric utilities, such utilities could be the principal beneficiaries of both facilities because they could secure (a) low-cost contracts to store their spent fuel at the facility for a specified period, perhaps as long as 50 years; and (b) low-cost contracts for supply of MOX fuel. The revenues generated from Russia's provision of these commercial services to Japan's utilities could contribute substantially to financing the capital costs of both the MOX plant and the storage facility, and could also provide additional funds for Russia and the population of the affected region. Meanwhile, the Japanese government could also purchase low-enriched uranium (LEU) downblended from HEU arising from retired nuclear weapons, which could later be sold to utilities or stored as a national "reserve." The proceeds from such sale of LEU would also apply towards the costs of building the Russian MOX fuel plant, supplementing the funds coming from the sale of MOX fuel to Japan's private utilities.

The main elements of the concept are outlined schematically in Figure 1.\*

Figure 1 – Scheme for Possible Japanese Contribution to the Disposition of Russian Ex-Weapons Plutonium, and Parallel Storage of Asian Spent Fuel in Russia

\* For simplicity, Figure 1 addresses only the commercial transactions between Russia and private utility companies in Asia as outlined in this paper and does not show the disposition of Russian weapons plutonium within Russia (and possibly other countries) which would occur in parallel with this concept, the purchase of LEU by the Japanese government as proposed in this paper, or the shipment of Russian naval spent fuel to the storage facility as also proposed in this paper.

During the specified spent fuel storage period, additional research would be performed on improved methods for management of spent fuel (including both recycling and disposal), and the parties could continue discussions of potential additional cooperation. At the end of the contract period, the fuel would be returned to its utility owners, unless the parties had agreed in the interim on mutually beneficial arrangements to pursue some other approach (such as a further extension of the storage period or even permanent disposal of the fuel). Russia would also use the facility to store its own spent fuel, including that from naval vessels in the Pacific Fleet, which may be in close geographic proximity to the facility. In fact, one option for the siting of the overall facility would be to locate it at a Russian naval base.

The MOX plant would fabricate MOX from some portion of the weapons plutonium declared excess to Russia's military needs (in parallel with disposition of U.S. excess weapons plutonium using facilities in the United States). The plant would fabricate light water reactor MOX fuel for

Japanese utilities, which by then may have gained experience using MOX fuel fabricated in European facilities from civilian plutonium. This plant would be a logical and complementary follow-on to the DEMOX pilot MOX facility proposed by Russia, France and Germany (if funding for that facility can be found), which is intended to be built at Chelyabinsk to produce MOX fuel for four of Russia's own light water reactors, at Balakovo, and its BN-600 fast reactor. Although this concept would differ from current assumptions in that the larger follow-on MOX plant would be built in the Russian Far East rather than at Chelyabinsk as an extension of DEMOX, financing for the program as currently assumed has been extremely difficult to obtain. In contrast it is envisioned that this concept, by harnessing the funds potentially available from utilities needing additional spent fuel storage as well as fresh fuel supply, would provide a mechanism for financing such additional Russian MOX fabrication capacity beyond the DEMOX facility. In addition, if it proved cost-effective to do so, lines for fabricating other types of MOX fuel could also be included in the facility, such as CANDU fuel for consumption in Canada or fuel for Japan's Fugen Advanced Thermal Reactor and the Monju Fast Reactor, if and when they restart. At the same time, the DEMOX facility, if built, could still continue supplying fuel to the Balakovo and BN-600 units. If the United States and Russia decided to jointly pursue the "dual-track" approach the United States has chosen, and funding could be found, an immobilization plant could be built and operated at this facility or elsewhere in Russia, in parallel with the MOX plant.

To address possible concerns over sending MOX containing weapons-grade plutonium to Japan, a non-weapons state, the weapons plutonium could be mixed with the stockpile of over 30 tons of separated reactor-grade plutonium now in storage at the Mayak Production Association at the town of Ozersk (formerly known as Chelyabinsk-65), allowing that stockpile to be reduced as well. The MOX spent fuel irradiated in Russia and Japan would also be stored at the joint facility.

If the Russian and Japanese partners agreed that it would be mutually beneficial to pursue other cooperative partners as well, the spent fuel storage facility in the Russian Far East might also seek contracts for storage of spent fuel from South Korea and Taiwan. Both South Korea and Taiwan are currently running out of spent fuel storage space, and some parties in both states remain interested in getting the United States to give its consent to foreign reprocessing of their U.S.-origin spent fuel – but U.S. consent does not appear likely in the foreseeable future. Storage at this facility could provide a proliferation-resistant approach to resolving this dilemma. In the future the facility could also receive spent fuel from the KEDO project, if nuclear reactors are in fact built and operated in North Korea in the future. If the partners in building this facility agreed that it was mutually beneficial to do so, other international partners could also be invited to store their spent fuel at the facility, in return for comparable payments.

### **The Importance of Securing Commercial Benefits**

While disposition of excess weapons plutonium will provide substantial security benefits to the entire international community, including the G-8, the G-8 states have so far failed to agree to provide funding for such a program, or even to enter into serious negotiations over such funding. This suggests that the most promising solutions to this problem may be those that also provide financial benefits sufficient to help the program pay for itself, substantially reducing the need for

direct government support. The concept presented in this paper aims to overcome the obstacles that have thus far blocked the development of a viable internationally-agreed approach to financing the disposition of Russian weapons plutonium, essentially by harnessing the substantial resources that electric utilities in Japan and elsewhere intend to spend in any case for spent fuel storage and new fuel procurement, in return for the siting within the Russian Far East of the nuclear facilities of which these utilities would be customers and in return for receiving services from these facilities at attractive prices. These commercial arrangements could greatly reduce the need for coordinated G-8 funding of Russia's plutonium disposition program, leading to an increased likelihood that disposition could be accomplished in the near term.

The key to the concept's economic viability is the presumption that the cost and political difficulty of building and operating both the MOX fuel fabrication plant and the spent fuel storage facility in Russia will be comparable to or less than those of alternative fuel cycle management options, even after allowance for economic benefits to Russia that must be provided as inducement for Russia to participate. Additional work is needed to flesh out the costs more precisely, but it appears very likely, given the relatively modest cost of dry cask storage facilities and the prevailing low labor and materials costs in Russia, that construction of such facilities in Russia would be an economically attractive option. In particular, it is very likely that the total capital and operating costs of the spent fuel storage facility would be lower than the cost that East Asian utilities are otherwise expecting to pay for management of their spent fuel over the next several decades, even if the capital cost of the MOX plant and the costs of providing associated economic benefits to Russia were included. Thus, the utilities might be able to save money on their spent fuel management even as Russia made substantial profits on operation of the spent fuel storage facility. Russia might also be able to make a profit from operation of the MOX plant: if the initial capital cost of the MOX plant were written off (paid for by some combination of governments and utilities as part of the overall cost of the disarmament and fuel storage scheme), then the operating cost-per-kilogram that Russia would incur to produce the MOX fuel would likely be less than the price Japanese utilities pay today for LEU fuel of equivalent energy value (particularly given the low prevailing wage rates in Russia).

If additional financing were needed to make the package economically attractive, and governments were not willing to provide it from on-budget resources, it would be possible, as already noted, for Japan and Russia to agree that Japan would purchase a substantial stock of LEU blended from Russian HEU (in parallel with the U.S. purchase of LEU blended from 500 tons of HEU), with a substantial portion of the proceeds from this purchase being used to finance the construction of the MOX facility. Japan could hold the purchased LEU off the market for the time being, bolstering its energy security by providing a strategic stockpile to deal with any future uranium supply interruptions.

In short, by generating revenues from commercial services in spent fuel management and fresh fuel supply, together with harnessing the value inherent in Russia's still large excess stockpile of HEU, it may be possible to accomplish both secure spent fuel storage and disposition of excess weapons plutonium without requiring large on-budget subsidies from the G-8 governments. All program costs could be covered even as utilities in Japan, South Korea and Taiwan paid less for spent fuel storage (and, in the case of Japan, less for new fuel procurement) than they might otherwise.

## **Benefits**

The potential benefits of this venture may be summarized as follows:

### *Benefits to Russia*

- Potential for billions of dollars in profit, and large-scale investment and jobs in the Russian Far East, by providing a broad package of nuclear services to Asia including spent fuel storage, MOX fuel fabrication and LEU fuel supply.
- Acquisition of a large-scale MOX fabrication plant, with possibilities for profitable operation of that facility.
- Acquisition of a storage facility for Russia's own spent commercial and naval reactor fuel.
- Resolution of the excess weapons plutonium problem in a manner that would implement the September 1998 Clinton-Yeltsin commitment and allow both the U.S. and Russian programs to move forward, reducing international concerns and helping to ensure the irreversibility of nuclear arms reductions, without cost to Russia.
- Establishment of a long-term commercial relationship and technical cooperation with the Japanese nuclear industry.
- Establishment of a leading role for Russia in nuclear power cooperation in East Asia, with the potential for additional nuclear-related contracts that this would bring.

### *Benefits to Japan*

- Opportunity to play a major role in resolving the excess weapons plutonium problem and contribute significantly to world peace and security. As the only country to know the consequences of nuclear weapons, Japan's interest in contributing to nuclear disarmament would be well understood and respected.
- Initiation of a large-scale cooperative project with Russia which could help ease the path toward completion of a peace treaty by the year 2000.
- Provision of a large spent fuel storage facility for Japanese spent fuel, avoiding the difficulties that would certainly be encountered in siting such a facility within Japan and providing ample storage capacity for decades to come and thus greater flexibility in the management of spent fuel.
- Potential savings in both spent fuel management and fresh fuel procurement costs to Japanese utilities.
- Potential for greatly reduced domestic and international public concern over Japan's commercial use of plutonium, particularly if access to additional spent fuel storage leads Japanese utilities to reprocess only when the resulting plutonium is required for fuel, thereby avoiding any build-up of stockpiles of separated plutonium either in Japan or abroad.
- Establishment of a leading role for Japan in nuclear power cooperation in East Asia.
- Opportunities for Japan to establish still more technological leadership in the nuclear fuel cycle.

### *Benefits to the United States and the international community*

In addition to its benefits for the two principal partners, this concept would also provide benefits to the rest of the international community. It is particularly important that it provide benefits to the United States, whose prior consent would be required for the shipment of spent fuel to the facility and whose support would also be important for this approach to resolving the excess weapons plutonium problem. Benefits to the United States and the international community would include:

- Timely and secure resolution of the excess weapons plutonium problem, implementing the September 1998 Clinton-Yeltsin commitment and allowing both the U.S. and Russian disposition programs to move forward, helping to ensure irreversibility of nuclear arms reductions.
- Resolution of the Taiwanese and South Korean spent fuel management dilemmas without near-term reprocessing.
- Potential to defer separation of civilian plutonium in Japan until plutonium is required for fuel, reducing potential proliferation risks.
- Increased transparency in the plutonium/HEU disposition process with international safeguards and thorough material accounting and physical protection.
- Establishment of large-scale nuclear cooperation in East Asia, with the potential for other measures to improve safety and prevent proliferation.
- Establishment of the principle of international cooperation in the creation and operation of spent fuel storage facilities, potentially facilitating similar cooperation elsewhere.

### **Disadvantages and Obstacles**

Legal and political issues in Russia probably pose the largest single obstacle to implementing this approach. There will be the difficulty of making the case there that such an approach is safe and profitable, and does *not* represent unacceptably turning Russia into "the world's nuclear dumping grounds." Key factors in making this case would include:

- a fixed term for the storage contracts, after which the fuel would be returned unless other arrangements had been agreed to in the interim;
- rigorous measures to ensure absolute safety for the facility, including international supervision of the safety arrangements;
- substantial financing for other projects in the affected region, to compensate for siting this nuclear facility there;
- substantial offers of potential income associated with agreeing to host the facility; and
- inclusion in the project of a cooperative effort to address spent fuel management from Russia's naval nuclear fleet.

In particular, Russian law currently forbids importing foreign nuclear waste for storage and disposal in Russia. Importing spent fuel for reprocessing, with return of the wastes to the foreign owner of the spent fuel, is permitted, but importing spent fuel simply for storage is not currently permitted. This law would have to be modified for this proposal to be implemented, which would require action by the Duma and the Federation Council. To succeed, such a modification would probably have to be strictly limited, as the law was enacted in the first place in part because of environmentalist objections to proposals for Russia to seize a substantial portion of the world

reprocessing market by offering to reprocess spent fuel without return of the waste. Thus, it seems likely that at least the initial approach would have to focus on permitting storage for a limited, fixed term.

A disadvantage in the Russian context is that very long-distance transport of the plutonium oxide would be required for a MOX plant located in the Russian Far East. A wide range of measures, comparable to those used to protect shipments of nuclear weapons themselves, would be required to ensure security and safety of these plutonium shipments.

Similarly, substantial ocean transport of spent fuel from Japan (and possibly South Korea, Taiwan, and other countries) would also be required to implement this proposal. Here, too, new efforts would be needed to ensure safety and address public and international concerns (which have been expressed concerning shipments of spent fuel, plutonium, and high level waste between Japan and Europe).

For Japan, a decision by the government and utilities to participate in the proposed program could mean that they would be making substantial changes in existing plans and commitments, including (A) potential further delay in the start-up of the Rokkasho-mura reprocessing facility and (B) reactor loading with MOX fuel containing plutonium that is not the property and responsibility of the utilities that own these reactors. Both of these aspects could be problematic, but there are measures that could potentially address both of them. While the potential for further delays in starting up the Rokkasho facility could damage relations between the government and the utilities on the one hand and the local government of Aomori prefecture and the surrounding area on the other, a commitment to continue to provide high-technology jobs at that facility with a large-scale fuel-cycle research and development center could go a long way toward assuaging the regional government's concerns. Japan might choose to conduct a substantial research program on improved methods for spent fuel management in the long term, including proliferation-resistant recycling approaches and better methods for permanent disposal. A \$1-\$2 billion research facility could be built at the Rokkasho-mura site, providing jobs and investment there to compensate in part for any lost because of further delays in operating the large reprocessing facility. Such a large-scale research program could help to ensure Japan's technological leadership in the nuclear fuel cycle. At the same time, the facility could be a center for joint research with Russia on advanced nuclear technologies, potentially including further development of Russian "vibropack" fuel fabrication concepts, proliferation-resistant fuels, and other technologies.

Concerning the use of MOX fuel in Japanese commercial reactors, it appears likely that by that time, the reactors in question will already be using MOX fuel shipped from European fabrication facilities. While MOX fabricated in Russia from weapons plutonium would not be the inevitable result of management of the utilities' own spent fuel, it would have the attraction of playing a key role in disarmament – a potentially important factor in Japan, particularly if the United States strongly supports this approach. Moreover, if operation of Rokkasho were further delayed because this approach made additional spent fuel storage capacity available, removing some of the pressure for near-term reprocessing, the MOX from Russia would in effect substitute for MOX that would otherwise have come from Rokkasho's reprocessing. As in the current plan, communities near reactors that would use the Russian MOX might receive additional benefits.

As noted earlier, there may be concern in some quarters over the prospect of sending MOX containing weapon-grade plutonium to Japan, a non-nuclear-weapon state. If this were judged to be a major issue, it could be addressed by mixing in reactor-grade plutonium, from the large civilian stockpiles that already exist in Russia and whose reduction is also an important nonproliferation objective.

Finally, from the U.S. point of view, while the benefits of such an approach would be substantial, it would be important:

- for the United States to be confident that the facility would be safe and secure and that nonproliferation would be ensured;
- that shipment of the spent fuel to Russia would not in any way imply that contracts for its reprocessing would be pursued (or would receive U.S. prior consent); and
- for the plutonium disposition portion of the approach to meet the nonproliferation criteria the United States has set for international cooperation in disposition of excess weapons plutonium: stringent security and accounting for all the nuclear material involved, international safeguards, and use of the facility only for disposition of excess weapons plutonium (or perhaps, only for already separated plutonium, if the civilian plutonium stored at Mayak were to be mixed in), at least until stockpiles of excess weapons plutonium were eliminated.

Furthermore, sending spent fuel covered by U.S. consent rights to Russia would appear to require a U.S.-Russian Agreement for Cooperation, unless some arrangement not apparent to the authors that would obviate this requirement could be found. Achieving such an agreement would require a significant change in either U.S. or Russian policy, as the United States has so far indicated that it will not pursue such an agreement with Russia until Russia ends its nuclear cooperation with Iran, a requirement which the United States also insisted on in its recent Agreements for Cooperation with China and Ukraine.

### **A Path Forward?**

This proposal could offer an approach to resolving several key international issues, including disposition of excess weapons plutonium, management of spent fuel, and East Asian nuclear cooperation, in a way that supports nonproliferation and arms reduction objectives. Most importantly, the concept offers potential global security benefits by providing a means for financing the disposition of Russian surplus weapons plutonium, which the G-8 governments have thus far unfortunately been unable to do. The project accomplishes this through the harnessing of resources that electric utilities in Japan and elsewhere would otherwise spend domestically for nuclear fuel cycle management and can instead use for a Russia-based, economical approach to both spent fuel storage and plutonium disposition/MOX fuel supply.

Nevertheless, the obstacles to implementation of the proposal are likely to be substantial. The next step is to explore the basic outlines of the idea with government officials, industry representatives and other experts in Japan, Russia, the United States, and other countries, to gain additional insights into the attitudes and concerns of all the relevant parties, and to adapt the proposal to maximize the benefits the parties perceive in it and minimize its disadvantages and

the obstacles it faces. Then it will be up to the governments involved to explore whether there is a basis for an agreement to pursue such a far-reaching cooperative initiative.

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