# Get SMART: The Case for a Strategic Materials Reduction Treaty, and Its Implementation

by

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## SUMMARY

*Inventories of weapons plutonium removed from nuclear warheads should be reduced as quickly as possible to prevent large-scale rearmament by the United States or Russia and to minimize the risk of theft or sabotage by a sub-national group. The U.S. and Russia should agree to a Strategic Materials Reduction Treaty (SMART) establishing an aggressive timetable for mutual reduction of these arsenals, and should jointly declare the majority of existing inventories to be in excess of national security needs and schedule the final disposition of this material.*

*An aggressive disarmament timetable will require an aggressive implementation program. This should take advantage of available resources within the U.S. and Russia as well as in third countries, including potentially both reactor and immobilization options, as long as stringent safeguards and security can be guaranteed at all participating facilities. Many existing light water reactors in the U.S. are well suited to the purpose, and several private operators of these plants have formally expressed interest to the U.S. government in providing such service. Russian fast and light water reactors appear to be less readily available to burn weapons plutonium. Russia, the United States and other G-7 countries should develop international programs to facilitate the most rapid possible reduction in weapons plutonium inventories, consistent with SMART. Such international cooperation would add credibility and transparency to the nuclear disarmament process in the spirit of the Non-Proliferation Treaty, and could add momentum toward the conclusion of both a Comprehensive Test Ban Treaty and a Fissile*

*Material Production Cutoff Treaty.*

*This international program should take advantage of existing global infrastructure for the use of plutonium fuel as well as other capability (e.g., in the U.S. and Canada) that could supplement existing civilian Pu use plans, as well as vitrification or other immobilization facilities. In combination, it is reasonable to forecast a global capability to disposition at least 10 tons of weapons plutonium per year. In addition to providing plutonium disposition capacity, third countries should participate in financing disposition programs and offering safeguards technologies to the global disarmament effort.*

*Weapons plutonium which the U.S. and Russia declare to be in excess of national security needs and place on the SMART timetable should be held under their ownership and under international safeguards until sent to various final disposition sites. However, it would be advantageous to establish an international entity with representatives of Russia, the U.S., other G-7 countries and possibly other states to play a role concerning the flow of weapons plutonium to third country disposition sites, based on the resources available in each country. Such entity could also play a role in preventing the further accumulation of stocks of separated civilian plutonium.*

## I. INTRODUCTION

The dismantling of weapons delivery systems by the United States and Russia has already yielded large quantities of material now unneeded for defense purposes, and extensive research is under way concerning the best way or ways to get rid of these materials irreversibly. But while these evaluations progress and the selection of disposition methods remains a subject of great interest, a question that often seems forgotten is: How much of the dismantled materials will the U.S. and Russia actually *decide to* disposition? Will we declare the vast majority of the dismantled materials to be in excess of national security needs, *and* will we in fact successfully disposition this quantity? Clearly, as successful as disposition programs may be, their benefits to society are limited by whatever amounts of fissile material the U.S. and Russia include in these programs. The United States has declared about 175t of HEU, but only about 40t of Pu, to be in excess of national security needs; to my knowledge no such declaration has yet been made on the Russian side. Furthermore, even the amounts that *have* been declared to be excess are of course not yet irreversibly dispositioned, and there is the risk that they could be returned to weapons use.

I would like to state as the underlying premise of my talk something which is very simple and upon which I think most or all of you would agree: that it is healthier for the planet if both sides downsize our nuclear arsenals as quickly as possible, keep them small, and establish a system of international control to oversee this process. By arsenals, I am including all weapons-grade fissile material that is still in the possession of each country, even it has already been declared to be in excess of national security needs and relinquished by the military, i.e., anything that has not yet been irreversibly converted to a non-weapons-usable form. The point is, it is strange, and

inadequate, that we have almost come to accept the dismantling of *delivery* systems as "disarmament," rather than the dismantling of the bombs themselves. If the bombs still exist, we have not disarmed them.
Let us assume steady progress towards START milestones and, looking just at plutonium, a fairly optimistic scenario in which 50 MT of Pu per side -- i.e., roughly half -- is declared surplus to national security needs, released for disposition, subjected to IAEA safeguards, and successfully dispositioned over the next two or three decades. Even with such a rosy forecast, a rough calculation shows that there would still be enough remaining weapons-grade Pu thirty years from today to arm 20,000 warheads (not just the 3,000 or so allowed under START-II).

Clearly a 50 MT reduction in W-Pu per side is totally inadequate. Even if we were confident that this remaining inventory was extremely well guarded, it would still be in the national arsenal, leaving open the possibility of an all-too-easy resumption of the arms race. Plus, if we accepted indefinite long-term storage of such a large remaining inventory of "loose nukes" (no longer in weapons but not yet dispositioned), we also run the risk of major changes in government and periods of loss of control over the material, potentially leading to diversion.

In any case, it is not even clear that we are now on our way to shedding even this inadequately small portion of our arsenals. We forget in good times that there is some risk that the process will lose momentum. There are still those voices in each country who would bring us back into a spiraling arms race.

## II. SMART

What can we do to ensure that the U.S. and Russia will indeed eliminate the vast majority of the "loose" inventories? What we need is a program and an agreed reduction timetable that both sides must honor if they expect the other to do it. The U.S. and Russia need a treaty-level agreement -- a Strategic Materials Reduction Treaty (SMART) -- establishing a joint framework and timetable for the disposition of fissile materials, and should jointly declare the majority of existing inventories to be in excess of national security needs and schedule its final disposition. SMART should have the following features:

- Goal of achieving a minimal residual inventory within 20 years, from the current inventory of about 100 tons W-Pu per side to perhaps 10 tons each;

- Compliance by whatever method or combination of methods each country prefers -- including domestic and third country options, employing either reactor burning or immobilization or other approved methods -- as long as the aggressive treaty goal is met; and

- As a first step, an agreed timetable for deforming plutonium pits, which should be

relatively quick and inexpensive. Pits would then need to be refabricated in order to use them in weapons.

According to the U.S. National Academy of Sciences[1], this last point -- pit deformation -- would only introduce a delay on the order of months to a rearmament program. However, it would have great symbolic importance, and if we could also reach agreement to decommission all pit fabrication facilities, we would introduce an even greater barrier to a rearmament program.

Implementing SMART would ensure the irreversibility of disarmament. Without such an agreed schedule, it is unlikely we can make rapid reductions because neither side can possibly implement significant cuts without a reciprocal move on the other side. We might instead be engaged, at best, in a game of stop-and-go disposition, with each side constantly concerned that they maintain near-parity with the other, and, at worst, in a stalemate where both sides sit on large inventories indefinitely.
Of course there are voices in both countries arguing that we should hold on to these inventories as they might be needed again for military purposes. This is a narrow and outdated Cold War mentality (and indeed, one of the major reasons that we should get rid of the inventories quickly). As long as the U.S. and Russia reduce inventories in parallel, nuclear parity will endure; large reductions are possible before we reach the fissile material inventory level of the other declared nuclear weapons states, China, France and the U.K. Furthermore, once the U.S. and Russia begin to make substantial progress, the other nuclear powers should reduce their inventories as well.

How SMART Fits Into Disarmament Framework

In addition to START II, which the U.S. Congress recently ratified, Presidents Clinton and Yeltsin made a joint statement on the Transparency and Irreversibility of the Process of Reducing Nuclear Weapons at their summit meeting in Moscow in May 1995. Their statement declared that:

> "Fissile materials removed from nuclear weapons being eliminated and excess to national security requirements will not be used to manufacture nuclear weapons;
>
> No newly produced fissile materials will be used in nuclear weapons; and
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> Fissile materials from or within civil nuclear programs will not be used to manufacture nuclear weapons."

[1] National Academy of Sciences, Committee on International Security and Arms Control, *Management and Disposition of Excess Weapons Plutonium*, National Academy Press, Washington, D.C., 1994; also NAS-CISAC, *Reactor-Related Options*, 1995.

These three elements -- no reuse, no new production for weapons, and no transfers from civilian to weapons -- are all the right elements, but they are not irreversible. SMART would make the first item irreversible. As an agreement to get rid of existing inventories, SMART would go hand-in-hand with START and with the commitment not to produce more fissile material for use in nuclear weapons (which has yet to be formalized internationally in a Fissile Material Production Cutoff Treaty).

Negotiations have been ongoing to implement other aspects of the May 1995 agreement, concerning increased transparency and irreversibility and the need for an agreement for cooperation allowing data exchanges. Hopefully these items will be resolved in connection with the April 1996 summit. But regardless of progress on this front, SMART can proceed independently.

## III. AN INTERNATIONAL PROGRAM FOR ACCELERATED DISPOSITION OF W-PU

How can we achieve the aggressive disarmament timetable spelled out under SMART? I will quickly summarize the current prospects for W-Pu disposition within the United States and Russia, and then turn to the potential contribution of third countries towards meeting aggressive disposition milestones.

United States

On the U.S. side, things are moving too slowly and not one kilogram has yet been dispositioned despite various existing technologies that could already have been employed to demonstrate their suitability for the purpose. The reason is that U.S. policy has not yet been decided and unfortunately even pilot-scale efforts will not begin until it has been. The development of disposition options is on hold until at least the end of 1996 when the U.S. Department of Energy expects to announce a decision.

On the other hand, DOE deserves credit for its recent steps to release inventory data, as part of Secretary of Energy Hazel O'Leary's openness drive. The report released by O'Leary on February 6 reveals that the U.S. inventory of Pu totals 99.5 metric tons, including 66.1 MT at the Pantex site in Texas.[2] It is DOE's intention that the release of these details will prompt Russia, China and others to make similar disclosures, and I hope that will occur.

Returning to DOE Pu disposition studies, Figure 1, from their February 1996 draft environmental impact statement, indicates that DOE is evaluating options in three categories: Deep Borehole

[2] U.S. Department of Energy, *Plutonium: The First 50 Years*, February 1996.

Disposal; Immobilization Followed by Repository Disposal; and Reactor Options. (Also shown is the "No Action" alternative, which would of course be the worst possible outcome and one which DOE will certainly not select, but is a standard element in the U.S. government's review of the environmental impact of actions it proposes to take.)
The use of existing reactors has substantially more support than building new reactors or completing partially-constructed ones, mainly for the obvious reason of economics. (This includes the option of employing Canadian CANDU reactors, which I will discuss in a few minutes.) In December 1995 DOE asked the nation's electric utilities to indicate whether they had an interest in offering one or more reactors for the purpose, and last month received positive responses from several utilities (who are attracted by the prospect of free fuel and a possible subsidy from the U.S. government for conducting Pu disposition activities):

- Arizona Public Service
- Commonwealth Edison
- Duke Power
- Southern Nuclear Operating Co.
- Tennessee Valley Authority
- Washington Public Power Supply System
- Others

Unfortunately DOE tied this request to a related invitation concerning the use of commercial reactors to produce tritium for maintenance of our stockpile of nuclear weapons. Some of the utilities have expressed interest both in producing tritium and burning W-Pu in the same reactors at the same time. The prospect of our regional electric utilities producing this key component for nuclear weapons would cancel out the disarmament benefits of burning W-Pu, and is likely to be so controversial that it would seriously delay efforts to employ existing reactors for Pu disposition. My feeling is that if an existing reactor is to be used for tritium production, it should be sold outright to DOE and operated by DOE.

Furthermore, extensive studies are now under way concerning the immobilization option. A December 1995 DOE workshop on the subject seemed to indicate that there are no major obstacles that would prevent immobilization of W-Pu in glass followed by repository disposal. Criticality concerns during processing apparently can be mitigated and a glass with high Pu solubility can be designed. On the other hand, long-term criticality control in a repository may be more difficult to assure. Neutron absorbers are being studied, such as gadolinium, but Pu loading may have to be low to gain licensing approval.

Finally, while the borehole option seems to be receiving positive technical reviews, it is probably the least likely option to be selected for the simple reason that a site would need to be found.

My expectation is that DOE will not narrow down these nine choices to a single strategy when it

reaches its decision later this year, but rather make a general determination to develop and demonstrate reactor and immobilization options in parallel. Potentially both options could be pursued in parallel, offering the assurance of some redundancy. This would be consistent with the NAS Reactor Options Panel report, which recommended "bringing both processes on-line by the end of the century or as shortly thereafter as possible." I would note that we already know that some Pu residues are unsuitable for MOX fuel and a waste management solution will be necessary, so the main question really is whether DOE will also pursue the MOX method of disposition. My hope is that they do and that they develop both options as expeditiously as possible, consistent with SMART objectives.

Russia

Russian experts at this conference have already described possible concepts for utilization of excess weapons Pu in Russia. My understanding is that using MOX in LWRs is clearly not the preference of the Russian government, as it was never intended and there is no direct experience burning MOX in Russia's LWRs. However, some work is now under way on fabricating MOX fuel for LWRs. At the September 1995 ASME conference in Berlin, Drs. Murogov, Kagramanian and Chebeskov described three possible scenarios: 1) building 3-4 BN-800 fast reactors, which could transform both civil and ex-weapons Pu into spent fuel by 2030 or 2040; 2) using only the existing BN-600 and VVERs, which can burn only 25 tons of ex-weapons Pu in their remaining life ; and 3) constructing new VVER-1000s (11 units burning 1/3 MOX could consume 3.3 tons/year).[3]

At the same conference, Dr. Rybatchenkov of the Ministry of Foreign Affairs of the Russian Federation, noting the financial difficulties in executing these concepts, spoke favorably of the option of disposing Russian W-Pu in existing foreign reactors. Focusing in particular on a proposal from Canada, Rybatchenkov stated that preliminary study "shows that it may be of interest to Russia from political, economic and social points of view." He noted the benefits of the concept for assuring transparency and irreversibility of W-Pu disposition; offering hard currency to Russia; and creating new work places in Russia's nuclear industry. Speaking also of other possible partners such as the U.K. (Sizewell), France, Germany, Belgium and even the U.S., Rybatchenkov concluded that "the very idea of using foreign reactors for disposition of Russian weapon grade plutonium seems to be sufficently productive and deserves a thorough investigation side by side with traditional projects, involving Russian reactors."[4]

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[3] V.M. Murogov, V.S. Kagramanian and A.N. Chebeskov, Institute of Physics and Power Engineering, "Scenarios of Separated Plutonium Utilization in Russian Thermal and Fast Reactors," *Fifth International Conference on Radioactive Waste Management and Environmental Remediation,* American Society of Mechanical Engineers, Berlin, Germany, September 3-8, 1995.

[4] V. Rybatchenkov, Ministry of Foreign Affairs of the Russian Federation, "Possible Involvement of Foreign Partners in Resolving the Problem of Russian Weapon Grade Plutonium Disposition," *Fifth International Conference on Radioactive Waste Management and Environmental*

Third Country Scenarios

Taking advantage of available resources not only within the U.S. and Russia but also in third countries, including potentially both reactor and immobilization options, might make possible a more aggressive disarmament timetable under SMART. Under the condition that stringent safeguards and security must be guaranteed at all participating facilities, there could be significant disarmament benefits to broadening our disposition programs in this manner. In addition to assuring accelerated disposition, international cooperation would add credibility and transparency to the nuclear disarmament process.

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*Remediation,* American Society of Mechanical Engineers, Berlin, Germany, September 3-8, 1995.

As I noted earlier, the Canadian nuclear industry has already offered proposals to both the United States and Russia to accept MOX fuel made from W-Pu at Ontario Hydro's Bruce station. Atomic Energy of Canada Limited projects that four reactors at the 8-unit Bruce station could consume 50 tons of W-Pu in just 12 years (or, for 8 units, 100 tons in 12 years). Ontario Hydro is committed to this proposal, and the Canadian government is currently addressing it at the highest levels and is expected to announce a position very soon.[5]

Clearly, the Canadian proposal is an important third country scenario, and indeed could be one of the most significant of any of the options for U.S. or Russian W-Pu disposition. But additional third-country scenarios should be considered as well for their potential benefits to the disarmament process. While it may be desirable to limit the total number of disposition sites in order to guarantee security arrangements, third country sites should be among those considered. Figure 2 identifies a range of conceivable domestic and third country MOX scenarios.

Unlike disposition scenarios involving U.S., Russian or Canadian reactors, which would generally be above and beyond existing civilian MOX use plans, these other third-country options, in Europe or Japan, which would take advantage of existing worldwide infrastructure for civilian Pu utilization, could either be above and beyond existing MOX use plans, or could potentially substitute W-Pu for reactor-grade Pu that is otherwise scheduled to be utilized in these countries. (France, Germany, Switzerland, Belgium and Japan are either already using MOX fuel in LWRs or plan to do so within the next few years.)

These options are complicated by the fact that there is already a large surplus of separated civilian Pu awaiting MOX fabrication and disposition, and it will be several years before this backlog can be worked off. (A large portion of that material happens to be nearly weapons-grade itself, resulting from the reprocessing of low-burnup fuel from gas-cooled reactors.) Nonetheless, the feasibility of certain scenarios should be carefully examined as possible further contributions beyond what happens in the U.S., Russia and Canada. I think these can be divided into two classes:

1. Above and beyond existing Pu use plans: It is conceivable that third-country reactors could consume some W-Pu beyond existing civilian Pu utilization plans. The main question is whether existing MOX fabrication capacity would be sufficient to accommodate such additional plutonium, or when it would be

[5] Personal correspondence with Philip Campbell, President, AECL Technologies, Inc., March 11, 1996.

available, without building additional capacity just for this purpose.

Reprocessing capacity and MOX fabrication capacity are expected to reach equilibrium over the next decade or so. In the event that reprocessing contracts are cancelled, however, it is conceivable that, after the backlog of separated Pu is worked off, there could be surplus capacity at existing MOX fabrication plants.

Another way would be to put some weapons-Pu ahead of already-separated civilian Pu to burn it sooner. But due to the problem of americium buildup in higher-burnup fuel, this could only practically be applied to low-burnup fuels that are nearly weapons-grade. Thus, the benefits would be minimal-- mainly just symbolic.

One further scenario for increasing Pu consumption rates in these countries has been proposed by Professor Atsuyuki Suzuki, of the University of Tokyo, under which Japan's government-owned reactors Fugen (Advanced Thermal Reactor) and Monju (Fast Neutron Reactor) would alter their operation to achieve faster Pu depletion, permitting the consumption of up to 2 tons/year of W-Pu.[6]

A problem common to all of these "addition" options is that utilities right now appear to be increasingly disinterested in Pu fuel.

2. Substitution for existing Pu use plans: If W-Pu was sent to existing (or already-planned) MOX fabrication facilities instead of an equivalent amount of civilian Pu, reprocessing activities necessary to separate that amount of civilian Pu could therefore be deferred until it was no longer necessary to burn W-Pu. This would require complicated arrangements depending on:

   - Political decisions by the U.K., France and others that accord enough importance to the disarmament benefits of weapons disposition in existing MOX programs to justify a disturbance to existing commercial fuel cycle service arrangements;
   - Future evolution of utility contracts for reprocessing and MOX fabrication services;
   - The schedule for reactor loading of already-separated civilian Pu; and
   - The willingness of utilities to accept weapons-grade rather than reactor-grade MOX fuel.

[6] A. Suzuki, University of Tokyo, "Japan's Civil Use of Foreign Military Plutonium," Proc. International Conference on Evaluation of Emerging Nuclear Fuel Cycle Systems (Global '95), Versailles, September 1-14, 1995, pp. 661-668.

Blending Option- There are limits to how long reactor-grade Pu can be stored following reprocessing, due to the buildup of Americium-241, if it is to be acceptable for MOX fabrication and recycle in reactors. This is especially true for Pu arising from more recent irradiations because of the higher burnup (higher burnup causes a lower grade of Pu including more Pu-241, the isotope that decays into Am-241). W-Pu does not have this problem. Thus, a fifth possibility would be to mix W-Pu with separated civilian Pu to dilute the Am-241 problem.

Such blending would not allow as high a throughput rate as possible and is thus less than ideal from a disarmament point of view. But, on the other hand, as a supplement to the major disposition pathways, which will probably be in the U.S., Russia and possibly Canada, this could absorb some W-Pu. The question concerning this option is whether reprocessing could be slowed down to match the amount of W-Pu added to the stream. This would allow total inventory reduction; furthermore, the alternative -- i.e., no change in the rate of reprocessing -- would require more utility burning of Pu, which may be difficult to arrange.

Another blending idea I have heard is to use W-Pu to deal with second generation spent fuel (i.e., spent MOX), which has a still-lower grade (which is for the most part being stored for the time being). In this case it is not an issue of Am-241, because the fuel is not yet reprocessed, but rather a question of 239 content-- second generation MOX fuel would perform better if blended with high-grade W-Pu. However, to me this is not attractive because you might actually cause more separation of Pu (spent MOX fuel might not otherwise necessarily be reprocessed, or at least not yet, because there is a backlog of separated first-generation Pu to work off).

The table below summarizes the above-mentioned disposition scenarios in countries with existing MOX infrastructure.

Opposition to third country reactor disposition could be expected from two principal quarters:

1. Reprocessors: To the extent that third country disposition in countries already using MOX fuel would substitute for existing plans, it would defer planned reprocessing activities. Possibly these same companies would gain additional MOX fabrication contracts as a result of the disarmament effort, but this would only partially offset the loss of important export sales and the associated employment benefits in France and the U.K. (An analogy can be made to the disposition of highly-enriched uranium (HEU), which will potentially cause economic dislocations to the uranium industry.) If substitution is to be at all feasible, it seems that some form of compensation might have to be offered to make up for each ton-year of deferred business, and this must be considered in estimating the costs of this disposition method.

**SPECIFIC THIRD COUNTRY SCENARIOS**
**IN COUNTRIES WITH EXISTING MOX INFRASTRUCTURE**

ADDITIONS

1. MOX fabrication capacity becomes available due to expiration and/or cancellation of reprocessing contracts

2. Put W-Pu ahead of burning already-separated low-burnup civilian MOX

3. Alter reactor operations to allow higher Pu depletion rates (esp. Fugen and Monju)

SUBSTITUTION

4. Slow down reprocessing by same rate that W-Pu is introduced into existing MOX programs

BLENDING

5. Blend with already-separated high-burnup civilian Pu, diluting Am-241

However, we should also keep in mind, in the event these arrangements are too difficult, that W-Pu burning that is above and beyond existing Pu plans would also have disarmament benefits, equivalent to W-Pu disposition in the U.S., Russia or Canada.

2. Opponents of Civilian Pu Utilization: Some organizations that have opposed civilian Pu use also oppose the MOX option for disposition of W-Pu, whether it is in the U.S. and Russia or in third countries, out of concern that this would ultimately lead to greater separation and use of plutonium. However, it should be possible to structure international efforts towards Pu disposition such that we can have the best of both worlds: achieving reductions in the total global inventory of separated Pu, and sending the signal that this inventory *should remain* low and should be under international control. As discussed below, this requires an international framework that has the goal not only to improve controls over all separated Pu but also to gradually reduce inventories. This would necessarily

imply establishing some controls over reprocessing rates -- based on demand. W-Pu disposition policies should be announced with a clear statement concerning the need to reduce total separated inventories, and to put remaining civilian and military inventories under greater international control.

Disarmament has increased the Pu glut, and to deal with the glut we must first of all increase the use and disposal of Pu, which is what U.S., Russian and Canadian disposition options would do. In addition, I think this is not just the responsibility of the U.S. and Russia, and other nations with existing MOX infrastructure who can contribute should do so. This also responds to the glut, either by increasing the use of Pu or by slowing the separation of additional Pu.

The National Academy of Sciences concluded in its 1994 report that "substituting excess weapons plutonium for reactor-grade plutonium in existing civilian plutonium fuel programs... would be the quickest practical means of disposition for excess weapons plutonium *if* the complex international agreements required could be achieved." The international arrangements that would be needed should be further examined to ascertain which specific scenarios, if any, could offer significant benefits in terms of accelerated disposition, and which therefore should be pursued.

**SUMMARY OF THIRD COUNTRY DISPOSITION**

CONTRIBUTES TO ACCELERATED DISPOSITION

ADDS CREDIBILITY AND TRANSPARENCY TO THE DISARMAMENT PROCESS

COULD BE ABOVE AND BEYOND EXISTING MOX USE PLANS, OR A SUBSTITUTION FOR EXISTING MOX USE PLANS

OPPOSITION FROM REPROCESSORS AND OPPONENTS OF CIVILIAN PU UTILIZATION

## IV. INTERNATIONAL CONTROL

Consistent with these thoughts on managing the total supply and demand of Pu, we should establish a process ensuring that we do not accumulate excessive stocks of separated civilian Pu, and that the inventories that do exist are kept under international control.

Extensive groundwork has already been laid concerning international Pu storage. I would like to quickly summarize these ideas and then add my further thoughts on international controls over Pu stocks.

An international control system for all fissile material was clearly foreseen at the dawn of nuclear age, but has never been implemented. Based on a U.S. proposal, Article XII of the IAEA's statute, entitled "Agency Safeguards," specifies, among other things, the agency's right:

> "to require deposit with the Agency of any excess special fissionable materials recovered or produced as a by-product over what is needed [for peaceful purposes under continuing Agency safeguards] "in order to prevent stock-piling of these materials, provided that thereafter at the request of the member or members concerned special fissionable materials so deposited with the Agency shall be returned promptly to the member or members concerned [for peaceful uses under Agency safeguards]."

The IAEA initiated a study in 1976 of ways to implement International Pu Storage to fulfill this provision, and experts from member states met from 1978 to 1982 to prepare further proposals for IPS schemes, but the concept has lain dormant.

New proposals in recent years concerning weapons material have included: 1) a call for physical protection by the host country and verification by the IAEA, and subsequent extension of this arrangement to civilian material (Scheinman and Fischer)[7]; 2) creation of an international Pu depository with an international guard force, and a "banking" system in which payments would go to depositors and withdrawals for safeguarded peaceful uses would require payment of a fee (Carter and Cote)[8]; and 3) establishing a storage regime first for U.S. and Russian civilian and military inventories, which could eventually be controlled by an international consortium and

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[7] L. Scheinman and D.A.V. Fischer, "Managing the Coming Glut of Nuclear Weapon Materials," *Arms Control Today*, March 1992.

[8] A.B. Carter and O. Cote, "Disposition of Fissile Materials," chapter 3 in *Cooperative Denuclearization*, G. Allison et al. (ed.), Center for Science and International Affairs, Harvard University, January 1993.

extended into a broad international regime (NAS)[9]. The NAS also urged agreement on cooperative international approaches to managing the reprocessing and use of Pu to avoid building up excess stocks. This latter idea would more or less internationalize the commercial use of Pu.

A specific way to manage Pu on an international basis so as to avoid the buildup of excess stocks would be for a group of countries, probably the G7 plus Russia, to charter an organization with the specific but vital role of making agreed determinations and arrangements for Pu separation and disposition. Such organization could be very valuable with respect to arranging third country disposition options for W-Pu as outlined above. Furthermore, it would seek to maintain a demand-driven system for Pu use. Although the reprocessing industry in particular might not welcome such international controls, such controls would at the same time provide a framework for internationally-agreed further industrial use of the closed fuel cycle, which could have benefits to the industry in the future.

## V. CONCLUSION

The conversion of surplus fissile materials over which the governments of the United States and Russia have relinquished military control will have important benefits for all nations of the world. But only if we declare a large portion of our total defense inventories to be surplus to national security needs, and permanently and irreversibly disposition them, will we achieve disarmament benefits that are more than simply symbolic. We need SMART, to take advantage of current warm relations between the U.S. and Russia and get on the track to disarmament. We also need an aggressive implementation program including third country participation, which should make possible the disposition of at least 10 tons of W-Pu per year, and an international control system over all Pu supply and demand. These efforts will add great credibility and transparency to the nuclear disarmament process in the spirit of the Non-Proliferation Treaty, and possibly momentum toward the conclusion of both a Comprehensive Test Ban Treaty and a Fissile Material Production Cutoff Treaty.

[9] National Academy of Sciences, Committee on International Security and Arms Control, *Management and Disposition of Excess Weapons Plutonium*, National Academy Press, Washington, D.C., 1994.

**FIGURE 1**

**FIGURE 2**

**CONCEIVABLE MOX SCENARIOS,**
**DOMESTIC AND THIRD COUNTRY**

| ACTIVITY | GROUP I SCENARIOS | GROUP II SCENARIOS | GROUP III SCENARIOS | GROUP IV SCENARIOS |
|---|---|---|---|---|
| ORIGIN | Russia | Russia | USA | USA |
| FABRIC-ATION | Russia | Belgium, France, Japan, U.K. | USA | Belgium, France, Japan, U.K. |
| BURNING | Russia; All Third Co's[1] | All Third Co's | USA, Canada | USA; All Third Co's |
| SF DISPOSAL[2] | Russia; All Third Co's | Russia; All Third Co's | USA, Canada | USA; All Third Co's |

[1] "All" = Belgium, Canada, France, Germany, Japan, Switzerland, United Kingdom, possibly others.

[2] MOX would be used as substitute for $UO_2$. Since a nearly equivalent amount of spent fuel would be produced, burning country should keep spent fuel. (If US/Russia were to take spent fuel back, this would be a significant incentive for third countries to take W-MOX as it would mean net reduction in waste management for equivalent amount of electricity.)