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Adequate Control of Weapon-Usable Fissile Materials

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Adequate Control of Weapon-Usable Fissile Materials

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the Armed Services Committee's
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[1] The views and recommendations presented in this testimony are solely those of the author and do not necessarily represent those of RAND or any of its research sponsors.

Mr. Chairman and members of the Panel, I appreciate the opportunity to share my views on what constitutes adequate control and effective management of weapon-usable fissile materials[2] with you. For this testimony, I will focus on three areas. First, what are the problems arising from the spread of these materials? Second, are the steps being taken by the United States and other countries useful in limiting the spread? Third, what other measures need to be implemented by the United States and other countries in order to make the control adequate and the management effective?

Problems From the Spread of Weapon-Usable Fissile Materials

Weapon-Usable Uranium

Uranium with a fissile isotopic content of less than 20 percent is generally considered as unsuitable for nuclear bombs. Since highly enriched uranium (HEU) from existing military inventory and dismantled nuclear weapons can be blended down into low-enriched uranium (LEU), the potential problems of blended-down HEU are, not the proliferation risks, but the financial burden to the United States, the disruption to the uranium and enrichment markets worldwide, and the weakening of the uranium and enrichment infrastructure in the United States.

Weapon-Usable Plutonium

Since plutonium of practically any isotopic composition is weapon-usable, limiting proliferation risk from plutonium is much more difficult than from HEU. There are basically two categories of plutonium issues--those associated with plutonium still in spent fuel and those with plutonium separated from spent fuel. The concern from the former is that, eventually, the radiation from spent fuel will drop so much that national or subnational groups can extract plutonium quickly and easily from spent fuel. Although such plutonium would likely be only of reactor grade, it could still be used to make nuclear bombs with yields in the kiloton range or more. This is a long-term issue that the world has to deal with sooner or later.[3] For this hearing, I will focus, however, on the separated plutonium. It is more immediate and urgent, because the most difficult task of

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[2] Weapon-usable fissile materials are defined as uranium with a fissile isotopic content of 20 percent or more and plutonium of any isotopic composition with a few exceptions. The most notable one is plutonium with 80 percent or more of Pu-238, which is exempted from IAEA safeguards. Weapon-usable plutonium includes plutonium separated from the typical spent fuel of commercial nuclear reactors (reactor-grade plutonium) and plutonium from nuclear weapons (weapon-grade plutonium). Plutonium before being separated from the intensely radioactive spent fuel is, however, not considered as weapon-usable fissile material is this testimony.

[3] The National Academy of Sciences (NAS) Study mentioned that both the U.S. Nuclear Regulatory Commission and the IAEA consider materials with radioactivity of more than 100 rads per hour at 1 meter to require a lower level of safeguarding (The NAS report, however, cautioned that the adequacy of that standard should be reexamined). It also mentioned that typical spent fuel would take more than 100 years to decay to that dose rate. Committee on International Security and Arms Control, National Academy of Sciences, *Management and Disposition of Excess Weapon Plutonium*, National Academy Press, 1994, p. 151.

extracting plutonium from the intensively radioactive spent fuel has already been performed; the remaining steps of incorporating the material into a nuclear bomb are much easier.

Separated plutonium comes from both nuclear weapon programs and civilian nuclear power. The United States has not produced plutonium for weapons since 1988. Russia recently agreed to shut down three nuclear reactors still producing weapon-grade plutonium.[4] Even if no more weapon-grade plutonium will be produced, the United States and former Soviet republics (FSRs) will still have about 80 and 100 metric tons of surplus plutonium respectively from the dismantled nuclear weapons by the year 2003. Only about five kilograms of such plutonium is needed to make a primitive nuclear weapon in the kiloton range. On the civilian side, 330 metric tons of reactor-grade plutonium will have been separated from spent fuel worldwide and be available for use by the year 2003. About seven kilograms of reactor-grade plutonium is needed for a bomb in the kiloton range. Countries that are currently reprocessing spent fuel for civilian purposes are France, the FSRs, the U.K., Japan, India, Israel and N. Korea. Although the last three countries are claiming a civilian intent for their reprocessing activities, some or all of the plutonium they have separated is most likely used in their undeclared nuclear weapon programs. It is the difficulty of ascertaining its real purpose that makes civilian reprocessing dangerous as well.

Military plutonium and civilian plutonium face two common problems. First is the potential for diversion of plutonium by terrorist groups. If the global economy comes to make extensive use of military or civilian plutonium, that would make it much more difficult for the International Atomic Energy Agency (IAEA) to do its job. Plutonium would appear in many places with multiple vulnerable nodes--reprocessing plants, fabrication plants, storage facilities, reactor sites and, most troublesome of all, the transportation network on land, at sea and in the air. IAEA safeguards can be effective, but only if the world does not create, in the first place, an impossible environment for the IAEA to operate in. Allowing massive use of plutonium in civilian nuclear power comes close to creating such a hostile environment. As to keeping separated plutonium in the FSRs, their economic destitution makes nuclear theft an ever present danger.

The second common problem is the potential for seizure of plutonium by host countries. The IAEA or any other organization cannot prevent countries from seizing plutonium that is located within their territories. The United States should be concerned about the political instability in the FSRs. If Russia reverts to tyranny, stored nuclear materials, even if they are safeguarded by the IAEA and a bilateral arrangement, might be refashioned into nuclear weapons. I am also worried about even the legal transfer of separated plutonium from the FSRs to other countries for civilian use. Although the recipients would likely be restricted to industrialized countries such as Japan, it would eventually be difficult for the world to draw an equitable line dividing those countries which can have separated plutonium and those which cannot. Countries with good

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[4] "Russia Agrees to Close Reactors, End Production of Plutonium," *Los Angeles Times*, March 17, 1994, p. A4.

nonproliferation credentials now could turn bad in the future. Had the United States helped the Shah of Iran develop a civilian plutonium reprocessing capability, as it had done with many other programs, Iran would have had separated plutonium now for its nuclear weapon development program.

Why, then, would countries want to introduce such a problematic element into commerce? From the dawn of the nuclear age to the seventies, countries thought that uranium resources for power generation were running out fast and that plutonium would be needed soon. Since the eighties, projections of civilian nuclear power growth have been revised severely downward and additional types and amounts of uranium ores have been discovered. Still, some countries are unwilling to alter their original plan of eventual plutonium use, because they remain worried that they would not have sufficient time to develop an alternative to plutonium. But in RAND's recent study[5], we found that plutonium use will be uneconomical for the next 30-50 years, or possibly much longer. Moreover, there will always be enough plutonium in the spent fuel to support even an optimistic plutonium-based breeder reactor buildup, in the event that breeders are needed unexpectedly. Therefore, countries do not have to plunge into plutonium use prematurely. It is disappointing to see that, while countries are reiterating their commitment to nonproliferation, they are not willing to forego even their uneconomical plutonium activities, which raise grave proliferation concerns.

Current Measures to Deal with Weapon-Usable Fissile Materials

From the start, President Clinton has considered limiting nuclear proliferation to be one of the top priority items on his administration's agenda. In his Nonproliferation and Export Control Policy issued last September, he seeks "to eliminate where possible the accumulation of stockpiles of highly-enriched uranium or plutonium," and proposes "a multilateral convention prohibiting the production of highly-enriched uranium or plutonium for nuclear explosives purposes or outside of international safeguards." These aims are worthy, but additional steps, which I shall discuss under the section on Additional Measures, must be taken to meet those aims.

Weapon-Usable Uranium

The United States had agreed to purchase 500 metric tons of HEU from Russia over the next 20 years. These materials will be blended down to LEU by the FSRs or the United States, and the United States will resell the LEU to recoup its financial commitment of $12 billion. I support the principle of purchasing all FSR HEU or the LEU that derives from it. I am, however, concerned that the purchase will not be budget neutral as the United States negotiators expected. This could cause the United States to lose billions of dollars and to weaken the long-term viability of its domestic uranium and enrichment industries. The problem might worsen, if the FSRs have substantially more

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[5] Brian G Chow and Kenneth A Solomon, *Limiting the Spread of Weapon-Usable Fissile Materials*, MR-346-USDP, November 1993.

HEU than previously thought[6] and the United States wants to purchase the remaining portion as well.

Weapon-Usable Plutonium

The Administration's current proposal of eliminating plutonium accumulation might be understood or misunderstood to mean the prompt use of separated plutonium in commerce so as to reduce the size of the plutonium stockpile; that is, the policy could result in spreading plutonium use. Similarly, halting fissile material production only for weapons would not prevent rogue countries from continuing their nuclear weapon development, because they would simply claim that their production is for civilian nuclear power programs instead of "for nuclear explosives purposes". Already, countries such as N. Korea are using such a claim for their weapon programs. Rogue countries could carry on parallel, covert programs to develop, simulate or even test all components of nuclear weapons, except the insertion of the plutonium pit into the weapon and the testing of the completed weapon. Even if the separated plutonium is under full-scope IAEA safeguards, these countries could at will seize the plutonium for weapons use, and the warning time, measured merely in days or weeks, would be so short that the international community would not be able to stop the bomb-making process. While many countries would never develop nuclear weapons even if they had the capability to do so, some countries might be tempted by the potential of bringing themselves close to the nuclear threshold covertly or even legitimately.

As to dealing with weapon-grade plutonium from the FSRs' dismantled nuclear weapons, many planners both inside and outside of the U.S. government are seriously considering the placement of plutonium in the FSRs under the IAEA and/or bilateral safeguards. I would argue that this arrangement is inadequate, because it does not prevent Russia from using the weapon-grade plutonium to re-establish its massive nuclear arsenal, in the event that the likes of Zhirinovsky gain power. Worse, many influential planners in Russia now advocate storing the weapon-grade plutonium for use in future breeders. With miserable breeder economics for the indefinite future, this plutonium could be kept in storage in Russia for decades to come.

Additional Measures to Deal with Weapon-Usable Fissile Materials

Weapon-Usable Uranium

The United States should not shoulder all the financial burden of uranium purchases. We recommend that the United States encourage other countries to buy directly from the FSRs or to repurchase what the United States has already committed to buy. Also, the Congress should urge that a study be undertaken to assess ways of managing HEU and releasing blended-down uranium so as to minimize the cost to the

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[6] In September 1993, Viktor N. Mikhailov, head of the Russian Ministry of Atomic Energy, said that the Russian inventory of HEU is more than 1,200 metric tons. That is considerably more than the 500 metric tons that the U.S. agreed to buy. His number has, however, been questioned as unreliable.

U.S. government and not to affect the U.S. and other countries' ability to secure uranium and enrichment services in the long run.

Weapon-Usable Plutonium

Any effective counter-plutonium policy must deal with both military and civilian plutonium. Any policy dealing with military plutonium alone is at best inadequate and at worst gives a false sense of security; it would allow proliferators to proceed uncomfortably close to nuclear status with little impediment and even with much outside civilian nuclear assistance that is readily applicable to their military pursuits. The drafters of the Non-Proliferation Treaty insisted from the start that nuclear weapons and peaceful nuclear devices not be treated differently. We should now insist that facilities associated with nuclear weapon materials and facilities associated with sensitive civilian nuclear materials, including plutonium, also not be treated differently. It would be futile to ban military nuclear facilities but not sensitive civilian nuclear facilities in nonnuclear weapon states.

The United States' counter-plutonium policy should have two objectives. First, it should take weapon-grade plutonium out of the FSRs' hands. Second, it should discourage both military and civilian plutonium separation and use worldwide.

The first objective can be accomplished by offering to purchase all of the FSRs' weapon-grade plutonium for, say, $1 billion, as the United States has agreed to buy the low-enriched uranium blended down from 500 metric tons of the FSRs' highly-enriched uranium.

There is a distinct possibility, however, that Russia would refuse to let its weapon-grade plutonium leave the FSRs, even after our best efforts. Another option would be to encourage the FSRs to bury their weapon-grade plutonium after it is mixed with high-level waste. Unfortunately, the FSRs might not have enough high level waste left. Mixing weapon-grade plutonium with spent fuel would require the chopping up of spent fuel and would be expensive. Vitrifying the plutonium alone or with some radioactive isotopes such as cesium-137 would be inadequate, because the FSRs would have the capability to extract the weapon-grade plutonium quickly. Between storing weapon-grade plutonium in the FSRs under safeguard and burning it in the FSRs' reactors, the United States should prefer the latter. The former runs the risk of returning such plutonium to nuclear weapons, while the latter at least turns the weapon-grade plutonium into reactor-grade plutonium. While this grade distinction is much less important in nonnuclear weapon states, it is important in the FSRs. The FSRs have already designed, tested and built many delivery platforms for their nuclear weapons. If they had to use reactor-grade plutonium instead for their nuclear rearmament, redesigning and re-testing their nuclear weapons and delivery platforms would be costly and time-consuming for them. The costs and delays could serve as a deterrent to rearmament, even if their political system changes for the worse.

As to the second objective of discouraging plutonium separation and use, the Administration's current position is "not to encourage the civil use of plutonium and accordingly does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes. The United States, however, will maintain its existing commitments regarding the use of plutonium in civil nuclear programs in Western Europe and Japan." The current approach puts too much emphasis on denial and too little on viable alternatives. The United States needs to offer civilian nuclear alternatives to the use of separated plutonium. We should take steps to assure other countries that they can maintain energy security without resorting to plutonium activities now. Moreover, they can share in the benefits of plutonium-based reactors, if these types of reactors ever turn economical. These steps include

- Prolonging the world's reliance on existing reactors in the once-through mode. This entails improving the reactors' efficiency and identifying additional uranium resources at current and higher prices.

- Encouraging development of advanced nuclear reactors that would be safer and even more efficient and proliferation-resistant. These advanced reactors do not have to be breeders; near-breeders or highly efficient converters will do. Both uranium- and thorium-based fuel cycles should be considered.

- Confining sensitive civilian nuclear materials and facilities within the five currently declared nuclear weapon states to the extent possible, while agreeing to share the benefits, if any, of these activities with other nations. I acknowledge that exceptions may have to be made for some Japanese and others' facilities that are already in operation. Still, these countries should scale back their plutonium activities. Nuclear weapons states that insist on continuing their plutonium activities should consider to invite other countries such as Japan to be passive stockholders in sensitive facilities located in nuclear weapons states, if these nonnuclear weapon states agree to forgo performing such sensitive activities.

Concluding Remarks

Since the dawn of the nuclear age, countries had planned to use plutonium in their civilian nuclear programs. Even when countries now recognize that the date for economic use of plutonium will be distant and that the threat of North Korea's plutonium-based nuclear weapon program is serious, halting the momentum toward a plutonium economy is still a daunting task. But, the chance to change the nuclear course is now better than ever. Many countries, including some of the most ardent plutonium supporters such as France, Germany, and the U.K., have scaled back their plutonium activities as a result of political and economic pressure. Even Japan's plutonium program faces delays. Considering that a continuation of the past course would lead to many countries being situated dangerously and ambiguously near the nuclear threshold, we have no alternative but to make a serious attempt to discourage the spread of both military and civilian weapon-usable fissile materials worldwide.

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Brian Chow is a senior physical scientist in RAND's Defense and Technology Planning Department. He joined RAND in 1989 after serving as a senior research specialist at Pan Heuristics, R&D Associates for ten years. In addition to performing policy studies for government agencies since 1978, Dr. Chow was appointed as a consultant to the Office of the Chief of Naval Operations (1989-1990), to the President's Science Adviser (1988-1989), and to the Under Secretary of Defense for Policy (1987-1988).

As project leader of three recent studies on nuclear and missile nonproliferation, he designed strategies that allow the United States and other countries to forgo proliferation-sensitive activities in civilian nuclear power, military nuclear materials and space launchers without losing major economic opportunities. His latest monographs in this area are *Limiting the Spread of Weapon-Usable Fissile Materials* and *Emerging National Space Launch Programs: Economics and Safeguards*. His other research interests include national and international nuclear energy policies, fuel cycle alternatives, military space policies, arms export control, ballistic missile defense and cruise missile submarines. He has authored more than sixty publications and has been listed in 18 biographical references.

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