Comments on

The U.S. Department of Energy's Draft Nonproliferation and Arms Control Assessment Of Weapons-Usable Fissile Material Storage And Plutonium Disposition Alternatives

Steven Dolley
Research Director
Nuclear Control Institute
Washington, DC

November 8, 1996

The Nuclear Control Institute (NCI) submits the following comments on the Department of Energy's (DOE) *Draft Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition Alternatives* ("Draft Assessment").

While the authors of the Draft Assessment should be commended for cataloguing the proliferation risks and non-proliferation benefits of each plutonium disposition alternative, it would have been helpful if they had also weighed the evidence and arrived at some useful conclusions. Instead, the Draft Assessment unhelpfully concludes that "[e]ach of the options under consideration for plutonium disposition has its own advantages and disadvantages with respect to nonproliferation and arms control, but none is clearly superior to the others."[1]

By effectively putting the MOX option on an equal non-proliferation footing with the direct immobilization approach, the Draft Assessment significantly alters U.S. non-proliferation policy, which heretofore has sought not to encourage the use of separated plutonium as fuel in civilian reactors. Generally, the Draft Assessment takes an "on-the-one-hand-on-the-other-hand" approach to disposition alternatives, but it nonetheless tilts toward the MOX option in a number of important ways.

Draft Assessment Ignores Dangerous Fuel Cycle Policy Signals

By contemplating a U.S. disposition policy that includes the use of MOX fuel, the Draft Assessment sends precisely the sort of adverse "fuel-cycle policy signal" that the National Academy of Sciences warned against:

> [P]olicymakers will have to take into account the fact that choosing to use weapons plutonium in reactors would be perceived by some as representing generalized U.S. approval of separated plutonium fuel cycles, thereby compromising the ability of the U.S. government to oppose such fuel cycles elsewhere. Conversely, choosing to dispose of weapons plutonium without extracting any energy from it could be interpreted as reflecting a generalized U.S. government opposition to plutonium recycle. Either choice could have an impact on fuel cycle debates now underway in Japan, Europe, and Russia.[2]

The Draft Assessment does not adequately consider that a U.S. decision to pursue a MOX plutonium-disposition option effectively would declare to the international community that: (1) recycle of separated plutonium as MOX fuel in LWRs is acceptable to the U.S. Government; (2) such plutonium recycle can be safeguarded effectively; (3) MOX plutonium recycle is a necessary

form of "waste management"; (4) plutonium that is already separated should be "unseparated" as quickly as possible by means of MOX fuel use if desired; (5) isotopic degradation of plutonium provides significant non-proliferation benefits; (6) the high economic costs of MOX disposition are justified; and (7) plutonium is a valuable energy resource. Each of these "signals," which run counter to U.S. domestic policy as well as stated U.S. non-proliferation objectives, should be carefully considered.

Unacceptability of Recycle of Separated Plutonium as MOX Fuel

The MOX disposition alternative would represent the first large-scale use of plutonium fuel in U.S. commercial nuclear-power reactors, which heretofore has been rejected on economic as well as non-proliferation grounds. Utility companies have not sought to use MOX fuel because of obvious marketplace and public-acceptance problems. Only the prospect of rich subsidies from the Federal Government has made the MOX disposition option attractive to a few hard-pressed utilities (see below).

Despite a tortured effort in the Draft Assessment to distinguish recycle of warhead plutonium from recycle of plutonium separated from commercial reactor fuel, this watershed surely will be seized upon by nations now pursuing, or interested in pursuing, plutonium fuel cycles. The United States will not be able to claim, with credibility or consistency, that other nations should forego the use of MOX fuel.

The Draft Assessment is dismissive of the fuel-cycle policy signal effect:

> It is unlikely, however, that a decision to use MOX fuel in the United States would, in and of itself, result in substantial additional reprocessing and use of MOX fuel in other countries. Decisions concerning reprocessing and use of MOX fuel in most nations are based on factors related to cost, waste management, perceptions of uranium availability and the need for energy security, and political and bureaucratic imperatives.3

This analysis sets up and knocks down a "straw man" caricature of the fuel cycle policy signal. NCI's concern is not that U.S. MOX disposition would *cause* many nations suddenly to undertake new reprocessing and MOX initiatives; rather, U.S. MOX disposition would shore up support and justification for, and undermine political opposition and economic forces that are now working effectively against, ongoing foreign plutonium programs in Western Europe, Japan, and India, and emerging programs in Russia, on the Korean Peninsula, and elsewhere in East Asia.4

NCI's discussions with knowledgeable nuclear industry representatives make it abundantly clear that, in spite of DOE protestations, the Japanese and European plutonium industries fully recognize, and are poised to exploit, economic and political benefits they would accrue as the result of an end to the U.S. prohibition on domestic use of plutonium fuel. One Japanese industry source told us that LWR plutonium recycle and reprocessing would be accelerated by Japanese electric utilities if the United States were to decide to dispose of weapons plutonium in reactors. Another Japanese nuclear industry representative, when asked if Japan would accept a U.S. assertion that a U.S. decision in favor of MOX disposition did not represent any change in domestic or non-proliferation policy toward civilian plutonium fuel cycles, responded: "If plutonium fuel is good enough for the United States, it is good enough for us."5

Ineffectiveness of Plutonium Recycle Safeguards

The Draft Assessment takes a sanguine view of International Atomic Energy Agency (IAEA) safeguards on plutonium fuel cycles that is not supported by real-world experience. As NCI emphasized in comments on the draft PEIS, proliferation risk at the fuel-fabrication stage of MOX disposition could be substantial. Difficulties at the Plutonium Fuel Processing Facility (PFPF) in Japan suggest that purportedly state-of-the-art MOX fabrication plants are difficult if not impossible to safeguard effectively.

In May 1994, the Nuclear Control Institute disclosed that a major plutonium inventory discrepancy was been building up at the PFPF since the plant began operating in 1988.6 The Japanese

government and International Atomic Energy Agency (IAEA) asserted that this plutonium, amounting to about 70 kilograms, or more than eight significant quantities (SQs), was not missing because it had been measured as "hold-up" material---that is, plutonium stuck to surfaces in the plant's process equipment. But such measurements were taken by means of neutron coincidence counting and were subject to significant uncertainty, perhaps as large as 30 percent in some instances.7 To deal with the uncertainty, the IAEA requested that Japan cut open the glove boxes to physically produce and measure the held-up plutonium for the purpose of verifying the plant's inventory. This request was strongly resisted by the Japanese and was not promptly met, as the IAEA had originally asked.8

At a reported cost of more than $100 million, and after more than two years of clean-out operations, about 10 kilograms of plutonium (more than one SQ) is still not accounted for.9 PFPF thus meets neither the 1-SQ nor the timeliness safeguards criteria required by the IAEA. Fabrication scrap is also a significant source of measurement uncertainty; PFPF has generated about 100 to 150 kilograms of such plutonium-laden scrap.10 Despite these major unresolved problems, the Draft Assessment dismisses concerns about safeguards at PFPF and similar facilities with a vague call for "a major emphasis in the design phase on the ability to accurately monitor and account for materials. . ."11

MOX fabrication plants in Europe, which are under consideration for use to produce warhead-plutonium MOX fuel,12 have not made sufficient disclosure of the design and operating history of their material control and accounting systems to permit any conclusion about the effectiveness of safeguards at these facilities. The Draft Assessment posits the following assertion about the accuracy of EURATOM plutonium and MOX measurements:

> Recent standards issued by the European Community's nuclear agency (EURATOM), endorsed by the IAEA, indicate that currently achievable measurement accuracy for plutonium oxide is in the range of 99.9% (for systematic errors). Mixing the plutonium oxide with uranium oxide complicates the task of measuring the amount of plutonium somewhat, resulting in an estimated achievable measurement accuracy of 99.8%.13

This claim is not referenced and strains credibility in light of the problems experienced at PFPF, a plant based largely on French technology. When asked about the availability of documentation to support the claim, a DOE representative at the Washington, DC public meeting on November 1 replied that any supporting information would be made available in the DOE Public Document Room. If, in fact, no documentation is available to substantiate this claim, he pledged that the claim would be removed from the final version of the Nonproliferation Assessment.

Fuel-cycle facilities in EURATOM countries are safeguarded by EURATOM, and the IAEA is denied access to the process and storage sections of MOX fuel fabrication and reprocessing plants. It is our understanding that the IAEA simply verifies the declared material balances at the head-end and back-end of the plants. Thus, neither the IAEA nor the United States is in a position to verify independently the safeguards effectiveness claims made by EURATOM.14

The Draft Assessment also embraces the dangerous notion that containment and surveillance (C/S) measures can make up for inadequacies in material accountancy:

> Unlike material accounting, where the MUF can be estimated numerically, the contribution of containment and surveillance to safeguards effectiveness cannot be quantified. But it is nonetheless a key factor: it is wrong to say that a safeguards system is ineffective solely because material accounting alone cannot eliminate significant measurement uncertainties.15

In its safeguards agreements with NPT-member states, the IAEA clearly establishes "materials accountancy as a safeguards measure of fundamental importance, with containment and surveillance as important complementary measures" for timely detection of diversions.16 One reason is that operators sometimes resist the installation of the most modern and intrusive containment and surveillance measures. Another is that even the most advanced measures can be defeated or rendered non-conclusive.

Seals can be broken or cut and the view of cameras can be blocked or obscured during normal operations or in response to emergencies without necessarily indicating an attempt to conceal a diversion. The IAEA does not publicly report breakdowns in containment and surveillance. Nor, in the absence of conclusive evidence of a diversion, is the agency in a strong political or technical position to challenge an operator's claim that the breakdowns were innocent. Yet, such breakdowns could be used to conceal diversions, by either the plant operator or individual employees.

Unpoliced diversion pathways are available to plant employees who might act independently of the operator in carrying out a diversion scheme on behalf of outside criminal or terrorist elements or of a state determined to acquire nuclear material for weapons. One such pathway is the trash---the so-called low-level radioactive waste stream in which lightly contaminated uniforms, wipes, tools and equipment are collected routinely and removed from the plant. This waste stream is not policed for deliberately concealed plutonium because no appreciable amounts of plutonium reach it in the normal operation of the plant. However, a knowledgeable employee could place diverted plutonium in a low-level waste drum in a manner that shielded the plutonium from environmental-monitoring equipment used to detect excessive contamination of the waste. NCI highlighted this danger in its comments on the scope of the outline of the Draft Assessment and provided a copy of an NCI study on the issue,17 but it is not addressed in the Draft Assessment.

In a 1990 investigation by a West German Bundestag committee into possible losses from the fuel-cycle industry, the committee elicited the following concurrence from a German government nuclear expert with our findings:

> Asked whether the expert witness Leventhal could be right saying that you cannot prove with the necessary certainty by non-destructive measurement that there is not plutonium or highly enriched uranium concealed in a [low level] waste barrel, the expert, Dr. Bueker, answered that for such non-destructive measurements you have to fix in detail in what small region [of the waste] you want to measure for what sort of element. On the one hand, it is quite easy to falsify such a non- destructive measurement. You could for instance just simulate the typical gamma- radiation of a certain element by inserting a different element with similar radiation. On the other hand, you can do a lot to conceal certain radiation by improved shielding [of concealed material].
>
> In order to exclude these different possibilities, a complicated and complex technique for measurements is required, which consists of active measurements, passive measurements, neutron measurements and eventually additional X-ray measurements. Only if you bring together all these data, do you get a more or less reliable picture of what is happening inside the container. If there were such an installation [for multiple measurements], the possibility of diversions from the waste stream could be excluded. But for the moment, the expert Dr. Bueker stated, we do not have this technique for measurements.18

It is our understanding that this situation still applies to the MOX industry worldwide (Germany's two MOX plants are now shut down). The Draft Assessment should be revised to include a discussion of this diversion pathway, including information obtained by DOE to document the present situation in the MOX industry in this respect.

By positing that current, inadequate international safeguards are sufficient to permit implementation of the MOX disposition option, the Draft Assessment puts the U.S. Government in the awkward and dangerous position of being unable to push persuasively for the strengthening of international safeguards on MOX facilities.

The Draft Assessment's treatment of safeguards is all the more tortured by its assertion that weapons material diversions of less than a ton are not "strategically significant" in nuclear-weapon states.19 This position can only serve to undermine severely international confidence in U.S.-Russian nuclear disarmament commitments. A number of non-nuclear-weapon states, including Germany and Japan, are likely to resent such discriminatory treatment and to press for equity in the form of relaxed material control and accounting safeguards for their nuclear facilities.20 The United States should in no way suggest that any standard less stringent than the IAEA's current

eight-kilogram SQ is acceptable. Indeed, the SQ should be reduced, because it is public knowledge that far less than eight kilograms of plutonium is required to build a nuclear bomb.21

MOX Plutonium Recycle Should Not Be Rationalized on "Waste Management" Grounds

Even with U.S. attempts to distinguish by "clear and authoritative statements" MOX disposition from more generalized commercial plutonium recycle, a U.S. MOX disposition program would still lend support to the false claim that plutonium recycle is necessary for waste management purposes. The United States would be sending a strong signal that, having carefully considered all technical options, it had determined MOX to be an acceptable way to "dispose" of separated plutonium instead of, or (in the case of the "hybrid option") in conjunction with, immobilization alternatives that are less expensive, more direct, and offer at least as much proliferation resistance as MOX disposition.

The United States effectively would be placing its imprimatur on perhaps the weakest justification for the plutonium fuel cycle, but one that has been increasingly emphasized by the foreign plutonium industry because of the bankruptcy of economic and energy-security justifications for plutonium.22 U.S. support of the MOX option as an acceptable way to put "separated" plutonium into "unseparated" form would lend significant international support to the waste-management claims of plutonium-recycle programs in France, Germany, and Japan---nations possessing substantial stocks of already- separated, surplus plutonium and facing the question of its disposition.

U.S. Non-Proliferation Policy Should Not Encourage Accelerated Recycle of Separated Plutonium

Certain measures proposed in the Draft Assessment would fundamentally change U.S. plutonium policy. The current policy of the Clinton Administration is that "[t]he United States does not encourage the civil use of plutonium and, accordingly, does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes."23 The Draft Assessment narrowly focuses on the second part of this statement, arguing that the policy only proscribes U.S. reprocessing, not use of already-separated plutonium in MOX.

> In fact, such a decision [to use excess weapons plutonium as MOX fuel in LWRs] would not represent any change in U.S. fuel cycle policies . . . No reprocessing or recycling of this material or of other civilian spent fuel is implied or contemplated.24

This interpretation ignores the stated reason *why* the U.S. does not reprocess, i.e., because it "does not encourage the civil *use* of plutonium." (emphasis added) In fact, the Draft Assessment boldly supports important U.S. encouragement of the widespread civil use of plutonium:

> If this [MOX] alternative is chosen, high-level U.S. officials should clearly outline how this approach fits within broader U.S. fuel cycle and nonproliferation policies. In particular, such a statement should make clear that this step is being taken only to eliminate a stockpile of separated, weapons-usable plutonium that already exists, and does not represent any change in the underlying U.S. approach to the nuclear fuel cycle . . . In effect, U.S. policy is that separated plutonium poses greater proliferation risks than unseparated plutonium, and that therefore, to the extent practicable, all plutonium that is unseparated should stay that way, and all plutonium currently separated should become unseparated -- i.e., be transformed into forms meeting the Spent Fuel Standard -- as rapidly as practicable, while ensuring effective nonproliferation controls.25 (emphasis added)

In other words, the Draft Assessment strongly implies that U.S. policy is now that nations already possessing stocks of separated plutonium should make it into MOX fuel and get it into reactors as fast as they can---unless they wish to immobilize it. But U.S. leadership will be clearly pointing the way to MOX. Certainly the United States will have no grounds on which to object to other nations' use of MOX for disposition of their own plutonium, either military or civil.

Isotopic Conversion of Plutonium Should Not Be Promoted as a Non-Proliferation "Benefit"

Another key consideration is the isotopic composition of the residual plutonium in the final-disposition waste forms. Plutonium disposed of in a vitrified matrix remains weapons-grade. Weapons plutonium in irradiated MOX fuel contains a considerably smaller proportion of fissile isotopes after irradiation than before. This factor, however, is not nearly as important from a non-proliferation perspective as some have argued.

Many MOX proponents emphasize the degree to which the isotopics of the weapons plutonium would be altered by irradiation in a particular reactor technology---that is, the degree to which the Pu-239 proportion can be reduced---as if this factor should be decisive in choosing among disposition technologies. This is an inappropriate criterion by which to assess proliferation risks because it perpetuates a dangerous myth that reactor-grade plutonium cannot be used to make reliable weapons.

As the Draft Assessment correctly points out that:

> While reactor-grade plutonium has a slightly larger critical mass than weapon-grade plutonium (meaning that somewhat more material would be needed for a bomb), this would not be a major impediment for design of either crude or sophisticated nuclear weapons. . . . In short, reactor-grade plutonium is weapons- usable, whether by unsophisticated proliferators or by advanced nuclear weapon states. Theft of separated plutonium, whether weapons-grade or reactor-grade, would pose a grave security risk.26

Yet, both DOE and the Draft Assessment go on to send dangerously mixed signals on this important point. Despite the above caution, the Draft Assessment counts "Isotopic Conversion" as an advantage of reactor disposition options, and "No Isotopic Conversion" as a disadvantage of immobilization options.27 In addition, a DOE representative at the November 1 public meeting emphasized that some (unspecified) foreign actors "perceive" isotopic conversion as an advantage of reactor options, and that the United States should be aware of and sensitive to these "perceptions."

The ability to construct effective nuclear bombs from reactor-grade plutonium was demonstrated decades ago. It is dangerous even to consider it an open question. Hans Blix, director-general of the IAEA, informed our Institute that there is "no debate" on this point in the Safeguards Department of the IAEA, and that the agency considers virtually all isotopes of plutonium, including high burn-up reactor-grade plutonium, to be usable in nuclear weapons.28 In June 1994, U.S. Energy Secretary Hazel O'Leary declassified further details of a 1962 test of a nuclear device using reactor-grade plutonium, which successfully produced a nuclear yield.29

In a future breakout scenario, the United States (or Russia) could presumably draw on its nuclear test data and predictive capabilities to reconfigure weapons designs and reconstitute a large arsenal, even from plutonium isotopically degraded to reactor-grade by irradiation in MOX. Since U.S. nuclear warheads are already designed to be "predetonation proof," use of reactor- grade plutonium in current warhead designs can be assumed to require only minor modifications.30 Also, development of laser isotope separation, such as AVLIS, is likely to be adaptable to the "mining" of the Pu-239 isotope from reactor-grade plutonium.

Thus, isotopic conversion does not pose a substantial barrier for the United States and Russia to re-militarization of warhead plutonium, and therefore does not constitute a compelling argument in favor of the MOX option. It is important to note that the 1995 NAS study agreed with this conclusion. In its comparison of the MOX and immobilization options it found that "[t]he plutonium in the spent fuel assembly would be of lower isotopic quality for weapons purposes than the still weapons-grade plutonium in the glass log, but since nuclear weapons could be made even with the spent fuel plutonium this difference is not decisive."31 [emphasis supplied] This point should be made explicit in the final version of the Nonproliferation Assessment, the final PEIS, and the Secretary's Record of Decision. Isotopic conversion should not be counted as even a "perceived" advantage in favor of reactor disposition.

Disposition Mission Should Not Be Used to Justify Poor Economics of Plutonium Fuels

Because of subsidies required to ensure the participation of U.S. nuclear-electric utilities, MOX disposition would cost hundreds of millions, perhaps billions, of dollars more than immobilization.32 NCI and 10 other public- interest groups called upon DOE to revise its Technical Summary Report on plutonium disposition to incorporate the cost of such subsidies.33 DOE's revised report now estimates that subsidies of about $500 million to electric utilities would be required to carry out reactor disposition of weapons plutonium in the United States.34

By selecting a MOX alternative that promises to be considerably more expensive than immobilization options,35 the United States would send the signal that plutonium recycle is justified, even in the face of extremely adverse economics. This would help defuse the most powerful force working against plutonium fuel cycles worldwide---their overwhelming cost compared with the cost of low-enriched uranium fuel. Justifying MOX programs on other grounds, despite the presence of cheaper alternatives, would give great comfort to international plutonium companies attempting to create markets for their MOX fuel fabrication and reprocessing services.

Plutonium Should Be Considered a Waste, Not an "Asset"

The MOX option effectively declares that plutonium has an asset value, and that the energy contained within it should be viewed as a "national asset" (as the U.S. DOE has put it)36 or a "national heritage" (as the Russians have put it).37 It would then become that much more difficult to persuade other nations, Russia in particular, to abandon their grandiose dreams of a closed nuclear fuel cycle. In contrast, as the National Academy of Sciences plutonium disposition study emphasized, "[t]reating pure weapons-grade plutonium as a waste to be disposed of would demonstrate the U.S. policy of generally discouraging the use of separated plutonium reactor fuels."38 The serious implications of the United States treating plutonium as an asset rather than a waste are not analyzed anywhere in the Draft Assessment, but deserve consideration and should be included.

Reversibility of "Can-in-Canister" Immobilization

The Draft Assessment makes prominent mention of the Sandia "Red Team" Report's claim that the "can-in-canister" immobilization form is relatively vulnerable to plutonium recovery by either the host state or by sub-national groups.39 While we cannot comment on the Red Team's analysis because it has not been made publicly available, the discussion of the matter in the Draft Assessment fails to make a convincing case for the credibility of the recovery scenarios proposed by the Red Team. These involve blowing apart the highly radioactive DWPF canisters with shaped charges to free the internal plutonium cans, and then processing them in a contact-handling facility. To show that a particular disposition option indeed fails to meet the spent fuel standard, one must not only demonstrate that technical options exist for recovering plutonium from the waste form, but that a party would actually choose to undertake such a path rather than simply carry out straightforward chemical reprocessing of the canisters.

In the case of the host state, it is highly unlikely that an explosive-based method would be chosen to recover plutonium from can-in-canister waste forms, even with the prospect of simplified processing afterward. How would the canisters be prepared for the explosion? Where would the detonations, which would be extremely dirty, take place? If carried out indoors (presumably in a hardened facility), the building would become contaminated with fission products, quickly rendering it unsuitable for operations. How would the cans be recovered? By sending personnel in to quickly gather them up? Even in the case of a fanatical regime with no concern for radiation protection that some analysts presumably envision, this seems extreme. Use of robotics would drive up costs and probably make the approach as costly as reprocessing. Rather than choose such an unpredictable, costly, and dirty method, a host state would be wiser to build a reprocessing plant or utilize an existing one, which would provide a much more stable processing environment.

With respect to sub-national theft, it is the overall radiation barrier that provides the most formidable deterrent, not the difficulty of later processing. Even if a sub-national group were to overcome this problem and gain possession of a highly radioactive high-level waste canister, there would be many practical difficulties in carrying out the detonation which are not addressed in the Draft Assessment.

Conclusion

The Draft Assessment should be revised to analyze the specific issues raised in these comments. In particular, the implications of the "fuel cycle policy signal" sent by a U.S. decision to pursue MOX disposition must be taken more seriously, and subjected to detailed analysis. We also strongly urge DOE to revisit the safeguards issue, with particular emphasis on the difficulty of safeguarding MOX fuel fabrication plants. Any foreign claims made about the effectiveness of such safeguards must be thoroughly documented.

We conclude---based on our own research and on data presented in the Draft Assessment, the Technical Summary Report, and the Draft PEIS---that the "can-in-a-canister" immobilization alternative is the most desirable option for non-proliferation, economics, and safety reasons. There are no advantages unique to the reactor or "hybrid" options, and there are many disadvantages. The "can-in-a-canister" approach can accomplish the disposition mission without subverting U.S. non-proliferation policy. We therefore recommend that the Draft Assessment highlight it as the preferable plutonium disposition alternative.

 Return to What's New Page  NCI Home Page

---

End Notes

1. Draft Assessment, p. xvi. Back to document

2. Committee on International Security and Arms Control, National Academy of Sciences, *Management and Disposition of Excess Weapons Plutonium*, 1994 [NAS 1994], p. 149. Back to document

3. Draft Assessment, p. 90. Back to document

4. It should also be noted that many nations with commercial nuclear-power programs will be making decisions on high-level waste disposal over the next five to ten years, and some---such as China, Taiwan, and South Korea---are actively considering reprocessing options. A U.S. MOX disposition program could have significant impact on these nations' decision-making processes. Back to document

5. Private communications with Nuclear Control Institute, October and November 1996. Back to document

6. "'Astounding' Discrepancy of 70 Kilograms of Plutonium Warrants Shutdown of Troubled Nuclear Fuel Plant in Japan," Nuclear Control Institute, May 9, 1994. Back to document

7. Paul Leventhal, "IAEA Safeguards Shortcomings---A Critique," Nuclear Control Institute, September 12, 1994. For further discussion of the limitations of IAEA safeguards on plutonium, see Marvin Miller, "Are IAEA Safeguards on Plutonium Bulk-Handling Facilities Effective?," Nuclear Control Institute, August 1990. Back to document

8. Mark Hibbs, "IAEA Gives Japan Till 1995 to Account for Holdup Inventory at PFPF Plant," *NuclearFuel*, October 10, 1994, pp. 12-13. Back to document

9. Mark Hibbs, "PFPF Holdup Pu Inventory Under 10 kg; R&D Work to Focus on Monju Fuel," *NuclearFuel*, November 4, 1996, pp. 15-16. Back to document

10. Ibid. At a recent briefing for public- interest groups, a high IAEA official acknowledged that the IAEA cannot yet assess with much accuracy how much plutonium is contained in scrap at MOX fuel fabrication plants. Back to document

11. Draft Assessment, p. 81.Back to document

12. "Foreign Implementation Variants," Draft Assessment, pp. 86-87. Back to document

13. Draft Assessment, p. 79. Back to document

14. At a recent briefing for public- interest groups, a high IAEA official confirmed that the Agency could not verify the results of EURATOM safeguards at bulk- handling facilities. For example, in France, he said, IAEA inspectors are limited to the spent-fuel receiving pool at La Hague--- meaning that they do not have access to the process stages of such plants. Back to document

15. Draft Assessment, p. 73. Back to document

16. *INFCIRC/153 (Corrected)*, International Atomic Energy Agency, Vienna, February, 1983, p. 9. Back to document

17. Paul Leventhal, Milton Hoenig, & Helen Hunt, "Nuclear No Man's Land: Low Level Radioactive Wastes as an Unpoliced Diversion Path for Thefts of Weapons-Usable Nuclear Materials," Nuclear Control Institute, September 16, 1988; letter from Paul Leventhal forwarding the study to Jon Wolfsthal, DOE, as supplement to comments on proposed outline of Draft Assessment, September 16, 1996. Back to document

18. *Final Report of German Bundestag Investigation Committee*, 2nd Investigation in the 11th Legislative Period, German Bundestag, Bonn, West Germany, Printed Matter Number 11/7800, October 15, 1990, p. 98 (majority report) (in German). Excerpts from the report are attached to these comments. Back to document

19. Draft Assessment, p. 39. Back to document

20. It has been reported that, in ongoing IAEA negotiations regarding the "93+2" proposal to strengthen safeguards, "[G]ermany and Japan [are] objecting to what they see as a double standard that imposes inspections on their industries but disregards the same industries in the nuclear weapons states..." Joseph Fitchett, "UN's Nuclear Watchdog is Sharpening Its Teeth," *International Herald Tribune*, July 2, 1996. See also Mark Hibbs, "Panel Inches Toward Completing Text on Implementing New IAEA Safeguards," *NuclearFuel*, October 21, 1996, p. 16, reporting the concern of the German IAEA delegation about the "discriminatory application of the measures" called for in 93+2, and objecting to the fact that "the weapons states have a privileged position" under the terms of the proposed safeguards revisions. Back to document

21. Thomas Cochran and Christopher Paine, "The Amount of Plutonium and Highly Enriched Uranium Needed for Pure Fission Nuclear Weapons," Natural Resources Defense Council, August 22, 1994. Back to document

22. Frans Berkhout, University of Sussex, "The Rationale and Economics of Reprocessing," presentation to the Global '95 conference, Lyons, France, September 1995, in *Selected Papers from Global '95 Concerning Plutonium*, Ed. W. G. Sutcliffe, Lawrence Livermore National Laboratory, June 14, 1996, pp. 35-46; Paul Leventhal and Steven Dolley, "A Japanese Strategic Uranium Reserve: A Safe and Economic Alternative to Plutonium," *Science & Global Security*, 1994, Volume 5, pp. 1-31. Back to document

23. White House, "Nonproliferation and Export Control Policy," September 27, 1993, p. 2. Back to document

24. Draft Assessment, pp. 89-90. Back to document

25. Draft Assessment, pp. 90-91.Back to document

26. Draft Assessment, pp. 35-36. Back to document

27. Draft Assessment, Table ES-1, "Nonproliferation and Arms Control Advantages and Disadvantages of the Plutonium Disposition Alternatives," pp. xxiii-xxv. Back to document

28. Letter from Hans Blix, Director-General of the IAEA, to Paul Leventhal, NCI, November 1, 1990; "Blix Says IAEA Does Not Dispute Utility of Reactor- Grade Pu for Weapons," *Nuclear Fuel*, November 12, 1990, p. 8. However, Blix made this statement only after the Nuclear Control Institute challenged assertions by IAEA safeguards officials earlier that year that reactor-grade plutonium was unsuitable for use in weapons. Back to document

29. U.S. Department of Energy, Office of the Press Secretary, "Additional Information Concerning Nuclear Weapon Test of Reactor-Grade Plutonium," DOE Fact Sheet released as part of the Openness Initiative, June 27, 1994. The fact that the test occurred and produced a nuclear yield was declassified in 1977. Robert Gillette, "Impure Plutonium Used in '62 A-Test," *Los Angeles Times*, September 16, 1977, part 1, p. 3. Back to document

30. NCI private communication with a nuclear weapons expert. Back to document

31. Committee on International Security and Arms Control, National Academy of Sciences, *Management and Disposition of Excess Weapons Plutonium: Reactor-Related Options*, 1995 [NAS 1995], p. 413. Back to document

32. Edwin S. Lyman, Nuclear Control Institute, "Weapons Plutonium: Just Can It," *Bulletin of the Atomic Scientists*, November/December 1996, pp. 48-52. Back to document

33. Letter from NCI and 10 other public-interest groups to Energy Secretary Hazel O'Leary, September 25, 1996.Back to document

34. Office of Fissile Materials Disposition, U.S. Department of Energy, *Technical Summary Report for Surplus Weapons-Usable Plutonium Disposition*, DOE/MD-0003, Revision 1, October 31, 1996, p. 6-3.Back to document

35. The revised DOE Technical Summary Report estimates the cost of a disposition program using existing light-water reactors to be $1.9 to $2.1 billion, CANDU-based disposition to cost about $3.1 billion, and immobilization disposition using can-in-a-canister technology to be about $1.8 billion (in constant 1996 dollars). *Technical Summary Report*, Revision 1, op. cit, pp. 4-5 and 4-10.

If the estimated $500 million in subsidies required for the reactor option was included in the cost projections, rather than treated as a "cost uncertainty" (Ibid., p. 6-1), then the existing reactor option would cost at least $2.4 to $2.6 billion. Back to document

36. "Report Calls Plutonium a 'National Asset,'" *Denver Post*, July 29, 1993. Back to document

37. Frank von Hippel, *Federation of American Scientists' Fund, Cooperative Research Project on Arms Reduction: Sixth Annual Report*, August 22, 1993, p. 3.Back to document

38. Committee on International Security and Arms Control, National Academy of Sciences, *Management and Disposition of Excess Weapons Plutonium*, 1994 [NAS 1994], p. 193. Back to document

39. Draft Assessment, pp. 112-113. Back to document

---

nci@mailback.com