GUEST EDITORIALS

Weapons-Grade Plutonium Disposition: Moving Beyond the Cold War

Brad Morse

The United States faces yet another critical decision as the millennium approaches. In the fog of the post-Cold War era, the United States must decide how it is to begin to dispose of excess nuclear weapons materials. It is a decision that is technically complex, politically complicated, and economically difficult, but of the utmost importance here in America and worldwide.

The U.S. is about to head down the wrong path by trying to reuse a substantial portion of plutonium from nuclear warheads in commercial power reactors rather than placing it in unusable forms that would create far less environmental and proliferation risk. The benefits of immobilizing excess weapons-grade plutonium far outweigh the many costs of using plutonium as reactor fuel. Among these costs are the environmental, economic, and proliferation issues involved with using plutonium in commercial nuclear reactors.

For the last 50 years, the United States, in the form of the Atomic Energy Commission, the Energy Research and Development Administration, and now the Department of Energy (DOE), has produced nuclear weapons materials with little or no regard for environmental consequences. These activities, which include uranium mining, fuel fabrication, reactor operations, weapons operations, weapons testing, and various other operations has resulted in, at last count, 36 million cubic meters of waste. If stacked on a football field it would reach over 4 miles high. This does not include 79 million cubic meters of contaminated soil and 1.8 billion cubic meters of contaminated water. DOE is now faced with an unprecedented cleanup effort, and the related question of how to dispose of tons of nuclear weapons materials.

The United States has recently declared 50 metric tons of weapons-grade plutonium as surplus to its national security needs. Plutonium-239 is one of the two fissile materials used in nuclear weapons (uranium-235 is the other). It is man made, produced in both military and civilian reactors, and it has a half-life of over 24,000 years (a half-life is the time it takes for about half of its atoms to decay). Plutonium is one of the most lethal and long-lasting substances on earth.

Largely because of the secretive nature of developing plutonium for weapons use, data on exact cancer risks and risks for other diseases from exposure to plutonium is sparse. However, the information that does exist is frightening. Studies continue to be developed, such as a joint US-Russian study on health effects of the Mayak plant in Russia to both workers and neighbors of the facility, which processed plutonium for Soviet and Russian weapons throughout the Cold War. The studies that have been done indicate that cancer risks can be astronomically increased by amounts of plutonium in the range of micrograms, to say nothing of other diseases such as respiratory illnesses. Therefore, the decision regarding how to dispose of weapons-grade plutonium is critical not only for proliferation concerns, but for environmental, health and safety reasons as well.

In early 1997, DOE, the government entity which currently has responsibility for nuclear material here in the U.S., announced its strategy for disposing of the 50 metric tons of surplus weapons-grade plutonium. This strategy, which has come to be known as a "dual track" strategy, involves two methods of disposing of excess weapons-grade plutonium.

One such method is called immobilization. As it is envisioned for this program, immobilization consists of mixing weapons-grade plutonium with ceramics. Mixing the plutonium with ceramics makes it difficult for the radioactivity to leach away from the source, and the ceramics are durable and long-lasting, to help account for the long-lasting dangers of plutonium. The plutonium-ceramic mix would then be poured into sealed cans, and the cans placed in canisters lined with glass containing intensely radioactive high level waste, delivering potential thieves with a lethal dose of radiation, and making re-extraction more costly and difficult. The immobilized plutonium would then presumably be stored at a secure DOE site where it would await final disposal.

The other method of disposition in the dual-track strategy is the mixed-oxide fuel (MOX) option. This approach involves replacing the usual uranium fuel rods with plutonium fuel rods for use in a commercial nuclear reactor. Some of the excess plutonium would be taken from its current form in "pits" (the classified form that plutonium is in when it is used in nuclear weapons), and manufactured into fuel rods to be used in yet-to-be-determined commercial nuclear reactors. When these plutonium fuel rods are used up, or "spent", they will be inspected and presumably be stored on site and await final disposal.

There are several reasons why DOE should abandon the MOX portion of the "dual track" approach, and continue to pursue the immobilization portion for all 50 metric tons of weapons-grade plutonium.

Environmental Concerns

The use of MOX fuel involves more steps and more opportunities to expose the environment and people to plutonium and other dangerous residual radionuclides. While both MOX and immobilization involve preliminary steps, like taking apart the plutonium "pits", MOX includes many more steps than does immobilization. Under both plans, the plutonium would essentially be cut up and turned into an oxide, (powder) form. Under the immobilization plan, the plutonium oxide would then be immobilized with ceramics and glass, and be stored at a secure DOE facility until a disposal decision is made, as described above. Under the MOX plan however, the plutonium oxide would be manufactured into fuel rods for use in commercial reactors, transported to that commercial facility, burned in a nuclear reactor, be stored on site to cool, and presumably await final disposal at a commercial facility.

There is still no solution for final disposal of nuclear waste in the US or in the world. MOX fuel would generate high-level waste

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in the form of spent fuel from commercial reactors, which would be even more radioactive than conventional uranium spent fuel, and for which there are no plans for permanent disposal. It would also generate a great deal of "low level" waste, from fuel fabrication, transportation, and irradiation operations

Lack of Experience and Credibility

Another negative aspect of the MOX fuel approach is the effect it will have on commercial nuclear reactors. MOX fuel would be derived from weapons-grade plutonium, which has significantly different characteristics than does uranium fuel. This difference creates a host of problems for current commercial reactors, including affecting the duration of their life cycle and operational safety. Despite some experience with reactor-grade plutonium MOX fuel in Europe, there has been very little experience with weapons-grade plutonium as MOX fuel. Furthermore, some of the corporations who are involved in bidding for the MOX program here in the US have had applications for reactor-grade plutonium MOX programs rejected in other countries.

Excessive Cost

Total cost estimates from DOE's July 1998 "Cost Analysis in Support of Site Selection for Surplus Weapons-Usable Plutonium Disposition" indicate that immobilization of 50 metric tons of plutonium would cost between $1.71 billion and $1.9 billion in constant 1997 dollars. For the "hybrid" approach, (a reference to the "dual track" approach of immobilizing about 17 tons and using about 33 tons for MOX) the total cost estimate is between $2.67 billion and $2.93 billion in constant 1997 dollars. Including MOX use as reactor fuel is by far the more costly of the options.

However, this "Cost Analysis" is completely flawed for two reasons.

First, DOE presumes that the cost for MOX will be offset by over $900 million because the commercial facility will purchase the MOX plutonium fuel instead of traditional low enriched uranium (LEU) fuel. However, in 1996 DOE wrote in a Technical Summary Report For Surplus Weapons-Usable Plutonium Disposition "in no case can MOX fuel compete economically with LEU fuel". This makes the $900 million "fuel offset" assumption dubious at best.

Second, commercial nuclear facilities will have to modify their reactors to use MOX plutonium fuel. As mentioned above, despite some experience in Europe with reactor-grade MOX plutonium fuel, there has been limited experience with weapons-grade plutonium as a fuel. Because of this, reactor modification could increase the MOX option cost as much as $2 billion. This is not included in the above cost estimate. Obviously, this cost would not be a factor if the MOX option were abandoned.

Proliferation Risks

Increasing the amounts of weapons-grade plutonium which are transported, fabricated, and burned as MOX fuel presents a significant proliferation risk. One of the most prevalent risks is the possibility of creating a plutonium fuel cycle. The creation of a plutonium fuel cycle refers to the wide-spread use of plutonium as a fuel source. The concern with using the primary source of nuclear weapons as a commodity which can easily be bought and sold should be apparent. While both MOX and immobilization would involve taking apart the plutonium pits (plutonium in the weapon), immobilization involves putting the plutonium in ceramics and storing or disposing of it, while MOX involves the many steps noted above. There are simply more opportunities for those with nuclear weapons aspirations to get their hands on weapons-usable plutonium throughout the MOX fuel cycle than there would be if it were immobilized. Furthermore, immobilized plutonium could only be separated out by getting past a lethal dose of radioactivity, and then running the immobilized plutonium through a massive reprocessing facility. Fresh MOX fuel, however, is practically weapons-usable. It would take very little effort to turn a plutonium fuel rod into a weapon of mass destruction.

Public Participation

While the proclamation of 50 metric tons of weapons-grade plutonium as excess is laudable, the public has effectively been shut out of this process. The DOE has held only 4 hearings at or near the 4 DOE sites that are proposed for production of the plutonium MOX fuel. Astonishingly, not one member of the public around the proposed commercial facilities which would actually burn the plutonium MOX fuel has had the opportunity to voice their opinion at a public hearing, nor was anyone along the many possible transportation routes involved. Here the DOE has used circular reasoning by asserting that it couldn't include the reactor communities because it didn't know which reactors would be used, but by the time the reactors are selected the decision will be made, and there will be no opportunity for input from states, local officials, or the public.

Simple Logic

In the overall picture, 17 metric tons out of the 50 total metric tons of excess weapons grade plutonium can not be used as MOX fuel due to impurities and other such concerns, according to DOE's July 1998 Surplus Plutonium Disposition Draft Environmental Impact Statement (SPDEIS). DOE, therefore, must immobilize at least some of the plutonium. On the other hand, there is no reason why all 50 tons couldn't be immobilized. In fact, in the SPDEIS mentioned above, DOE recognizes that immobilizing all 50 tons of plutonium is feasible by examining *six* "Immobilization Only" alternatives.

What Can Be Done?

The debate is not over. There are many opportunities to ask critical questions. The proposed immobilization program will take the step of putting plutonium into a form that is no longer weapons-usable, and preparing it for final disposal. The proposed MOX program will be another ongoing program that will add to the environmental catastrophe created by 50 years of unfettered nuclear weapons production. How does conversion of pits, production of fuel, transportation of fuel, and irradiation in reactors fit into DOE's overall cleanup plans?

The National Academy of Sciences has commissioned a report on the disposition of excess weapons-grade plutonium. The

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Department of Energy is in the process of producing a final Environmental Impact Statement on the same subject, having released a draft version in July of 1998. The DOE is also devising a plan for spending $200 million on Russian disposition of weapons-grade plutonium, which is more than was budgeted for in the US program for fiscal year 1999. How this money is spent is critical to the direction of the disposition program here in the US and abroad.

Conclusion

MOX technology represents Cold War thinking. In the last 50 years, the DOE nuclear weapons complex has resulted in unprecedented contamination that will take until 2070 to clean up, cost at least $150 billion, and more credible estimates suggest that it could take longer and cost more. MOX is more of the same technology that contributed to this huge environmental legacy. MOX is technologically complicated, it will cost in the range of billions of dollars, it will increase the risk of proliferation of weapons of mass destruction, and it doesn't solve the problem of excess weapons plutonium. Immobilization is a credible and viable option that will be used in any scenario currently under consideration. By continuing to pursue plutonium fuel, we are simply increasing risk, environmental degradation, and cost.

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The Personal Connection

Marc C. Bruner, PhD

It seems that the strength of people's emotional response to environmental issues is often related to the sense of connection they have to the matter at hand. Sometimes environmental issues are supported in the abstract, such as wilderness, when most people don't go there, or endangered species, when most people won't ever see them, but often a more direct connection seems to evoke a deeper response. I'm sure that our colleagues that deal with public involvement see this sometimes.

In solid waste management, one of the most common personal connections is the NIMBY (Not In My Back Yard) response, which is a subset of the larger BANANA (Build Absolutely Nothing Anywhere Near Anything) syndrome. This is the negative side of the personal connection we deal with when siting new facilities. But there is a positive connection that I have often seen, and it is worth mentioning, and trying to build upon when we can.

In their daily lives, a lot of the members of the public I interact with do not seem to sense that they have a direct impact on protecting or improving the environment. Air quality, greenhouse gases, hazardous waste and drinking water quality all appear beyond their control, or at least seem to be. The personal choices and decisions that lead to improvements in these areas don't seem to draw as direct a personal connection. In some cases, technology has made the improvements, and they are transparent to the individual and involve no personal choice. You can't make the choice to buy a car without a catalytic converter, chlorofluorocarbons have been removed from aerosol cans and air conditioning systems, water treatment plants implement technologies to reduce trihalomethanes, and the individual has "done" nothing. At this point, most people can't make a choice of how the electricity they consume is produced. This detachment can lead people to focus their interest on issues where they feel a more personal connection.

One thing people do every day is generate solid waste. It often moves directly from their hand to the trash can. They take it to the curb, put it in the recycling bin, the compost pit, the garbage disposal, or some other place. They make choices and decisions every day with what they do with their solid waste. This seems to create a closer personal connection between solid waste as an environmental issue and the general public than many other issues.

When I meet people and tell them I work as an environmental professional, they are interested. When I tell them I work in solid waste management, they are engaged. Parents speak proudly of their children and how diligent they are at recycling. If they have a compost bin, I hear about it. I hear about how they do it "back home", either better or worse than here. I often hear what I've come to call the "shooting rats at the dump" story from people old enough to have been around in the bad old days of waste management. I never got the same level of involvement and response from people when I worked in other areas of environmental management, such as wetlands. I attribute this to the personal connection.

This could only be a slightly interesting observation, but I think it may point to a larger issue. Public support of sound environmental management may ultimately depend on the strength of the personal connection people feel with the environment. As professionals, I hope we all feel a strong connection, and one of our challenges is to help the general public make that personal connection. Lest someone misunderstand me, I'm not necessarily suggesting advocacy, like the environmental activist groups. I'm thinking of a greater level of general knowledge and awareness. If we as professionals can promote a higher level of awareness, I believe a more positive personal connection with environmental management and it's issues is possible for the general public. I think this would be good for the public, the profession, and the environment. The greater the level of knowledge and commitment, the better we are able to face decisions, and make the right choices, even if they are hard ones.

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