The impact of Japan's reprocessing program on the risks of nuclear proliferation and nuclear terrorism

Steve Fetter

- I believe Japan is fully committed to the Nonproliferation Treaty, and to do what it can to help prevent additional countries from acquiring nuclear weapons. I have no concerns about Japan's commitment to remain a non-nuclear weapon state and to strengthen the nonproliferation regime.

- But others have doubts, and a key reason is that Japan has amassed an enormous stockpile of plutonium as a result of reprocessing spent fuel from power reactors. This plutonium can be used to build nuclear weapons. In preparing for this talk I found a passage on the JNFL web page that states, "This plutonium is useable only as a reactor fuel. It is not suitable for nuclear weapons." That is absolutely false.[i]

- There are now 10 tons of separated plutonium in Japan—enough for 1500 nuclear weapons.[ii] An additional 34 tons of plutonium—enough for 5000 nuclear weapons—is stored in France and the United Kingdom.

- These stockpiles were in excess of civilian needs even before the Fukushima disaster. The Rokkasho plant can produce an additional 8 tons of plutonium per year—enough for more than 1000 nuclear weapons per year. Because Japan has no realistic plan to use 8 tons of plutonium per year, the stockpile would continue to grow if Rokkasho operates.

- If Japan continues to accumulate plutonium without any economic rationale, and without firm plans for its immediate use in power generation, this can sow doubts about Japan's intentions. Countries often make worst-case assumptions about the intentions of their neighbors. They assume the worst, and base their assessments and defense planning solely on capabilities.

- I have attended meetings elsewhere in East Asia where participants questioned the nature of Japan's plutonium program. They suggested that it was a type of nuclear deterrent—a signal that Japan could quickly build large numbers of nuclear weapons if it chose to do so. They find it difficult to believe that Japan's huge stockpile of plutonium is the by-product of flawed policies and delayed programs.

- So that is one concern with Japan's reprocessing program: that neighboring countries might believe that Japan has accumulated a large stockpile of plutonium in part to provide a nuclear weapon option. If other countries perceive a growing Japanese plutonium stockpile as a latent nuclear weapon capability, this will contribute to instability in East Asia, and it will undermine Japan's international reputation.

- But I am more concerned about the example that Japan's reprocessing program sets for other countries. Japan is the only country without nuclear weapons that produces separated plutonium. If Japan claims that plutonium separation is a vital part of its civilian nuclear power program, this makes it more difficult to prevent the spread of plutonium separation to other countries, especially countries for which there is much greater concern about nuclear weapons. This is particularly true if Japan stockpiles plutonium for which it has identified no near-term use.

- Japan views its plutonium program as an indication of its special status, but other countries resent this. Double-standards can exist for a time, but they cannot endure for long. Other countries, such as South Korea, legitimately question why are not permitted to do something that Japan is permitted to do. Japan may argue that it is unique among non-weapon states because it has a large and sophisticated nuclear power program. But South Korea is not far behind Japan.

- South Korea's desire to revise its agreement for cooperation with the United States to permit reprocessing is an example of how Japan's nuclear fuel cycle programs undermine nonproliferation norms. Like Japan, South Korea argues that reprocessing provides important waste-management benefits.

- But there are good reasons to believe that South Korea is interested in reprocessing for other reasons. South Korea had a nuclear weapon program in the 1970s, and South Korea remains in a technical state of war with a nuclear-armed North Korea. If South Korea begins reprocessing and stockpiling plutonium, it is easy to see how this would be portrayed by other countries as a security threat.

- If Japan claims that reprocessing is essential, then any country with spent fuel—which means any country with a nuclear reactor—can say that they, too, need reprocessing to manage their nuclear wastes—that reprocessing is one their "inalienable rights" under the NPT. If Japan continues reprocessing, particularly without any economic rationale or any firm plans for the use of the plutonium that is produced, this will undermine negotiations with countries of proliferation concern, such as Iran. Indeed, Iran has cited Japan as a model of its fuel cycle development.

- This was the reason that the United States decided to abandon reprocessing 35 years ago: to help persuade other countries to forego reprocessing. Any country with reprocessing, any country with stocks of separated plutonium, is a virtual nuclear weapon state, able to build nuclear weapons very quickly, with almost zero warning. The existence of such a situation is destabilizing, because it can prompt rivals to take similar steps to hedge against a rapid move to go nuclear, and so on in a cascade of proliferation of nuclear capabilities.

- A third type of concern is about the theft and misuse of nuclear materials by terrorists. The very highest standards of protection and accounting must be applied to plutonium—as high as one would apply to nuclear weapons. Because of the nature of the reprocessing and MOX fuel production

processes, it is impossible to account precisely for all the plutonium in these facilities. In the smaller Tokai reprocessing plant, at times enough plutonium was unaccounted for to build several nuclear weapons. This can undermine international confidence that no plutonium has been diverted or stolen.

- I am even more concerned about the physical security of MOX fuel in transit and in storage at reactors in Japan. If terrorists could intercept a shipment or break into a storage site, they could steal a fuel assembly. A single MOX fuel assembly for a boiling water reactor contains enough plutonium for two nuclear weapons; the assemblies for pressurized water reactors contain more than twice.

- It would not be difficult for technically trained members of subnational groups to separate this plutonium. Unlike spent fuel, fresh MOX fuel poses no significant external radiation hazard. Once the fuel pellets are extracted, the chemical separation could be done in a glove box. The chemistry is straightforward; step-by-step instructions were posted on the web.

- Although some people claim that it would be impossible for terrorists to build a nuclear weapon with this plutonium, I regret that this simply is not true. And even if they could not trigger a nuclear explosion, they could disperse plutonium throughout a significant area in a major city, resulting in widespread panic and enormous economic damage. The risks of nuclear terrorism are very real and cannot be discounted.

- The best way to address all three of these concerns would be for Japan to end the separation and use of plutonium. This would be the single largest contribution that Japan could make to strengthening the nonproliferation regime. As President Obama said last year in Seoul, "we simply can't go on accumulating huge amounts of the very material, like separated plutonium, that we're trying to keep away from terrorists."

- Japan could take a leading role in preventing the production of plutonium worldwide, dealing a fatal blow to claims by South Korea and any other country that they need reprocessing. The U.S. and Japan could work together on technical methods to dispose of their plutonium stockpiles without producing MOX fuel. The United Kingdom and France could agree to take responsibility for the disposal of Japan's plutonium stocks in Europe.

- The next best option would be for Japan to take seriously its 20-year-old pledge not to possess surplus plutonium—that is, plutonium beyond the amount required for its nuclear power program. The amount of plutonium currently stockpiled in Japan—not to mention the amount stockpiled in Europe—is far in excess of what is required. This would be true even if Japan restarted all of the reactors that are licensed to burn MOX fuel.

- At a minimum, Japan should commit not to operate Rokkosho and not to separate any additional

plutonium until its stockpile of plutonium is reduced to the smallest feasible working stock. Existing plutonium stocks would be fabricated into MOX fuel and loaded into licensed reactors as they become operational. Security should be upgraded for the transport and storage of MOX fuel, comparable to the level of security that the U.S. provides for nuclear weapons. Reprocessing would restart only when plutonium stockpiles have been reduced to a minimum working stock—no more than one year's supply—and plutonium would be produced only at the rate needed to meet actual demand for reactor fuel. Given the reduction in demand for MOX fuel, the restart of Rokkosho could be delayed for many years.

- Some analysts have mentioned the possibility of converting Rokkasho into a multilateral or international fuel cycle center. I am not in favor of this because it perpetuates the mistaken idea that reprocessing is a useful and even necessary service. Although international management of plutonium separation at Rokkasho might be considered a confidence-building measure, it would lead to the shipment and use of plutonium fuels in South Korea and perhaps other countries.

- In closing, the Fukushima disaster has provided an opportunity for Japan to reconsider its plutonium program—a costly program that poses serious risks of nuclear proliferation and terrorism, risks that far outweigh the modest energy security and waste-disposal benefits that are claimed by advocates. I sincerely hope that Japan will seize this opportunity and take a leading role in strengthening the nonproliferation regime by ending, or at least suspending, the separation of plutonium; and that Japan and the U.S. can work together to develop safer approaches to nuclear energy, approaches that reduce the risks of nuclear terrorism and proliferation.

---

[i] See, for example, J. Carson Mark, "Explosive properties of reactor-grade plutonium," *Science & Global Security*, 4, no. 1, (1993): 111-128; Matthew Bunn and Anthony Wier, "Terrorist Nuclear Weapon Construction: How Difficult?" *Annals of the American Academy of Political and Social Science* (2006), p. 607; and Frank Barnaby, "How Not to Reduce Plutonium Stocks: The Dangers of MOX-Fuelled Nuclear Reactors," Corner House Briefing 17. Mark shows that replacing the plutonium used in the Trinity device with reactor-grade plutonium would give a yield of more than 1 kiloton with high probability. Bunn and Wier note that terrorists might prefer reactor-grade plutonium because the high rate of spontaneous neutron emission eliminates the need for an initiator; that the chemical process for converting plutonium oxide to metal is widely published and not complex; and that glove boxes that would allow safe handling and processing of plutonium are used in the illegal narcotics industry. Barnaby notes that "Having obtained a MOX fuel assembly by diversion or theft, a terrorist group would have little difficulty in making a crude atomic bomb. The necessary steps of chemically separating the plutonium oxide from uranium oxide, converting the oxide into plutonium metal, and assembling the metal or plutonium oxide together with conventional explosive to produce a nuclear explosion are not technologically demanding and do not require materials from specialist suppliers. The information required to carry out these operations is freely available in the open literature." Note that the MOX used in Japan typically contain 8-9 percent plutonium; the product of Rokkasho is 50 percent plutonium. Of course, separating plutonium from the latter mixture would be even easier than from the former.

[ii] The IAEA defines "significant quantity" (SQ) as the amount of nuclear material that a state would need to manufacture its first nuclear explosive. For plutonium, the SQ is 8 kilograms, regardless of isotopic composition (except for plutonium that is more than 80 percent Pu-238, which is used as a power source). For comparison, the first plutonium weapon (the Trinity/Nagasaki device) contained 6 kilograms of plutonium. Effective weapons can be made with less plutonium.