Chapter 9

Conclusions

All things being equal, weapon-grade plutonium is preferred over reactor-grade plutonium for the production of nuclear weapons. However, today, unlike the 1940s and 1950s, all things are not equal. A non-nuclear weapon state would find it difficult to build a plutonium production reactor without being subjected to enormous international pressure and, as Syria found out in 2007, the reactor could be bombed before it even began operation. In contrast, nuclear power reactors are readily available and, as part of the continuing legacy of the myth of denatured plutonium, half a dozen non-nuclear weapon states have large quantities of separated plutonium. Japan currently has several metric tons of plutonium in the form of pure plutonium nitrate solution or pure plutonium dioxide. In 13 years, after the Comprehensive Joint Plan of Action expires, Iran will be permitted to reprocess spent fuel to obtain pure plutonium nitrate.

For countries today, the choice is not between weapon-grade plutonium and reactor-grade plutonium for nuclear weapons but rather between reactor-grade plutonium and no nuclear weapons at all. In the past, both Sweden and Pakistan at one time based their nuclear weapon programs on reactor-grade plutonium when weapon-grade plutonium was unavailable. That neither country would eventually produce reactor-grade based nuclear weapons does not change these facts. In the case of Pakistan, its failure to produce nuclear weapons using reactor-grade plutonium had nothing to do with the properties of such weapons. Rather, the United States recognized the dangers of reactor-grade plutonium and applied pressure to France to block the sale of the reprocessing plant needed to produce separated reactor-grade plutonium. Today, India may have deployed nuclear weapons using reactor-grade plutonium.

It has been claimed that nuclear weapons manufactured using reactor-grade plutonium would be "unreliable," "unpredictable," "bulky," and "hazardous to bomb makers." None of this is true. The *entire* 270 metric ton current world stockpile of separated plutonium can be used to produce nuclear weapons by simply using a reduced amount of plutonium that is only 60% of a critical mass and coating the core with a half a centimeter of uranium. Employing early 1950s U.S. unboosted implosion technology and modern high explosives, these weapons would have the same predetonation probability as that of the same type of weapon using weapon-grade plutonium and a near critical core. The weapons would be the same exact size and weight as ones using weapon-grade plutonium, and they would require no special cooling. The gamma radiation from the core would be significantly less than that of an unshielded weapon-grade plutonium core. The only difference would be that while the weapon-grade plutonium weapon would produce a yield of 20 kilotons, the reactor-grade plutonium weapon would produce a yield of only 5 kilotons, though its destructive area would still be about 40% that of the 20 kiloton weapon. Further, boosting technology appears to be becoming more readily available to early nuclear weapon states. Boosted weapons produce the same yield regardless of whether weapon-grade or reactor-grade plutonium is used.

Many claims about so-called denatured plutonium relate to reactor-grade plutonium produced by spiking reactor fuel with either neptunium or americium. However, this spiking has not been done nor is it likely to ever be done since this would greatly increase the costs and technical difficulty of using plutonium as nuclear reactor fuel. Even then, the plutonium could be used to produce nuclear weapons though in this case some special effort would be needed to cool the core by expanding the size of the core to improve heat dissipation and using thermal bridges to conduct the heat away from the core.

The obvious solution to the nuclear weapon dangers posed by reactor-grade plutonium is to deny non-nuclear weapons states easy access to this material by banning all reprocessing and plutonium recycling, including unirradiated MOX fuel, from such countries. This was the conclusion of the analysis that I participated in at Pan Heuristics over 40 years ago. Our conclusion led to the Carter Administration to end commercial reprocessing in the United States and to try to prevent it in non-nuclear weapon states as well. The intervening years have only reinforced the wisdom of this recommendation. In the 1970s, those in the nuclear industry objected that such a policy would retard the growth of nuclear power which they believed was destined to be a major if not the main source of electricity generation. The nuclear industry expected that uranium resources would be insufficient to support such a large nuclear industry and only plutonium fuel in breeder reactors could power the large number of reactors that they expected.

Today there are no commercial breeder reactors and none are in sight. Nuclear power did not grow to become anywhere as important as was predicted and uranium resources have proven to be no constraint on nuclear power. The use of plutonium based reactor fuels is universally acknowledged to be uneconomic. Nuclear energy faces stiff competition from natural gas and renewable energy sources.

Though plutonium reprocessing in nuclear weapon states poses little proliferation risk, it is clearly uneconomic and unnecessary given the 270 metric ton stockpile of separated plutonium that already exists. Reprocessing should be ended in these countries as well to prevent this unnecessary plutonium stockpile from growing even larger.