Evidence to the Blue Ribbon Commission on America's Nuclear Future
Subcommittee on Reactor and Fuel Cycle Technology

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It is an honour to be invited to appear before this committee. Let me add by way of introduction that I am a supporter of nuclear power. If we are to mitigate climate change, I believe that nuclear power must be part of the solution. The challenge facing us is how nuclear power can be expanded safely and securely. I would like to focus my remarks today on whether an American policy of restraint—of continuing not to reprocess spent reactor fuel—is likely to prove an effective non-proliferation tool.

In the 68 years since the first nuclear reactor went critical in a squash court at the University of Chicago, the United States has employed three basic strategies for managing nuclear technology.

From 1946 to 1954, the US employed a strategy of *develop and deny*, that is, it developed nuclear technologies but did not share them at all. A variant of this strategy—a willingness to share fuel cycle technology with just a few carefully selected 'safe' states—was adopted in the Global Nuclear Energy Partnership.

A second strategy, first adopted by the Ford administration for reprocessing and subsequently supported by the Carter and Clinton administrations, is *desist and discourage*. That is, the United States desisted from developing reprocessing technology and encouraged others to show equal restraint.

A third strategy of *develop and disseminate* has been—quite rightly—employed with respect to light water and some other reactor types since 1954, but for obvious reasons would be a foolhardy option for reprocessing.

When it comes to reprocessing, the choice facing the United States is, therefore, between develop and deny, and desist and discourage; or, put more simply, between denial and restraint.

Critics of restraint argue that it has done little to slow domestic reprocessing programmes in China, France, India, Japan, Russia and the United Kingdom. This is certainly correct (although the British programme appears to be grinding towards a slow death for other reasons). However, it misses the point.

The real value of American restraint is not that it encourages existing reprocessers to stop; it is that it doesn't encourage new ones to start.

The seminal 1976 study, *Moving Towards Life in a Nuclear Armed Crowd?*, which was conducted by a team led by Albert Wohlstetter, observed that, given contemporary plans, 17 states would have a significant reprocessing capability within ten years. Today, thirty-four years later, only the six

aforementioned states have civilian reprocessing programmes. This, I believe, has been the real success of American restraint.

To understand why a US decision to reprocess might encourage others to do likewise, it is necessary to realize that states decide to procure sensitive nuclear technologies for reasons other than cold, hard economic analyses demonstrating that a fuel cycle choice would lower electricity costs—or even that it would provide other essentially economic benefits such as energy security or simplified radioactive waste disposal. The decision-making of states is more complicated. They can be strongly affected by non-economic factors including prestige and, what I term, received wisdom.

The role of prestige in nuclear technology procurement decisions is well known and I don't think I need to labour the point. The role of received wisdom is less well recognized. Received wisdom is the assumed belief, based on the actions of other states, that a fuel cycle technology is beneficial.

Received wisdom, especially from the United States but also from the United Kingdom, explains why, prior to the mid 1970s, every state with a nuclear power programme outside the Soviet bloc (apart from Canada) planned to reprocess spent fuel. Few, if any, of these states surveyed uranium resources to assess their scarcity or made detailed estimates of the cost of nuclear electricity from fast reactors. They simply copied the US and the UK. Indeed, when the United States changed its policy and opposed reprocessing in 1976, Japanese diplomats repeatedly complained that 'our belief in the necessity of the plutonium cycle is based on American teaching'.

My concern, therefore, is that an American decision to reprocess would create received wisdom that plutonium separation was the way to go; that it would confer prestige on reprocessing technology and, hence, encourage other states to start separating plutonium.

These concerns would, unfortunately, not be significantly mitigated if the United States adopted a process, such as UREX+, which did not completely separate plutonium but left it mixed with minor actinides. Even this fuel cycle choice would send out the message that reprocessing was an essential part of a modern nuclear energy programme and enhance the risk that other states would develop PUREX.

New reactor technologies don't provide a solution to this problem either. The Global Nuclear Energy Partnership provides a cautionary tale. When it was launched in 2006, GNEP specifically advocated the development of fast *burner* reactors, capable of consuming more transuranic material than they produced. Burner reactors were seen as a solution to US waste management concerns. They were also argued to be proliferation resistant (which is true, but only if you ignore the reprocessing required to make their fuel). By arguing for the development of burners on non-proliferation grounds, GNEP tacitly and correctly conceded that *breeders*, which produce more plutonium than they consume—plutonium that is highly suitable for use in nuclear weapons—pose serious proliferation risks.

Realistically, however, it is impossible to develop burners and not breeders. The challenges to the development of the two reactor types are similar; American support for the burner inevitably contributes to the development of its more proliferative sibling, the breeder. Indeed, even before GNEP was launched, the 2002 Generation IV International Forum 'Road Map', in deference to the different priorities of the participating states, recognized that all fast reactor designs under consideration could equally contribute to the development of breeders and burners.

I am concerned, therefore, that American support for reprocessing and fast reactors—even technologies such as UREX+ and burners—could have the unintended consequence of enhancing the overall proliferation risk.

This raises a final issue, which I want to touch on briefly: how proliferation risks can be assessed. As should be clear by now, I believe that assessing proliferation risks is more than just a technical exercise. Although criteria such as safeguardability and material attractiveness matter, so too do political factors like prestige and received wisdom.

The Generation IV International Forum methodology for assessing proliferation resistance, which the United States is currently involved in developing, is admirable in many ways. It is systematic and transparent. However, it does not take the political factors I have discussed today (as well as others) into account. Perhaps, if natural and political scientists work together, the methodology could be extended to give a more comprehensive assessment of proliferation risks. Such a task presents numerous challenges, however, and is unlikely to be completed in the short term. In the final analysis, proliferation is a political problem. The key to assessing proliferation risks is political judgement.

The arguments in this testimony are elaborated further in:

James M. Acton, 'The Myth of Proliferation-Resistant Technology', *Bulletin of the Atomic Scientists,* vol. 65, no. 6, November/December 2009, pp. 49—59.

James M. Acton, 'Nuclear Power, Disarmament and Technological Restraint', *Survival*, vol. 51, no. 4, August/September 2009, pp. 101—126.