

## The Nonproliferation Impacts of GNEP

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Much of the renewed interest in nuclear energy, in the United States and elsewhere, is a result of concerns about climate change. Over at least the next 20 years, nuclear will most likely be the lowest-cost carbon-free energy source that can be expanded substantially. And to make a significant contribution to mitigating climate change, nuclear must be expanded very substantially—by at least a factor of five over the next 50 years.

As worried as I am about climate change, I am more worried about the spread of nuclear weapons. An expansion of nuclear power must not be accompanied by a corresponding increase in the risks of nuclear proliferation and nuclear terrorism. There are abundant signs that the existing technological and institutional arrangements are not adequate.

The Bush administration's proposed solution is the Global Nuclear Energy Partnership, or GNEP. The central nonproliferation feature of GNEP is an effort to establish reliable fuel-cycle services for any country that forswears enrichment and reprocessing.

The administration (at least, the State Department) insists that this will be voluntary. That's fine, but in order for countries to volunteer the promise to supply fuel-cycle services must be ironclad and believable.

Satisfactory arrangements are, I think, possible for the front end—the supply of fresh LEU fuel. Although many countries would have good reason to doubt any U.S. promise to supply fuel, multiple suppliers or the actual transfer of enriched uranium to the IAEA probably could provide a credible and reliable supply of fresh fuel.

The back-end of the fuel cycle is more problematic. If fuel suppliers agreed to take-back spent fuel and assume complete responsibility for its management and ultimate disposition (including any high-level wastes generated by reprocessing), then this would provide a huge boost to fuel leasing arrangements. So far, only Russia has stated its intention to take back spent fuel. It initially appeared that this was part of the U.S. proposal under GNEP, but it is now clear that the U.S. has no intention of taking back spent fuel.

But even if the promises of fresh fuel supply and spent fuel take-back are credible enough to persuade some countries to forswear enrichment and reprocessing, voluntary arrangements do nothing to address the tough cases. Indeed, Russia offered this deal to Iran, and Iran refused. The value of an initiative that fails to address the countries that are pursuing or may pursue nuclear weapons is very limited.

But the situation is even worse than this, because GNEP envisions dividing the world into “supplier” and “user” nations, without any clear rules to govern this division (except, perhaps, the preferences of the U.S. government). GNEP has prompted a number of countries, including Canada, Australia, South Africa, Argentina, Brazil, and Ukraine, have expressed interest in being “supplier” states. By threatening to close the door on new suppliers of fuel-cycle services, GNEP may end up making the problem worse by prompting countries to squeeze through the door while it is still open.

One might deal with this problem in one of two ways. First, one might establish clear and universal rules by which countries would be permitted to become suppliers. A reasonable rule would be that a country would either have to produce enough uranium to supply a typical commercial enrichment facility (~1 million SWU), or have enough nuclear reactors to absorb the low-enriched uranium product of such a facility. Similarly, one might permit reprocessing only when a country has both a supply of spent fuel sufficient to supply a large facility (~800 tons/yr), as well as a demand for the output. To this I would add a requirement to take back and assume responsibility for any fuel that is supplied and any wastes generated by reprocessing—this would naturally limit the number of suppliers and make it clear that responsibilities as well as benefits come with being a supplier.

Alternatively, one might adopt the El Bardadei option and require that all enrichment and reprocessing facilities be placed under international or multilateral control. The U.S. doesn't like either of these solutions, because they could allow "bad" countries to qualify as supplier states. But any system that relies on the U.S. to determine who is in and who is out is doomed to fail. So far, I haven't heard a persuasive story about how the number of suppliers will be stabilized and limited to "safe" states.

Although the provision of reliable fuel-cycle services is the main nonproliferation feature of GNEP, most of the proposed funding goes to activities—reprocessing and transmutation in fast reactors—that are at best unnecessary and likely to make nuclear electricity more expensive and less competitive, and at worst could increase the risks of nuclear proliferation and theft.

I say it's unnecessary, because fresh fuel leasing and spent fuel take-back can be done today, without separation and transmutation. The architect of GNEP, Vic Reis, will say that S&T are necessary to reduce the radioactive waste, and thereby overcome a key barrier to the public acceptance of nuclear power. But I don't think this is correct, because GNEP won't eliminate the need for geologic disposal. Most of the people who complain about nuclear waste either use it as a surrogate issue for a broader opposition to nuclear power, or oppose waste disposal in their backyard (Nevada). Building reprocessing plants and fast reactors will simply energize the first group, and the second group won't be placated by the fact that the waste will be hazardous from thousands rather than hundreds of thousands of years—Nevadans, in particular, won't be happy to find that they will be the sole disposal site for a greatly expanded U.S. nuclear industry.

Rather, we should focus on providing adequate long-term storage spent fuel. Spent fuel can be stored safely, securely, and inexpensively in dry casks for 50 to 100 years. Eventually, people will become persuaded that the benefits of nuclear power are sufficient to accept the very low risks of geologic disposal. If Americans cannot become persuaded, perhaps Russia, China, Australia, or Canada, or some other country will agree to do so—for a high enough price. The need to provide reliable fuel cycle services, including firm commitments to take back spent fuel, cannot await a separation-and-transmutation scheme that might—or might not—materialize 25 years from now.

No one knows how much separation and transmutation cost, but I don't know anyone who believes it will be cheaper than light-water reactors operating on a once-through fuel cycle. The

question is whether the required subsidy will be modest or prohibitive. Although reprocessing and subsequent fuel fabrication and HLW disposal are more expensive than direct disposal of spent fuel, this extra cost is minor compared with the additional capital cost of fast reactors to transmute the transuranics. I believe that the best estimate is still the 1995 NAS study, which estimated a cost of \$50-100 billion—in addition to the costs of Yucca Mountain—to separate and transmute the 60,000 tons of spent fuel which the United States had already discharged—an additional cost on the order of \$1 billion per LWR. I find it very difficult to believe that reactor operators, rate payers, or tax payers will be willing to pay this premium merely to reduce the amount of repository space that will be required. Will we or other supplier states pay this subsidy for user countries, from whom they accept spent fuel? If not, why would they pay it? Wouldn't they shop for cheaper disposition options?

Finally, contrary to DOE claims, the proposed separation facilities and processes will not be significantly more proliferation resistant than would a new PUREX plant, and would require the same level of physical security and safeguards. There would still be concerns about diversion of technology to hidden facilities; concerns about timely warning of diversion; and concerns about theft of the product. Even though the plutonium would be mixed with other transuranics, the radiation dose rate of the TRU product would be far below the IAEA's standard for self-protecting materials, and the plutonium could be separated from the other transuranics in a glove box.

One aspect of GNEP has received relatively little attention, and, so far, no money: small (less than 100 MW) reactors appropriate for deployment in developing countries, with sealed cores with very long lifetimes (20 to 40 years). These reactors could be built in factories to a standard design, much like commercial aircraft are built, and shipped to site complete with fuel, ready to go on line. At the end of the core life, the entire reactor would be returned to the vendor. There would be no need for the user country to have any fuel cycle services. Moreover, if the concept proves economically attractive—if economies of mass production compensate for the diseconomy of the smaller unit size—it could lead to something like a natural monopoly, where only a few countries can afford to compete. Safeguards in most countries would then become simple—ensure that the reactor is still in place and that the core has not been unsealed. The difficult problems of protecting and safeguarding enrichment and reprocessing facilities might naturally be concentrated into a handful of sites.

Private companies, like GE, are unlikely to pursue this idea. If I had to choose an avenue of federal nuclear R&D that might be truly transformative and dramatically reduce the proliferation risks of the expanded use of nuclear energy, I'd put my money in small reactors rather than separation and transmutation.