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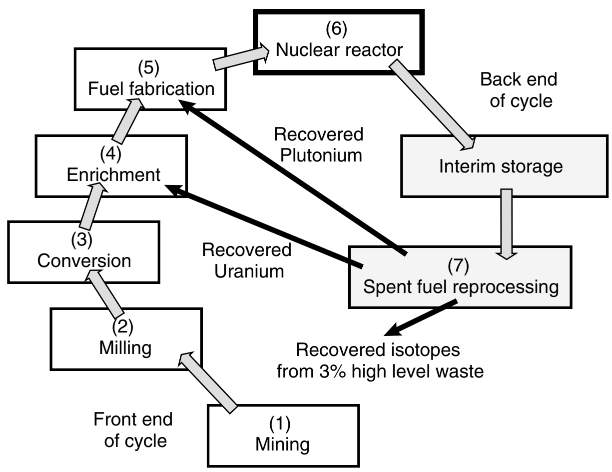
U.S. Nuclear Energy Program: Too Little Mission

A "Review of the Department of Energy's Nuclear Energy Research and Development Program," issued Oct. 29 by a committee of the National Academy of Sciences,[1] criticized the Department of Energy's Global Nuclear Energy Partnership (GNEP) program, but for all the wrong reasons. Instead of critically looking at GNEP's goal of preventing other countries from developing a complete nuclear fuel cycle on their own, the committee focussed on how there is no real need for the United States to develop the reprocessing of spent nuclear fuel, and how it's too expensive anyway.

"All committee members agree that the GNEP program [for fuel recycling] should not go forward and that it should be replaced by a less aggressive research program.... Domestic waste management, security, and fuel supply needs are not adequate to justify early deployment of commercial-scale reprocessing and fast reactor facilities," the report states. "There is no economic justification to go



COMPLETING THE NUCLEAR FUEL CYCLE

The full nuclear fuel cycle shows that nuclear is a renewable energy source: The spent fuel can be reprocessed to recover unburned uranium and plutonium that can be fabricated into new reactor fuel. Since 1976, the U.S. nuclear cycle has been "once through," going from spent fuel to interim storage and then longer-term storage.

The spent fuel produced by a single 1,000-megawatt nuclear plant, over its 40-year lifetime, is equal to the energy in 130 million barrels of oil, or 37 million tons of coal, plus strategic metals and other valuable isotopes that could be retrieved from the high-level fission products. Other nuclear nations reprocess this resource.

forward with this program at anything approaching commercial scale."

The head of this small-thinking NAS committee, Robert W. Fri, happens to be the same person who headed President Gerald Ford's nuclear group in 1975, which made the decision to stop the reprocessing of spent fuel. (This nuclear group worked with Ford's chief-of-staff, Dick Cheney.) Ford lost the election, but Jimmy Carter, as President, then implemented the same Ford nuclear program and stopped U.S. spent-fuel reprocessing. This decision led to the accumulation of spent fuel in storage at nuclear plants, and thus created a perpetual "cause" for the anti-nuclear movement: "But what about the waste?"

Spent fuel from nuclear plants, it should be emphasized, is not "waste." About 97 percent of it can be recycled into new fuel, and the remaining 3 percent of actinides—high level radioactive elements—could also be "mined" to retrieve valuable isotopes for medical and industrial use. Until the decision of the Carter Administration, the United States, like other nuclear nations, routinely reprocessed spent fuel in a large industrial facility (the Savannah River Site in South Carolina), which worked well and did not have a security problem.

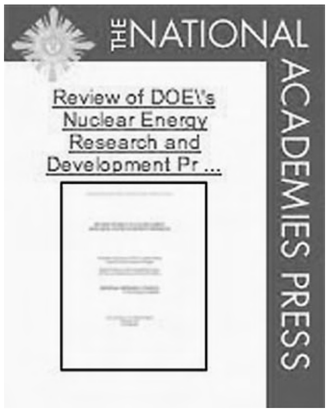
The NAS committee's report recommends that the DOE Office of Nuclear Energy put more emphasis on the department's Nuclear Power 2010 program, which is geared to facilitating the siting, design, and licensing of new nuclear power plants. It also supports more funding for the Generation IV program, which aims to put a next-generation nuclear plant in operation by 2017.[2]

These recommendations are good, as far as they go. Both programs need more funding to achieve their limited goals (compared to the need), and both programs should be accelerated. But the littleness of the DOE's vision is exceeded, not challenged, by the committee's report.

The Real Issue: American System Development

The real issue, not addressed by either the DOE or the NAS report, is the *mission* of the United States in the economic future of the world. The world needs 6,000 nuclear plants by the year 2050, in order to bring the entire world's population up to a decent standard of living, by ensuring an adequate supply of electricity.[3] To accomplish this requires American System thinking, like that successfully implemented by Alexander Hamilton and, more recently, by Franklin Roosevelt. This means low-interest credit for projects that will build needed infrastructure and benefit the economy.

Long-term nuclear development projects, 25-50 years, will *pay for themselves and more,* as the Apollo Program did, which returned $10-$14 to the economy for every dollar spent. The spinoffs, in terms of new technologies, an educated and employed workforce, and plentiful electricity, will allow the entire world economy to grow.



Imagine what an industrial boom we would have in this country, if we put our mind and resources to mass-producing nuclear plants (and mass-producing the facilities that could mass-produce reactors) for the world, at the same time training a future workforce in the necessary skills.

But this NAS committee, like most of today's decision-makers in industry, is fatally stuck in the post-Bretton Woods economic mode, even as the world financial system is imploding in front of its eyes. It bows to the market's "bottom-line," with its invisible hand that commands what will turn a "profit" in the shortest possible amount of time. This is *not* how this country was built and became an industrial giant.

The recommended incremental approach, taking step by tiny baby step, like the Achilles in Zeno's Paradox, never arrives at the destination. This kind of thinking is what killed the U.S. fusion program, and a host of other promising technologies that could have moved civilization forward.

Both the head of the DOE nuclear program and most of the members of the NAS committee, are without doubt "pronuclear." But some members of the committee, might most charitably be described as "anti-pronuclear," that is, technically qualified nuclear experts who in fact want to curb civilian nuclear energy, especially in the developing sector, and who use their technical expertise to have a seat at the table of policy-making bodies.

Closing the Nuclear Fuel Cycle

The U.S. civilian nuclear program, like others around the world, was established with the intention of recycling spent nuclear fuel. After all, that is what makes nuclear a truly *renewable* energy: Uranium fuel can be used to produce heat and electricity, and when it is "spent," it can be recycled into new reactor fuel. No other energy source can do that.

But, when reprocessing was stopped under the Carter Administration, in 1975-1976, the United States adopted a "once-through" nuclear fuel cycle, with all the attached political baggage. This once-through cycle was touted as being both cheaper, and non-proliferation friendly. If we don't reprocess, the Carter reasoning went, other nations will be encouraged not to reprocess.

Plans were made for a permanent burial place for the U.S. spent fuel that would accumulate, a site that, *billions* of dollars later, is still today in contention.

The GNEP program was announced in February 2006. In addition to its aim of policing the fuel cycles of other nuclear countries, GNEP set out to research and develop the recycling of spent fuel as an alternative to the once-through fuel cycle, but to do this *without* the separation of plutonium.

When spent fuel is reprocessed, the highly radioactive fission products (3 percent) are removed, and the fissionable uranium-235 (96 percent) and plutonium (1 percent) are separated for reuse. This plutonium could be directly used as fuel in breeder reactors, or mixed with uranium to make MOX, mixed oxide fuel for conventional reactors. (MOX, made from surplus weapons plutonium, has been used in 35

European reactors, and MOX is beginning to be used in the United States, with the Savannah River Facility designated as the production site.)

GNEP: It's All About Nonproliferation

GNEP, however, has set as a goal the development of a recycling process that will prevent any plutonium from being used. A second goal is to develop a breeder reactor whose fast neutrons would be used, not to make electricity, while at the same time breeding more reactor fuel,[4] but instead to "burn up" the highly radioactive fission products (3 percent of the spent fuel). Both of these GNEP goals are geared to develop commercial-scale facilities not for advancing nuclear technology in order to produce power more efficiently, but simply for preventing proliferation.

The NAS report does not question the aims of GNEP. It criticizes the timetable, saying that GNEP should not rush into developing a commercial facility for nuclear fuel recycling or an advanced sodium-cooled burner reactor; that it should instead continue research, and not select a particular technology yet. In particular, the NAS report states that GNEP should not skip the step of building an engineering-scale facility by moving directly into the commercial facility stage.

The NAS report outlines all the technical and political problems that remain for GNEP to solve, and concludes that delay is inevitable, so why not delay: "If and when technical progress justifies construction of a major facility, it is the very strong view of this committee that an engineering-scale facility is by far the safest, most effective, and least risky course.... [The committee believes that DOE should] commit to the construction of a major demonstration or facility only when there is a clear economic, national security, or environmental policy reason for doing so.... The committee is concerned that the plan to move rapidly to recycling and fast reactors has no economic basis."

What's missing here is any sense of mission or reality: What role will the United States play, as the rest of the world, led by Russia, India, and China intends to move forward—fast—with nuclear? Will we bury our heads in the sands of bureaucracy and continue to "study" and talk about the issue, as the NAS committee recommends? Will we inch along, inventing a new recycling process, and building a new facility based solely on an unproven and misguided goal of preventing proliferation? Neither GNEP nor the NAS has a solution befitting the nation that pioneered civilian nuclear technologies and, under the Atoms for Peace program, trained hundreds of nuclear engineers and scientists from around the world.

In short, if the United States doesn't wake up and make nuclear power the centerpiece of a domestic reindustrialization program, with a renewed mission to help the world industrialize, someday soon we will have to import both nuclear electricity and nuclear engineers, scientists, and technicians from other countries.

—Marjorie Mazel Hecht

Notes

1. "Review of DOE's Nuclear Energy Research and Development Program," National Research Council of the National Academy of Sciences, Oct. 29, 2007, 144 pp. Available online at www.nap.edu.
2. For more on the fourth-generation nuclear plants, see: Marsha Freeman, "Time for Next-Generation Nuclear Plants in the USA," and Marjorie Mazel Hecht, "Fourth-Generation Reactors Are Key to World's Nuclear Future," in this issue's Nuclear Report.
3. Massachusetts State Nuclear Engineer Jim Muckerheide discusses "How To Build 6,000 Nuclear Plants by 2050," and why we need them, in the Summer 2005 *21st Century Science & Technology*, available at www.21stcenturysciencetech.com/Articles%202005/Nuclear2050.pdf.
4. Breeder reactors, also called fast reactors, produce electricity *and* new nuclear fuel, and were considered to be an essential part of the Atoms for Peace nuclear development plans. In a conventional reactor, a moderator such as water, slows down the fast neutrons of the fission reaction to the optimal rate for maintaining a chain reaction. In the breeder reactor, these neutrons are not slowed down, but are caught in a "blanket" of uranium or thorium surrounding the reactor core. There, the neutrons produce new fissile material, such as plutonium-239. At the same time, the heat from the fission reactions in the core is used to produce electricity.

   The Russians have operated sodium-cooled fast reactors since 1958, including the prototype BN-350, which produced electricity and desalinated water from 1972 to 1999. They have an ambitious program for developing larger commercial fast reactors.