BEFORE THE

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ENERGY AND SCIENTIFIC RESEARCH, DEVELOPMENT, TECHNOLOGY DEPLOYMENT, EDUCATION AND TRAINING

Testimony
Of

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My name is Thomas B. Cochran. I am the director of the Nuclear Program and hold the Wade Greene Chair for Nuclear Policy at the Natural Resources Defense Council (NRDC). I am a member of the Department of Energy's (DOE's) Nuclear Energy Research Advisory Committee (NERAC), but I am testifying today on behalf of NRDC, not NERAC. I am a fellow of the American Physical Society and the American Association for the Advancement of Science. I received my Ph.D. in nuclear physics from Vanderbilt University, where I also did my Masters research thesis in radiation chemistry. I was an AEC Health Physics Fellow at Vanderbilt and spent one month training at a pilot nuclear fuel reprocessing plant at Oak Ridge National Laboratory. I am the author of *The Liquid Metal Fast Breeder Reactor: An Environmental and Economic Critique* and co-author of several books on nuclear weapons and the nuclear weapons programs of the United States and the Soviet Union/Russia.

I am pleased to be here today to testify about U.S. nuclear energy policy and proposals for funding research and development by the DOE' Office of Nuclear Energy. My testimony will focus on research and development of advanced fuel processing technologies and whether the United States should abandon its longstanding non-proliferation policy and promote the development and deployment of pyroprocessing and transmutation technologies. Let me begin with a few general observations.

Civilian nuclear activities have directly and indirectly contributed to the spread of nuclear weapons. India's first nuclear weapons test in 1974, for example, used plutonium produced in a Canadian-supplied research reactor using U.S.-supplied heavy water as a moderator, and the plutonium was separated in a reprocessing plant built from blueprints supplied by an American firm, Vitro International. This plant was nominally part of India's civilian breeder reactor research and development program. Between 1955 and 1974, Argonne and other DOE national laboratories trained some 1100 Indian scientists and engineers in nuclear fuel cycle technology, including techniques for plutonium separation. Some nations have established nominally civilian nuclear programs as a pretext to acquire technologies for military programs or have acquired materials, equipment, technologies or technical personnel from the civilian sector for their nuclear weapons programs. Israel's plutonium production reactor and reprocessing plant at Dimona were provided by France ostensibly for civilian purposes, but were actually used for military purposes.

Several non-weapon states have pursued nuclear weapons primarily through the plutonium production and reprocessing route. For example, Taiwan's covert nuclear weapons program was conducted under the cloak of its civilian nuclear program. Under intense pressure from the United States Taiwan's program was shut down in the 1970s, restarted in the 1980s, and shut down a second time under pressure by the United States. In the 1970s the United States had provided a small amount of plutonium to Taiwan for research purposes and some was fabricated into metal in what was claimed to be a civilian facility. Evidence strongly suggested that Taiwan planned to divert the plutonium from its safeguarded facility for weapons research. Subsequently, Taiwan provided assurances to the United States that it would not reprocess, dismantled its reprocessing research facility and sent the separated plutonium back to the United States. Similarly,

South Korea began a secret nuclear weapons program based on plutonium production and reprocessing. Under pressure from the United States South Korea agreed to end its program.

Unfortunately, the nuclear nonproliferation threat stemming from civilian nuclear power technologies is still alive today, as evidenced by Iran's pursuit of a nuclear weapons option by purchasing nuclear expertise and dual-use technology from Russia.

Because of the very real proliferation risks associated with the separation of plutonium by reprocessing, the United States government has long taken the position that it does not "encourage the civil use of plutonium and accordingly, does not itself engage in plutonium processing." The United States has also recognized as far back as the Ford Administration that the closed nuclear fuel cycle with reprocessing and plutonium separation and recycling, is uneconomical and presents unacceptable proliferation risks. In fact it was the Ford Administration, not the Carter Administration, which stopped commercial reprocessing in the United States by refusing to subsidize the completion of the Barnwell reprocessing plant in South Carolina. For existing light water reactors the closed fuel cycle has been, continues to be, and in the foreseeable future is projected to be more expensive than "once-through" utilization followed by direct disposal of spent fuel.

Unfortunately, while the United States has actively sought to limit reprocessing in some regions of proliferation concern, it regrettably has taken the position that it will "honor its existing commitments regarding the use of plutonium in civil nuclear programs in Western Europe and Japan,"[1] thus establishing an unworkable double standard in dealing with global nuclear weapons proliferation and leading to the stockpiling of huge quantities of weapon-usable plutonium in Western Europe and Japan.

Large reprocessing plants, plutonium stockpiles and advanced research on new fuel processing technologies in non-weapon states provide an ideal cover for nascent nuclear weapon states to pursue a nuclear weapons option while claiming their programs are entirely for peaceful purposes. Advanced reprocessing research, even in weapon states, provides the necessary justification for nascent nuclear weapon states to pursue similar research ostensibly for peaceful purposes. It is primarily for these reasons that NRDC believes the better course is to oppose all commercial use of nuclear weapon-usable materials, including separated plutonium and highly enriched uranium, and oppose the research, development and commercialization of nuclear fuel reprocessing technologies.

The Bush Administration's National Energy Policy has recommended that "the United States should reexamine its policies to allow for research, development and deployment of fuel conditioning methods [i.e., reprocessing] (such as pyroprocessing) that reduce waste streams and enhance proliferation resistance," and "[t]he United States should also consider technologies, in collaboration with international partners with highly developed fuel cycles and a record of close cooperation, to develop reprocessing and fuel treatment technologies that are cleaner, more efficient, less waste intensive, and more proliferation resistant." Some of the legislative proposals being considered by the Senate are designed

[1] White House National Policy Statement of September 1993.

to implement the Bush Administration proposal. In my view implementation of the Bush plan and these legislative proposals would be a grave mistake. Let me explain why.

First, as noted above, reprocessing light water reactor spent fuel is uneconomical today and will remain so for the foreseeable future. The issue then is whether there are new reactor concepts using new fuel cycles that are cheaper and more proliferation resistant than the light water reactor once-through fuel cycle. The simple answer is that **there are no known fuel cycles that are cheaper, and no known fuel cycles that rely on reprocessing that are more proliferation resistant, than the once through fuel cycle.** In fact, neither pyroprocessing nor any other reprocessing scheme proposed to date is cleaner, less waste-intensive or more proliferation-resistant than the once-through fuel cycle, i.e., direct disposal of spent fuel, the practice planned for use in the United States today.

Why is there so much interest in pyroprocessing in the United States? Pyroprocessing is an outgrowth of the failed Liquid Metal Fast Breeder Reactor (LMFBR) program. After the Clinch River Breeder Reactor Demonstration Reactor was cancelled in 1983 in response to criticisms that the Liquid Metal Fast Breeder Reactor fuel cycle would have produced huge quantities of separated plutonium and posed a significant proliferation risk, Argonne National Laboratory began promoting the Integral Fast Reactor (IFR) concept. The IFR concept relied on pyroprocessing, an electro-refining technique, instead of aqueous reprocessing, the traditional method for separating plutonium from spent fuel. Also the IFR concept envisioned that a pyroprocessing facility would be located at each fast reactor site. The IFR concept, like its LMFBR predecessor is grossly uneconomical. When IFR R&D was terminated, the proponents of pyroprocessing used the excuse that this was the best methodology for processing and disposing of EBR-II spent fuel. Now that this program has run its course Argonne and Argonne-West are seeking additional Congressional funding to preserve their program by suggesting that pyroprocessing R&D could be continued for some illusory “proliferation-resistance” benefit.

The claim that pyroprocessing is “proliferation resistant” is misleading. Pyroprocessing is not more proliferation resistant than the once-through fuel cycle in use today. It is more proliferation resistant than aqueous reprocessing, which we abandoned more than 20 years ago because it was uneconomical and because it carried a high proliferation risk. Pyroprocessing appears less risky than aqueous reprocessing because the plutonium is not completely separated from other radioactive actinides and therefore an additional processing step is needed to obtain weapon-usable plutonium. This would make it very difficult for terrorists to steal the plutonium from the IFR fuel cycle. However, the most serious nonproliferation threat associated with reprocessing technologies is not the terrorist threat, but the so-called “state threat.” The IFR concept and the pyroprocessing technique offer little in the way of reducing this threat. If pyroprocessing facilities are located in non-weapon states, these states will have cadres of experts trained in plutonium chemistry and metallurgy along with hot cells and other facilities that can be readily used for the recovery of plutonium for weapons. In this regard pyroprocessing cannot meet the so-called “timely warning” international safeguards criterion.

In one respect pyroprocessing is actually worse than aqueous reprocessing in terms of their respective proliferation risks. Pyroprocessing involves access to technologies for working with plutonium in metallic form, the form most often used for weapons.

What is more, engaging in pyroprocessing research now will encourage or provide an excuse for non-weapons states to do the same, thus giving these states yet another avenue to get close to a weapon option without declaring their true intention. No one would want to see Iran engaging in pyroprocessing research associated with the Bushehr reactor now under construction.

Another problem with pyroprocessing is that there are no known fuel cycles that rely on pyroprocessing that show any promise of being economical in the foreseeable future. For the United States to pursue an expensive pyroprocessing R&D effort at this stage is simply a waste of the taxpayers money.

In sum, pyroprocessing R&D is a waste of money and an unnecessary proliferation risk. It is being promoted by entrenched interests that have lived off the taxpayer for decades and are now engaged in a last ditch effort to preserve their existence without substantive justification.

I now wish to turn to the issue of accelerator transmutation of [nuclear] waste (ATW). This program has been combined with accelerator production of tritium, a proposal to develop a backup method for producing tritium, under a budget category called "Advanced Accelerator Applications." The argument for transmutation of waste is that by reprocessing spent fuel, separating out selected isotopes and transmute these isotopes with accelerators and/or fast reactors, the long-term health effects from radioactivity released from a geologic repository can be reduced and the uncertainty in the long-term dose assessment would also be reduced. The proposal sounds worthy in theory, but in terms of practicality it is a ridiculous proposal. First, to have any significant impact on the first geologic repository, all the existing spent fuel would have to be reprocessed. This is such an extremely expensive proposition that it simply not credible. DOE estimated the life-cycle cost of the ATW program at approximately $280 billion![2]

There are about 40,000 tonnes of power reactor spent fuel spent fuel in storage in the United States. Over the future lifetime of existing reactors another 40,000 tonnes or so will be generated. Even if only the future waste were transmuted, the theoretical impact at the geologic repository—at Yucca Mountain if it is licensed—would be to reduce the long-term dose from those isotopes transmuted only by about one-half. It is ridiculous to suggest that we should spend hundreds of billions of dollars today to reduce the radiation dose to people living tens to hundreds of thousands of years from now by a factor of two or less.

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[2] DOE, "A Roadmap for Developing Accelerator Transmutation of Waste (ATW) Technology," October 1999, p. E-2.

It the arguments get even worse. There is not a shred of evidence in any of the ATW proposals that the collective dose reductions associated with the geologic repository, assuming ATW is implemented, will be less than the collective dose from operating the reprocessing facilities and the transmutation facilities. In fact everything we know about these facilities today suggests the opposite—ATW would result in a higher collective radiation dose to people than they would receive if ATW were not implemented. We should not spend hundreds of billions of dollars to give more people cancer. Finally, ATW provides yet another cover for non-weapon states to engage in reprocessing and the study of plutonium and actinide chemistry and metallurgy. It is a serious proliferation risk.

With regard to backup tritium production, this apparently is not a request coming from the Administration. Rather, this request comes from a Los Alamos accelerator group that lost a bid to produce tritium for weapons when the Administration decided to qualify TVA reactors for this purpose in the event that the pace of nuclear arms reductions lags behind the decay curve of tritium. If the United States needs a second backup method for tritium production, we should use another reactor alternative. Reactors have reliably produced tritium for weapons for 40 years.

The NRDC does not object to continued support of university nuclear research programs, the DOE Nuclear Energy Research Initiative (NERI), and the study of Generation IV reactor/fuel cycle technologies. Research on advanced fuel cycle technologies should be limited to paper studies until there is clear evidence that the new technology is cheaper, inherently safe, and more proliferation resistant than the LWR operating on a once-through fuel cycle. At this time Congress should reject any legislative proposals to fund pyroprocessing or ATW R&D beyond such paper studies.

Comments on Specific Legislative Proposals before the 107th Congress, 1st Session

S193 Department of Energy Advanced Scientific Computing Act. (Bingaman, et al.)
The Department of Energy is already subsidizing the supercomputer industry through the Accelerated Strategic Computing Initiative (ASCI) program to the tune of some $5.2 billion for fiscal years 1992-2004. It should be made clear that funding under S193 should be for non-defense work, i.e., other than ASCI and other National Nuclear Security Administration (NNSA) activities, and that it should be accommodated by drawing down the ASCI weapons computing program to a more sensible level of funding. GAO has demonstrated in several reports that DOE is able to effectively utilize only a fraction of the new computing capacity it is rushing to install.

S.242 Department of Energy University Nuclear Science and Engineering Act. (Bingaman, et al.)
I concur that university nuclear science departments are on the decline. Because of the wide range of nuclear activities in the United States, including environmental cleanup of sites contaminated by radioactivity, nuclear medicine and nuclear related national security programs, as a general matter university nuclear programs could benefit from federal support. Due to the lack of U.S. student interest in nuclear engineering, U.S.

nuclear engineering departments are increasingly relying on foreign students to fill the student ranks in these departments. The Congress may wish to consider restrictions on nuclear training of foreign nationals, particularly in cases where the students are from countries that do not share U.S. nonproliferation policies and objectives. Consequently, I recommend that the undergraduate and graduate fellowships and faculty grants under this proposed legislation be limited to the support of U.S. citizens.

S.259 National Laboratories Partnership Improvement Act of 2001. (Bingaman, et al.)

This legislative proposal should be rejected in that it is an unwarranted subsidy for small businesses that meets vague criteria, e.g., work that can "support the missions of the National Laboratories or facilities," or encourage "the exchange of scientific or technological expertise."

S. 388 National Energy Security Act of 2001. (Murkowski, et al.)

SEC. 106. Nuclear Generation Study

An NRC report on the state of nuclear power would be useful. As a regulatory agency NRC at least should maintain the semblance of independence and not take positions for or against the relicensing of nuclear power plants.

SEC. 107. Development of a National Spent Nuclear Fuel Strategy and Establishment of an Office of Spent Nuclear Fuel Research.

This legislative proposal should be rejected. To a large extent this proposal is an unnecessary duplication of the work of the DOE Office of Civilian Radioactive Waste Management. There is no evidence that reprocessing of spent fuel is economical so there is no merit to this aspect of the proposed activities. Moreover, establishment of this office and carrying out recycle research activities would be counter to the nonproliferation interest of the United States for reasons given in my general comments above.

SEC. 410. Nuclear Energy Research Initiative.

The NERI program of the department is a good program and deserves the support of the Congress

SEC. 411 Nuclear Energy Plant Optimization Program

Plant optimization is in the interest of the nuclear industry. Congress should not subsidize a mature industry to do what is in their economic interest to do without federal subsidization.

SEC. 412 Nuclear Energy Technology Development Program

A roadmap to design and develop a new energy facility is premature. There is nothing coming out of the NERI studies or GEN IV programs that is commercially attractive and justifies federal support at this time.

SEC. 420 Nuclear Energy Production Initiatives

Congress should not subsidize a mature industry to do what is in their economic interest to do without federal subsidization.

SEC. 830 Emission Free Control Measures Under at State Implementation Plan

Sec. 830 offers unwarranted federal subsidies to nuclear power plant operators in the form of emission credits, since the facilities do not emit air pollution causing acid rain (sulfur dioxide), ozone smog (nitrogen oxide), or mercury, as do many fossil fuel-fired

power plants. Under the Clean Air Act, fossil fuel-fired power plants are offered economic incentives to adopt the most efficient pollution control measures available for sulfur dioxide and nitrogen oxide emissions by requiring operators to have emission allowances equal to the amount of pollution emitted at each fossil fuel-fired power plant. This section would undermine the reductions in acid rain and ozone smog pollution achieved under these Clean Air Act programs at fossil fuel-fired power plants by giving nuclear power plant operators emission allowances that would flood the market, significantly lower the value of banked allowances and discourage continued investment in pollution control measures at fossil fuel-fired power plants. This is an unjustified and damaging federal subsidy.

S. 472 Nuclear Energy Electricity Supply Assurance Act of 2001. (Domenici, et al.)
Title I—Support for Continued Use of Nuclear Energy
Subtitle A—Price Anderson Amendments
The Price Anderson Act should not be renewed. This is an unwarranted federal subsidy to a mature industry. Moreover, the industry and its supporters cannot have it both ways. They cannot claim nuclear reactors are safe, and that Generation IV reactors will be even safer, and then claim that Price Anderson is necessary. Asserting a requirement for Price Anderson coverage of supposedly "inherently safer" Generation IV reactors is disingenuous and unwarranted. The single criterion that will do most to insure that Generation IV designs are safe is for the Congress to explicitly exclude any Price Anderson coverage of new nuclear power plants.
Subtitle C—Funding of Certain Department of Energy Programs
SEC. 122. Nuclear Energy Research Initiative.
The NERI program of the department is a good program and deserves the support of the Congress.
SEC. 123 Nuclear Energy Plant Optimization Program
Plant optimization is in the interest of the nuclear industry. Congress should not subsidize a mature industry to do what is in their economic interest to do without federal subsidization.
SEC. 124 Uprating of Nuclear Plant Operations
Whether to increase the power at a nuclear power plant is a decision to be made by the plant owner and the Nuclear Regulatory Commission. Congress should not by subsidizing a mature industry to do this.
SEC. 125 University Programs
See comments under S.242 Department of Energy University Nuclear Science and Engineering Act. (Bingaman, et al.) above.
SEC. 126 Prohibition of Commercial Sales of Uranium and Conversion Held by the Department of Energy Until 2006
This legislative proposal should be supported so as not to jeopardize the HEU Purchase agreement with Russia.
SEC. 127 Cooperative Research and Development and Special Demonstration Projects for the Uranium Mining Industry
This appears to be a sweet heart deal for Rio Algom and possibly other uranium mining companies. Congress should not by subsidizing the uranium mining industry which has been in business in the United States for more than 50 years.

SEC. 128 Maintenance of a Viable Domestic Uranium Conversion Industry

This appears to be a sweet heart deal for Converdyn, owned by Honeywell and General Atomics, to make them more profitable. General Atomics has been surviving off of this type of special interest legislation for 30 years. Congress should not by subsidizing General Atomics or the uranium conversion industry, a mature industry.

SEC. 129 Portsmouth Gaseous Diffusion Plant

First Congress privatized the domestic uranium enrichment industry and is now stepping in to subsidize the maintenance of the Portsmouth gaseous diffusion plant. This has more to do with job security than nuclear energy security.

SEC. 130 Nuclear Generation Report

An NRC report on the state of nuclear power would be useful.

Title II—Construction of New Nuclear Power Plants

SEC. 203 Early Site Permit Demonstration Program

This is an unwarranted federal subsidy of the nuclear industry, a mature industry

SEC. 204 Nuclear Energy Technology Study for Generation IV Reactors

The Generation IV studies deserve support. The primary goal s should be to identify reactor concepts that are economically competitive, inherently safe and more proliferation resistant than light water reactors operation on a once through fuel cycle. The following goals should be deleted:

(3) substantially reduce the production of high-level waste, …;
(5) sustainable energy generation …
(6), substantially improve thermal efficiency …

These goals will generally conflict with, the goals related to economics, safety and proliferation resistance, and have no independent utility

Title III – Evaluations of Nuclear Energy

SEC. 302 offers unwarranted federal subsidies to nuclear power plant operators in the form of emission credits, since the facilities do not emit air pollution causing acid rain (sulfur dioxide), ozone smog (nitrogen oxide), or mercury as do many fossil fuel-fired power plants. Under the Clean Air Act, fossil fuel-fired power plants are offered economic incentives to adopt the most efficient pollution control measures available for sulfur dioxide and nitrogen oxide emissions by requiring operators to have emission allowances equal to the amount of pollution emitted at each fossil fuel-fired power plant. This section would undermine the reductions in acid rain and ozone smog pollution achieved under these Clean Air Act programs at fossil fuel-fired power plants by giving nuclear power plant operators emission allowances that would flood the market, significantly lower the value of banked allowances and discourage continued investment in pollution control measures at fossil fuel-fired power plants. This is an unjustified and damaging federal subsidy.

Title IV—Development of National Spent Fuel Strategy

This legislative proposal should be rejected. To a large extent this proposal is an unnecessary duplication of the work of the DOE Office of Civilian Radioactive Waste Management. There is no evidence that reprocessing of spent fuel is economical so there is no merit to this aspect of the proposed activities. Moreover, establishment of this office and carrying out advanced fuel recycle research activities would be counter to the nonproliferation interest of the United States for reasons given in my general comments above.

Title V—National Accelerator Site
There is no redeeming social merit to this legislative proposal for reasons given under my general remarks above.

S. 597 Comprehensive and Balanced Energy Policy Act of 2001. (Bingaman, et al.)
Title XIV—Research and Development Programs
SEC. 1405. Enhanced Nuclear Energy Research and Development
The goals are very general authorization of appropriations lacks specificity. With respect to the goals see comments under S. 472 Nuclear Energy Electricity Supply Assurance Act of 2001. (Domenici, et al.), Sec. 204 Nuclear Energy Technology Study for Generation IV Reactors, above.