Health, Education, Labor, and Pensions.

STEM CELL RESEARCH ACT OF 2000

Mr. SPECTER. Mr. President, I have sought recognition to send to the desk, on behalf of Senator HARKIN and myself, a bill captioned the ''Stem Cell Research Act of 2000.'' It is being introduced after a series of four hearings, which have been conducted in the Appropriations Subcommittee on Labor, Health, Human Services, and Education, which I chair and on which Senator HARKIN is the ranking Democrat.

The subject has been a very important one because approximately 15 months ago, there were disclosures about stem cell research which provided an opportunity for a veritable fountain of youth. The scientific discoveries have found that from the stem cells, new cells may be created which have the potential to cure a great many severe maladies. For example, on Parkinson's disease, stem cells are enormously helpful. There is potential for cures on Alzheimer's, on heart ailments, and really on the whole range of human ailments, illnesses, and diseases.

There has been a limiting factor on the use of stem cells because of a provision, which was inserted many years ago into the appropriations bill for our subcommittee, which limits Federal funding on research relating to stem cells.

The Department of Health and Human Services has handed down a ruling which would permit federal scientists to conduct research on stem cells that have been derived by private sources.

The concern has been that the human embryo, subjected to scientific research, would potentially destroy life. The fact is that the only human embryos which are used as a basis for stem cell research are human embryos from discarded in vitro fertilization clinics. It is not a matter of using a human embryo which has the potentiality for life to extract the stem cells because these are embryos which have been discarded.

Notwithstanding the legal opinion handed down by the general counsel of the Department of Health and Human Services, it is our view that there are still undue restrictions on scientific research from existing law. That is why this legislation has been introduced. It will eliminate the ban on the use of Federal funding for the research on stem cells.

There are a number of very important restrictions.

First, the research would not apply to the creation of human embryos for research purposes.

Second, the research would not result in the cloning of a human being.

Third, it would be unlawful for any person receiving Federal funds to knowingly acquire, receive, or transfer any human embryos for valuable consideration, even if the transfer affected interstate commerce.

These limitations have been engrafted into the legislation to be sure this kind of inappropriate conduct is being prohibited.

The legal opinion issued by the Department of Health and Human Services covers the statutory prohibition on the use of funds, stating that human embryo research would not apply to research utilizing human pluripotent stem cells because such stem cells do not constitute a human embryo. However, applying the Federal funding solely to pluripotent stem cells is not sufficient because there ought to be an opportunity for broader research, as I have suggested.

The controversy on stem cell research is very similar to the controversy which had existed on prohibiting research on fetal tissue when many people advanced the argument that it would induce abortions to secure fetal tissue. It soon became readily apparent that the research on fetal tissue was from discarded fetal tissue and that, in fact, there would not be an inducement of abortions to produce fetal tissue for research purposes. That is very similar, almost identical, except for what is involved with the issue of human embryos. Human embryos which will not be used for research for stem cells where there is any possibility that they might produce life and may be used only from discarded embryos, similarly to the discarded fetal tissue.

When the appropriations bill was considered last fall, a provision was inserted into the committee report which would eliminate the prohibition of use of funds for research on stem cells. When it became apparent that this provision would likely stall the progress of the appropriations bill, an agreement was reached to remove that provision in committee before the bill got to the floor under an arrangement with our distinguished majority leader, Senator LOTT, who agreed to bring up the legislation as a freestanding bill. That is the legislation Senator HARKIN and I are introducing today.

We intend to have an additional hearing within the next several weeks so that the stage will be set by late February or early March to proceed with the schedule of this bill as a freestanding measure and so that the Senate may vote up or down and the House of Representatives may ultimately have an opportunity to vote as well.

Over the past 14 months, the Labor, Health and Human Services and Education Subcommittee which I chair, held four hearings, the latest on November 4, 1999, to discuss the advances in stem cell research made by two research teams. One team, led by Dr. James Thompson at the University of Wisconsin, and the other headed by Dr. John Gearhart at Johns Hopkins University. Stem cell research is one area that holds particular promise for the development of future medical treatment and cures. Stem cells originating in an embryo have the unique ability, for a very limited period of time, to become any cell type of the body. This power, if harnessed by science, could lead to replacement therapies for failing cells, for example, or lead to organ tissues that could be implanted into a patient. Scientists are just beginning preliminary research into the potential practical applications of this line of work. At a Senate hearing convened by my subcommittee on December 2, 1998, Dr. Gearhart testified that he has been able to induce some stem cells to grow into nerve cells. Other scientists also stated that cures for Parkinson's, Alzheimer's, heart disease, diabetes, and other diseases and illnesses that plague mankind could be greatly accelerated by stem cell research. Some scientists, for example, believe that stem cell research could lead to tangible benefits to Parkinson's Disease patients in as soon as 7 to 10 years.

What has been delaying the advancement of this new line of research is a provision in the Labor-HHS appropriations bill that prohibits research on human embryos. On January 15, 1999, the Department of Health and Human Services issued a legal opinion finding that the statutory prohibition of the use of funds appropriated to HHS for human embryo research would not apply to research utilizing human pluripotent stem cells because such cells do not constitute a human embryo. But even this limited use of stem cells may be blocked by those who misunderstand its purpose. According to Dr. Harold Varmus, the former head of the National Institutes of Health, research on stem cells is not the same as research on human embryos. Stem cells do not have the capacity to develop into a human being.

While I applaud the HHS ruling, I do not believe that it goes far enough. To achieve the greatest and swiftest benefits, Federal researchers need their own supply of stem cells. Therefore, I am proposing this legislation to enable Federally-funded researchers to derive their own stem cells from spare embryos obtained from in vitro fertilization clinics. Allowing scientists to conduct human stem cell research would greatly accelerate advances in many avenues of study and, in collaboration with private industry, expedite the production and availability of new drugs and treatments. Enacting such legislation would clarify the boundaries governing Federally-funded researchers and make clear the commitment of this Congress to biomedical research.

Let me review the key provisions of this bill:

It would amend the Public Health Service Act and give permanent authority to the Secretary of Health and

Human Services to conduct, support, or fund research on human embryos only for the purpose of generating stem cells. Human embryonic stem cells may be derived and used in research only from embryos that would otherwise be discarded and donated by in vitro fertilization clinics and only with the written informed consent of the donors.

The Secretary shall issue guidelines governing human stem cell research, including definitions and terms used in such research.

All Federal research protocols and consent forms involving human pluripotent stem cell research shall be reviewed and approved by an institutional review board.

The Secretary shall annually submit to the Congress a report describing the activities carried out under this section during the preceding fiscal year, including whether and to what extent research has been conducted in accordance with this purpose.

The following restrictions would apply:

(A) The research shall not result in the creation of human embryos for research purposes.

(B) The research shall not result in the cloning of a human being.

(C) It shall be unlawful for any person receiving Federal funds to knowingly acquire, receive, or transfer any human embryos for valuable consideration if the transfer affects interstate commerce.

We have heard very compelling testimony from many individuals who are hoping for treatments and cures from stem cell research. One individual, Mr. Richard Pikunis of Malvern, New Jersey, a 27 year-old stricken with Parkinson's Disease, told the Subcommittee how the disease has affected every facet of his young life—from law school graduation to the birth of his son. Dr. Douglas Melton, a prominent professor at Harvard, told of the struggles of his son afflicted with juvenile diabetes. We also heard from Michael J. Fox, who implored us to do more for people with Parkinson's disease. Mr. Fox told of his daily medication routine and progressing physical and mental exhaustion. He asked for the Subcommittee's help to eradicate the disease so that he could dance at his children's weddings. Mr. Fox has just recently announced that he is leaving his popular television series to devote more time to his family and to advocate for more research on finding a cure for Parkinson's disease.

Mr. President, these are just a few of the voices pleading with us to allow this research to move ahead. While stem cell research does not guarantee that a cure will be found, without it the opportunity to halt their suffering may be denied then. The enactment of this legislation as soon as possible could give thousands of individuals a chance to see a cure within their lifetime.

Mr. President, I ask unanimous consent that the bill be printed in the RECORD.

There being no objection, the bill was ordered to be printed in the RECORD, as follows:

S. 2015

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the ''Stem Cell Research Act of 2000''.

SEC. 2. RESEARCH ON HUMAN EMBRYONIC STEM CELLS.

Part G of the Title IV of the Public Health Service Act (42 U.S.C. 288 et seq.) is amended by inserting after section 498B the following:

''SEC. 498C. RESEARCH ON HUMAN EMBRYONIC STEM CELLS.

''(a) IN GENERAL.—Notwithstanding any other provision of law, the Secretary may only conduct, support, or fund research on, or utilizing, human embryos for the purpose of generating embryonic stem cells in accordance with this section.

''(b) SOURCES OF EMBRYONIC CELLS.—For purposes of carrying out research under paragraph (1), the human embryonic stem cells involved shall be derived only from embryos that otherwise would be discarded that have been donated from in-vitro fertilization clinics with the written informed consent of the progenitors.

''(c) RESTRICTIONS.—

''(1) IN GENERAL.—The following restriction shall apply with respect to human embryonic stem cell research conducted or supported under subsection (a):

''(A) The research involved shall not result in the creation of human embryos.

''(B) The research involved shall not result in the reproductive cloning of a human being.

''(2) PROHIBITION.—

''(A) IN GENERAL.—It shall be unlawful for any person receiving Federal funds to knowingly acquire, receive, or otherwise transfer any human gametes or human embryos for valuable consideration if the acquisition, receipt, or transfer affects interstate commerce.

''(B) DEFINITION.—In subparagraph (A), the term 'valuable consideration' does not include reasonable payments associated with transportation, transplantation, processing, preservation, quality control, or storage.

''(d) GUIDELINES.—

''(1) IN GENERAL.—The Secretary, in conjunction with the Director of the National Institutes of Health, shall issue guidelines governing human embryonic stem cell research under this section, including the definitions and terms used for purposes of such research.

''(2) REQUIREMENTS.—The guidelines issued under paragraph (1) shall ensure that—

''(A) all Federal research protocols and consent forms involving human embryonic stem cell research must be reviewed and approved by an institutional review board; and

''(B) the institutional review board is empowered to make a determination as to whether or not the proposed research is in accordance with National Institutes of Health Guidelines for Research Involving Human Pluripotent Stem Cells.

''(e) REPORTING REQUIREMENTS..—Not later than January 1 2001, and each January 1 thereafter, the Secretary shall prepare and submit to the appropriate committees of Congress a report describing the activities carried out under this section during the preceding fiscal year, and including a description of whether and to what extent research under subsection (a) has been conducted in accordance with this section.''.

Mr. HARKIN. Mr. President, I am pleased to join my distinguished colleague, Senator SPECTER, in the introduction of the ''Stem Cell Research Act of 2000.'' I want to commend Senator SPECTER for having the leadership and foresight to introduce legislation which will broaden federally-funded scientists to pursue stem cell research, under certain, limited conditions.

From enabling the development of cell and tissue transplantation, to improving and accelerating pharmaceutical research and development, to increasing our understanding of human development and cancer biology, the potential benefits of stem cell research are truly awe-inspiring.

Stem cells hold hope for countless patients through potentially lifesaving therapies for Parkinson's, Alzheimers, stroke, heart disease and diabetes. Also exciting is the possibility that researchers may be able to alter stem cells genetically so they would avoid attack by the patient's immune system.

But all of these potential benefits could be delayed or even denied to patients without a healthy partnership between the private sector and the federal government.

While market interest in stem cell technology is strong, and private companies will continue to fund this research, the government has an important role to play in supporting the basic and applied science that underpins these technologies. The problem is that early, basic science is always going to be underfunded by the private sector because this type of research does not get products onto the market quickly enough. The only way to ensure that this research is conducted is to allow the NIH to support it.

The Department of Health and Human Services ruled last year that under the current ban on human embryo research, federally-funded scientists can conduct stem cell research if they use cell lines derived from private sources. This is a positive step forward, but it continues to handicap our researchers in the pursuit of cures and therapies that will help our citizens,

Last fall, the National Bioethics Advisory Commission (NBAC) released its final report, ''Ethical Issues in Human Stem Cell Research.'' The Commission concluded that stem cell research should be allowed to go forward with federal support, as long as researchers were limited to only two sources of stem cells: fetal tissue and embryos resulting from infertility treatments. And they recommended that federal support be contingent on an open system of oversight and review.

NBAC also arrived at the important conclusion that it is ethically acceptable for the federal government to finance research that both derives cell lines from embryos and that uses those cell lines. Their report states, ''Relying on cell lines that might be derived exclusively by a subset of privately funded researchers who are interested in this area could severely limit scientific and clinical progress.''

The Commission goes on to say that ''scientists who conduct basic research and are interested in fundamental cellular processes are likely to make elemental discoveries about the nature of ES [embryonic stem] cells as they derive them in the laboratory.''

NBAC's report presents reasonable guidelines for federal policy. Our bill bans human embryo research, but allows federally-funded scientists to derive human pluripotent stem cells from human embryos if those embryos are obtained from IVF clinics, if the donor has provided informed consent and the embryo was no longer needed for fertility treatments. The American Society of Cell Biology estimates that 100,000 human embryos are currently frozen in IVF clinics, in excess of their clinical need.

In addition, our language requires HHS and NIH to develop procedural and ethical guidelines to make sure that stem cell research is conducted in an ethical, sound manner. As it stands today, stem cell research in the private sector is not subject to federal monitoring or ethical requirements.

Stem cell research holds such hope, such potential for millions of Americans who are sick and in pain, it is morally wrong for us to prevent or delay our world-class scientists from building on the progress that has been made.

As long as this research is conducted in an ethically validated manner, it should be allowed to go forward, and it should receive federal support. That is why Senator SPECTER and I have joined together on legislation that will allow our nation's top scientists to pursue critical cures and therapies for the diseases and chronic conditions which strike too many Americans. I urge my Senate colleagues to join us in supporting this bill.

By Mr. DOMENICI:

S. 2016. A bill to authorize appropriations for, and to improve the operation of, the Nuclear Regulatory Commission, and for other purposes; to the Committee on Environment and Public Works.

THE NUCLEAR REGULATORY COMMISSION AUTHORIZATION AND IMPROVEMENTS ACT OF 2000

Mr. DOMENICI. Mr. President, I rise today to introduce legislation important to the energy security of our country. This legislation entitled the ''Nuclear Regulatory Commission Authorization and Improvements Act of 2000'' not only includes provisions authorizing the annual funding for the Nuclear Regulatory Commission (NRC), but makes essential amendments to the Atomic Energy Act of 1954.

Mr. President, the legislation I am introducing today will assist the NRC in its efforts to achieve greater efficiencies and eliminate outdated restrictions within our nuclear energy sector. As mentioned, this legislation includes several amendments to the Atomic Energy Act, including the following:

Eliminating provisions in current law that preclude any foreign ownership of power and research reactors located in the United States. These outdated provisions are a significant obstacle to foreign investment or participation in the U.S. nuclear power industry and its restructuring. No valid reasons exist to prohibit investors from countries such as the United Kingdom from participating in the ownership of nuclear plants in this country. The provisions in current law that protect U.S. security interests are unchanged by my legislation.

Eliminationg the current statutory requirement that the NRC conduct an antitrust review in connection with licensing actions. Other federal agencies already have comprehensive responsibility to enforce antitrust laws affecting electric utilities. Requiring the NRC to do independent antitrust evaluations for licensing actions is redundant, time-consuming and unnecessary.

Simplifying the hearing requirements in a proceeding involving an amendment to an existing operating license, or the transfer of an existing operating license. The amendment provides that the Commission should not use formal adjudicatory procedures in such cases, but rather should comply with the informal rulemaking requirements contained in the Administrative Procedure Act.

Giving the NRC the authority to establish such requirements it deems necessary to ensure that non-licenses fully comply with their obligations to provide funding for nuclear plant decommissioning. This includes jurisdiction over non-licensees, i.e., those who have transferred their license but retain responsibility for decommissioning.

The proposed package also includes legislative provisions sought by the NRC. The foreign ownership and antitrust review changes just mentioned were included in the NRC's legislative proposals last year. Other provisions requested by the NRC should serve to enhance nuclear safety and physical security, increase efficiency, and enhance the economic use of Commission resources.

These changes are necessary to ensure that nuclear energy remains part of our nation's energy portfolio. Nuclear energy is a vital ingredient for providing U.S. base load capacity based on economic, environmental and electricity needs.

Mr. President, I am sure everyone is aware of my strong commitment to nuclear energy. This conviction is well-founded. One need only consider a few simple facts to find justification for my position.

Ensuring diversity and reliability in our nation's future energy portfolio is a critical national security concern. As just one example, our increasing dependence on imported fossil fuel is a cause for concern. Last year oil imports accounted for 54% of U.S. oil consumption. This dependence could create a national security crisis. This dependence may also contribute to an environmental crisis.

Similarly, although we continue to invest in renewable energy resources, the hard facts demonstrate that renewables alone cannot obtain sufficient energy generation to meet future needs.

An article by Richard Rhodes and Denis Beller in the most recent edition of Foreign Affairs argues the case for nuclear energy in detail. Mr. President, allow me briefly to review some facts found in this article that address some very important questions. These repeat the same points I made in a speech at Harvard in October of 1997 and have made many times since.

First, what estimated energy demands will the world face?

A 1999 report by the British Royal Society and Royal Academy of Engineering estimates that the consumption of energy will at least double in the next 50 years and grow by a factor of up to five in the next century.

The OECD projects 65% growth in world energy demand by 2020.

How can nuclear energy play a role in meeting future energy needs?

The anti-nuclear groups are dead wrong. Nuclear power is neither dead nor dying. France generates 79 percent of its electricity with nuclear power; Belgium, 60 percent; Sweden, 42 percent; Japan 34 percent; and the United States, 20 percent. The United States remains the largest producer of nuclear energy in the world, and the U.S. nuclear industry generated nine percent more nuclear electricity in 1999 than 1998. In order to sustain economic growth, China has plans for as many as 100 nuclear power plants, and South Korea will more than double its capacity by building 16 new plants.

Nuclear power's advantage is the ability to generate a vast amount of energy from a minute quantity of fuel. For example, whereas one kilogram of firewood can produce one kilowatt-hour of electricity and the ratio for oil is one-to-four, one kilogram of uranium fuel in a modern light-water reactor generates 400,000 kilowatts of electricity, even without recycling.

Nuclear safety and efficiency have improved dramatically in the last decade. For example, the average U.S. capacity factor in 1998 was 80 percent, compared to 58 percent in 1980 and 66 percent in 1990. The average production costs for nuclear energy are now at just under two cents per kilowatt-hour, while electricity produced from gas costs almost three and a half cents per kilowatt-hour. Most importantly, radiation exposure to workers and waste produced per unit of energy have hit new lows.

What about the risks from radioactivity?

Good evidence exists that exposure to low doses of radioactivity actually improves health and lengthens life through stimulation of the immune system. Unfortunately, U.S. standards, in particular those established by the Environmental Protection Agency, rely on a theory—the ''linear no-threshold'' theory (LNT)—that predicts exposure to trivial levels of radiation increases the risk of cancer. One should keep in mind that the levels argued to increase risk of cancer by this model are considerably less than preexisting natural levels of background radiation. Furthermore, this theory is by no means accepted by the entire scientific community.

According to recent studies by the Harvard School of Public Health, a 1,000 megawatt coal-fired power plant releases about 100 times as much radioactivity into the environment as a comparable nuclear plant. However, the same standards for radioactive releases do not apply to coal and nuclear plants. And, experts on coal geology and engineering have concluded that ''radioactive elements in coal and fly ash should not be sources of alarm.''

Can we not place more reliance on renewables?

Even if robustly subsidized, renewables will only move from their present 0.5 percent share to claim no more than five to eight percent by 2020.

The U.S. leads in renewable energy generation, but such production declined by 9.4 percent from 1997 to 1998: hydro by 9.2%, geothermal by 5.4%, wind by 50.5%, and solar by 27.7%.

Are we making smart investments for U.S. energy security?

Federal R&D investment per thousand kilowatt was only five cents for nuclear and coal, 58 cents for oil, and 41 cents for gas; however, it was $4,769 for wind and $17,006 for photovoltaics.

In brief, we need nuclear. Our economic growth and security depend on it. The benefits of nuclear outweigh the risks. Renewables cannot fill the gap—either between today's demands and future needs or today with nuclear and today without. Not only are coal, gas and oil finite resources, but their use is harmful to human health and the environment.

Mr. President, we must not fail to ensure that nuclear is part of our energy mix. Our nation's energy future must include nuclear in order to be sufficiently diverse, reliable and adequate to meet future energy needs.

The legislation I am offering today will help ensure that nuclear remains part of our energy mix.

Deregulation of the electric utility industry increases the need to keep operating costs low enough to be competitive. For this reason, nuclear energy's future rides on decreasing costs of regulation, especially that of the Nuclear Regulatory Commission.

With gentle prodding and some more overt tactics from the Congress, positive changes at the NRC have been forthcoming.

While holding fast to its primary health and safety mission, the NRC needed to move from a traditional deterministic approach to a more risk-informed and performance-based approach to regulation. In brief, the NRC needed to achieve a rapid transition to an entirely different regulatory framework, streamline its processes, and offer clear definitions, standards, and requirements.

Let me briefly highlight two of the milestones of the past year:

Reactor Oversight.—The NRC commenced with a pilot program for the new reactor licensee oversight process. This process will replace the current inspections, assessment and enforcement processes.

Plants will be evaluated in three key areas: reactor safety, radiation safety and security safeguards. Twenty ''performance indicators'' will assess overall performance in each area. Most stakeholders view this as a big step toward more consistent and objective assessments.

The NRC plans full implementation of this inspection regime for all nuclear plants this year.

Licensing Actions.—The NRC continued completion of licensing actions at a rate greater than NRC Performance Plan output measures and continued to reduce the licensing action inventory.

For instance, one indicator of greater efficiency in licensing actions is the age of the inventory. 1999 showed consistent improvements in turnaround time. For fiscal year 1998, the NRC licensing action inventory included 65.6% of licensing actions that were less than 1 year old; 86% that were less than 2 years old; and 95.4% that were less than 3 years old. By October 1999, 95% of the licensing action inventory was less than 1 year old; and 100% was less than two years old.

These are just two examples. With Congress and industry demanding regulatory change, the agency is responding. All elements of change, especially the overall shift from a deterministic to a risk-informed paradigm, remain work-in-progress. I believe, however, the general consensus is that the last couple years have been very positive.

At the same time, the NRC needs our assistance in removing outdated and unnecessary statutory provisions. This legislation will achieve that.

Mr. President, I close with the same thoughts as Richard Rhodes and Denis Beller: ''Nuclear power is environmentally safe, practical, and affordable. It is not the problem—it is one of the best solutions.''

Mr. President, I ask unanimous consent that a copy of the legislation and the Foreign Affairs article entitled ''The Need for Nuclear Power'' by Dr. Rhodes and Dr. Beller be printed in the RECORD.

There being no objection, the material was ordered to be printed in the RECORD, as follows:

S. 2016

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the ''Nuclear Regulatory Commission Authorization and Improvements Act of 2000''.

SEC. 2. DEFINITIONS.

Section 11 of the Atomic Energy Act of 1954 (42 U.S.C. 2014) is amended—

(1) in subsection f., by striking ''Atomic Energy Commission'' and inserting ''Nuclear Regulatory Commission''; and

(2) by adding at the end the following:

''(kk) NUCLEAR DECOMMISSIONING OBLIGATION.—The term 'nuclear decommissioning obligation' means an expense incurred to ensure the continued protection of the public from the dangers of any residual radioactivity or other hazards present at a facility at the time the facility is decommissioned, including all costs of actions required under rules, regulations and orders of the Commission for—

''(1) entombing, dismantling and decommissioning a facility; and

''(2) administrative, preparatory, security and radiation monitoring expenses associated with entombing, dismantling, and decommissioning a facility.''.

SEC. 3. OFFICE LOCATION.

Section 23 of the Atomic Energy Act of 1954 (42 U.S.C. 2033) is amended by striking ''; however, the Commission shall maintain an office for the service of process and papers within the District of Columbia''.

SEC. 4. LICENSE PERIOD.

Section 103c. of the Atomic Energy Act of 1954 (42 U.S.C. 2133(c)) is amended—

(1) by striking ''c. Each such'' and inserting the following:

''c. LICENSE PERIOD.—

''(1) IN GENERAL.—Each such''; and

(2) by adding at the end the following:

''(2) COMBINED LICENSES.—In the case of a combined construction and operating license issued under section 185(b), the initial duration of the license may not exceed 40 years from the date on which the Commission finds, before operation of the facility, that the acceptance criteria required by section 185(b) are met.''.

SEC. 5. ELIMINATION OF FOREIGN OWNERSHIP PROHIBITIONS.

(a) COMMERCIAL LICENSES.—Section 103d. of the Atomic Energy Act of 1954 (42 U.S.C. 2133(d)) is amended in the second sentence—

(1) by inserting ''for a production facility'' after ''license''; and

(2) by striking ''any any'' and inserting ''any''.

(b) MEDICAL THERAPY AND RESEARCH AND DEVELOPMENT LICENSES.—Section 104d. of the Atomic Energy Act of 1954 (42 U.S.C. 2134(d)) is amended in the second sentence by inserting ''for a production facility'' after ''license''.

SEC. 6. ELIMINATION OF NRC ANTITRUST REVIEWS.

Section 105 of the Atomic Energy Act of 1954 (42 U.S.C. 2135) is amended by adding at the end the following:

''(d) APPLICABILITY.—Subsection (c) shall not apply to an application for a license to construct or operate a utilization facility under section 103 or 104(b) that is pending on or that is filed on or after the date of enactment of this subsection.''.

SEC. 7. GIFT ACCEPTANCE AUTHORITY.

(a) IN GENERAL.—Section 161g. of the Atomic Energy Act of 1954 (42 U.S.C. 2201(g)) is amended—

(1) by striking ''g.'' and inserting ''(g)(1)'';

(2) by striking ''this Act;'' and inserting ''this Act; or''; and

(3) by adding at the end the following:

''(2) accept, hold, utilize, sell, and administer gifts of real and personal property for the purpose of aiding or facilitating the work of the Commission.''.

(b) NUCLEAR REGULATORY COMMISSION FUND.—

(1) IN GENERAL.—Chapter 14 of title I of the Atomic Energy Act of 1954 (42 U.S.C. 2201 et seq.) is amended by adding at the end the following:

''SEC. 170C. NUCLEAR REGULATORY COMMISSION FUND.

''(a) ESTABLISHMENT.—There is established in the Treasury of the United States a fund to be known as the ''Nuclear Regulatory Commission Fund'' (referred to in this section as the 'Fund').

''(b) DEPOSITS IN FUND.—Any gift accepted under section 161g.(2), or net proceeds of the sale of such a gift, shall be deposited in the Fund.

''(c) USE.—

''(1) IN GENERAL.—Amounts in the Fund shall, without further Act of appropriation, be available to the Chairman of the Commission.

''(2) CONSISTENCY WITH GIFT.—Gifts accepted under this section 161g.(2) shall be used as nearly as possible in accordance with the terms of the gift, if those terms are not inconsistent with this section or any other applicable law.

''(d) CRITERIA.—

''(1) IN GENERAL.—The Commission shall establish written criteria for determining whether to accept gifts under section 161g.(2).

''(2) CONSIDERATIONS.—The criteria under paragraph (1) shall take into consideration whether the acceptance of the gift would compromise the integrity of, or the appearance of the integrity of, the Commission or any officer or employee of the Commission.''.

(2) CONFORMING AND TECHNICAL AMENDMENTS.—The table of contents of chapter 14 of title I of the Atomic Energy Act of 1954 (42 U.S.C. prec. 2011) (as amended by section 2(b)) is amended by adding at the end the following:

''Sec. 170B. Uranium supply.
''Sec. 170C. Nuclear Regulatory Commission Fund.''.

SEC. 8. CARRYING OF FIREARMS BY LICENSEE EMPLOYEES.

(a) IN GENERAL.—Chapter 14 of title I of the Atomic Energy Act of 1954 (42 U.S.C. 2201 et seq.) (as amended by section 7(b)(1)) is amended—

(1) in section 161, by striking subsection k. and inserting the following:

''(k) authorize to carry a firearm in the performance of official duties such of its members, officers, and employees, such of the employees of its contractors and subcontractors (at any tier) engaged in the protection of property under the jurisdiction of the United States located at facilities owned by or contracted to the United States or being transported to or from such facilities, and such of the employees of persons licensed or certified by the Commission (including employees of contractors of licensees or certificate holders) engaged in the protection of facilities owned or operated by a Commission licensee or certificate holder that are designated by the Commission or in the protection of property of significance to the common defense and security located at facilities owned or operated by a Commission licensee or certificate holder or being transported to or from such facilities, as the Commission considers necessary in the interest of the common defense and security;'' and

(2) by adding at the end the following:

''SEC. 170D. CARRYING OF FIREARMS.

''(a) AUTHORITY TO MAKE ARREST.—

''(1) IN GENERAL.—A person authorized under section 161k. to carry a firearm may, while in the performance of, and in connection with, official duties, arrest an individual without a warrant for any offense against the United States committed in the presence of the person or for any felony under the laws of the United States if the person has a reasonable ground to believe that the individual has committed or is committing such a felony.

''(2) LIMITATION.—An employee of a contractor or subcontractor or of a Commission licensee or certificate holder (or a contractor of a licensee or certificate holder) authorized to make an arrest under paragraph (1) may make an arrest only—

''(A) when the individual is within, or is in flight directly from, the area in which the offense was committed; and

''(B) in the enforcement of—

''(i) a law regarding the property of the United States in the custody of the Department of Energy, the Commission, or a contractor of the Department of Energy or the Commission or a licensee or certificate holder of the Commission;

''(ii) a law applicable to facilities owned or operated by a Commission licensee or certificate holder that are designated by the Commission under section 161k.;

''(iii) a law applicable to property of significance to the common defense and security that is in the custody of a licensee or certificate holder or a contractor of a licensee or certificate holder of the Commission; or

''(iv) any provision of this Act that subjects an offender to a fine, imprisonment, or both.

''(3) OTHER AUTHORITY.—The arrest authority conferred by this section is in addition to any arrest authority under other law.

''(4) GUIDELINES.—The Secretary and the Commission, with the approval of the Attorney General, shall issue guidelines to implement section 161k. and this subsection.''.

(b) CONFORMING AND TECHNICAL AMENDMENTS.—The table of contents of chapter 14 of title I of the Atomic Energy Act of 1954 (42 U.S.C. prec. 2011) (as amended by section 7(b)(2)) is amended by adding at the end the following:

''Sec. 170D. Carrying of firearms.''.

SEC. 9. COST RECOVERY FROM GOVERNMENT AGENCIES.

Section 161w. of the Atomic Energy Act of 1954 (42 U.S.C. 2201(w)) is amended—

(1) by striking ''or which operates any facility regulated or certified under section 1701 or 1702,'';

(2) by striking ''section 483a of title 31 of the United States Code'' and inserting ''section 9701 of title 31, United States Code,''; and

(3) by inserting before the period at the end the following: ''; and commencing on October 1, 2000, prescribe and collect from any other Government agency, any fee, charge, or price that the Commission may require in accordance with section 9701 of title 31, United States Code, or any other law''.

SEC. 10. HEARING PROCEDURES.

Section 189 a.(1) of the Atomic Energy Act of 1954 (42 U.S.C. 2239(a)(1)) is amended by adding at the end the following:

''(C) HEARINGS.—A hearing under this section shall be conducted using informal adjudicatory procedures established under sections 553 and 555 of title 5, United States Code, unless the Commission determines that formal adjudicatory procedures are necessary—

''(i) to develop a sufficient record; or

''(ii) to achieve fairness.''.

SEC. 11. HEARINGS ON LICENSING OF URANIUM ENRICHMENT FACILITIES.

Section 193(b)(1) of the Atomic Energy Act of 1954 (42 U.S.C. 2243(b)(1)) is amended by striking ''on the record''.

SEC. 12. UNAUTHORIZED INTRODUCTION OF DANGEROUS WEAPONS.

Section 229a. of the Atomic Energy Act of 1954 (42 U.S.C. 2278a(a)) is amended in the first sentence by inserting ''or subject to the licensing authority of the Commission or to certification by the Commission under this Act or any other Act'' before the period at the end.

SEC. 13. SABOTAGE OF NUCLEAR FACILITIES OR FUEL.

Section 236a. of the Atomic Energy Act of 1954 (42 U.S.C. 2284(a)) is amended—

(1) in paragraph (2), by striking ''storage facility'' and inserting ''storage, treatment, or disposal facility'';

(2) in paragraph (3)—

(A) by striking ''such a utilization facility'' and inserting ''a utilization facility licensed under this Act''; and

(B) by striking ''or'' at the end;

(3) in paragraph (4)—

(A) by striking ''facility licensed'' and inserting ''or nuclear fuel fabrication facility licensed or certified''; and

(B) by striking the period at the end and inserting ''; or''; and

(4) by adding at the end the following:

''(5) any production, utilization, waste storage, waste treatment, waste disposal, uranium enrichment, or nuclear fuel fabrication facility subject to licensing or certification under this Act during construction of the facility, if the person knows or reasonably should know that there is a significant possibility that the destruction or damage caused or attempted to be caused could adversely affect public health and safety during the operation of the facility;''.

SEC. 14. NUCLEAR DECOMMISSIONING OBLIGATIONS OF NONLICENSEES.

The Atomic Energy Act of 1954 is amended by inserting after section 241 (42 U.S.C. 2015) the following:

''SEC. 242. NUCLEAR DECOMMISSIONING OBLIGATIONS OF NONLICENSEES.

''(a) DEFINITION OF FACILITY.—In this section, the term 'facility' means a commercial nuclear electric generating facility for which a nuclear decommissioning obligation is incurred.

''(b) DECOMMISSIONING OBLIGATIONS.—After public notice and in accordance with section

181, the Commission shall establish by rule, regulation, or order any requirement that the Commission considers necessary to ensure that a person that is not a licensee (including a former licensee) complies fully with any nuclear decommissioning obligation.''.

SEC. 15. CONTINUATION OF COMMISSIONER SERVICE.

Section 201(c) of the Energy Reorganization Act of 1974 (42 U.S.C. 5841(c)) is amended—

(1) by striking ''(c) Each member'' and inserting the following:

''(c) TERM.—

''(1) IN GENERAL.—Each member''; and

(2) by adding at the end the following:

''(2) CONTINUATION OF SERVICE.—A member of the Commission whose term of office has expired may, subject to the removal power of the President, continue to serve as a member until the member's successor has taken office, except that the member shall not continue to serve beyond the expiration of the next session of Congress after expiration of the fixed term of office.''.

SEC. 16. LIMITATIONS ON ACTIONS RELATING TO SOURCE, BYPRODUCT, AND SPECIAL NUCLEAR MATERIAL.

(a) DEFINITION OF FEDERALLY PERMITTED RELEASE.—Section 101 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. 9601) is amended by striking the period at the end and inserting '', or any release of such material in accordance with regulations of the Nuclear Regulatory Commission following termination of a license issued by the Commission under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) or by a State acting under an agreement entered into under section 274b. of that Act (42 U.S.C. 2021b.).''.

(b) LIMITATION ON ACTIONS.—Section 121(b) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. 9621(b)) is amended by adding at the end the following:

''(3) LIMITATION ON ACTIONS RELATING TO SOURCE, BYPRODUCT, AND SPECIAL NUCLEAR MATERIAL.—No authority under this Act may be used to commence an administrative or judicial action with respect to source, special nuclear, or byproduct material that is subject to decontamination regulations issued by the Nuclear Regulatory Commission for license termination under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) or by a State that has entered into an agreement under section 274b. of that Act (42 U.S.C. 2021b.) unless the action is requested by the Nuclear Regulatory Commission or, in the case of material under the jurisdiction of a State that has entered into such an agreement, the Governor of the State.''.

SEC. 17. AUTHORIZATION OF APPROPRIATIONS FOR FISCAL YEAR 2001.

(a) IN GENERAL.—

(1) SALARIES AND EXPENSES.—There is authorized to be appropriated to the Nuclear Regulatory Commission in accordance with section 261 of the Atomic Energy Act of 1954 (42 U.S.C. 2017) and section 305 of the Energy Reorganization Act of 1974 (42 U.S.C. 5875) $465,400,000 for fiscal year 2001, to remain available until expended, of which $19,150,000 is authorized to be appropriated from the Nuclear Waste Fund established by section 302 of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10222).

(2) OFFICE OF INSPECTOR GENERAL.—There is authorized to be appropriated to the Office of Inspector General of the Nuclear Regulatory Commission $6,000,000 for fiscal year 2001, to remain available until expended.

(b) ALLOCATION OF AMOUNTS AUTHORIZED.—

(1) IN GENERAL.—The amounts authorized to be appropriated under subsection (a)(1) shall be allocated as follows:

(A) NUCLEAR REACTOR SAFETY.—$210,043,000 shall be used for the Nuclear Reactor Safety Program.

(B) NUCLEAR MATERIALS SAFETY.—$63,881,000 shall be used for the Nuclear Materials Safety Program.

(C) NUCLEAR WASTE SAFETY.—$42,143,000 shall be used for the Nuclear Waste Safety Program.

(D) INTERNATIONAL NUCLEAR SAFETY SUPPORT PROGRAM.—$4,840,000 shall be used for the International Nuclear Safety Support Program.

(E) MANAGEMENT AND SUPPORT PROGRAM.—$144,493,000 shall be used for the Management and Support Program.

(2) LIMITATION.—The Nuclear Regulatory Commission may use not more than 1 percent of the amounts allocated under paragraph (1) to exercise authority under section 31a. of the Atomic Energy Act of 1954 (42 U.S.C. 2051(a)) to make grants and enter into cooperative agreements with organizations such as universities, State and local governments, and not-for-profit institutions.

(3) REALLOCATION.—

(A) IN GENERAL.—Except as provided in subparagraphs (B) and (C), any amount allocated for a fiscal year under any subparagraph of paragraph (1) for the program referred to in that subparagraph may be reallocated by the Nuclear Regulatory Commission for use in a program referred to in any other such subparagraph.

(B) LIMITATION.—

(i) ADVANCE NOTIFICATION.—The amount made available from appropriations for use for any program referred to in any subparagraph of paragraph (1) may not, as a result of a reallocation under subparagraph (A), be increased or decreased by more than $1,000,000 for a quarter unless the Commission provides advance notification of the reallocation to the Committee on Commerce of the House of Representatives and the Committee on Environment and Public Works of the Senate.

(ii) CONTENTS.—A notification under clause (i) shall contain a complete statement of the reallocation to be made and the facts and circumstances relied on in support of the reallocation.

(C) USE OF CERTAIN FUNDS.—Funds authorized to be appropriated from the Nuclear Waste Fund—

(i) may be used only for the high-level nuclear waste activities of the Commission; and

(ii) may not be reallocated for other Commission activities.

(c) LIMITATION.—No authority to make payments under this section shall be effective except to such extent or in such amounts as are provided in advance in appropriation Acts.

SEC. 18. EFFECTIVE DATE.

(a) IN GENERAL.—Except as provided in subsection (b), this Act and the amendments made by this Act shall be effective on the date of enactment of this Act.

(b) DECOMMISSIONING AND LICENSE REMOVAL.—The amendments made by sections 14 and 16 take effect on the date that is 180 days after the date of enactment of this Act.

[From Foreign Affairs, January-February, 2000]

THE NEED FOR NUCLEAR POWER

(By Richard Rhodes and Denis Beller)

A CLEAN BREAK

The world needs more energy. Energy multiplies human labor, increasing productivity. It builds and lights schools, purifies water, powers farm machinery, drives sewing machines and robot assemblers, stores and moves information. World population is steadily increasing, having passed six billion in 1999. Yet one-third of that number—two billion people—lack access to electricity. Development depends on energy, and the alternative to development is suffering: poverty, disease, and death. Such conditions create instability and the potential for widespread violence. National security therefore requires developed nations to help increase energy production in their more populous developing counterparts. For the sake of safety as well as security, that increased energy supply should come from diverse sources.

''At a global level,'' the British Royal Society and Royal Academy of Engineering estimate in a 1999 report on nuclear energy an climate change, ''we can expect our consumption of energy at least to double in the next 50 years and to grow by a factor of up to five in the next 100 years as the world population increases and as people seek to improve their standards of living.'' Even with vigorous conservation, would energy production would have to triple by 2050 to support consumption at a mere one-third of today's U.S. per capita rate. The International Energy Agency (IEA) of the Organization for Economic Cooperation and Development (OECD) projects 65 percent growth in world energy demand by 2020, two-thirds of that coming from developing countries. ''Given the levels of consumption likely in the future,'' the Royal Society and Royal Academy caution, ''it will be an immense challenge to meet the global demand for energy without unsustainable long-term damage to the environment.'' That damage includes surface and air pollution and global warming.

Most of the world's energy today comes from petroleum (39.5 percent), coal (24.2 percent), natural gas (22.1 percent), hydroelectric power (6.9 percent), and nuclear power (6.3 percent). Although oil and coal still dominate, their market fraction began declining decades ago. Meanwhile, natural gas and nuclear power have steadily increased their share and should continue to do so. Contrary to the assertions of antinuclear organizations, nuclear power is neither dead nor dying. France generates 79 percent of its electricity with nuclear power; Belgium, 60 percent; Sweden, 42 percent; Switzerland, 39 percent; Spain, 37 percent; Japan, 34 percent; the United Kingdom, 21 percent; and the United States (the largest producer of nuclear energy in the world), 20 percent. South Korea and China have announced ambitious plans to expand their nuclear-power capabilities—in the case of South Korea, by building 16 new plants, increasing capacity by more than 100 percent. With 434 operating reactors worldwide, nuclear power is meeting the annual electrical needs of more than a billion people.

In America and around the globe, nuclear safety and efficiency have improved significantly since 1990. In 1998, unit capacity factor (the fraction of a power plant's capacity that it actually generates) for operating reactors reached record levels. The average U.S. capacity factor in 1998 was 80 percent for about 100 reactors, compared to 58 percent in 1980 and 66 percent in 1990. Despite a reduction in the number of power plants, the U.S. nuclear industry generated nine percent more nuclear electricity in 1999 than in 1998. Average production costs for nuclear energy are now just 1.9 cents per kilowatt-hour (kWh), while electricity produced from gas costs 3.4 cents per kWh. Meanwhile, radiation exposure to workers and waste produced per unit of energy have hit new lows.

Because major, complex technologies take more than half a century to spread around the world, natural gas will share the lead in power generation with nuclear power over the next hundred years. Which of the two will command the greater share remains to be determined. But both are cleaner and more secure than the fuels they have begun to replace, and their ascendance should be endorsed. Even environmentalists should welcome the transition and reconsider their infatuation with renewable energy sources.

CARBON NATIONS

Among sources of electric-power generation, coal is the worst environmental offender. (Petroleum, today's dominant source of energy, sustains transportation, putting it in a separate category.) Recent studies by the Harvard School of Public Health indicate that pollutants from coal-burning cause about 15,000 premature deaths annually in the United States alone. Used to generate about a quarter of the world's primary energy, coal-burning releases amounts of toxic waste too immense to contain safely. Such waste is either dispersed directly into the air or is solidified and dumped. Some is even mixed into construction materials. Besides emitting noxious chemicals in the form of gases or toxic particles—sulfur and nitrogen oxides (components of acid rain and smog), arsenic, mercury, cadmium, selenium, lead, boron, chromium, copper, fluorine, molybdenum, nickel, vanadium, zinc, carbon monoxide and dioxide, and other greenhouse gases—coal-fired power plants are also the world's major source of radioactive releases into the environment. Uranium and thorium, mildly radioactive elements ubiquitous in the earth's crust, are both released when coal is burned. Radioactive radon gas, produced when uranium in the Earth's crust decays and normally confined underground, is released when coal is mined. A 1,000-megawatt-electric (MWe) coal-fired power plant releases about 100 times as much radioactivity into the environment as a comparable nuclear plant. Worldwide releases of uranium and thorium from coal-burning total about 37,300 tonnes (metric tons) annually, with about 7,300 tonnes coming from the United States. Since uranium and thorium are potent nuclear fuels, burning coal also wastes more potential energy than it produces.

Nuclear proliferation is another overlooked potential consequence of coal-burning. The uranium released by a single 1,000-MWe coal plant in a year includes about 74 pounds of uranium-235—enough for at least two atomic bombs. This uranium would have to be enriched before it could be used, which would be complicated and expensive. But plutonium could also be bred from coal-derived uranium. Moreover, ''because electric utilities are not high-profile facilities,'' writes physicist Alex Gabbard of the Oak Ridge National Laboratory, ''collection and processing of coal ash for recovery of minerals . . . can proceed without attracting outside attention, concern or intervention. Any country with coal-fired plants could collect combustion by products and amass sufficient nuclear weapons materials to build up a very powerful arsenal.'' In the early 1950s, when richer ores were believed to be in short supply, the U.S. Atomic Energy Commission actually investigated using coal as a source of uranium production for nuclear weapons; burning the coal, the AEC concluded, would concentrate the mineral, which could then be extracted from the ash.

Such a scenario may seem far-fetched. But it emphasizes the political disadvantages under which nuclear power labors. Current laws force nuclear utilities, unlike coal plants, to invest in expensive systems that limit the release of radioactivity. Nuclear fuel is not efficiently recycled in the United States because of proliferation fears. These factors have warped the economics of nuclear power development and created a politically difficult waste-disposal problem. If coal utilities were forced to assume similar costs, coal electricity would no longer be cheaper than nuclear.

DECLINE AND FALL OF THE RENEWABLES

Renewable sources of energy—hydroelectric, solar, wind, geothermal, and biomass—have high capital-investment costs and significant, if usually unacknowledged, environmental consequences. Hydropower is not even a true renewable, since dams eventually silt in. Most renewables collect extremely diluted energy, requiring large areas of land and masses of collectors to concentrate. Manufacturing solar collectors, pouring concrete for fields of windmills, and downing many square miles of land behind dams cause damage and pollution.

Photovoltaic cells used for solar collection are large semiconductors; their manufacture produces highly toxic waste metals and solvents that require special technology for disposal. A 1,000–MWe solar electric plant would generate 6,850 tonnes of hazardous waste from metals-processing alone over a 30-year lifetime. A comparable solar thermal plant (using mirrors focused on a central tower) would require metals for construction that would generate 435,000 tonnes of manufacturing waste, of which 16,300 tonnes would be contaminated with lead and chromium and be considered hazardous.

A global solar-energy system would consume at least 20 percent of the world's known iron resources. It would require a century to build and a substantial fraction of annual world iron production to maintain. The energy necessary to manufacture sufficient solar collectors to cover a half-million square miles of the Earth's surface and to deliver the electricity through long-distance transmission systems would itself add grievously to the global burden of pollution and greenhouse gas. A global solar-energy system without fossil or nuclear backup would also be dangerously vulnerable to drops in solar radiation from volcanic events such as the 1883 eruption of Krakatoa, which caused widespread crop failure during the ''year without a summer'' that followed.

Wind farms, besides requiring millions of pounds of concrete and steel to build (and thus creating huge amounts of waste materials), are inefficient, with low (because intermittent) capacity. They also cause visual and noise pollution and are mighty slayers of birds. Several hundred birds of prey, including dozens of golden eagles, are killed every year by a single California wind farm; more eagles have been killed by wind turbines than were lost in the disastrous Exxon Valdez oil spill. The National Audubon Society has launched a campaign to save the California condor from a proposed wind farm to be built north of Los Angeles. A wind farm equivalent in output and capacity to a 1,000–MWe fossil-fuel or nuclear plant would occupy 2,000 square miles of land and, even with substantial subsidies and ignoring hidden pollution costs, would produce electricity at double or triple the cost of fossil fuels.

Although at least one-quarter of the world's potential for hydropower has already been developed, hydroelectric power—produced by dams that submerge large areas of land, displace rural populations, change river ecology, kill fish, and risk catastrophic collapse—has understandably lost the backing of environmentalists in recent years. The U.S. Export-Import Bank was responding in part to environmental lobbying when it denied funding to China's 18,000–MWe Three Gorges project.

Meanwhile, geothermal sources—which exploit the internal heat of the earth emerging in geyser areas or under volcanoes—are inherently limited and often coincide with scenic sites (such as Yellowstone National Park) that conservationists understandably want to preserve.

Because of these and other disadvantages, organizations such as World Energy Council and the IEA predict that hydroelectric generation will continue to account for no more than its present 6.9 percent share of the world's primary energy supply, while all other renewables, even though robustly subsidized, will move from their present 0.5 percent share to claim no more than 5 to 8 percent by 2020. In the United States, which leads the world in renewable energy generation, such production actually declined by 9.4 percent from 1997 to 1998: hydro by 9.2 percent, geothermal by 5.4 percent, wind by 50.5 percent, and solar by 27.7 percent.

Like the dream of controlled thermonuclear fusion, then, the realty of a world run on pristine energy generated from renewables continues to recede, despite expensive, highly subsidized research and development. the 1997 U.S. federal R&D investment per thousand kWh was only 5 cents for nuclear and coal, 58 cents for oil, and 41 cents for gas, but was $4,769 for wind and $17,006 for photovoltaics. This massive public investment in renewables would have been better spent making coal plants and automobiles cleaner. According to Robert Bradley of Houston's Institute for Energy Research, U.S. conservation efforts and nonhydroelectric renewables have benefited from a cumulative 20-year taxpayer investment of some $30-$40 billion—''the largest governmental peacetime energy expenditure in U.S. history.'' And Bradley estimates that ''the $5.8 billion spent by the Department of Energy on wind and solar subsidies'' alone could have paid for ''replacing between 5,000 and 10,000 MWe of the nation's dirtiest coal capacity with gas-fired combined-cycle units, which would have reduced carbon dioxide emissions by between one-third and two-thirds.'' Replacing coal with nuclear generation would have reduced overall emissions even more.

Despite the massive investment, conservation and nonhydro renewables remain stubbornly uncompetitive and contribute only marginally to U.S. energy supplies. If the most prosperous nation in the world cannot afford them, who can? Not China, evidently, which expects to generate less than one percent of its commercial energy from nonhydro renewables in 2025. Coal and oil will still account for the bulk of China's energy supply in that year unless developed countries offer incentives to convince the world's most populous nation to change its plan.

TURN DOWN THE VOLUME

Natural gas has many virtues as a fuel compared to coal or oil, and its share of the world's energy will assuredly grow in the first half of the 21st century. But its supply is limited and unevenly distributed, it is expensive as a power source compared to coal or uranium, and it pollutes the air. A 1,000-MWe natural gas plant releases 5.5 tonnes of sulfur oxides per day, 21 tonnes of nitrogen oxides, 1.6 tonnes of carbon monoxide, and

0.9 tonnes of partculates. In the United States, energy production from natural gas released about 5.5 billion tonnes of waste in 1994. Natural gas fires and explosions are also significant risks. A single mile of gas pipeline three feet in diameter at a pressure of 1,000 pounds per square inch (psi) contains the equivalent of two-thirds of a kiloton of explosive energy; a million miles of such large pipelines lace the earth.

The great advantage of nuclear power is its ability to wrest enormous energy from a small volume of fuel. Nuclear fission, transforming matter directly into energy, is several million times as energetic as chemical burning, which merely breaks chemical bonds. One tonne of nuclear fuel produces energy equivalent to 2 to 3 million tonnes of fossil fuel. Burning 1 kilogram of firewood can generate 1 kilowatt-hour of electricity; 1 kg of coal, 3 kWh; 1 kg of oil, 4 kWh. But 1 kg of uranium fuel in a modern light-water reactor generates 400,000 kWh of electricity, and if that uranium is recycled, 1 kg can generate more than 7,000,000 kWh. These spectacular differences in volume help explain the vast difference in the environmental impacts of nuclear versus fossil fuels. Running a 1,000-MWe power plant for a year requires, 2,000 train cars of coal or 10 supertankers of oil but only 12 cubic meters of natural uranium. Out the other end of fossil-fuel plants, even those with pollution-control systems, come thousands of tonnes of noxious gases, particulates, and heavy-metal-bearing (and radioactive) ash, plus solid hazardous waste—up to 500,000 tonnes of sulfur from coal, more than 300,000 tonnes from oil, and 200,000 tonnes from natural gas. In contrast, a 1,000-MWe nuclear plant releases no noxious gases or other pollutants n1 and much less radioactivity per capita than is encountered from airline travel, a home smoke detector, or a television set. It produces about 30 tonnes of high-level waste (spent fuel) and 800 tonnes of low- and intermediate-level waste—about 20 cubic meters in all when compacted (roughly, the volume of two automobiles). All the operating nuclear plants in the world produce some 3,000 cubic meters of waste annually. By comparison, U.S. industry generates annually about 50,000,000 cubic meters of solid toxic waste.

n1 Uranium is refined and processed into fuel assemblies today using coal energy, which does of course release pollutants. If nuclear power were made available for process heat or if fuel assemblies were recycled, this source of manufacturing pollution would be eliminated or greatly reduced.

The high-level waste is intensely radioactive, of course (the low-level waste can be less radioactive than coal ash, which is used to make concrete and gypsum—both of which are incorporated into building materials). But thanks to its small volume and the fact that it is not released into the environment, this high-level waste can be meticulously sequestered behind multiple barriers. Waste from coal, dispersed across the landscape in smoke or buried near the surface, remains toxic forever. Radioactive nuclear waste decays steadily, losing 99 percent of its toxicity after 600 years—well within the range of human experience with custody and maintenance, as evidence by structures such as the Roman Pantheon and Notre Dame Cathedral. Nuclear waste disposal is a political problem in the United States because of wide-spread fear disproportionate to the reality of risk. But it is not an engineering problem, as advanced projects in France, Sweden, and Japan demonstrate. The World Health Organization has estimated that indoor and outdoor air pollution cause some three million deaths per year. Substituting small, properly contained volumes of nuclear waste for vast, dispersed amounts of toxic wastes from fossil fuels would produce so obvious an improvement in public health that it is astonishing that physicians have not already demanded such a conversion.

The production cost of nuclear electricity generated from existing U.S. plants is already fully competitive with electricity from fossil fuels, although new nuclear power is somewhat more expensive. But this higher price tag is deceptive. Large nuclear power plants require larger capital investments than comparable coal or gas plants only because nuclear utilities are required to build and maintain costly systems to keep their radioactivity from the environment. If fossil-fuel plants were similarly required to sequester the pollutants they generate, they would cost significantly more than nuclear power plants do. The European Union and the International Atomic Energy Agency (IAEA) have determined that ''for equivalent amounts of energy generation, coal and oil plants, . . . owing to their large emissions and huge fuel and transport requirements, have the highest externality costs as well as equivalent lives lost. The external costs are some ten times higher than for a nuclear power plant and can be a significant fraction of generation costs.'' In equivalent lives lost per gigawatt generated (that is, loss of life expectancy from exposure to pollutants), coal kills 37 people annually; oil, 32; gas, 2; nuclear, 1. Compared to nuclear power, in other words, fossil fuels (and renewables) have enjoyed a free ride with respect to protection of the environment and public health and safety.

Even the estimate of one life lost to nuclear power is questionable. Such an estimate depends on whether or not, as the long-standing ''linear no-threshold'' theory (LNT) maintains, exposure to amounts of radiation considerably less than preexisting natural levels increases the risk of cancer. Although LNT dictates elaborate and expensive confinement regimes for nuclear power operations and waste disposal, there is no evidence that low-level radiation exposure increases cancer risk. In fact, there is good evidence that it does not. There is even good evidence that exposure to low doses of radioactivity improves health and lengthens life, probably by stimulating the immune system much as vaccines do (the best study, of background radon levels in hundreds of thousands of homes in more than 90 percent of U.S. counties, found lung cancer rates decreasing significantly with increasing radon levels among both smokers and nonsmokers). So low-level radioactivity from nuclear power generation presents at worst a negligible risk. Authorities on coal geology and engineering make the same argument about low-level radioactivity from coal-burning; a U.S. Geological Survey fact sheet, for example, concludes that ''radioactive elements in coal and fly ash should not be sources of alarm.'' Yet nuclear power development has been hobbled, and nuclear waste disposal unnecessarily delayed, by limits not visited upon the coal industry.

No technology system is immune to accident. Recent dam overflows and failures in Italy and India each resulted in several thousand fatalities. Coal-mine accidents, oil- and gas-plant fires, and pipeline explosions typically kill hundreds per incident. The 1984 Bhopal chemical plant disaster caused some 3,000 immediate deaths and poisoned several hundred thousand people. According to the U.S. Environmental Protection Agency, between 1987 and 1997 more than 600,000 accidental releases of toxic chemicals in the United States killed a total of 2,565 people and injured 22,949.

By comparison, nuclear accidents have been few and minimal. The recent, much-reported accident in Japan occurred not at a power plant but at a facility processing fuel for a research reactor. It caused no deaths or injuries to the public. As for the Chernobyl explosion, it resulted from human error in operating a fundamentally faulty reactor design that could not have been licensed in the West. It caused severe human and environmental damage locally, including 31 deaths, most from radiation exposure. Thyroid cancer, which could have been prevented with prompt iodine prophylaxis, has increased in Ukrainian children exposed to fallout. More than 800 cases have been diagnosed and several thousand more are projected; although the disease is treatable, three children have died. LNT-based calculations project 3,420 cancer deaths in Chernobyl-area residents and cleanup crews. The Chernobyl reactor lacked a containment structure, a fundamental safety system that is required on Western reactors. Postaccident calculations indicate that such a structure would have confined the explosion and thus the radioactivity, in which case no injuries or deaths would have occurred.

These numbers, for the worst ever nuclear power accident, are remarkably low compared to major accidents in other industries. More than 40 years of commercial nuclear power operations demonstrate that nuclear power is much safer than fossil-fuel systems in terms of industrial accidents, environmental damage, health effects, and long-term risk.

GHOSTS IN THE MACHINE

Most of the uranium used in nuclear reactors is inert, a nonfissile product unavailable for use in weapons. Operating reactors, however, breed fissile plutonium that could be used in bombs, and therefore the commercialization of nuclear power has raised concerns about the spread of weapons. In 1977, President Carter deferred indefinitely the recycling of ''spent'' nuclear fuel, citing proliferation risks. This decision effectively ended nuclear recycling in the United States, even though such recycling reduces the volume and radiotoxicity of nuclear waste and could extend nuclear fuel supplies for thousands of years. Other nations assessed the risks differently and the majority did not follow the U.S. example. France and the United Kingdom currently reprocess spent fuel; Russia is stockpiling fuel and separated plutonium for jump-starting future fast-reactor fuel cycles; Japan has begun using recycled uranium and plutonium mixed-oxide (MOX) fuel in its reactors and recently approved the construction of a new nuclear power plant to use 100-percent MOX fuel by 2007.

Although power-reactor plutonium theoretically can be used to make nuclear explosives, spent fuel is refractory, highly radioactive, and beyond the capacity of terrorists to process. Weapons made from reactor-grade plutonium would be hot, unstable, and of uncertain yield. India has extracted weapons plutonium from a Canadian heavy-water reactor and bars inspection of some dual-purpose reactors it has built. But no plutonium has ever been diverted from British or French reprocessing facilities or fuel shipments for weapons production; IAEA inspections are effective in preventing such diversions. The risk of proliferation, the IAEA has

concluded, ''is not zero and would not become zero even if nuclear power ceased to exist. It is a continually strengthened nonproliferation regime that will remain the cornerstone of efforts to prevent the spread of nuclear weapons.''

Ironically, burying spend fuel without extracting its plutonium through reprocessing would actually increase the long-term risk of nuclear proliferation, since the decay of less-fissile and more-radioactive isotopes in spend fuel after one to three centuries improves the explosive qualities of the plutonium it contains, making it more attractive for weapons use. Besides extending the world's uranium resources almost indefinitely, recycling would make it possible to convert plutonium to useful energy while breaking it down into shorter-lived, nonfissionable, nonthreatening nuclear waste.

Hundreds of tons of weapons-grade plutonium, which cost the nuclear superpowers billions of dollars to produce, have become military surplus in the past decade. Rather than burying some of this strategically worrisome but energetically valuable material—as Washington has proposed—it should be recycled into nuclear fuel. An international system to recycle and manage such fuel would prevent covert proliferation. As envisioned by Edward Arthur, Paul Cunningham, and Richard Wagner of the Los Alamos National Laboratory, such a system would combine internationally monitored retrievable storage, the processing of all separated plutonium into MOX fuel for power reactors, and, in the longer term, advanced integrated materials-processing reactors that would receive, control, and process all fuel discharged from reactors throughout the world, generating electricity and reducing spend fuel to short-lived nuclear waste ready for permanent geological storage.

THE NEW NEW THING

The new generation of small, modular power plants—competitive with natural gas and designed for safety, proliferation resistance, and ease of operation—will be necessary to extend the benefits of nuclear power to smaller developing countries that lack a nuclear infrastructure. The Department of Energy has awarded funding to three designs for such ''fourth-generation'' plants. A South African utility, Eskom, has announced plans to market a modular gas-cooled pebble-bed reactor that does not require emergency core-cooling systems and physically cannot ''melt down.'' Eskom estimates that the reactor will produce electricity at around 1.5 cents per kWh, which is cheaper than electricity from a combined-cycle gas plant. The Massachusetts Institute of Technology and the Idaho National Engineering and Environmental Laboratory are developing a similar design to supply high-temperature heat for industrial processes such as hydrogen generation and desalinization.

Petroleum is used today primarily for transportation, but the internal combustion engine has been refined to its limit. Further reductions in transportation pollution can come only from abandoning petroleum and developing nonpolluting power systems for cars and trucks. Recharging batteries for electric cars will simply transfer pollution from mobile to centralized sources unless the centralized source of electricity is nuclear. Fuel cells, which are now approaching commercialization, may be a better solution. Because fuel cells generate electricity directly from gaseous or liquid fuels, they can be refueled along the way, much as present internal combustion engines are. When operated on pure hydrogen, fuel cells produce only water as a waste product. Since hydrogen can be generated from water using heat or electricity, one can envisage a minimally polluting energy infrastructure, using hydrogen generated by nuclear power for transportation, nuclear electricity and process heat for most other applications, and natural gas and renewable systems as backups. Such a major commitment to nuclear power could not only halt but eventually even reverse the continuing buildup of carbon in the atmosphere. In the meantime, fuel cells using natural gas could significantly reduce air pollution.

POWERING THE FUTURE

To meet the world's growing need for energy, the Royal Society and Royal Academy report proposes ''the formation of an international body for energy research and development, funded by contributions from individual nations on the basis of GDP or total national energy consumption.'' The body would be ''a funding agency supporting research, development and demonstrators elsewhere, not a research center itself.'' Its budget might build to an annual level of some $25 billion, ''roughly one percent of the total global energy budget.'' If it truly wants to develop efficient and responsible energy supplies, such a body should focus on the nuclear option, on establishing a secure international nuclear-fuel storage and reprocessing system, and on providing expertise for siting, financing, and licensing modular nuclear power systems to developing nations.

According to Arnulf Grubler, Nebojsa Nakicenovic, and David Victor, who study the synamics of energy technologies, ''the share of energy supplied by electricity is growing rapidly in most countries and worldwide.'' Throughout history, humankind has gradually decarbonized its dominant fuels, moving steadily away from the more polluting, carbon-rich sources. Thus the world has gone from coal (which has one hydrogen atom per carbon atom and was dominant from 1880 to 1950) to oil (with two hydrogens per carbon, dominant from 1950 to today). Natural gas (four hydrogens per carbon) is steadily increasing its market share. But nuclear fission produces no carbon at all.

Physical reality—not arguments about corporate greed, hypothetical risks, radiation exposure, or waste disposal—ought to inform decisions vital to the future of the world. Because diversity and redundancy are important for safety and security, renewable energy source ought to retain a place in the energy economy of the century to come. But nuclear power should be central. Despite its outstanding record, it has instead been relegated by its opponents to the same twilight zone of contentions ideological conflict as abortion and evolution. It deserves better. Nuclear power is environmentally safe, practical, and affordable. It is not the problem—it is one of the best solutions.

ADDITIONAL COSPONSORS

S. 148

At the request of Mr. L. CHAFEE, his name was added as a cosponsor of S. 148, a bill to require the Secretary of the Interior to establish a program to provide assistance in the conservation of neotropical migratory birds.

S. 149

At the request of Mr. L. CHAFEE, his name was added as a cosponsor of S. 149, a bill to amend chapter 44 of title 18, United States Code, to require the provision of a child safety lock in connection with the transfer of a handgun.

S. 171

At the request of Mr. L. CHAFEE, his name was added as a cosponsor of S. 171, a bill to amend the Clean Air Act to limit the concentration of sulfur in gasoline used in motor vehicles.

S. 206

At the request of Mr. L. CHAFEE, his name was added as a cosponsor of S. 206, a bill to amend title XXI of the Social Security Act to provide for improved data collection and evaluations of State Children's Health Insurance Programs, and for other purposes.

S. 285

At the request of Mr. Robb, his name was added as a cosponsor of S. 285, a bill to amend title II of the Social Security Act to restore the link between the maximum amount of earnings by blind individuals permitted without demonstrating ability to engage in substantial gainful activity and the exempt amount permitted in determining excess earnings under the earnings test.

S. 333

At the request of Mr. L. CHAFEE, his name was added as a cosponsor of S. 333, a bill to amend the Federal Agriculture Improvement and Reform Act of 1996 to improve the farmland protection program.

S. 429

At the request of Mr. DURBIN, the name of the Senator from North Dakota (Mr. CONRAD) was added as a cosponsor of S. 429, a bill to designate the legal public holiday of ''Washington's Birthday'' as ''Presidents' Day'' in honor of George Washington, Abraham Lincoln, and Franklin Roosevelt and in recognition of the importance of the institution of the Presidency and the contributions that Presidents have made to the development of our Nation and the principles of freedom and democracy.

S. 443

At the request of Mr. L. CHAFEE, his name was added as a cosponsor of S. 443, a bill to regulate the sale of firearms at gun shows.

S. 457

At the request of Mr. L. CHAFEE, his name was added as a cosponsor of S. 457, a bill to amend section 922(t) of title 18, United States Code, to require the reporting of information to the chief law enforcement officer of the buyer's residence and to require a minimum 72-hour waiting period before the purchase of a handgun, and for other purposes.

S. 494

At the request of Mr. L. CHAFEE, his name was added as a cosponsor of S. 494, a bill to amend title XIX of the Social Security Act to prohibit transfers