Nuclear Energy

U.S. national energy policy recognizes that the continued development of commercial nuclear power in the United States is vital to U.S. national security and energy stability since it is a significant domestic energy resource that is relatively free from international pressures. As of this writing (August 1989) the United States had 108 nuclear power reactors in commercial status. In January 1989 nuclear energy produced 46 billion Kwh or 20% of total U.S. electricity generated in contrast to 45 billion Kwh (18.8%) produced in January 1988.

The U.S. Federal Government has been engaged in a variety of activities to ensure that nuclear energy remains a safe, economically competitive and environmentally acceptable option.

The fundamental policy and program goals that the Federal Government has been pursuing in this area have included:

- the development of an effective and predictable regulatory and institutional environment that enables nuclear power projects to proceed and compete freely in the marketplace under safe and environmentally acceptable conditions;

- the support of appropriate efforts (in collaboration with industry) to revitalize the light water reactor option for the United States and to ensure its long-term availability as a vital component of the U.S. national energy system;
the exploration of the feasibility and practicability of advanced nuclear reactor systems that have the potential for significant advances and breakthroughs in economics, safety, licensability and modes for managing radioactive waste;

the placement of the first national high level nuclear waste repository in operation by around the year 2003;

efforts to preserve and strengthen the position of the United States as a major international supplier of uranium enrichment services under attractive and economically competitive conditions and to support long-term national interests by providing a framework for U.S. international cooperation with other countries in the civil nuclear field under conditions that further U.S. non-proliferation objectives.

Much of the federal effort in recent months has been devoted to developing initiatives designed to remove institutional and regulatory obstacles to the continued use of nuclear power as part of the U.S. energy system.

Within this context, the following paragraphs summarize the major features of the current status of the U.S. nuclear energy program and policies.

**Reactor Research and Development**

The Department of Energy has been supporting two main areas of endeavor in the field of reactor research and development:

In the light water reactor area the focus has been on developing, in conjunction with industry, advanced light water reactor concepts (ALWR) that could be certified as standard designs by the USNRC in the 1990’s. This has included the planned
certification in 1991 of the so-called evolutionary ALWR's plus development of a mid-sized (600 MWe) passively safe version of the ALWR to be certified around 1995.

Insofar as more innovative concepts are concerned the focus of attention is aimed at pursuing the development and establishing the licensability of the modular high temperature gas cooled reactor concept (MHTGR) and an innovative liquid metal reactor concept. Both approaches involve the evaluation of designs that possess passive safety features and that are amenable to modular construction and the application of shop fabrication techniques. The HTGR is the unique nuclear energy source that can be used for process heat applications as well as for electrical and cogeneration uses. The focus of the DOE attention is on the design and ultimate certification of a 550 MWe standard modular HTGR facility that will consist of four helium cooled 350 MWt reactor modules, each with a core composed of uranium oxycarbide fuel particles in graphite. A conceptual design has been completed and presented to the Nuclear Regulatory Commission and discussions are well along with the NRC in ascertaining NRC's views, pursuant to its advanced reactor policy statement, on the probable licensability of the plant. It also is anticipated that a lead demonstration plant will be needed to achieve NRC certification of such an advanced design. Also as of this writing, one U.S. utility is conducting a feasibility study on the merits of deploying an MHTGR, and discussions are proceeding at the private level as to how such a project conceivably might be financed and organized.

The objective of the Department of Energy's advanced liquid metal reactor program is to achieve a licensable, economically competitive, commercially viable LMR concept suitably tailored to the U.S. market. The distinguishing features of the approach being pursued includes: a reactor design concept and accompanying metal fuel that provides for passive operation of the safety systems, the use of a fuel cycle and reprocessing technology that
promises to significantly simplify the process of managing radioactive wastes, a modular approach to plant construction and a system that is amenable to factory fabrication.

The reactor design program involves support of work being performed by the General Electric Company on the so-called Power Reactor Inherently Safe Module (PRISM) design which was selected in 1988 following a competitive assessment of the alternatives. Each PRISM reactor would be designed to produce 155 MWe and would involve use of a sodium cooled pool type system with a heterogeneous core. The minimum electrical power block would consist of 3 reactors, each with one steam generator, supplying steam to one 465 MWe turbine generator.

As a major distinguishing factor, the PRISM reactor approach is to make use of a metal fuel cycle concept, called the Integral Fast Reactor, that is being developed at Argonne National Laboratory. The IFR concept has established itself over the past two years as the centerpiece of the DOE liquid metal reactor program. In addition to its use of U-Pu-Zr metal alloy fuel, a major characteristic of the IFR concept is the development of an electrochemical reprocessing technique. This fuel cycle approach is expected to produce only very small amounts of actinides in the high level waste streams. This, in turn, should simplify the processing of radioactive wastes by significantly shortening the period during which high level waste needs to be stored in a repository. In time, the potential waste handling benefits of this process could be of value to the light water reactor fuel cycle as well as to the liquid metal reactor programs. As in the case of the MHTGR, talks are advancing between DOE, the USNRC and the pertinent technical support contractors on the potential licensability of this concept.

It is hoped that with such programs nuclear power plants with lower costs and improved safety characteristics can be made
available to utilities as attractive options to meet future energy needs. The role of the U.S. Federal Government is to conduct the necessary longer term research and development activities that are beyond the capability of the private sector to complete on its own.

Regulatory Related Advances and Considerations

For several years it has been the policy of the United States to work to achieve further rationalizations and improvements in the U.S. regulatory process that will help assure reactor safety, while offering a more predictable, rational and efficient regulatory environment.

Some of the significant developments that have occurred in this area in recent months have included the following.

In April 1989, the USNRC approved significant changes in the licensing process for considering applications to build and operate new plants. The changes seek to reinforce the goal that future plants should be standardized, they allow for early NRC approval of sites, and provide for a combined construction permit and operating license. If a utility decides to construct a new power plant of an approved standardized design at an approved site, it would apply for a combined license to construct and operate the plant. If a combined license is issued, the construction work would be inspected and approved by the Nuclear Regulatory Commission staff as it is completed. Of importance is that there should be no procedural delay after a plant is completed in accordance with the tests, inspections, and analyses. There is, however, the opportunity for an interested person to request a hearing to determine whether the acceptance of criteria in the combined license have been met.
In the area of emergency preparedness planning, the President issued an Executive Order on November 18, 1988. This Order calls for involvement of the Federal Emergency Management Agency whenever State or local governments decline or fail either to (1) prepare radiological preparedness plans for nuclear power plants sufficient to satisfy Nuclear Regulatory Commission licensing requirements; or (2) participate adequately in the preparation, demonstrating, testing, exercise, or use of such plans.

Also in 1988, the Price-Anderson Amendments Act was signed into law, which provides for continuing indemnification relative to accidents occurring at commercial nuclear power plants or at Department of Energy nuclear-related facilities. For the commercial nuclear power plant sector, the level of indemnification is related to the number of licensed power plants and, at present, this calls for an indemnification level of about $7.4 billion.

**Enrichment**

As one of its primary functions the U.S. Department of Energy enriches uranium for end-use in commercial reactors, for defense purposes, and for research. Through contractors DOE operates gaseous diffusion plants in Paducah, Kentucky, and Portsmouth, Ohio.

The long established U.S. objective has been to provide these services on as stable and attractive terms as possible. In this regard, the uranium enrichment enterprise constantly seeks ways to meet the considerable electric power requirements of the diffusion facilities at the lowest possible cost. For example, DOE has negotiated long-term contracts for a base quantity of the least expensive "firm" power available and has made arrangements to make greater use of still lower-cost "nonfirm" power, available during off-peak hours.
Although these and other measures have allowed more extensive use of low-cost power, electricity remains the most expensive component of gaseous diffusion production costs. Within this context, the Department of Energy looks to the development of a new technology -- Atomic Vapor Laser Isotope Separation, or AVLIS -- as the means to reduce the power cost component of uranium enrichment and to produce a far cheaper product. It is hoped that, in time, AVLIS will provide superior technological and economic flexibility by displacing marginal-cost gaseous diffusion plant capacity, enabling the U.S. uranium enterprise to maintain cost competitiveness in the next century. A next logical step in the pursuit of this technology would involve a commercial demonstration of the process to verify its economic operation. It also will be necessary to integrate industrial experience into the AVLIS program in order to facilitate its transition to commercial use. The Livermore National Laboratory is now in the process of testing out critical components of the process in preparation for a major technology demonstration to take place in late 1991/early 1992, and believes that the U.S. enrichment enterprise should be in a position to decide on next steps (including to commit to some form of commercial plant) by around 1992. The next few years should be of considerable importance in determining the future course of AVLIS within the United States.

In the years before a commercial AVLIS plant is ready, the Department of Energy expects to keep its enrichment services competitive by transforming the DOE uranium enrichment enterprise into a Government-owned enrichment corporation that will possess greater flexibility from a business perspective than is found in a government agency. It is believed that a properly structured corporation could enhance the financial and economic efficiency of the U.S. enrichment enterprise. Accordingly, with the encouragement of the Bush Administration, legislative proposals to establish a public enrichment corporation have been introduced in the U.S. Congress and are under active consideration.
Implementation of the Nuclear Waste Policy Act

The Nuclear Waste Policy Act (NWPA), as amended, directs DOE to characterize only one site, the Yucca Mountain site in Nevada, to determine its suitability for the first repository for spent fuel and high-level waste. DOE issued the Site Characterization Plan for Yucca Mountain in December 1988. The current goal is to begin exploratory shaft construction in November 1989. Subsequently, if DOE concludes, based on a site characterization period lasting about five years, that the site is suitable, DOE would submit a license application for the repository to the Nuclear Regulatory Commission in 1995; receive NRC’s authorization to construct the repository in 1998; and receive NRC’s license to receive and possess waste at the repository in 2003.

The NWPA also authorizes DOE to site, construct and operate a monitored retrievable storage (MRS) facility for spent fuel, but imposes several conditions linking MRS construction and operation to progress in the repository program. These conditions are, intended to ensure that the MRS will not become a de facto repository if the repository effort does not move forward. The independent MRS Review Commission is due to submit its final report to Congress in November 1989 on the need for an MRS, after which DOE may begin MRS siting efforts.

DOE faces continuing obstacles to sinking exploratory shafts at Yucca Mountain and has stated that the current goal of beginning exploratory shaft construction in November of 1989 now appears less achievable. The start of exploratory shaft construction is a critical milestone in the site characterization effort and unfortunately has had to be pushed back on several occasions over the past year and a half; thus there is a strong desire to make progress towards this goal.
One major obstacle contributing to the expected delay in shaft construction is the need to obtain the Nuclear Regulatory Commission's approval of DOE and contractors' quality assurance programs and procedures for the characterization program. Once this is done, DOE can begin its five-month surface preparation work at the site. This was originally scheduled to begin in May and has now slipped.

Another factor is the delay in receiving from the State of Nevada the air and water permits that are necessary before DOE can begin site preparation and shaft work. The state has said it will not treat DOE differently from the hundreds of other applicants ahead of them for such permits. Nevada continues to voice strong opposition to the proposed repository at Yucca Mountain. The state has recently focused its attention on DOE's proposed location of the two exploratory shafts, stating that earlier studies show that an earthquake fault intersects the proposed shaft locations. The state claims that drilling in this location could encounter perched water that could severely flood the shafts. The governor of Nevada recently wrote to the Secretary of Energy asking him to personally review and reconsider issues surrounding the exploratory shaft location. The NRC has also criticized the shaft location as well as the shaft conceptual design and design control process, in its comments on DOE's Site Characterization Plan.

The State of Nevada's opposition to the project, which is manifested in various forms, is likely to be the most serious long-term obstacle to the progress of the repository effort. The state recently enacted a law outlawing the storage of high-level nuclear waste in the state, signalling possible legal battles ahead. Secretary Watkins stated in late April that DOE will restructure its approach to managing this project, including figuring out ways to ensure full participation by Nevada and thereby overcome the state's obstacles to progress. The details of such restructuring have not yet been announced.
Improvement in U.S. Nuclear Power Plant Performance

The foregoing discussion covers actions relevant to the support of nuclear power that primarily have been taken in recent months by the U.S. Federal Government. It is broadly recognized however, that the revitalization of the nuclear power option within the United States may well depend on activities beyond the direct control of the Government. This will include a period of steady, accident-free performance by the U.S. nuclear power projects as well as an increasing recognition among U.S. utilities and state public service commissions that the time is coming when larger base load capacity may have to be ordered again in selected U.S. regions. More broadly, there will have to be a restoration of confidence in utilities and the financial community that economically competitive nuclear power units can be completed, within budget and on schedule without fear that there will be major actions by some public utility commissions against allowing some costs of completing nuclear units to be included in the rate base. Hopefully progress in all of these areas will be achieved in the next few years.

For example, over the past several years a number of U.S. utilities have been making steady efforts to improve the performance of their nuclear units. Such performance is commonly measured by the capacity factor, which compares a plant’s actual output with its maximum potential output, expressed as a percentage. The average capacity factor for U.S. nuclear power plants in 1988 reached 65 percent, 3 points higher than 1987 and about 5 percentage points higher than in 1986. Other key measures of nuclear plant performance also improved in 1988 with a reduction in automatic shutdowns as well as a drop in unplanned activations of safety systems.
Uranium

The Secretary of Energy is required by statute to determine the viability of the U.S. domestic uranium mining industry annually. Based on the Energy Information Administration’s annual assessments and established criteria, the Secretary found that the industry was "not viable" for the years 1984 through 1987. Following a lawsuit brought by representatives of the uranium mining industry against the Department, in mid-1988 the U.S. Supreme Court reached a judgment that served to sustain the decision of the Secretary of Energy not to impose restrictions on the enrichment of foreign uranium for domestic use inasmuch as such restrictions would not assure the uranium industry’s viability. Because of the Supreme Court verdict as well as the ratification in 1988 of the U.S./Canada Free Trade Agreement, the miners withdrew their lawsuit against DOE. These developments served to assure the continuation of a free and open market for uranium that should stimulate competitive efficiencies.

In the meantime, the Secretary of Energy has requested that the Secretary of Commerce investigate the national security ramifications of the uranium industry’s non-viability. The results of this investigation are expected to be available in late 1989.

DOE Remedial Action and Waste Technology

The DOE Remedial Action and Waste Technology Program conducts environmental cleanup efforts at contaminated Department of Energy (DOE) and legislatively authorized non-government facilities across the United States. These activities reflect the Department’s intention to help ensure that the environment and public health and safety are protected. The focus of these activities is on sites that were supportive to civilian nuclear research and development. As has been well publicized DOE also
has launched a major multibillion dollar effort to cleanup a number of sites that have been supportive to DOE's military or defense oriented activities.

There are five activities included under the Remedial Action and Waste Technology program. The Formerly Utilized Sites Remedial Action Project currently includes 31 sites, 26 former nuclear processing sites which became contaminated as a result of DOE predecessor agency activities as well as 5 sites designated by Congress. The Uranium Mill Tailings Remedial Action Project includes 24 inactive uranium mill tailing sites and an estimated 5,000 vicinity properties. The Surplus Facilities Management Program provides for the safe management and disposition of designated contaminated facilities and sites resulting primarily from civilian nuclear energy programs. There are currently 41 projects included under this activity. The West Valley Demonstration Project will demonstrate the solidification of high-level radioactive wastes at the former spent fuel reprocessing plant new West Valley, New York. Finally, the Low-Level Waste Program provides technical assistance to States and regions in developing new low-level waste disposal capacity.

Non-Proliferation and International Nuclear Cooperation

Finally, during 1988 the United States continued to make progress in fostering civil nuclear cooperation under terms designed to be supportive to non-proliferation interests. This was manifested at the bilateral level as well as in various U.S. activities to support the International Atomic Energy Agency and the Nuclear Energy Agency of the OECD.

As a notable matter the United States and Japan successfully concluded a new Agreement for Cooperation which achieves a number of important objectives. The new Agreement provides the basis under which Japan will receive various long term programmatic
approvals of reprocessing, retransfers and plutonium use activities involving nuclear materials falling within the framework of the Agreement. The Agreement also brings U.S.-Japanese nuclear relationships within the framework of the U.S. Non-Proliferation Act of 1978 by including various up-dated non-proliferation conditions called for by the Act.

The Department of Energy also moved to establish a closer and more systematic cooperative relationship with Japan on liquid metal cooled reactors by seeking to conclude a new Memorandum of Understanding on this subject, by establishing a Joint U.S.-Japanese Standing Committee on LMR cooperation and by negotiating a closer Japanese association with the U.S. Fast Reactor Program.