



UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

February 24, 1998

The Honorable Albert Gore, Jr.
President of the United States Senate
Washington, DC 20510

Dear Mr. President:

I am pleased to transmit to the Congress the 1997 report of the Advisory Committee on Reactor Safeguards on the U.S. Nuclear Regulatory Commission's Safety Research Program. This report is required by Section 29 of the Atomic Energy Act of 1954, as amended by Section 5 of Public Law 95-209. This report concludes that severe budget reductions are causing substantial deterioration of the internationally respected capability of the U.S. Nuclear Regulatory Commission to conduct a forward-looking, effective safety research program.

Sincerely,

A handwritten signature in cursive script, reading "R. L. Seale".

R. L. Seale
Chairman

Enclosure:

Nuclear Safety Research, A Report to the U.S. House of Representatives and the U.S. Senate, by the Advisory Committee on Reactor Safeguards of the U.S. Nuclear Regulatory Commission, dated February 1998



UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

February 24, 1998

The Honorable Newt Gingrich
Speaker of the United States
House of Representatives
Washington, DC 20515

Dear Mr. Speaker:

I am pleased to transmit to the Congress the 1997 report of the Advisory Committee on Reactor Safeguards on the U.S. Nuclear Regulatory Commission's Safety Research Program. This report is required by Section 29 of the Atomic Energy Act of 1954, as amended by Section 5 of Public Law 95-209. This report concludes that severe budget reductions are causing substantial deterioration of the internationally respected capability of the U.S. Nuclear Regulatory Commission to conduct a forward-looking, effective safety research program.

Sincerely,

A handwritten signature in cursive script, reading "R. L. Seale".

R. L. Seale
Chairman

Enclosure:

Nuclear Safety Research, A Report to the U.S. House of Representatives and the U.S. Senate, by the Advisory Committee on Reactor Safeguards of the U.S. Nuclear Regulatory Commission, dated February 1998

NUCLEAR SAFETY RESEARCH

A Report to the U.S. House of Representatives and the U.S. Senate

by the

Advisory Committee on Reactor Safeguards

of the

U.S. Nuclear Regulatory Commission

February 1998

The Atomic Energy Act of 1954, as amended by Section 5 of Public Law 95-209, requires that the Advisory Committee on Reactor Safeguards of the U.S. Nuclear Regulatory Commission report annually to Congress on the status of nuclear reactor safety research. This is the 1997 report of the Advisory Committee on Reactor Safeguards.

This report concludes that severe budget reductions are causing substantial deterioration of the internationally respected capability of the U.S. Nuclear Regulatory Commission to conduct a forward-looking, effective safety research program. As we described in the report of 1996, this deterioration is occurring at a time when the U.S. nuclear power industry is undergoing substantial changes in response to economic deregulation made possible by the Energy Policy Act of 1992. These changes may have safety implications that must be addressed by the Commission. Research is needed to ensure that the agency effectively addresses these changes. The deterioration in research capabilities is also inhibiting the ability of the Commission to continue the evolution of nuclear reactor regulation to a risk-informed, performance-based structure. Finally, the Commission's core capability in nuclear waste research has been dramatically reduced. Further reductions could inhibit the Commission staff's effectiveness and timeliness in conducting reviews of the nuclear waste repository program and cause delays and additional expenditure of National resources.

Background

The use of nuclear energy to provide electricity to the civilian population was pioneered in the United States. This technology has now spread among the developed nations of the world and all indications are that it will also be adopted by developing nations in the future. Today, the majority of the 450 operating nuclear power plants and plants under construction throughout the world are based on U.S. technology.

It was, of course, well recognized in the initial applications of nuclear energy for civilian purposes that the health and safety of the public must be adequately protected. Because there was at the time so little experience with such a new technology, very conservative, prescriptive regulations emphasizing a defense-in-depth approach to safety were established to control the civilian use of

nuclear power and the management of nuclear waste. Overly conservative regulations that do not have safety significance serve only to inhibit the fruitful application of the technology. Congress recognized, however, that even the most stringent regulations might not anticipate all the safety issues of a new technology. Congress, therefore, encouraged safety research to further develop and refine the regulation of nuclear power. Recently, Congress has encouraged all regulatory agencies, including the Nuclear Regulatory Commission, to assess and refine regulatory actions to ensure that the costs and burdens imposed by regulatory actions are commensurate with the derived societal benefit.

Since the early days, nuclear power has become an essential, reliable contributor to the Nation's energy supplies. Today, nuclear energy provides about 20 percent of the overall electrical energy in the country, and it does so with very low emissions of particulate and gaseous pollutants. There are regions of the country where nuclear power is the dominant source of electrical energy. In some countries, nuclear power is an even more important source of electrical energy. Along with its role in the development and dissemination of this technology, the U.S. has become the world leader in nuclear safety. This leadership is due in no small part to the thorough safety research that the U.S. Nuclear Regulatory Commission has been able to perform in the past. This safety technology contributes significantly to the acceptance and purchase of U.S. nuclear technology by other nations. Well researched, well maintained standards and regulations for the nuclear fuel cycle, such as those developed by the Commission, reduce the potential for the proliferation of nuclear weapons materials as the worldwide use of nuclear power expands.

The Situation Today

While use of nuclear energy in the United States is not growing, the U.S. nuclear industry is by no means static. The industry is, in fact, undergoing substantial change. Changes due to modern technical developments such as the "digital revolution" in the instrumentation and control of nuclear reactors are to be expected and will improve both safety and efficiency if properly implemented. The changes that occur as nuclear power plants age must be addressed to ensure continued safety and reliability. Of more importance, and a definite source of greater uncertainty, is the change in the nuclear industry caused by economic deregulation. The pressures of increased competition will produce changes that could well have safety implications. Certainly, steps taken

by the industry to reduce manpower and to enhance the productivity of the remaining personnel need to be scrutinized closely and researched for safety significance. Similar comments can be made about steps being taken by the nuclear industry to extend the lifetime of nuclear fuel and to diversify the suppliers of nuclear fuel for individual plants.

The nuclear industry also faces the challenge in the future of a growing volume of spent nuclear fuel. Repositories for the disposal of nuclear wastes are prerequisites for the sustained use of nuclear power. Radioactive disposal facilities will also be crucial for continued use of nuclear materials in medicine, other industries, and scientific research.

If regulation is not to stifle economic and technical improvements in the U.S. nuclear industry, the U.S. Nuclear Regulatory Commission must be in a position to modernize its safety regulations. Modernization will also be essential if the United States is to maintain its world leadership as a supplier of both nuclear technology and nuclear safety technology. There are now about 3,000 reactor-years of operational experience in the commercial use of nuclear power. The Commission has fostered through research the development and refinement of systematic methods to collect operational safety data, to assess these data, and to combine the data sets into integrated evaluations of the safety of nuclear power plants. On the basis of the data and analyses, the Commission is now undertaking an important evolution of its regulations to a risk-informed, performance-based structure. The Commission is the leader, in fact, among this country's regulatory agencies and within the world's nuclear regulatory agencies at rational regulation that focuses efforts on topics of the greatest safety significance and assures that regulations are commensurate with the derived societal safety benefits.

Over the last year, the U.S. Nuclear Regulatory Commission has initiated changes to its regulations and practices that encourage risk-informed considerations to be taken in the development of technical specifications for nuclear power plants, in-service inspection and testing of safety systems, and graded quality assurance programs for safety systems. Pilot applications of these efforts to improve regulations are being conducted and the results are now being assessed. These moves toward risk-informed regulation are expected to improve safety and regulatory efficiency. They are also expected to reduce costs to the nuclear industry and to the American public. For example, the recent move to performance-based containment leak rate testing is

expected to produce cost savings approaching a billion dollars over the projected lifetimes of existing plants.

Innovations being made today by the U.S. Nuclear Regulatory Commission in its regulations are made possible by the research that has been done in the past. The Commission has, in fact, a good record regarding the prudent identification of important safety research issues and the effective conduct of research. During the last year, for example, past results from the research program have enabled the Commission to assess industry arguments concerning required inspections of reactor vessel welds. Potential problems identified by the research program have led to requirements for additional attention to the qualification of motor-operated valves in existing nuclear power plants. Past research has also made possible the certification of two new nuclear power plant designs: the General Electric Advanced Boiling Water Reactor and the ABB-CE System 80+ pressurized water reactor. The research program is contributing to the evaluation of the advanced light water reactor design now being proposed by Westinghouse for certification by the Commission.

The Crisis in Nuclear Safety Research

Despite the substantial changes the nuclear industry is undergoing, the budget available for the conduct of regulatory activities by the Nuclear Regulatory Commission is decreasing. In the face of declining resources, priority, of course, must be given to operational activities such as effective monitoring and inspection of licensees and the disposition of current licensing actions. Recent, well-publicized events at particular nuclear facilities have underscored the priority that needs to be given to such continuing vigilance. Consequently, many of the longer term benefits that could come from research have had to be deferred. The resources available for research have decreased disproportionately in the last several years. The research program has sustained reductions of 23 percent in 1996, 19 percent in 1997, and 16 percent in 1998. The declining resources available for needed research are having impacts now. Examples include:

- o A program to monitor industry research and to anticipate initiatives that may require revisions of regulations in the future has not been undertaken. The Nuclear Regulatory Commission is being forced into a position where it must wait and react to industry

proposals and thereby delay implementation of innovations even if these initiatives improve safety. Delays have already been encountered in the implementation of revised accident source terms and new dosimetry methods because the Commission cannot afford to complete needed research. Delays caused by deferred research on risk-informed pilot projects have distressed the nuclear industry whose hopes for improved regulations in the near future have begun to dwindle.

- Research needed to evaluate the potential for safety-significant human errors, especially as the nuclear industry "downsizes" staff in response to economic deregulation, remains in the planning stages despite continuing evidence from plant operations that human errors are important contributors to off-normal events at nuclear power plants.
- The technology has not been developed to extend systematic evaluations of risk from normal power plant operations to shutdown and low power operations despite evidence that these are modes of operation that pose risk to the public comparable to that from power operations.
- Research needed to evaluate licensee proposals to extend the lifetime of reactor fuel, which will also reduce the societal burden of spent nuclear fuel, remains to be performed.
- Safety research that will be needed to regulate the use of mixed oxide fuels as a means for the disposal of the Nation's excess weapon grade plutonium has not been initiated.
- The program to develop a technical understanding of public health and safety risks posed by severe reactor accidents may have to be terminated prematurely. Research on the safety and risk significance of fires has been deferred. The ability of the Commission to leverage dwindling research resources by collaboration in initiatives by other countries with more ambitious research programs may be jeopardized.
- Validation of industrial standards to use in place of Government-formulated regulations will be slowed.

- o Key elements of a well-designed research program to assist in the licensing of a high-level nuclear waste repository are being adversely impacted by Congressional funding reductions. Without the research results that reduce uncertainties, it may be necessary to add conservatism, and thus raise costs for the design of the waste repositories to ensure adequate protection of the public health and safety.
- o Fifteen of the generic safety issues identified since the 1979 amendments to the Energy Reorganization Act of 1974 have still not been resolved.

Deficiencies in the research program that the U.S. Nuclear Regulatory Commission can afford to maintain will affect the performance of line organizations responsible for ongoing regulatory activities with licensees. Even today, requests or "user needs" for research by line organizations are being withheld because it is known that the reduced research program cannot respond to such requests. Of concern now are limitations developing in the ability of the research program to conduct systematic examinations of the effectiveness of existing regulations and to identify additional areas for risk-informed, performance-based improvements. There are also concerns about the availability of financial resources to sustain safety research on emerging digital technologies. Without advanced safety research, application of these superior technologies to the instrumentation and control of nuclear power plants will be delayed, along with attendant improvements in safety and plant performance.

Conclusions

The U.S. Nuclear Regulatory Commission and the safe regulation of nuclear power plants have benefited from research done in the past. Reductions in the Commission budget have forced serious cutbacks in the research program and deterioration of the research capability. The Commission still needs a research program. It certainly needs a viable program to be able to evaluate proposals independently and to assess safety arguments advanced by the industry. It needs a stronger research program to continue the evolution of its safety regulations. The Commission also needs a research program to meet new obligations it is undertaking. Notable among the new obligations is the implementation of safety regulations for a geologic repository for

spent nuclear fuel. The agency is also conducting a pilot program to assess the viability of undertaking the safety regulation of certain Department of Energy nuclear facilities.

The Nuclear Regulatory Commission capacity for research is no longer commensurate with the agency's regulatory obligations. It will not be possible to maintain core competencies in all the areas that have historically proven to be of recurring importance in safety and regulatory actions by the agency. Modernization of regulations will be delayed because research cannot be performed to ensure that appropriately high levels of safety are maintained. Responses to industrial initiatives taken as a result of competitive pressures will be slowed without a broader research program. Delay in the implementation of cost competitive innovations may well force the nuclear industry to retire more plants prematurely, and the Nation will incur all the societal costs such unnecessary retirements entail. The development of a high-level nuclear waste repository is facilitated by the availability of well-researched safety regulations and analytical tools for licensing. Uncertainties left when research cannot be done because of funding constraints may delay the development of the repository or force the addition of costly conservatism.

In summary, there are benefits to the entire society that may be delayed or even lost as the research capability of the U.S. Nuclear Regulatory Commission deteriorates in response to declining financial resources.