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Honorable Nunzio J. Palladino
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Dr. Palladino:

SUBJECT: ACRS COMMENTS ON THE NRC SAFETY RESEARCH PROGRAM AND BUDGET FOR FISCAL YEAR 1988

During its 314th meeting, June 5-7, 1986, the Advisory Committee on Reactor Safeguards completed its review of the proposed program and associated budget for the Office of Nuclear Regulatory Research (RES) for Fiscal Year 1988. This matter was considered also by the ACRS Subcommittee on the Safety Research Program at meetings on May 7 and June 4, 1986 and at several meetings of other ACRS subcommittees having interests in specific portions of the research program. During our review, we had the benefit of discussions with representatives of RES, the Office of Nuclear Reactor Regulation (NRR), and the Office of Nuclear Material Safety and Safeguards (NMSS). We also had the benefit of the documents referenced.

Our comments and recommendations are directed to the program presented to our Subcommittee on June 4, 1986, based on an allocation of $99.6 million for program support. Although the program presented to us was categorized in accordance with Mission Area Codes (MACs), our comments are directed to the traditional program areas.

Our comments are provided below. In general, they relate to research that is not being proposed but should be, or in some cases to research that is proposed but may not be needed. For those programs that are not mentioned, we are in general agreement with what the Staff is proposing.

REACTOR ENGINEERING

Primary System Integrity

Cast stainless steel components in the primary system lose ductility with time in service. The implications of this phenomena for long-term primary system integrity need more attention. Appropriate emphasis should be placed on ascertaining the likelihood of flaws resulting from fabrication or from service, and on developing means of assessing conditions under which they could pose significant risk.

Electrical Equipment Qualification

The research and funding for Electrical Equipment Qualification proposed for FY 1988 are inadequate. In our report dated February 19, 1986 to the Congress, we recommended that this research be continued; contrary to this recommendation, the research is scheduled for termination by the end of FY 1986 and funding has been eliminated for FY 1987 and thereafter. We consider the continuation of this work to be vital to the

nuclear safety program and again recommend that it be funded.

The objective of this research is to assess the probability of survival and performance of aged electrical equipment when subjected to hostile environmental conditions during and following incidents, including severe accidents, fires, hydrogen burns, seismic events, and credible combinations. The results obtained from this research are vital to preventing accidents as well as mitigating the consequences of accidents, should they occur.

Four unique test facilities, with a combined cost of over $2 million, were constructed at Sandia especially for this program. These facilities are: (a) the high-intensity adjustable cobalt radiation facility for creating an accident environment of steam, radiation, chemicals, and gas; (b) the low-intensity adjustable cobalt facility for creating a temperature-radiation environment for life aging of specimens; (c) the high-temperature facility for creating severe accident environments; and, (d) the fire test research facility for assessing the effects of fires, including hydrogen burns. These test facilities are unique in being able to create environments for assessment of the effects on aged equipment of practically any credible incident, including design basis or severe accidents, hydrogen burns, and fires. In order to preserve and maintain the existing test facilities and staff experience sufficient to continue and complete the electrical equipment qualification work efficiently, it will be necessary to continue funding this work in FY 1987. Since its inception from about 1976, more than $10 million has been spent on this program. Funds needed to continue and complete the program are approximately $1.5 million in FY 1987 and $0.9 million in FY 1988.

Electrical equipment qualification work and the electrical elements in the program to determine the effects of plant aging and irradiation are closely related and to some extent interdependent. The research on aging in this program can utilize the same testing facility and extensive experience base for the electrical equipment qualification work. Both programs are essential as input to the program to determine life expectancy of electrical equipment for future reactor life extension licensing.

We recommend that the Electrical Equipment Qualification work that was originally included in the FY 1987 budget be completed and be funded by deferring or stretching out other work, for example, the program to determine the effects of aging and irradiation.

THERMAL HYDRAULICS

Research planned in the thermal-hydraulics area is divided into two general parts. The first is a continued program to improve the understanding of thermal-hydraulic behavior in Babcock and Wilcox (B&W) reactor systems; in its fullest form, this calls for substantial industry support. The second is a more general program of code development and experiments which does not include direct industry participation. We believe that the emphasis on B&W systems is appropriate and that the industry should provide major support to this program as the RES Staff has proposed. It is also important that the NRC continue a viable general program of research into the foreseeable future, including integral testing, separate-effects testing, and code development.

The following comments relate to research areas for which neither the program plans nor the funding levels have been established clearly.

Multi-Loop Integral System Test (MIST) Follow-On

Substantial questions remain about the thermal-hydraulic behavior of B&W systems. There is no independent program by the vendor or utilities to address these questions. We believe that a limited series of tests should be conducted following the initial program. However, it is not clear to us that the "full power" tests are justified. Additional funding, including substantial support from the industry, is essential.

Once-Through Steam Generator (OTSG) Separate Effects Test

The OTSG is a unique feature of B&W nuclear steam supply systems. The transient behavior of the OTSG, especially with auxiliary feedwater flow, cannot now be predicted with accuracy. A large-scale experimental model of an OTSG proposed by RES can provide needed information. This facility would complement the MIST follow-on program noted above. It is not necessary that this facility be capable of full pressure, but it should be large enough in scale to permit accurate modeling and measurement of key phenomena.

Water Hammer

We believe that it is essential to continue development of an experimental and analytical program to provide a better understanding of the causes and consequences of water hammer in nuclear power plants, especially as a complicating effect in complex transients induced from other causes.

Bleed and Feed Phenomena

The ability of pressurized water reactor (PWR) plants to "bleed and feed" from the primary system, either to remove core heat or to permit controlled depressurization of the primary coolant, is assuming increased importance as more attention is being paid to procedures and methods for managing off-normal and accident situations. In addition, increased consideration is being given to the design of systems specifically for controlled primary blowdown. Largely because of the locations of valves and pumps used for this process, the thermal-hydraulic phenomena involved in bleed and feed can be quite complex. The phenomena involved in the process and the capability of equipment called on are not well enough understood to validate the designs and to support the development of applicable rules, procedures, or practices. We believe that a research program, possibly in the proposed new integral test facility, should be developed to provide an appropriate base of information. Separate-effects tests and equipment tests may also be necessary.

SEVERE ACCIDENTS

The research program being proposed under the rubric of Severe Accidents includes a significant experimental component. The relationship of this research to dealing with the severe accident regulatory issue should be made clearer than it now is. For example, there are three major experimental programs to investigate phenomena that will be encountered (if at

all) only after the reactor core has melted and has penetrated the vessel. The experiments are related to containment heating, to core-concrete interaction, and to containment behavior under extreme over-pressure. Presumably each of these experiments is designed to reduce the uncertainties estimated in connection with the preparation of NUREG-1150, "Nuclear Power Plant Risk and Regulatory Applications." In order to decide whether additional research is needed to reduce existing uncertainties, NRR must decide what uncertainties are acceptable in connection with its regulatory responsibilities. We have not seen any indication that this decision has been made. We (and we would suppose RES as well) must, under the circumstances, try to judge the relevance of the proposed research with insufficient information.

With this caveat, we make the following comments:

- The research on containments under extreme overpressure seems well designed and should produce results that are relevant and that are needed to calibrate codes being developed for a description of containment behavior.

- The proposed work on core-concrete interaction is needed. However, in order to plan research that will answer questions likely to arise in regulation, the important uncertainties attributable to incomplete understanding of particular phenomena should first be identified. The research can then focus on those phenomena.

- Some risk analyses indicate that high pressure core melt sequences may produce enough direct heating of containment atmosphere to cause early containment failure by overpressure. The proposed research on direct containment heating may be of considerable significance to understanding risk; however, it may be relevant only if a high pressure core melt sequence for PWRs has a sufficiently high probability. We believe that the proposed research be performed concurrently with an investigation of the likelihood and effect of direct-heating events. We also recommend that the experimental investigation give first consideration to the expulsion process, to the effects of containment geometry, and to the presence of water in the sub-vessel cavity.

These comments do not represent a complete coverage of the severe accident research program. We use them as an example of our conclusion that more consideration needs to be given to what has been learned from the research of the past five years or so, and what uncertainty can be tolerated by the regulators; or put another way, what are the questions that regulators have encountered or are likely to encounter in formulating regulations for dealing with severe accidents that cannot be answered with existing information. With diminishing resources, it is increasingly important that the research be specifically designed to address safety concerns.

RISK ANALYSIS

We agree with the proposal for increased emphasis on work related to understanding the risk significance of equipment qualification, aging and fire. We recommend that a continued search for possible weaknesses in the current analyses, e.g., accident paths either not currently evaluated or dismissed as insignificant, which may, on closer scrutiny,

prove to be very important to risk.

It is important that a dependable assessment be made of the containment performance for each containment type for a wide range of postulated scenarios. We recommend that research on the development and evaluation of containment performance criteria be continued. We also recommend that research into the management of severe core damage accidents and on containment performance be given emphasis. It is vital to evaluate each type of nuclear steam supply system and the major variations in containment design. Some research will also be required on complex systems interactions if this area is to be appropriately treated in the NRC's severe accident evaluation.

HUMAN FACTORS

We anticipate that the National Research Council will recommend a considerable program of research effort for human factors. Plans for implementation of such a program should be factored into the budget.

WASTE MANAGEMENT

High-Level Waste

We support the efforts of the NRC Staff to develop an improved system for assigning priorities to individual research projects pertaining to High-Level Waste Management. We believe that more emphasis should be directed to the development of field data on the movement of radionuclides within the environment and on the associated impact of heat-water-rock interactions. There is also a need for the development of data on the predicted performance of repository systems under realistic field conditions. Although to a major extent such work should be conducted by the Department of Energy (DOE), the NRC Staff needs to be sufficiently active to provide the Commission with a capability for independent assessment of the DOE proposals.

Low-Level Waste

We endorse the program on Low-Level Radioactive Waste Management. At the present time, the NRC is one of the few Federal agencies conducting research in this field. The results of these studies are urgently needed by the states which have been mandated by the Congress to meet a strict timetable for developing facilities for the disposal of such wastes. We believe that the program, as outlined, is the minimum necessary to meet NRC responsibilities in this area.

Additional funds should be provided for research to develop a technical basis for defining criteria for the designation of low-level radioactive materials that are below regulatory concern, and for radiation protection guidance for alternatives to shallow-land burial of low-level wastes. Both of these needs are mandated by the Low-Level Radioactive Waste Policy Act of 1985.

Wastes with radionuclide concentrations above Class C are not receiving adequate NRC research attention. Since the Low-Level Radioactive Waste Policy Act of 1985 requires that DOE develop methods for the management of such wastes, and since the related disposal facilities must be licensed by the NRC, we urge that the NRC move promptly to define and

initiate a research program to develop an appropriate technical base for meeting its needs in this subject area.

Sincerely,

David A. Ward
Chairman

References:

1. Table on the Office of Nuclear Regulatory Research Program Support Budget for FY 1986-1989, dated June 3, 1986, submitted at the June 4, 1986 ACRS Safety Research Program Subcommittee meeting.

2. U.S. Nuclear Regulatory Commission, Advisory Committee on Reactor Safeguards, "Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program for Fiscal Year 1987 - A Report to the Congress of the United States of America," dated February 19, 1986.

3. U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, "Reassessment of the Technical Bases for Estimating Source Terms," Draft NUREG-0956, dated May 23, 1986.

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