



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

June 16, 1983

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

Dear Dr. Palladino:

SUBJECT: COMMENTS ON THE NRC SAFETY RESEARCH PROGRAM BUDGET FOR FISCAL YEARS  
1985 AND 1986

During its 278th meeting, June 9-11, 1983, the Advisory Committee on Reactor Safeguards (ACRS) completed its review of the Program Support Budget of the Office of Nuclear Regulatory Research (RES) for Fiscal Years 1985 and 1986. This matter was considered also by the ACRS Subcommittee on the Safety Research Program at meetings in Washington, DC, on May 11 and June 8, 1983, and at several meetings of other ACRS Subcommittees having interests in specific portions of the research programs. During our review, we had the benefit of discussions with representatives from RES, the Office of Nuclear Reactor Regulation (NRR), and the Office of the Executive Director for Operations (EDO).

As you have requested, this report has been prepared and is being submitted about a month earlier than our previous reports. Because of this, our review and comments are based on the budget that has been submitted by RES to the EDO rather than on the budget submitted by the EDO to you, as was the case in the past.

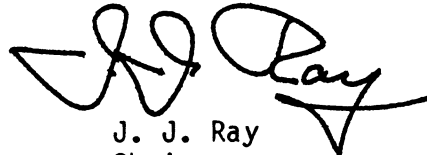
As in previous reports, most of our comments are directed to the budget for the first year of the two-year cycle, in this instance for FY 1985. The budget for FY 1986 is addressed chiefly with respect to trends and the total amount.

In our report last year, we recommended that the proposed budget for FY 1985 be increased from \$195.0 million to \$201.5 million to allow for new programs. This recommendation was accepted by you, and the higher figure was included in the Commission's request to the Office of Management and Budget. The FY 1985 budget submitted to the Congress, however, was for only \$175.8 million, a reduction of \$25.7 million, of which \$10.0 million resulted from the transfer

of the Loss of Fluid Test (LOFT) Facility from the NRC to the Department of Energy. Excluding LOFT, the proposed budget was reduced from \$191.5 million to \$175.8 million, about 8 percent. This reduction was accepted by the ACRS in its report to the Congress in February 1983, but we indicated in that report that further reductions below that level would be undesirable. The budget submitted for our review totals \$186.4 million, which is \$10.6 million higher than that proposed in January 1983.

Our comments regarding the importance, priorities or effectiveness of the programs, and our recommendations for additions or deletions are given in Sections 1 through 10 of the attached report, arranged by Decision Units. Our recommendations for funding levels are given in Table 1 and summarized in Section 11.

Sincerely,

A handwritten signature in black ink, appearing to read "J. J. Ray". The signature is stylized with large, sweeping loops and a long horizontal stroke at the end.

J. J. Ray  
Chairman

**Attachment:**

ACRS Comments and Recommendations on the NRC Safety Research Program Budget for Fiscal Years 1985 and 1986.

ACRS COMMENTS AND RECOMMENDATIONS ON  
THE NRC SAFETY RESEARCH PROGRAM BUDGET FOR  
FISCAL YEARS 1985 AND 1986

1. REACTOR AND FACILITY ENGINEERING

1.1 General

The majority of the program in this Decision Unit is concerned with assuring the integrity of safety systems (mechanical, electrical, and structural) of nuclear power plants throughout their life. We concur with the program as planned with the following exceptions.

1.2 Primary System Integrity

The Office of Nuclear Reactor Regulation (NRR) suggests deferring the work funded by the Office of Nuclear Regulatory Research (RES) on "Steam Generators and Environmentally Assisted Degradation." We would draw a sharp distinction between degradation in steam generators and degradation of the boiling water reactor (BWR) primary pressure boundary. We would concur in phasing out support of the work centered around the Surry steam generator at the Pacific Northwest Laboratory. However, we are concerned about the fundamental lack of understanding of what operating practices are influencing the degradation of BWR piping, and believe it would be a mistake for the NRC to depend entirely on the work done by others in this area.

1.3 Process Control

The current plans for decommissioning the Shippingport Atomic Power Station and the decontamination efforts underway at Three Mile Island Unit 2 (TMI-2), represent unusual opportunities for the NRC Staff to gain valuable data for application in regulating the decommissioning of commercial nuclear power plants. We support the currently proposed funding for decommissioning (\$0.6 million for FY 1985 and \$0.5 million for FY 1986) and recommend that it be used to enable the NRC Staff to keep abreast of the TMI-2 and Shippingport activities and to evaluate the results.

2. FACILITY OPERATIONS

2.1 General

We believe that the reduction in FY 1985 funding for this Decision Unit is wrong. We recommend that funding for this Decision Unit be increased by \$2.0 million in both FY 1985 and 1986.

The experience of TMI-2, the results of probabilistic risk assessments (PRAs), and the reports of numerous committees, commissions, and review groups have all indicated the paramount importance of operational considerations in the safety of nuclear power plants. Despite this, the NRC has increased research in this area only modestly and with hesitation over the past few years. And now, for FY 1985, the Staff has proposed a decrease. We believe that this reduction is inappropriate. In the U.S., no nuclear power plants are being designed, only a few are being constructed, but many are being operated. The preoccupation with expensive hardware and elaborate analytical procedures continues. It is clearly apparent that the safety of nuclear power plants is strongly dependent on the qualities and attitudes of the people who operate and maintain them and on the practical tools, such as procedures and training, at their command. The NRC research should be directed to answer the important new safety questions which have been asked, not to grind out more and more detailed solutions to yesterday's questions.

## 2.2 Human Engineering and Safeguards

### 2.2.1 Human Engineering

Halting the trend of recent years toward increased funding of this area will have a serious effect on the conduct of an effective Human Factors research program. The NRC Staff has generally been responsive to our concerns related to the Human Factors research program as expressed in our last report to the Congress (Ref. 1)\*. However, because of funding restrictions, the Staff has been forced to suspend, dilute, or stretch out research activities in several important areas. These include research on improved diagnostic aids, and research into means that the NRC can use to assess and assure the effectiveness of licensee organizations to operate nuclear power plants. While some Industry efforts may address these areas, they will not address the regulatory research concerns previously identified by the Staff and endorsed by the ACRS. For example, while the work that the Institute of Nuclear Power Operations (INPO) is doing in assessing the effectiveness of utility organizations seems to be of great value, it is not research. Rather it is the type of evaluation that NRR or the Office of Inspection and Enforcement (IE) might do if INPO did not.

We continue to believe that careful attention should be given to placing research in the human factors area with research organizations that are most appropriately qualified by academic credentials and experience to perform the needed work. The ease of contractual arrangements should not be a primary consideration. This would likely result in placing more research in the human factors area with academic and private/industrial research organizations than with National Laboratories.

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\*References appear in Appendix A.

In view of the fact that the Human Factors research program accounts for only about 3 percent of the total research budget and an estimate that approximately 40 percent of the recent Licensee Event Reports (LERs) at nuclear power plants involve adverse human actions, we believe that the Human Factors research budget should be increased substantially in FY 1985 and ensuing years. While we recognize that neither the NRC Staff nor the research community can effectively accommodate large step increases in funding from one year to the next, we find that this oft-stated argument loses force given the record of only modest growth in Human Factors research over the past few years. We believe that funding for the Human Engineering Program should be increased by \$2.0 million in both FY 1985 and 1986 over the amounts currently proposed by RES. Ten percent or more of the NRC research budget to this area might be an appropriate goal for the longer range.

A few specific comments in the human factors area follow:

- Development of improved emergency procedure guidelines (EPGs) has been one of the most important NRC and Industry programs. We endorse a research effort to extend EPGs to so-called severe-accident sequences.
- A start should be made, albeit modest in funding or expectations, on research toward a better understanding of the qualities that are characteristic of superior licensee operating organizations.
- Continued involvement by NRC in the human factors work at Halden is warranted. European nuclear organizations have made important advances in this area from which U.S. programs can benefit. An expansion of activities to incorporate foreign experience and research should be considered.
- The concept of developing models to understand how changes in nuclear power plant staffing and related considerations can influence reactor safety is useful and deserves continued support.
- We reiterate our suggestion from an earlier report (Ref. 1) that a modest program to evaluate the effectiveness of traditional quality assurance (QA) practices would provide valuable insights into how QA programs might be improved.
- We are not comfortable with the exclusive emphasis on human error in the human factors area. Humans often take actions that are miti-gative, as at Salem. We recommend that some effort be expended (perhaps by LER sampling) to develop a data base on human performance under upset conditions, to help quantify the positive role of the operator.

### 2.2.2 Safeguards

We believe that research into means to understand and prevent sabotage at nuclear power plants should continue at a funding level equal to or greater than that of the past few years. In particular, greater attention should be given to developing a better understanding of sabotage vulnerabilities posed by existing plant arrangements and the presence of an "insider."

On a number of prior occasions (Refs. 1,2,3), we have recommended that the NRC Staff devote enough research to design measures against sabotage to enable regulatory resolution both for existing and for new plants. The currently planned effort to define such design measures is inadequate and lacks the appropriate definition of purpose. In particular, we believe that the current licensing efforts for new standard plants are not supported by adequate consideration of the question of sabotage. We recognize the difficulties in doing sabotage research and the apparent lack of success in deriving practical results from work experience. However, it is an issue that cannot be ignored, and we believe that a reduction in funding is inappropriate. We are particularly disturbed that budget reductions in this area have caused the NRC to cancel its plans to evaluate sabotage prevention measures employed by other countries.

### 2.3 Plant Instrumentation and Control

We concur with the general scope and funding level for this Subelement and with the priorities indicated by the Staff, with the exceptions discussed below.

Because at least one nuclear steam supply system vendor is developing plans for reactor protection and control systems using digital computers, we believe that some research in this area is warranted to provide the NRC with information which it will need to define requirements for such systems. Issues such as redundancy and diversity requirements and QA for software appear to be important.

A major effort of this program is devoted to an investigation of Safety Implications of Control Systems. In NUREG-0963 (Ref. 1), we recommended that an effort be made to define the problem in a general sense and to explore the formulation of appropriate reliability or performance criteria before beginning study of specific plant performance. The approach being taken begins by using a hybrid computer to model one specific power plant with the goal of learning how the control systems perform in that plant. Effort will then be made to extend the results of this study to other plants. From what we have seen, we are skeptical of the usefulness of information obtained by this approach, even in its application to that one plant. We have no evidence that what may be learned on the one plant will have general applicability. We also see little correlation between this program and the work toward

resolution of the associated Unresolved Safety Issue (USI) being undertaken in Task A-47. While we believe there is an important question to be answered by research in this area, we believe that the currently planned program is ill conceived.

We believe that the Component Assessment project should be eliminated. This should be a responsibility of the Industry.

We concur with the elimination of the proposed evaluation of fluidics emergency core cooling activation study, of the study of automatic testing of safety channels, of the evaluation of bypass/inoperability of safety equipment, and of the assessment of reactor coolant flow measurement alternatives.

#### 2.4 Occupational Protection

For FY 1985 and 1986, RES has proposed \$0.8 million per year for the Occupational Protection Subelement, the majority of which is allocated to research projects on Decontamination and Respiratory Protection. We believe that this proposed funding is not sufficient for supporting the research needs in this area. Such needs include:

- Beta and neutron dosimetry.
- Performance standards for radiation protection instruments.
- Better methods for recording and interpreting personnel exposure data.
- Review of dose-reduction techniques that have proven effective in other countries.

The nuclear utility industry as well as other federal agencies look to the NRC as a leader in radiation protection research. We believe that the proposed reduction in funding (from \$2.6 million to \$0.8 million) for FY 1985 and 1986 would send the wrong signal to these groups at the very time that the NRC program in radiation protection research is beginning to be effective. We therefore recommend that \$2.6 million be provided for this Subelement.

### 3. THERMAL HYDRAULIC TRANSIENTS

#### 3.1 General

We concur with the general scope and funding level for this Decision Unit. However, we believe some comments on certain Subelements and on the apparent priorities being assigned to individual programs by the NRC Staff are warranted.

### 3.2 Integral Facilities

We believe that this effort, consisting of work at the Semiscale, Full Integral System Test (FIST), and Multi-Loop Integral System Test (MIST)/Once Through Integral System (OTIS) Facilities, is better balanced than it has been in the past in providing information on all U.S. light-water reactor (LWR) types. While we are particularly encouraged by development of the joint NRC/Babcock and Wilcox (B&W)/Electric Power Research Institute (EPRI) integral-system tests (MIST/OTIS), we have some concerns. Modeling and scaling problems associated with the MIST Facility will be severe. We recommend that the NRC give high priority to the assurance that the MIST Facility will be designed and the associated analysis program arranged to evaluate all the key thermal-hydraulic phenomena that are of concern in B&W plant systems. As we have noted previously in NUREG-0963 (Ref. 1), a well-developed program of separate-effects experiments is needed in support of the integral-system tests.

### 3.3 Separate Effects

A comprehensive and diverse program of separate-effects experiments is of critical importance to the overall research effort in thermal hydraulics. These experiments, many at universities and other small laboratories, are much less expensive and more flexible than the sometimes ponderous integral-facility tests. Such experiments are invaluable in exploring poorly understood phenomena and in promoting advances in thermal-hydraulic technology. The Staff has assigned low priority to continuation of work at one such facility, the Thermal Hydraulic Experimental Facility. We can concur with this only if there is assurance that experimental work at the ROSA-IV Facility in Japan will continue and that the NRC will have access to the Japanese data. At any rate, we endorse NRC's participation in the ROSA-IV program.

In NUREG-0963 (Ref. 1), we noted the initiation of joint NRC/Westinghouse/EPRI experiments (MB-2) to investigate primary to secondary system heat transfer and fluid dynamics under transient conditions in steam generators. We expressed concern that the experimental results will not apply to B&W Once Through Steam Generator (OTSG) plants. RES has informed us that an EPRI-sponsored research program has generated OTSG data comparable to those expected from MB-2. We urge RES to attempt to obtain the EPRI data and perform the associated analysis for B&W plants in conjunction with the NRC/Westinghouse/EPRI effort.

### 3.4 Transient Models and Codes

The main focus of effort is on the development of a Plant Analyzer and a Plant Data Bank. The Plant Analyzer effort is divided between the Brookhaven National Laboratory (BNL), and a cooperative program at the Los Alamos

National Laboratory (LANL) and the Idaho National Engineering Laboratory (INEL). The former is to develop a parallel processor approach for a BWR Plant Analyzer and the latter is to develop a pressurized water reactor (PWR) Plant Analyzer using fast-running versions of the TRAC and RELAP-5 codes. We believe that the goal of the Plant Analyzer research is not sufficiently well focused. NRR, the intended customer for a Plant Analyzer, has recommended a low priority for this program. While we believe that the Plant Analyzer could become an important and useful tool for NRR, the development will be expensive. This program should be deferred until NRR becomes more enthusiastic and involved in defining the research goals.

Further, it is not clear that the two programs are coordinated well enough to lead to equally competent systems for both BWRs and PWRs. It appears that the parallel processor concept, if effective, could apply to both BWRs and PWRs. Broader aspects of the BWR analyzer are apparently not being developed in the current BNL effort.

A vital part of the Plant Analyzer and Plant Data Bank Programs is the review of actual plant data on normal and transient operating parameters to validate codes. RES has noted that it has been extremely difficult to obtain these data from U.S. licensees. We recommend that NRC explore the possibility of a cooperative program, perhaps with EPRI, to obtain this needed information.

#### 4. SITING AND HEALTH

##### 4.1 Earth Sciences

We have in the past (Refs. 1,3) supported the Seismology and Geology portion of the Earth Sciences Program and continue to support funding of this work at the current levels. We recommend that the personnel responsible for the program in this area attempt to develop an improved capability for estimating the severity of earthquake-induced ground motions that may have a return frequency in the range of  $10^{-4}$  to  $10^{-5}$  per year at nuclear power plant sites.

##### 4.2 Health Effects

For some time we have strongly supported a modest NRC Health Effects research program consistent with the need to be able to assure the public of the adequacy of the related NRC regulations. Through careful coordination with other federal agencies, the NRC Health Effects Program has been directed specifically to regulatory needs and does not duplicate similar efforts by other organizations. Several of the ongoing projects are long term and their

abrupt termination would result in a loss of much potentially useful data. Projects of importance include studies on the health effects of neutrons, the metabolism and effects of inhaled uranium, the early effects of acute internal exposures, and problems associated with radon. If this program cannot be funded at the proposed level (\$2.7 million for FY 1985 and \$3.1 million for FY 1986), we recommend that at least \$2.0 million per year be allocated for carrying out the above studies.

## 5. RISK ANALYSIS

### 5.1 General

We have given general support to the research program in Risk Analysis in our previous reports to the Commission and to the Congress (Refs. 1,2). However, we have made many recommendations for changes in emphasis or in program to which RES has not been responsive. We repeat the following comments.

### 5.2 PRA Methodology Development

In NUREG-0963 (Ref. 1), we recommended that first priority be given to the early development of practical risk models to treat the following in near-term PRAs: seismic events, externally induced floods, fires, systems interactions, operator errors of commission, and design and construction errors. RES has advised us that their program will now include all but the last of these matters. However, RES has lagged badly in attacking these issues previously, and its currently proposed pace of development is too slow. Also, it appears that much of the available resources may be consumed in an elaborate, full-scope, state-of-the-art risk assessment of a specific plant. Although this would be useful, it may require neglecting a variety of studies of important systems in types of nuclear power plants other than that chosen.

### 5.3 Reactor Risk Analysis

We have repeatedly recommended (Refs. 1,2,3) a high priority and greater funding support for research intended to provide information vital to decision making with regard to Severe Accident Policy. However, in its response to this recommendation made most recently in NUREG-0963 (Ref. 1), RES stated that it was proceeding with the work necessary to support the Severe Accident Policy effort consistent with established schedules. It stated also that further acceleration of the work and increased funding do not appear to be warranted at this time.

If RES has a sufficiently broad, well-defined program with established schedules in this regard, we have not seen it. Presumably, such a defined program would answer the following questions, among others:

- For Severe Accident Policy making, what are the specific informational needs for each existing nuclear power plant, for plants under construction, for plants like GESSAR II, and for any new Westinghouse or Combustion Engineering product line?
- How are these specific informational needs being filled, in detail?
- How well do we know the risk from existing nuclear power plants? How well do we need to know it? How should policy decisions be made?
- What are the specific accident prevention measures and accident mitigation measures to be considered for each existing nuclear power plant or class of plants? What are their merits, problems, and costs, in detail and what are the uncertainties in this regard?
- Can a containment performance criterion be specified for each nuclear power plant or plant type? If so, how? If not, why not?
- What is the role of external events, design errors, systems interactions, sabotage, aging, equipment qualification, operator errors of commission etc., in this evaluation? What information is needed? On what schedule is it being obtained and how?
- How are decisions to be arrived at in light of the large uncertainties that are in current risk analysis results?

We would be pleased to be convinced that the existing program is adequate for the purpose. We await the evidence. Lacking such evidence, we continue to urge the Commission to require that the Staff do the needed research.

#### 5.4 Transportation and Fuel Cycle Risk

We believe that the Transportation and Fuel Cycle Risk Program should have a low priority and might well be eliminated in view of a restricted budget.

### 6. ACCIDENT EVALUATION AND MITIGATION

We have consistently supported the investigation of severe accidents and severe accident phenomena. We believe that the funds allocated are appropriate to the magnitude of the task. We have, however, repeatedly raised

questions about the approach being taken in the program we have reviewed. It is difficult to say anything new about this. We reiterate:

- Research in this area is of utmost importance in providing information needed to construct the regulatory framework for dealing with severe accidents.
- We believe that more emphasis should be given to understanding the accident sequences that could produce the severe core damage that leads to the release and dispersion of fission products.
- We remain unconvinced that the computer codes being developed for a deterministic description of severe core damage can be demonstrated to provide information useful for licensing.

We would like to observe also that much of the program on the physics and chemistry of the source term within containment involves cold (up to several years old) or unexposed fuel that has been spiked with token fission products. In either case the radiolytic environment of an accident is missing-- a circumstance that may well invalidate the results of the research.

We note current considerations of:

- SECY 82-1B, Proposed Commission Policy Statement on Severe Accidents and Related Views on Nuclear Reactor Regulation.
- The Nuclear Power Plant Severe Accident Research Plan (NUREG-0900).
- Policy Statement on Safety Goals for the Operation of Nuclear Power Plants (NUREG-0880, Revision 1).

All of these are related to the regulatory problem of dealing with severe accidents. Yet the enunciated policies and programs are in some cases uncoordinated and even contradictory. The research program must be related to all of these. Its focus is blurred by uncertainty of direction. We urge continuing effort toward coordination and prioritization of the various activities.

Further, we note the current consideration of an application for approval of a standard plant design. We are not convinced that the research program described to us will provide information needed by the Commission to resolve the severe accident issue for this proposed standard plant.

We agree that, if decreases are necessary, a lower priority can be given to work on development of specific design information addressing consequence mitigation systems and to two of the four separate-effects experiments planned in the Annular Core Research Reactor (ACRR).

On many occasions in the past, we have recommended that a meaningful program be established and pursued on Improved Safety Systems. As examples, we have suggested studies of more reliable (possibly dedicated) shutdown heat removal systems, and investigations of ways to improve the performance and capability of reactor containment systems. We reiterate our recommendation in NUREG-0963 (Ref. 1) that at least \$2 million be allocated to a broadened research program on Improved Safety Systems; the additional funding for this program should be taken from the in-pile test programs on Fuel Damage and Fission Product Source Term. We believe that these programs represent a relatively less cost-effective portion of the NRC Safety Research Program and should therefore be a major target for reallocation of funds to this and other research.

## 7. LOSS-OF-COOLANT ACCIDENTS

### 7.1 General

We believe that the research program directed toward understanding the thermal-hydraulic phenomena associated with the large-break LOCA should be regarded as completed, with the exception discussed below. This massive and expensive program has successfully and conclusively shown that the requirements of Appendix K of 10 CFR Part 50 are adequate to assure the health and safety of the public, should a large-break LOCA occur in an operating nuclear power plant. We recommend that funding in this Decision Unit be reduced by \$2.0 million for FY 1985.

### 7.2 2D/3D Program

We recommend that the NRC withdraw from further support of the 2D/3D Program when the international agreement governing this program expires in April 1985. If continuation at a modest level would assure availability of some useful test data, that may be warranted. However, because usefulness of such data is questionable, this should not take precedence over making funds available to other safety research areas.

### 7.3 Computer Simulation Scaling

NRC is expending effort here to undertake a revision of the requirements to Appendix K of 10 CFR Part 50. We support this effort because it will make

use of the extensive large-break LOCA data base to the economic advantage of utilities and ratepayers. We support this effort also because the traditional Appendix K focus on an extremely conservative evaluation of large-break LOCAs has influenced, and will continue to influence, the design and operation of emergency core cooling systems in a manner that could be deleterious to the overall concerns of emergency core cooling. We therefore endorse this program to develop means to evaluate LOCAs by best-estimate models, making appropriate allowance for variability and uncertainty.

## 8. ADVANCED REACTORS

In the recent past (Ref. 1), we have recommended that a funding level of about \$7.5 million be retained for generic Liquid Metal Fast Breeder Reactor (LMFBR) work as Clinch River Breeder Reactor (CRBR) needs are fulfilled; that the NRC move to develop a regulatory position for post-CRBR LMFBRs including the preparation of design criteria, the definition of safety research needs, and the definition of an appropriate NRC safety research program; and that the NRC provide safety advice at the design-initiation stage of future LMFBR efforts. We also suggested that the NRC should perform a PRA on CRBR, which we still believe would be a wise expenditure of funds.

We continue to believe that a funding below the \$7.5 million level would risk loss of a viable program.

We are concerned that almost no progress has been made toward developing a regulatory position for a near-commercial size LMFBR such as is currently being designed. We are also concerned that the NRC does not have the capability (and possibly, opportunity) to provide safety guidance early in the design of such units. We believe that the Commissioners have never really addressed the question of how the NRC should gear up to fulfill its responsibilities in the LMFBR area, and we worry that problems that are small today may become severe in future years, if not addressed promptly.

## 9. WASTE MANAGEMENT

We recommend that the research project on the Development of Corrosion Testing Methods for High-Level Waste Containers be carefully reviewed and evaluated. As part of this effort, the need for this work should be scrutinized by materials engineers within the NRC and advantage should be taken of the large amount of related research being conducted by other federal agencies. We believe that such an evaluation will likely show that this project can be terminated.

## 10. PROGRAMS NOT SPECIFICALLY INCLUDED IN THE BUDGET

This Section includes a number of research programs that we believe should be included in the NRC Safety Research Program for FY 1985 and 1986.

### 10.1 LWR Safety Approaches in Other Countries

In NUREG-0875 (Ref. 2), we recommended that the NRC Staff make a major effort to understand the increasingly sophisticated approaches to LWR safety that are now being used and developed in many foreign countries. We continue to believe that work of this type would provide a highly cost-effective way of improving the current regulatory process.

### 10.2 Design-Related Safety Research

On more than one occasion (Refs. 1,2), we have recommended that the NRC Staff undertake a program in design-related safety research and have provided examples of what might be done in such a program. NRC Staff actions in this area continue to be driven by the occurrence of specific incidents, such as the Salem circuit breaker failures, rather than being a planned program which attempts to seek out design weaknesses and to eliminate them. We believe that a program such as this would reduce the risk and costly outages associated with events such as that which occurred recently at Salem.

### 10.3 Seismic Effects in Control Rooms

In NUREG-0875 (Ref. 2), we recommended that a research program be initiated concerning possible effects of a severe earthquake on control rooms and the operators' ability to function. The Commission directed the NRC Staff to initiate a program pursuant to our recommendation. Funding for this program was first set at \$0.5 million but was later cut to \$0.1 million. At present no working program exists. We recommend that the NRC Staff restore this program to its initial level of funding and work toward the timely resolution of this problem.

### 10.4 Quantification of Seismic Design Margins

In our letter dated January 11, 1983 (Ref. 4) and in NUREG-0963 (Ref. 1), we identified the need for a major program intended to provide a much improved knowledge of the contribution of earthquakes to LWR risk. In a memorandum from W. J. Dircks to J. F. Ahearne, dated April 4, 1983 (Ref. 5), the NRC Staff appeared to support the timely resolution of this issue with such a program. The discussions that we have had with the NRC Staff and with representatives of the Industry indicate that the present plan for resolution of this issue will involve a joint effort among NRR, RES, and Industry. However, it appears from those discussions that only that effort which addresses geology and seismology is defined in the FY 1985 and 1986 budgets.

We recommend that a focused research program in this area be formulated, with a program director and enough funding to provide for resolution of the bulk of this issue by FY 1986 or that it be identified as a high priority USI. We recognize that planning and funding will extend beyond the RES portion of the budget and recommend that the Commission assure that an adequate funding and planning effort be included in the NRC FY 1985 and 1986 budget proposal.

#### 10.5 Use of PRAs in Decision Making

In NUREG-0963 (Ref. 1), we noted a need for the following: well-established quality assurance criteria for PRAs, a definition of what constitutes adequate peer review, the development of a guiding philosophy on how to factor uncertainties into decision making, and guidance concerning threshold criteria for action. The Staff's response to our recommendations is thus far inadequate. We believe that the execution of studies appropriate to meeting these needs should be accomplished on about the same schedule as the evaluation of the NRC's Safety Goals.

### 11. BUDGET RECOMMENDATIONS

Our recommendations for changes in the proposed levels of funding are given in Table 1 and explained and discussed below as they relate to the recommendations in Sections 1 through 10.

#### 11.1 Fiscal Year 1985

We believe that a total of about \$179.9 million would be sufficient to support a safety research program in the Office of Nuclear Regulatory Research adequate to meet the NRC's needs. Our recommendations for distribution to the various Decision Units and our reasons therefor are summarized in the following:

##### 11.1.1 The reduction of \$3.6 million in Decision Unit 1, Reactor and Facility Engineering, is based on:

- Transfer of the Program on Equipment Qualification Tests from RES to another office. This is not research.
- Elimination of the Program on Steam Generator Degradation.
- Delay of the development of methodology to check the contamination level of decommissioned facilities.

11.1.2 For Decision Unit 2, Facility Operations, we recommend an increase of \$2.0 million, and internal reallocations within this Decision Unit as follows:

- An increase of about \$2 million for the work on Human Engineering.
- An increase of about \$1.8 million in the area of Occupational Protection.
- Restoration of the funding for the research on Safeguards to the level of recent years.
- Elimination of the work on Component Assessment.
- Elimination of the work on new Instrumentation and Control Technology.

11.1.3 We recommend a decrease of \$0.5 million in Decision Unit 3, Thermal Hydraulic Transients, to be accommodated by termination of the work in the Thermal Hydraulic Experimental Facility.

11.1.4 We recommend a reduction of \$0.7 million in the funding for Decision Unit 4, Siting and Health, to be accomplished by a similar reduction in the program on Health Effects.

11.1.5 For Decision Unit 5, Risk Analysis, we recommend elimination of the transportation risk programs, for a reduction of \$1.3 million.

11.1.6 For Decision Unit 6, Accident Evaluation and Mitigation, we recommend a reduction of \$2.4 million to be accomplished by terminating the work on "core catchers" and by reducing the number of tests in the ACRR Facility from four to two. In addition, we have recommended that about \$2 million be reallocated from the in-pile test programs on Fuel Damage and Source Term to provide funds for a broadened research program on Improved Safety Systems.

11.1.7 We recommend that the NRC withdraw from further support of the 2D/3D Program when the international agreement expires in April 1985. This would permit a reduction of about \$2 million in funding for Decision Unit 7, Loss-of-Coolant Accidents.

11.1.8 We believe that the proposed funding for Decision Unit 8, Advanced Reactors, is marginally adequate and should not be further reduced.

11.1.9 We recommend that a careful review and evaluation should be made of the project on Development of Corrosion Testing Methods for High-Level Waste Containers. We believe that such a review will lead to elimination or drastic reduction in this program, and have recommended a corresponding reduction of \$1.0 million in the funding for Decision Unit 9, Waste Management.

11.1.10 In Section 10 of this report, we have proposed a number of research programs or areas that we believe should be included in the safety research program for FY 1985 (and FY 1986). We cannot estimate accurately the costs of these programs but believe that they can be initiated and undertaken within a budget of about \$2 to \$3 million, depending to some extent on the number of PRAs to be done in connection with the program on Quantification of Seismic Design Margins. Funding of \$3.0 million is indicated in Table 1.

## 11.2 Fiscal Year 1986

Our recommendations for FY 1986 cannot be as specific as those for FY 1985. Although it seems reasonable that the general trend of reductions in research funding will and probably should continue, we believe that the reduction should not be as great as might be suggested by projections of current programs on current problems. We believe that the levels of funding given in Table 1 should be reasonably adequate to avoid the need for major reallocations or requests for additional funding in FY 1986.

TABLE 1

OFFICE OF NUCLEAR REGULATORY RESEARCH  
PROGRAM SUPPORT BUDGET FOR  
FISCAL YEARS 1985 AND 1986  
(DOLLARS IN MILLIONS)

| DECISION UNITS                        | FY 1985     |                      | FY 1986     |                      |
|---------------------------------------|-------------|----------------------|-------------|----------------------|
|                                       | RES REQUEST | ACRS RECOMMENDATIONS | RES REQUEST | ACRS RECOMMENDATIONS |
| 1. REACTOR AND FACILITY ENGINEERING   | 44.7        | 41.1                 | 47.6        | 45.3                 |
| 2. FACILITY OPERATIONS                | 12.9        | 14.9                 | 14.4        | 16.4                 |
| 3. THERMAL HYDRAULIC TRANSIENTS       | 26.0        | 25.5                 | 23.0        | 23.0                 |
| 4. SITING AND HEALTH                  | 8.4         | 7.7                  | 9.1         | 9.1                  |
| 5. RISK ANALYSIS                      | 18.0        | 16.7                 | 17.9        | 16.6                 |
| 6. ACCIDENT EVALUATION AND MITIGATION | 47.3        | 44.9                 | 42.8        | 40.0                 |
| 7. LOSS-OF-COOLANT ACCIDENTS          | 9.0         | 7.0                  | 7.4         | 3.0                  |
| 8. ADVANCED REACTORS                  | 9.1         | 9.1                  | 9.1         | 9.1                  |
| 9. WASTE MANAGEMENT                   | 11.0        | 10.0                 | 13.5        | 13.0                 |
| 10. NEW PROGRAMS                      | --          | 3.0                  | --          | 3.0                  |
| TOTAL                                 | 186.4       | 179.9                | 184.8       | 178.5                |

## APPENDIX A

### REFERENCES

1. Advisory Committee on Reactor Safeguards, U.S. Nuclear Regulatory Commission, "Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program for Fiscal Years 1984 and 1985 - A Report to the Congress of the United States of America," NUREG-0963, February 1983.
2. Advisory Committee on Reactor Safeguards, U.S. Nuclear Regulatory Commission, "Comments on the NRC Safety Research Program Budget for Fiscal Years 1984 and 1985," NUREG-0875, July 1982.
3. Advisory Committee on Reactor Safeguards, U.S. Nuclear Regulatory Commission, "Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program for Fiscal Year 1983 - A Report to the Congress of the United States of America," NUREG-0864, February 1982.
4. Letter from J. J. Ray, Chairman, Advisory Committee on Reactor Safeguards, to Nunzio J. Palladino, Chairman, U.S. Nuclear Regulatory Commission, "Quantification of Seismic Design Margins," January 11, 1983.
5. Memorandum from William J. Dircks, Executive Director for Operations, NRC, to Commissioner Ahearne, NRC, "ACRS Comments on Seismic Design Margins," dated April 4, 1983.