

MAR 25 1982

MEMORANDUM FOR: Robert B. Minogue, Director
Office of Nuclear Regulatory Research

FROM: Harold R. Denton, Director
Office of Nuclear Reactor Regulation

SUBJECT: DRAFT LONG RANGE RESEARCH PLAN FY84-88
(LRRP)

This memorandum provides NRR's comments on the draft RES Long Range Research Plan for FY84-88.

The program of research outlined in the LRRP is generally responsive to NRR needs, but the plan would be more useful if it included crosswalks, by problem areas, and if resource estimates were available as foreseen in the Dircks February 3, 1982, memo. Before I can endorse the plan in accordance with the procedures in that memo, I will need to know the approximate level of effort proposed for the various portions of the plan to make cost effectiveness judgments and to assist in refining priorities.

* We have reviewed the problem areas of concern to NRR that could benefit from research early in the FY 84-88 time frame, and have identified the following high-priority areas:

1. Human Factors research directed toward identifying and developing the scientific basis for licensing requirements and criteria, consistent with the Commission's PPG of 1982.
2. Code validation research to maintain the best-estimate models up to date through such programs as Semiscale, FIST, and separate effects programs.
3. Degraded core accident research, including prevention and mitigation, to support or confirm the staff regulatory actions applied to operating reactors, plants in the staff review process, and new plant applications. See my memorandum dated Feb. 24, 1982 regarding draft NUREG-0900.
4. Research into aging of plant structures, systems, and components, including material degradation, valve behavior, flaw detection, maintenance, and inservice inspection.

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- 4 { 2. Qualification research, such as qualification testing techniques to meet NRC acceptance criteria.
- 3. Demonstration research such as demonstration of decommissioning and fuel development techniques.

Additional more detailed comments on the draft LRRP document are provided in the enclosure.

Original Signed by
H. R. Denton

Harold R. Denton, Director
Office of Nuclear Reactor Regulation

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Note: See previous concurrences.*

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DETAILED COMMENTS ON
DRAFT LONG-RANGE RESEARCH
PROGRAM FY 84-88

GENERAL COMMENTS:

1. Resource information is needed for NRR evaluation due to the importance of level of effort in judging cost effectiveness of programs.
2. A summary chapter (and charts) would be helpful in presenting such a large program.
3. The plan should make clear that the NRC PPG-1982 guidance will be followed for consolidation and coordination of programs with industry and other agencies and elimination of marginal programs.

2.0 LOCA AND TRANSIENT

2.1.5 Semiscale

B&W owners groups are performing analysis to evaluate a number of NRC concerns about plant characteristics under off design conditions. Semiscale 2x4 configuration designs are being prepared. If NRC concerns are not resolved by analysis, a joint NRC-industry venture will be pursued.

2.4.5 Code Development and Application

An important point to be raised in this area is that the system codes developed in support of NRR's licensing needs should be user-convenient and should be compatible with different computers. This requirement should be identified in the LRRP.

The need to establish accuracy goals for various calculations should be included to assure that our limited resources are applied only to significant improvements in code accuracy.

4.0 ACCIDENT EVALUATION AND MITIGATION

NRR comments on this area were provided in a memorandum from Denton to Minogue, subject: Initial Review of Nuclear Plant Severe Accident Research Plan (Draft NUREG 0900) dated February 4, 1982. This LWR work should peak in about FY 85 and should drop off to a relatively low level of confirmatory effort by FY 87.

5.0 ADVANCED REACTORS

As directed by the memorandum from Dircks to Minogue and Denton, dated September 24, 1981, the NRR/RES working group recently completed plans for short term research needed for CRBR construction permit licensing. During the course of the CP review we propose the working group also identify that additional longer term research needed for the CRBR operating license. At this time we do not anticipate a need for LMFBF research other than that related to CRBR. Consequently we intend to defer comment on details of the proposed long term LMFBF research program until the NRR/RES working group has completed the plan for CRBR research. We believe that will allow ample time for planning the needed programs in sufficient detail to meet the licensing objectives.

6.0 REACTOR AND FACILITY ENGINEERING

6.1 Mechanical Systems and Components

Mechanical Components

The LRRP should be revised to include research programs in the following specific problem areas in mechanical engineering:

- (a) Reactor Internals Confirmatory Dynamic Analyses for BWRs and PWRs
- (b) Jet Loads Due To Up-Stream Flow Limiting Effects
- (c) Confirmatory Impedance Tests for Essential Piping
- (d) High Temperature Effects on Mechanical Components Design
- (e) Thermal Shock Effects to Reactor Internals Mechanical Design
- (f) Flow Transient and Structural Response Monitoring for Essential Piping

4 { Based upon NRR's Equipment Qualification Program, we would expect to phase out the mechanical equipment testing by the end of FY 1987. The LRRP should be modified to identify the availability of results and associate them with the objectives and major milestones of the Equipment Qualification Program Plan.

6.2 Seismic Design Research

4 { Based upon NRR's Equipment Qualification Program, we would expect to phase out the Seismic/Dynamic testing program by the end of FY 1987. The LRRP should be consistent with these plans.

6.3 Structures

Experience with an increasing number of structural reviews of nuclear power plant applications suggests the need for standard problems, code benchmarking and development of audit capability to identify the adequacy of the applicant's analysis and design. This need has been identified through staff structural audit of various nuclear power plant designs at the offices of the respective architect and engineers. If new CP applications are anticipated in the FY 84-88 time span, the development of an interactive structural hardware and software system capable of analyzing Category I structures is needed to provide a tool whereby the Structural Engineering Branch can ensure that the structural analyses used by the applicants are correct and that they are being used correctly.

6.3.5.2 Safety Of Plant Structures

We agree with the general statements in the LRRP describing the Safety of Plant Structures Program, but the program description should be expanded to include the following:

- (a) Review and develop as needed, methods for characterizing loads from earthquakes, flooding, and tornadoes, including the relationship between probability of occurrence, load magnitude, load duration, and other factors which would significantly affect plant response.
- (b) Clarify the status of studies on seismic loadings, flooding loadings, and tornado loadings.

The study on load combinations for design of structures considers probabilistically the combination of loads, on a structure, of extreme environmental phenomena, postulated accidents, and normal plant operation. Failure mechanisms are also considered probabilistically.

The LRRP should include an expanded description of the Benchmarking of Containment Pressure Response, so we can determine whether the project meets our needs.

Modeling of soil-structure interaction (SSI) is one of the major problems confronting seismic design and analysis. Research efforts have produced many analytical methods, and disagreements among different methods have been commonly seen. As none of these methods have been benchmarked, data need to be obtained and benchmarking standard problems need to be established.

In the area of geotechnical engineering, specific mention should be made of a need for research with other agencies and the industry on seismically induced lateral movements in embankments. Many nuclear power plants have safety-related facilities founded on dams or embankments. Seismically induced lateral movements have a significant impact to the safety of these facilities. Currently, Newmark's procedure is used to estimate the amount of seismically induced lateral movement. However, a recent report by Franklin and Chang indicates that Newmark's procedure underestimates actual movements. Research is needed to develop a new procedure or to modify Newmark's procedure for estimating seismically induced lateral movements.

6.7 Decommissioning

The Draft Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, November 1980 (NUREG-0586) dismisses entombment as a decommissioning alternative for nuclear reactors because of the long half-lives of certain radioisotopes, such as ^{59}Ni and ^{94}Nb , which accumulate as activation products in the reactor vessel and internals. It has not been established, however, what the residual risk from entombment would be and whether the total net reduction in risk achieved by employing another decommissioning method would be worth the additional costs involved. This work in support of the rulemaking should be included in the LRRP if consistent with the completion of the rulemaking.

6.8 Effluent Control and Chemical Systems

The draft LRRP indicates that the planned FY 83 program includes an evaluation of the continuation of the source term measurement program for additional BWR's, i.e., obtain measurements at more than one BWR. NRR believes that consideration of more than the one unit in 1982 is necessary to provide adequate measurements. It may require two additional BWR's to provide this representative data, thus extending the program into 1984 or later. The results are needed to update NUREG-016, "Calculation of Releases of Radioactive Material in Gaseous and Liquid Effluents from Boiling Water Reactors." Once NUREG-016 is revised, the models used by NRR to calculate radiological effluent source terms for PWR's and BWR's would both be realistic, since they would have been developed from actual experience.

6.9 Qualification of Electrical Equipment

Based upon NRR's Equipment Qualification Program, we would expect to phase out the electrical equipment testing by the end of FY 84. The LRRP should be consistent with these plans.

7.3 Occupational Protection

Because of the aging of operating reactors accompanied by buildup of radioactivity in the primary system, and the need to keep occupational radiation doses ALARA, plants may require decontamination of their primary systems. RES should include in the FY 84-88 LRRP efforts to closely monitor industry research on the effectiveness and cost of alternative methods for decontamination. This information is necessary for the staff to assess applicant occupational ALARA designs and programs.

9.0 Siting and Environment

9.1 Siting and Environmental Impact

Although relatively low in priority due to new CP application inactivity, the following areas of research should be identified in the long range plan to assure their recognition at the appropriate time.

- 1) Research on the effects of hazardous chemical releases upon plant equipment.
- 2) A sensitivity analysis of electricity demand forecasts on our licensing process. Effort is also needed for the maintenance of the ORNL computer model and data base, which is their used for on call computing of use-specific demand projections.

9.2 Earth Sciences

There are several areas of research, the priority of which should be established by their direct application to the current operating plant concerns. These should be specifically acknowledged in the LLRP. These areas are as follows:

Seismology and Geology

- 1) The Ramapo Fault Zone, in which the Indian Point NPP is located, is subject to frequent, low level seismicity with only a suggestion of a linear trend of epicenters. Recent research indicates two types of faults within the zone, one of which may be related to the seismicity. Detailed research may result in typing the seismicity of these faults. This would be of great significance for the siting of nuclear facilities in the eastern U.S. where it has not been possible to tie earthquakes to particular structures. A test line should be run, using seismic reflection techniques, to determine the feasibility of determining the geometry of the faults to see if they continue steeply at depth or change to shallow dip. If the signals are clear enough, the program should be extended to include at least two more lines across the Triassic basin. Earthquake monitoring should continue.
- 2) Nuclear power plants in the Western U.S. are often located in proximity to earthquake-generating faults. In these cases an estimate of the potential earthquake magnitude is needed as one parameter used to develop the seismic design input. The development of fault parameter-earthquake magnitude relationships is a rapidly evolving field.
- 3) The procedures of site specific response spectra have been used to determine the seismic design input for some nuclear power plants. Very often suites of appropriate site specific records are too few or not available. Simplified techniques for the estimation of site specific spectra from peak or other ground motion parameters are needed. P. 2-8
- 4) Most nuclear power plants are sited east of the Rocky Mountains. Profound differences in attenuation with those areas in the Western U.S. where data are available make ground motion estimation difficult. It is also becoming apparent that differences in attenuation exist for different parts of the Central and Eastern U. S. Effort is needed to develop regionalized attenuation models for ground motion at different frequencies for different parts of the Central and Eastern U.S. that conform with both theory and available data. Compare and contrast these models with western U.S. models for relationships. Determine the uncertainty associated with these models. P. 2-8

- 5) The staff has initiated the use of site specific spectra based upon 50th and 84th percentile of suites of response spectra associated with a given magnitude, distance, and site condition range. An initial study done by LLL should be expanded, taking into account new data and sensitivity evaluations. RES should initiate a project to develop representative site specific spectra for given site magnitude and distance conditions based upon a collection and evaluation of all existing data.

In the area of geotechnical engineering, specific mention should be made of a need for research with other agencies and the industry on seismically induced lateral movements in embankments. Many nuclear power plants have safety-related facilities founded on dams or embankments. Seismically induced lateral movements have a significant impact to the safety of these facilities. Currently, Newmark's procedure is used to estimate the amount of seismically induced lateral movement. However, a recent report by Franklin and Chang indicates that Newmark's procedure underestimates actual movements. Research is needed to develop a new procedure or to modify Newmark's procedure for estimating seismically induced lateral movements.

Health Effects

Coordination with the appropriate agencies is needed to insure that the controversy over the dosimetry for Japanese A-Bomb survivors is adequately investigated and resolved to the point where NRC can use realistic risk estimates. Reference: Memorandum dated June 30, 1981, from G. Beebe, Public Health Service, to D. Frederickson, subject: "Dosimetry for Japanese A-Bomb Survivors".

10. Systems and Reliability Analysis

This section appears to be a very ambitious program and as such does not suggest any clear indication of relaxation in effort through FY 88. There are areas of proposed RES work that, under limited resources, may be reduced through building on IREP/NREP studies rather than performing new independent studies. Some of these areas that may be reduced in effort are the proposed MARK II BWR assessment, the CRBR IREP-like study, and the IREP study for demonstration of PRA application to standard plant designs. We believe that these programs could be more cost effective building on the Limerick MARK II study by Philadelphia Electric, the CRBR update by DOE, and the GESSAR study by GE based upon the NREP procedures.

There is concern about the need for a complete WASH-1400 update. Updating may be accomplished more cost effectively through selective modification. Recognizing that our knowledge of human error, multiple failure consideration, and extreme-external-phenomena are continually improving, selective modification may be a superior approach.

THE FOLLOWING ITEMS SHOULD BE CONSIDERED IN THE REVIEW OF THE SAFETY/SAFEGUARDS AREA:

- o THE PURPOSE FOR COMPARTMENTALIZATION OF VITAL EQUIPMENT - WHY NOT TREAT TOTAL BUILDING OR FACILITY AS ONE VITAL AREA?
- o THE ISSUE OF WHETHER THE SAFETY/SAFEGUARDS "PROBLEM" PRODUCES SUFFICIENT SAFETY CONCERNS TO JUSTIFY NO COMPARTMENTALIZATION.
- o EXPERIENCE WITH RESPECT TO MALEVOLENT ACTS BY REACTOR EMPLOYEES, RECOGNIZING THAT WE CURRENTLY REQUIRE NO CLEARANCE OR SCREENING.
- o ADDED ASSURANCES OF TRUSTWORTHINESS GAINED THROUGH PERSONNEL SCREENING.
- o PRACTICES AND EXPERIENCE OF OTHER AGENCIES WITH ANALOGOUS PROTECTION SITUATIONS.
- o PARALLELS BETWEEN REACTORS AND FUEL PLANT REQUIREMENTS --- AND DIFFERENCES.
- o ACRS CONCERNS FOR REACTOR SAFEGUARDS, INCLUDING DESIGN CONSIDERATIONS TO PREVENT SABOTAGE.