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MINUTES OF THE  
ACRS SUBCOMMITTEE MEETING ON THE  
SAFETY RESEARCH PROGRAM  
MARCH 31, 1982  
WASHINGTON, D.C.

INTRODUCTION

The ACRS-Subcommittee on the Safety Research Program met on March 31, 1982 at 1717 H Street, N.W., Washington, D.C. to continue its discussion of the proposed NRC Long-Range Research Plan (LRRP) for FY 1984 through FY 1988 (NUREG-0784). The entire meeting was open to public attendance. Mr. Sam Duraiswamy was the Designated Federal Employee for the meeting. A list of documents submitted to the Subcommittee is included in Attachment A.

ATTENDEES

ACRS: C. P. Siess (Subcommittee Chairman), D. Okrent, D. A. Ward, M. S. Plesset (part time), C. Mark (part time), D. W. Moeller (part time), S. Duraiswamy (Designated Federal Employee).

Principal

NRC Speakers: D. Ross, W. Beach, F. Gillespie, O. Bassett, W. Morrison, C. Goller, F. Arsenault, L. Shao, C. Kelber, W. Anderson, M. Silberberg, R. Bernero, G. Knighton.

EXECUTIVE SESSION

Dr. Siess, the Subcommittee Chairman, convened the meeting at 8:30 am and indicated that the purpose of the meeting was to continue the discussion of the proposed NRC LRRP for FY 1984 through FY 1988. He said that a previous draft of the LRRP dated February 1, 1982 was discussed by the Subcommittee at the February 3, 1982 meeting. Since then, a revised draft of the LRRP dated March 15, 1982 has been issued and the Subcommittee will discuss the contents of this draft at the subject meeting.

Prior to holding detailed discussions on NRC's proposed LRRP, the Subcommittee discussed some possible means to consolidate several annual ACRS reviews of the NRC safety research program. Dr. Siess mentioned that the ACRS had exchanged correspondence (ACRS letters dated October 20, 1981, December 14, 1981 and the Commission's letter dated December 10, 1981) with the Commission on this issue. It seems that the Commission desires to have ACRS comments on the LRRP at the earliest stage possible (February or March). This might have been possible if the LRRP were made available to the ACRS in December 1981 as stated in Chairman Palladino's letter to the ACRS on December 10, 1981. Since the

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LRRP was submitted to the ACRS in February 1982, it would be very difficult for the cognizant ACRS subcommittees to perform a detailed review and develop detailed comments for submittal to the Commission in February or March 1982. He suggested that the cognizant subcommittees continue to review the LRRP as a basis for the review of the NRC safety research program and budget for FY 1984 and FY 1985; during such reviews, the subcommittees should look at the out-years FY 1986 - FY 1988 and develop comments on the program in those years for submittal to the Commission in July 1982 along with the comments on the FY 1984 and FY 1985 safety research program and budget.

Dr. Ross said that, in his opinion, comments on the LRRP are not really comments on the research programs, but are comments on the agency goals. With regard to the timing of the ACRS comments on the LRRP, Dr. Ross suggested that the ACRS comment on the published version of LRRP instead of commenting on a draft LRRP. Since the NRC Staff updates the LRRP starting from September of each year, he believes that if the ACRS provided comments on the final LRRP before September, they could still be factored into the next year's LRRP. Unless the Commission needs to have ACRS comments at an early stage of the LRRP, he believes that ACRS could provide its comments on the final published version of the LRRP in September.

#### OFFICE OF NUCLEAR REGULATORY RESEARCH (RES) PRESENTATION

##### Overview of the LRRP For FY 1984 - FY 1988 - Dr. D. Ross

Dr. Ross provided an overview, indicating that the proposed LRRP for FY 1984 - FY 1988 has been restructured from that for FY 1983 - FY 1987 to add relationships to other programs. The current version of the LRRP dated March 15, 1982 includes proposed funding levels (Attachment B, page 1) for various programs and cross-program descriptive material (Attachment B, page 2) to tie together major program elements in different Decision Units. He said that some of the areas that receive greater emphasis in the proposed LRRP are as follows:

- Identification and understanding of complex system transients.
- Fuel damage and fission product behavior over a wide range of transients and accidents.
- Human factors, operator training, man-machine interface.

- ° Pressure boundary safety, operability of equipment, integrity of electrical connections, and structural integrity of aging plants.
- ° Development of nondestructive examination techniques.
- ° Application of risk assessment techniques to better focus the regulatory process on safety issues.
- ° Approaches to decay heat removal and improved containment.

Dr. Ross discussed briefly the long-range efforts associated with research related to Reactor/Facility Safety (Accident Prevention research) and Reactor Accidents (Accident Mitigation research) (Attachment B, pages 3-6).

Dr. Siess commented that there are clear trends indicated much better in some cases than in others in the LRRP report. The reasons for several items such as the following are not clear:

- ° What are the reasons for a continually decreasing budget? Is it due to the expectation of research needs to decrease in the future or due to decrease in resources?
- ° Why is the Systems and Reliability research scaling down? Does this mean that the activity of the agency in the risk assessment area is going down? Since the agency seems to be moving toward the direction of probabilistic-based safety goals, shouldn't the activity of the agency in the probabilistic risk assessment area go up?

Indicating that the NRC research budget is decreasing from about \$226 million in FY 1984 to about \$144 million in FY 1986 (Attachment B, page 3), Dr. Siess asked whether there is a corresponding decrease in the overall safety research activities being carried out by the industry, Department of Energy (DOE) and foreign countries. Dr. Ross responded that he cannot say for certain whether there is a decrease in the overall safety research activities.

Dr. Siess commented that the continually decreasing research budget seems to imply that there may not be any new issues that will come up in the future. However, he believes that we have been identifying new issues at least as fast as we have been solving the old ones. Further, the LRRP is not set up

in such a way to anticipate new future issues. In his opinion, the LRRP is basically a five-year projection of the current issues.

Commenting that the long-range planning of research depends to a certain extent on what the industry, DOE and foreign countries are planning to do, Mr. Ward asked how the NRC coordinates with these other research activities. Dr. Ross responded that the NRC has several cooperative research programs ongoing or planned with Electric Power Research Institute (EPRI), General Electric Company, and Westinghouse. They obtain comments from EPRI on the LRRP. In addition, they conduct periodic management meetings with EPRI and other industry personnel to discuss the combined research activities. NRC participates also in certain research activities in foreign countries; as part of cooperative agreements, they send engineers to participate in certain foreign countries' research activities. He believes that the NRC is very well coordinated on combined research activities.

Dr. Siess asked about the level of funding for technical assistance associated with Standards. Dr. Ross responded that he will provide that information later.

Dr. Plesset commented that it seems that the LRRP includes mainly reactive research. He believes that it should include some visionary research. Further, he does not believe that the NRC Staff's long-range projections of LOCA & Transient research are right; he believes that the research in the LOCA & Transients area may be there longer than is predicted in the LRRP and also may require more money than is proposed. He mentioned that he had already provided some written comments on the LOCA & Transient Research Chapter of the February 3, 1982 LRRP report and he would like to have the NRC Staff's responses to his comments sometime during the subject meeting or in the near future. Dr. Plesset's written comments and the NRC Staff's responses are included in Attachment C.

Dr. Ross responded that he believes that there is some visionary research included in the LRRP. He believes that the Commission has to provide a



clear direction as to whether the research being done or planned is adequate for a regulatory agency to perform its work or whether they need to look deeper into the future. He said that the ACRS advice on this issue would be very valuable. The ACRS may even want to recommend that a certain percentage of the total research budget be available for visionary research.

Dr. Siess commented that it seems that the NRC has been doing research in reaction to what has happened. He believes that there also should be some imagination as to what might happen in the future.

Dr. Okrent commented that it is not clear to him from reading the LRRP whether RES thinks it is appropriate to develop conceptual design information that might be useful for NRC in its decision-making process. Dr. Ross responded that Sandia Laboratories has been developing some information along this line for NRC.

Dr. Okrent asked whether the Sandia Program as currently defined is adequate to meet the NRC needs. Dr. Ross responded that he had not seen the final results of the Sandia study. However, the main objective of that study is to develop procedures for use by the NRC to decide whether a proposed change in a plant would have enough risk reduction potential to justify the cost. The results of the Phase 1 of the Sandia Program are expected to be available in the summer of 1982. After examining the results, if the NRC Staff feels that the Program does not meet its main scope, then appropriate changes will be made prior to carrying out Phase 2 of the Program, the results of which are expected sometime in the summer of 1983.

Dr. Okrent asked whether the NRC management had made any effort to first determine the design-related safety research needs of the NRC for decision-making and then to examine the ongoing and proposed research program to see whether they are commensurate with these needs. Dr. Ross responded that generally this has not been done. Mr. Bernero said that they have been studying certain conceptual designs such as decay heat removal systems, vented-filtered containments, etc. and obtaining necessary information on these designs. The

results of some of these studies will be made available to the ACRS in the very near future.

Dr. Okrent asked when the results of the Sandia Study on conceptual designs will be available to the ACRS. Dr. Ross responded that those results are expected to be made available to the ACRS for discussion during the months of June or July 1982.

#### DISCUSSION OF THE PROPOSED LRRP FOR VARIOUS DECISION UNITS

##### LOCA & Transient Research - Mr. O. Bassett

Mr. Bassett said that the LOCA & Transient Research Decision Unit includes programs on integral systems, separate effects and model development, 2D/3D, code development and application, and fuel behavior under operational transients. The proposed funding levels for the various Subelements of this program for FY 1984 - FY 1988 are included in Attachment B, page 7. Mr. Bassett discussed briefly the levels of effort associated with the LOCA research and the Operational Transients (OT) research (Attachment B, page 8). He stated that more emphasis will be placed on OT research in FY 1984.

Mr. Bassett discussed briefly the planned long-range research in this Decision Unit (Attachment B, pages 9 and 10).

Dr. Okrent asked for additional information on the research associated with waterhammer. Mr. Bassett said that they have been conducting some tests in the support facilities of Semiscale to examine the phenomena of induced waterhammer and the resulting loads on the systems. He believes that these tests have been completed and they plan to complete the analyses by FY 1985.

Dr. Okrent commented that he is not aware of any such waterhammer tests being run at the Semiscale support facilities. It is also not clear to him whether there has been a systematic program to study the issues associated with waterhammer. Mr. Bassett said that this program is not an in-depth one to look at the waterhammer issues; he will provide additional information on this program at a later date.

Dr. Okrent asked whether RES thinks that there should be a systematic program on waterhammer. Mr. Landry responded that RES plays only a minor role in the waterhammer issue. The main responsibility on this issue lies with the Office of Nuclear Reactor Regulation (NRR). Mr. Shao added that the waterhammer problem is listed as an unresolved safety issue; there has been a Task Action Plan (A-1) on this issue and a Task Group is studying this problem. He believes that NRR's position on the waterhammer issue is that it is not a serious problem that warrants research.

Dr. Okrent asked whether RES itself has looked at the waterhammer problem by using Probabilistic Risk Assessment (PRA) methodology and decided that it has negligible contribution to risk. Dr. Kelber responded that he is not aware of studying the waterhammer problem using PRA methodology.

Dr. Okrent suggested that RES coordinate with the Task Group that is studying the waterhammer issue and also try to increase its role.

Dr. Ross said that unless NRR wants to do more work on the waterhammer issue, RES may not be able to do much.

Dr. Siess suggested that it is better to provide ACRS comments directly to the Task Action Plan Group in NRR who is studying the waterhammer problem. Dr. Okrent said that the ACRS should notify NRR that they should coordinate more with RES in studying the waterhammer issue.

Mr. Knighton from NRR said that NRR has looked at the waterhammer issue several times in response to ACRS concerns and concluded that it is not a serious problem that warrants research. Further, he is not aware of any record suggesting that ACRS considers the waterhammer issue as a significant safety issue.

Dr. Okrent indicated that the ACRS position is and has always been that increased emphasis should be given to the waterhammer problem. He believes that the ACRS position has been made clear in several of its meetings. It has

also been documented in the ACRS Report to Congress on the NRC FY 1983 Safety Research Program (NUREG-0864); in Section 3.7 of Part I of NUREG-0864, it is stated that expanded knowledge about the likelihood and effects of severe waterhammer during a wide range of possible transients and accident warrants increased emphasis.

Dr. Okrent commented that waterhammer occurs only under certain sets of transients; under certain transient conditions, it may lead to loss of some safety systems. The NRC Staff should look at various kinds of transients to identify situations where a severe waterhammer might occur and then try to determine what needs to be done. If they do not study this problem, there is a possibility that they will learn it by experience sometime in the future and one such experience may have severe consequences. He believes that the Severe Accident Sequences Analysis (SASA) Program should include a task to study this issue.

Dr. Ross suggested that detail discussion of the waterhammer issue at a future meeting of the combined Fluid Dynamics and Safety Research Program Subcommittees would be helpful.

With regard to the 2D/3D program, Mr. Bassett said that the NRC has been negotiating with the Federal Republic of Germany (FRG) with regard to NRC's participation in the Upper Plenum Test Facility (UPTF) in FRG. Recently, they have signed an agreement for a new program plan with reduced scope and budget. Further negotiations are still underway for possible reduced NRC participation in the UPTF in the out-years.

Dr. Siess asked whether the UPTF program includes any small-break LOCA analyses. The NRC Staff responded that FRG plans to do only large-break analyses in the UPTF; they do not have any interest in analyzing small-break LOCAs.

Mr. Bassett discussed briefly the NRC Staff's responses to ACRS recommendations on the LOCA & Transient Research Program that are delineated in NUREG-0864 (Attachment B, page 11).

Dr. Okrent asked about the status of the program on Fuel Behavior Under Operational Transients that is included in Section 2.5 of Chapter 2 of the LRRP. Mr. Kelber responded that the fuel behavior tests are scheduled to be completed in FY 1982 and the analyses of these tests are expected to be completed in FY 1983.

Indicating that one of the statements in paragraph 2.5.2 of the LRRP states that the fuel behavior under operational transient research ends in FY 1985, Dr. Okrent wondered how the NRC Staff could say that the tests and analyses associated with this program will be completed by FY 1983. Mr. Silberberg responded that the main elements of this program will be completed by FY 1983. This program includes also some activities to update and maintain already developed codes in this area, and such activities will be completed by FY 1985.

Dr. Okrent asked whether someone has evaluated the Fuel Behavior Under Operational Transients program to determine its cost effectiveness on a risk reduction basis. He asked also how much money they can save if this program is terminated at this point. The NRC Staff responded that no specific evaluation was made to determine its cost effectiveness on a risk reduction basis, and if this program is terminated at this point, they might save about \$200,000.

Dr. Okrent asked how this program is going to contribute to the NRC needs. The NRC Staff responded that this program was initiated as a result of NRR request and to aid NRR to analyze the fuel behavior in a licensee's plant design during normal operation and during any postulated accident. Originally they planned to conduct seven tests; they now plan to do only two tests and those will be completed by June 1982.

Dr. Okrent asked about the need for the planned program on Degraded Core Cooling that is included in paragraph 2.2.5 of the LRRP. Dr. Kelber responded that it is a Separate Effects Program at UCLA, intended to investigate the thermal-hydraulic and heat-transfer behavior in distorted core geometries; development of instrumentation and evaluation of proposed or existing plant instrumentation will be conducted to aid in assessing degraded core conditions.



Dr. Okrent commented that it is not clear how the experiments planned under this program will examine or relate to the instrumentation at existing plants.

Dr. Okrent asked how the program on Pellet Clad Interaction (PCI) included in Section 2.5.5 of the LRRP is going to help NRR. Dr. Marino responded that this program was initiated as a result of NRR request; it is intended to provide NRR with an analysis code based on experimental data to assess reactor cores after power transients.

Dr. Okrent asked whether anyone has evaluated the cost effectiveness of the PCI program based on its risk reduction potential. Dr. Marino responded that no such analysis has been done.

Dr. Okrent commented that he does not believe that the PCI program will provide NRR with a tool that they could use with any degree of confidence.

LOFT - Mr. O. Bassett

Mr. Bassett said that the NRC-sponsored testing in LOFT will be concluded in FY 1983. The last test (L2-6, double-ended cold leg break) is scheduled to be conducted in February 1983. He discussed briefly the proposed funding level for LOFT (Attachment B, page 12), indicating that the FY 1983 funding level for LOFT has been reduced from \$42 M to \$15 M. The proposed funding for FY 1984 is \$9 million and for FY 1985, \$5 million. He said that deactivation of the LOFT facility will be started after the completion of the last test.

Dr. Siess asked about an estimate for decontamination and decommissioning of the LOFT facility. Mr. Bassett said that it was estimated to be about \$17 million (in FY 1982 dollars) two years ago.

Dr. Siess asked about the status of the LOFT consortium. Mr. Bassett said that DOE is considering establishing an international LOFT consortium to run a test program in the LOFT facility for an additional three years. The proposed consortium would involve major participation by foreign countries, DOE, EPRI, and the NRC. On May 19, 1982 a letter has been sent to DOE by Mr.

Dircks (Executive Director for Operations, NRC) including comments concerning NRC's participation in a LOFT consortium. Some of the points included in this letter are as follows:

- ° NRC will continue to furnish Staff support of LOFT consortium feasibility studies.
- ° Operation of such a consortium should relieve NRC from further fiscal responsibility for the eventual decontamination and decommissioning of the LOFT facility. In return for such relief, NRC would furnish the funds it has planned for LOFT decontamination and decommissioning activities to DOE on a budgeted yearly basis.
- ° If enough interest and funding support can be organized to make a LOFT consortium viable, NRC would anticipate sponsoring and funding some specific experiments as a consortium member for the purpose of obtaining data useful for regulatory purposes.

Mr. Bassett said that the total funding for operating the LOFT consortium is estimated to be about \$27 million per year for three years; a total funding of \$15 million per year for three years (FY 1983 - FY 1985) is expected from both DOE and NRC; the remaining funds necessary are expected to be raised from foreign countries and from the U.S. nuclear and utility industry. The NRC portion of the contribution would be \$10 million per year, of which \$5 million would serve to discharge the NRC decontamination and decommissioning responsibilities and \$5 million would support LOFT experiments.

Dr. Siess asked how many tests the NRC could get for its contribution. Mr. Bassett responded that for the NRC's contribution of \$15 million for three years, they expect to get about three or more tests.

#### Accident Evaluation and Mitigation - Mr. O. Bassett

Mr. Bassett discussed briefly the proposed long-range research programs in this Decision Unit and the associated funding levels (Attachment B, pages 13-15). He mentioned some of the changes made in the LRRP for FY 1984 - FY 1988 as compared to the last year's LRRP for FY 1983 - FY 1987 (Attachment B, page 16). He said that a separate Subelement on the Severe Accident Sequence Analysis (SASA) has been included in the current LRRP.

Dr. Okrent asked about the main objectives of the program on Management Strategies for Severe Accidents that is included in the SASA Subelement. Mr. Knighton responded that this program addresses the problem of improving the understanding of reactor accidents both within and beyond the design basis with the goal of developing better strategies to prevent, manage, and mitigate severe accidents.

Dr. Okrent asked whether NRR believes that the Management Strategies for Severe Accidents program will be responsive to the information needs of the severe accident rulemaking. Mr. Knighton responded that NRR does not believe that this program as described in the LRRP reflects the comments made by NRR previously on NUREG-0900, Nuclear Plant Severe Accident Research Plan.

Dr. Okrent commented that he does not believe that the Severe Accident Research Plan is structured or organized in such a way to provide timely information to the Commission for use in its decision-making process. Further, the planned long-range research does not seem to address all of the concerns expressed by NRR. Dr. Ross responded that RES had received several comments from NRR, EPRI and the Industry Degraded Core Cooling Research (IDCOR) Group. RES is in the process of resolving these comments and also redrafting the Severe Accident Research Plan.

With reference to one of NRR comments on NUREG-0900 which questions the cost effectiveness of the experimental program in Power Burst Facility (PBF) and NRU (Canadian Reactor), Dr. Okrent asked what RES plans to do with regard to this NRR comment. Mr. Bassett responded that he believes that the experimental programs in PBF and NRU are cost effective. Dr. Ross said that RES has not yet responded to the concern expressed by NRR on the cost effectiveness of the experimental programs in PBF and NRU. They may have to discuss this issue with NRR prior to providing a response.

Dr. Okrent commented that it is not clear whether there is a well laid out program in the Accident Mitigation Subelement to look at conceptual designs and to provide information to the Commission and NRR to come up with a position. Dr. Kelber commented that based on his experience, he believes that

the conceptual design by itself does not help much; such a design should be focused to an actual plant, either an existing one or a future one. Nevertheless, they have identified several issues in this area (such as coolant-concrete interaction, debris core coolability, hydrogen control, etc.), and planned research on these issues are included in the LRRP.

Dr. Okrent commented that the funding level for the Accident Mitigation Subelement should be increased in FY 1982 - FY 1984 to look at some conceptual designs and to provide the necessary information to the Commission for making decisions. Further, he believes that relatively a large amount of money has been proposed for the Subelement on the Behavior of Damaged Fuel; he is not sure whether the cost effectiveness of this program can be justified in terms of its risk reduction potential. Although he believes that some work is essential in this area to get information for the decision-making process, he thinks that too much money is being spent. In his opinion, the test programs in PBF and NRU are not cost effective and he does not endorse such programs.

Dr. Okrent commented further that the sentence in Section 4.2.4.2 of the LRRP that states that "These experiments have given important information, but sufficient understanding does not currently exist to construct a mechanistic model of the thermal detonation process that would have predictive capability" seems to imply that additional experiments need to be done to have a predictive capability; he suggested that if that is not the real intention, certain modifications are necessary.

Dr. Mark asked about the schedule for the TMI-2 core examination. Mr. Silberberg responded that it will be sometime in 1984.

The Subcommittee discussed briefly the NRC Staff's responses (Attachment B, page 17) to ACRS recommendations delineated in NUREG-0864.

Advanced Reactors - Mr. O. Bassett

Mr. Bassett said that the NRC effort in this Decision Unit is devoted to develop the necessary expertise and regulatory tools to support the licensing

audit of the Clinch River Breeder Reactor (CRBR) plant. He discussed briefly the proposed funding levels, the changes in the program plan as compared to the LRRP for FY 1983 - FY 1987 and the planned research in this area (Attachment B, pages 19-21).

Dr. Okrent asked whether RES plans to add one million dollars to this Decision Unit as recommended by the ACRS in NUREG-0864. Mr. Bassett responded that in accordance with the Commission directions, they do not plan to add one million dollars to study the post-CRBR LMFBRs. However, if commercialization of LMFBR proceeds, RES will provide additional funding.

Dr. Okrent said that the previous recommendation for one million dollar increase to the Advanced Reactor Decision Unit should be reiterated in the next ACRS report to the Commission on the NRC Safety Research Program and Budget for FY 1984 and FY 1985.

Dr. Mark asked whether there is a program to look at the source terms for LMFBRs. Mr. Bassett responded that they have some programs to look at the source terms associated with LMFBRs.

#### Reactor and Facility Engineering - Mr. L. Shao

Mr. Shao said that the research in this Decision Unit is based on operating experience and anticipated future problems (Attachment B, page 22). He discussed briefly the directions of the programs in this Decision Unit (Attachment B, page 23). He said that although research in this Decision Unit is directed toward operating plants, a small but significant effort is also directed at research on new facilities. He indicated that the NRC Staff plans to develop a comprehensive research program to deal with the overall aging issue. As suggested by Dr. Okrent, they plan to conduct an workshop in August 1982 to discuss the aging problem.

Dr. Siess commented that the research in this Decision Unit to look at the structural failure of containment does not seem to look at leakage through penetrations. He believes that this effort is focussed on a wrong question. Dr. Anderson responded that a program in Sandia Laboratories is intended to look at the leakage through penetrations.



Dr. Siess said that based on his recent review of the Sandia program in this area, he does not believe that they are looking at the penetrations. Mr. Anderson said that the NRC Staff will discuss this issue with the Sandia Laboratories and make sure that their program includes evaluation of leakage through penetrations.

Dr. Okrent asked whether there is any research planned to look at the operational problems during and following a severe earthquake. He also asked whether there are any emergency procedures for the operator to follow during and following an earthquake. Mr. Goller responded that there are no specific procedures laid out to cope with a seismic event. He does not believe that they have a comprehensive program to analyze the operational complexities during and following a severe seismic event. However, they intend to do some work to look at the psychological effect of a seismic event on the operator capability to cope with the event.

Dr. Okrent suggested that the NRC Staff think about this issue and try to include a program to look at the possible influence of an earthquake on the ability of the operator to cope with the situation.

Facility Operations and Safeguards - Mr. C. Goller

Mr. Goller discussed briefly the research programs in this Decision Unit and the proposed funding levels (Attachment B, pages 24-27). He mentioned that the research in this Decision Unit has been given high priority by the Commission, NRR and the ACRS and a significant increase in budget has been proposed for this Decision Unit in FY 1984.

Dr. Okrent asked whether there is any research in the human factors area for the development of a diagnostic adjunct to the Safety Parameter Display System (SPDS) to assist the operator in recognizing and managing abnormal plant conditions. Mr. Norberg responded that he believes that one of the Tasks planned in this area will look at the diagnostic capability of the SPDS.

Mr. Ward pointed out that during one of the Human Factors Subcommittee meeting of the ACRS, EPRI expressed some concern indicating that the SPDS should include some diagnostic capability to help the operator understand the situation; an SPDS without diagnostic capability will not be that much help to the operator.

Mr. Ward and Dr. Siess commented that the research planned in the Quality Assurance (QA) area should include a task to evaluate the effectiveness of the QA program. Mr. Goller responded that he believes that the research planned in this area is intended to look at this issue. He said that they will take a look at the research plan in this area and make sure that a task has been included to evaluate the effectiveness of the QA program.

Mr. Goller discussed briefly the changes in the program direction as compared to the previous LRRP for FY 1983 - FY 1987 and the NRC Staff's responses to ACRS recommendations delineated in NUREG-0864 (Attachment B, Pages 28-30).

#### Waste Management - Mr. Arsenault

Mr. Arsenault discussed briefly the proposed funding levels for the long-range research planned under the Waste Management Decision Unit (Attachment B, Page 31). He said that the main objectives of the LRRP in the waste management area are to:

- ° provide validated technical information to NRC for use in its independent assessment of the site and plan proposed by DOE for disposal of high level radioactive waste in deep geological repositories.
- ° provide necessary information for closure of low-level waste burial sites.
- ° Assess alternative methods of low-level waste disposal.
- ° License active milling and in-situ extraction operations.
- ° provide information to evaluate DOE proposals to perform remedial actions at inactive uranium mill sites.

Mr. Arsenault said that the LRRP for FY 1984 - FY 1988 includes more emphasis than that for FY 1983 - FY 1987 to identify and reduce the uncertainties in assessing the risk or safety performance of waste disposal facilities.

He mentioned that they are in the process of setting up a peer review group, as has been recommended by the ACRS on several occasions, to review and evaluate the ongoing and planned research programs in the waste management area.

Mr. Arsenault discussed briefly the NRC Staff's responses (Attachment B, page 32) to ACRS recommendations delineated in NUREG-0864. He said that the ACRS comments and recommendations in NUREG-0864 have been factored into the development of the LRRP for FY 1984 - FY 1988 in the waste management area.

Siting and Environmental Research - Mr. F. Arsenault

Mr. Arsenault discussed briefly the proposed funding levels for the long-range research planned under the Siting and Environmental Research Decision Unit (Attachment B, Page 33). He said that in FY 1982 a review and a reevaluation of the Seismology/Geology Program that is included under the Earth Sciences Subelement of this Decision Unit was initiated to determine how this program can be formulated better to meet the current NRC needs. He believes that the result of this review will have some effect on the reformulation of Seismology/Geology Program by the end of FY 1983. Based partly on this review, increased emphasis has been placed to investigate specific areas of seismic activity in the Eastern United States. He said that the \$2 million reduction in funding for the Seismology/Geology Program in FY 1982 is expected to be fully restored in FY 1985. All of the non-radiological work included in the Environmental Impact Subelement is being terminated in FY 1982 and there is no funding proposed for this Subelement beyond FY 1982. The portion of the research in this Subelement associated with radiological issues has been transferred to the Siting and Environmental Subelement. He indicated that although the funding for Health Effects Subelement has been reduced in FY 1982 as a result of the Administration's budget reduction program, they expect to increase the funds for this Subelement in FY 1983 and maintain it at a significantly high level for several years.

Dr. Okrent asked whether there is a program to study the external flood hazards, and if so where that program is included. Mr. Arsenault responded that there is a program of modest scale to study the external flood hazards and it is included under the Earth Sciences Subelement.

Indicating that Section 9.2.5.3 of the LRRP states that the program on floods is planned to be accomplished by FY 1987, Dr. Okrent asked on what basis the NRC Staff has decided the schedule for this program. Mr. Arsenault responded that it is a subjective judgment; it is based on the availability of funds and the apparent degree of urgency associated with answering questions in this area as compared to some other areas.

Dr. Okrent asked on what basis the NRC Staff has assigned the priority for the program on floods as compared to some other programs. Mr. Arsenault responded that he believes that if the contribution to risk from a certain item and the uncertainties associated with the ability to assess that risk contribution are very large, then they normally perform research to identify and reduce those uncertainties. The priority for the research on flood hazards has been set based on the user office needs. However, since he has not been involved in setting priority for this program, he may not be able to provide the exact reasons for not giving a high priority for this program. He said that he will provide additional information at a later date on how they decided the priority for the program on flood hazards.

Mr. Bernero said that initially they planned to have a research program to study the river flood hazards. However, owing to lack of sufficient funding, such a research was not initiated. Further, NRR withdrew its endorsement for such a program saying that they did not need the river flood research to support its licensing activities in the foreseeable future. He indicated that the Systems and Reliability Analysis Decision Unit includes a program to look at the contribution to risk from floods.

Dr. Okrent commented that although he believes that the NRC Staff has been generally responsive to previous ACRS recommendations on several

issues, it is not clear to him on what basis the NRC Staff has assigned priorities to various programs and why they think they are the right priorities.

Dr. Siess commented that the contribution to risk from the nuclear plants may be relatively modest compared to the total risk to which the public is exposed. A sudden collapse of a dam may have severe consequences and kill more people than a nuclear plant. Considering these, he believes that other federal agencies should also be interested in probabilities, consequences, and risks from such events. He asked to what extent other federal agencies are involved in these problems either by contributing money for research or by providing expertise. Mr. Bernero responded that Mr. Bivens, a former employee of the NRC, now with the Federal Emergency Management Agency (FEMA), thinks that the NRC should do the research on flood hazards.

Dr. Siess said that he believes that the NRC has the responsibility to alert other federal agencies that they have problems that may be equally large or larger and see whether they can provide some funding to support research on the same problems.

Dr. Siess asked how much reduction in uncertainties is expected to be achieved from the meteorological program as compared to the flood hazards program, if reduction in uncertainties in the risk calculations is one of the criteria for doing research. Mr. Arsenault responded that most of the meteorological work is to provide a basis for developing a better emergency response plan. He does not believe that he can quantify the reduction in uncertainties until additional work has been done.

Mr. Arsenault discussed briefly the NRC Staff's responses to ACRS recommendations delineated in NUREG-0864 (Attachment B, page 34).

Systems And Reliability Analysis (SARA) - Mr. R. Bernero

Mr. Bernero said that research in this Decision Unit is intended to:



- ° Strengthen NRC's capability to analyze risks and understand the relative importance of various safety issues.
- ° Help NRC to evaluate alternative methods for resolving safety issues and to select effective strategies for regulation.
- ° Help NRC identify and select priorities.
- ° Develop comprehensive assessment of risk for principal nuclear activities, including systematic appraisal of the significant sensitivities and uncertainties associated with that risk.

Mr. Bernero discussed briefly the various Subelements included in this Decision Unit and the proposed funding levels (Attachment B, page 35-46).

Mr. Ward asked whether the NRC Staff has an adequate data base for human failures and, if not, whether they have any plans to develop such a base. Mr. Bernero responded that he believes that the Nuclear Power Reliability Data System (NPRDS) and proposed LER rule would provide such a data base.

Mr. Ward commented that in his opinion, the NPRDS program will provide a data base on equipment failures. Further, he believes that the new LER rule will provide lesser data on human performance than the old LER rule. He asked about the NRC Staff's efforts in dealing with software errors. Dr. Ross responded that RES has already sent a research plan to NRR that deals with software errors. He said that they will provide additional information later.

In response to a question from Dr. Siess related to risk analysis for High Temperature Gas Cooled Reactors (HTGR), Mr. Bernero stated that in view of the limited prospect for HTGRs and limited resources, they plan to use the existing risk analysis developed by the General Atomic Company.

Dr. Okrent asked about an estimate of money being spent on conceptual-design research. Mr. Bernero responded that it is about \$200,000 to \$400,000.

Dr. Okrent commented that the Staff's effort to try to get design-related safety information is inadequate. He believes that the effort and funding level in this area should be increased. Further, there does not seem to be

any effort to look at certain external events so as to provide necessary information to the licensing Staff.

Dr. Okrent asked for a copy of the report that includes the results of the study performed to assess the risk from external events for plutonium fabrication facilities. Mr. Bernero agreed to provide a copy of that report.

Dr. Siess thanked all participants and adjourned the meeting at 6:45 p.m.

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Additional meeting details can be obtained from a transcript of this meeting available in the NRC Public Document Room, 1717 H Street, N.W., Washington, D.C., or can be purchased from Alderson Reporting Company, Inc., 400 Virginia Avenue, S.W., Washington, D.C. 20024, (202) 554-2345.

Nuclear Safety Research Program Meeting

March 31, 1982

LIST OF DOCUMENTS SUBMITTED TO THE SUBCOMMITTEE

Draft Long-Range Research Plan For FY 1984 - FY 1988,  
dated March 12, 1982

ATTACHMENT A

3/19/82

## NUCLEAR REGULATORY RESEARCH

FY 1984-88 LRRP

(DOLLARS IN MILLIONS)

	FY 82	FY 83 CONG.	△	FY 84	FY 85	FY 86	FY 87	FY 88
LOCA & TRANSIENT	\$ 30.9	\$ 30.0	4.8	\$ 34.8	\$ 31.4	\$ 28.3	\$ 26.2	\$ 18.9
LOFT	42.0	15.0	-6.0	9.0	5.0	0	0	0
ACCIDENT EVALUATION & MITIGATION	33.1	47.2	6.7	53.9	45.7	39.5	29.5	24.6
ADVANCED REACTORS	7.5	13.0	2.5	15.5	14.5	9.0	5.0	3.0
REACTOR & FACILITY ENG.	33.8	38.0	6.7	44.7	47.1	45.7	43.4	42.3
FACILITY OPER. & SAFE- GUARDS	13.0	13.5	5.9	19.4	19.7	20.6	18.5	16.0
WASTE MANAGEMENT	12.2	13.6	1.2	14.8	15.1	15.4	14.9	14.2
SITING & ENVIRONMENT	9.0	9.0	2.2	11.2	12.0	11.7	10.9	10.5
SYSTEMS & RELIABILITY ANALYSIS	15.1	15.9	6.5	22.4	22.7	20.9	18.3	14.7
TOTAL PROG. SUPPORT	\$196.6	\$195.2	30.5	\$225.7	\$213.2	\$191.1	\$166.7	\$144.2

LRRP MAJOR REGULATORY/RESEARCH TOPICS  
SECTIONS WHICH PERTAIN TO TOPIC

CHAPTERS	2 LOCA & TRANS.	3 LOFT	4 ACCIDENT EVAL. & MITIGATION	5 ADVANCES REACTORS	6 REACTOR & FACILITY ENG.	7 FACILITY OPS. & SAFEGDS.	8 WASTE MANAGE.	9 SITING & ENVIR.	10 SYS. & RELIABILITY ANALYSIS
AGEING					6.1-6.6				10.2
HUMAN FACTORS						7.1			
INSTRUMENTATION					Sec. 6.5.4 6.5.5	Sec. 7.2			
LOCA CODE ASSESS.	2.1-2.4	All							
PRES. THERMAL SHOCK	2.1, 2.2 2.4				6.2				10.1
SEV. ACC./CORE DMG.	2.4		All	5.1		7.1, 7.2 7.4		9.2	10.1
STEAM GENERATOR	2.1, 2.4				6.2-6.3				
NUCL. CYCLE LICENS.					6.9	7.3		9.1	10.3
MATERIALS LICENS.						7.3		9.3	10.3
TRANSPORTATION					6.4				10.3
WASTE MGMT.					6.11		All		
DECOMMISSIONING		3.4			6.10	7.3	8.2		
EMERG. PREPAREDNESS						7.4		9.1	10.1
FIRE, FLOOD & EARTHQK.					6.5, 6.8			9.2	10.2
RADIATION PROTECT.						7.3		9.3	
SFGDS/SABOTAGE						7.5			10.2

FIGURE 1.1

1-10

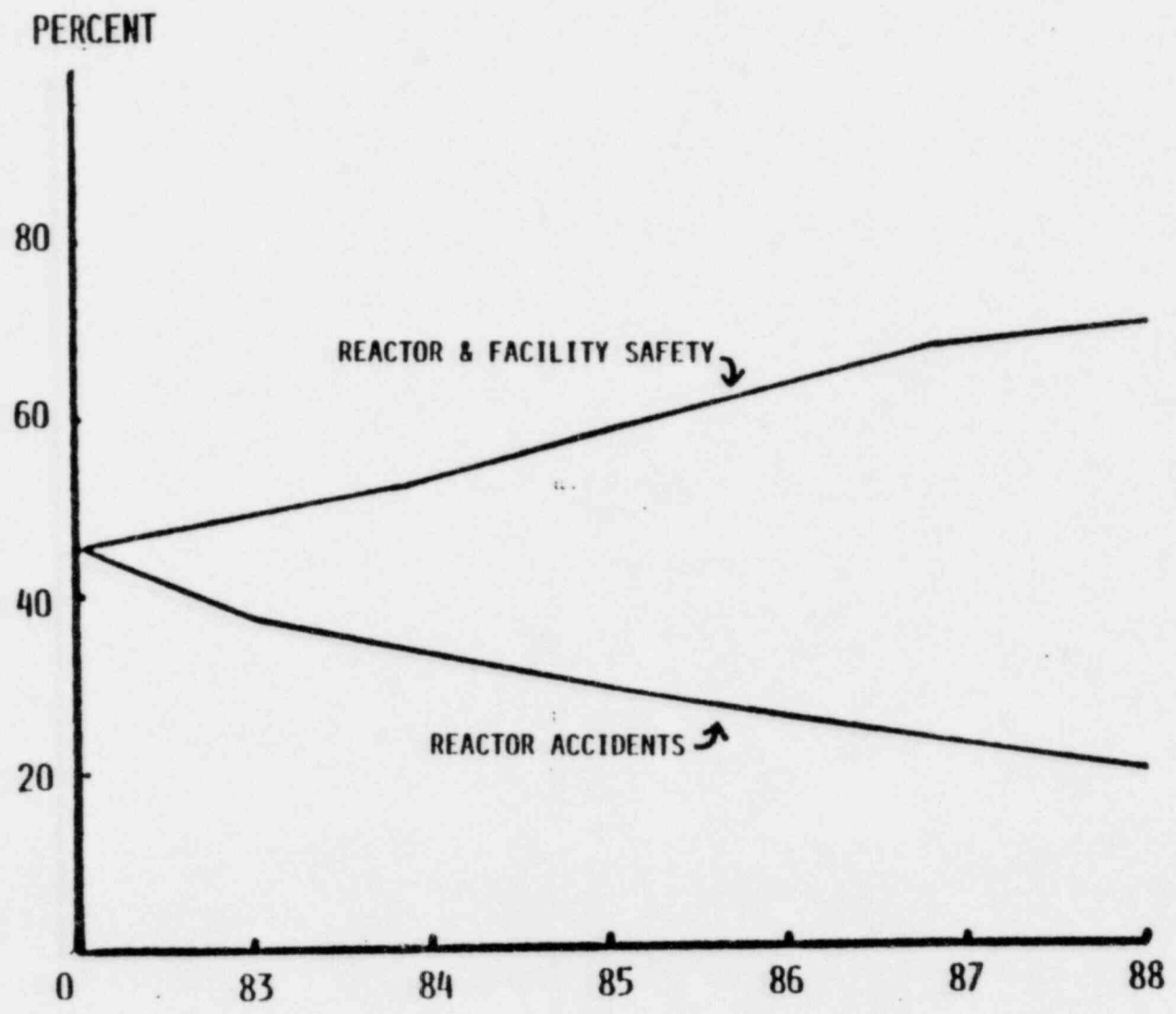


NUCLEAR REGULATORY RESEARCH  
(DOLLARS IN MILLIONS)

	<u>FY 82</u>	<u>FY 83</u>	<u>FY 84</u>	<u>FY 85</u>	<u>FY 86</u>	<u>FY 87</u>	<u>FY 88</u>
<u>REACTOR/FACILITY SAFETY</u>							
REACTOR & FACILITY ENG.	\$ 33.8	\$ 38.0	\$ 44.7	\$ 47.1	\$ 45.7	\$ 43.4	\$ 42.3
FACILITY OPERATIONS	13.0	13.5	19.4	19.7	20.6	18.5	16.0
OPERATIONAL TRANSIENTS	17.6	18.0	22.3	21.4	20.6	20.6	14.9
SITING & ENVIRONMENT	9.0	9.0	11.2	12.0	11.7	10.9	10.5
RELIABILITY ANALYSIS	15.1	15.9	22.4	22.7	20.9	18.3	14.7
TOTAL	\$ 88.5	\$ 94.4	\$120.0	\$122.9	\$119.5	\$111.7	\$ 98.4
<u>REACTOR ACCIDENTS</u>							
ACCIDENT EVAL. & MITIGATION	33.1	47.2	53.9	45.7	39.5	29.5	24.6
LOCA	13.3	12.0	12.5	10.0	7.7	5.6	4.0
LOFT	42.0	15.0	9.0	5.0	0	0	0
TOTAL	88.4	74.2	75.4	60.7	47.2	35.1	28.6
<u>ADVANCED REACTORS</u>	7.5	13.0	15.5	14.5	9.0	5.0	3.0
<u>WASTE MANAGEMENT</u>	12.2	13.6	14.8	15.1	15.4	14.9	14.2
TOTAL PROGRAM SUPPORT	\$196.6	\$195.2	\$225.7	\$213.2	\$191.1	\$166.7	\$144.2

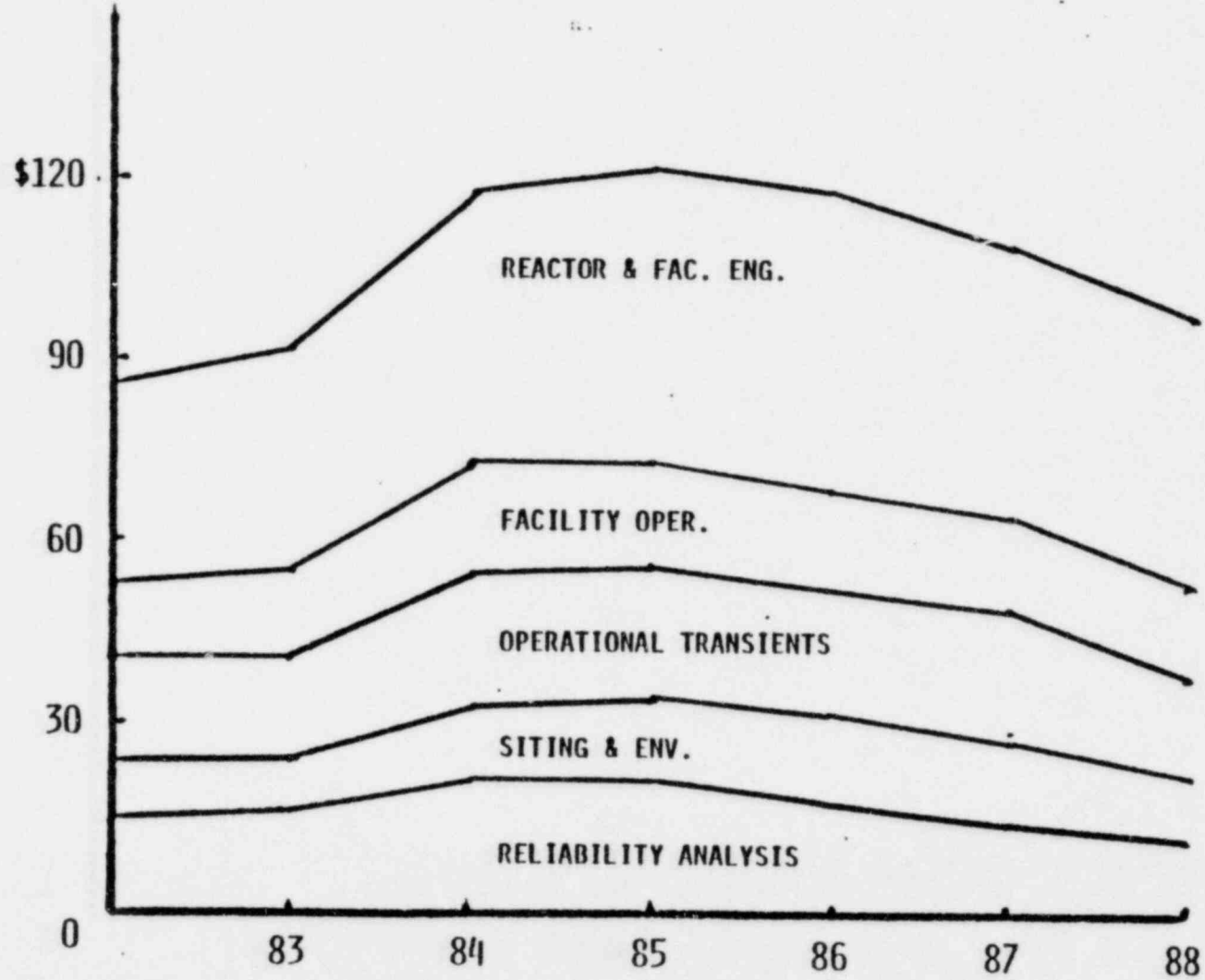
3/82

# NUCLEAR REGULATORY RESEARCH LONG RANGE RESEARCH PLAN PERCENT OF BUDGET BY ACTIVITY



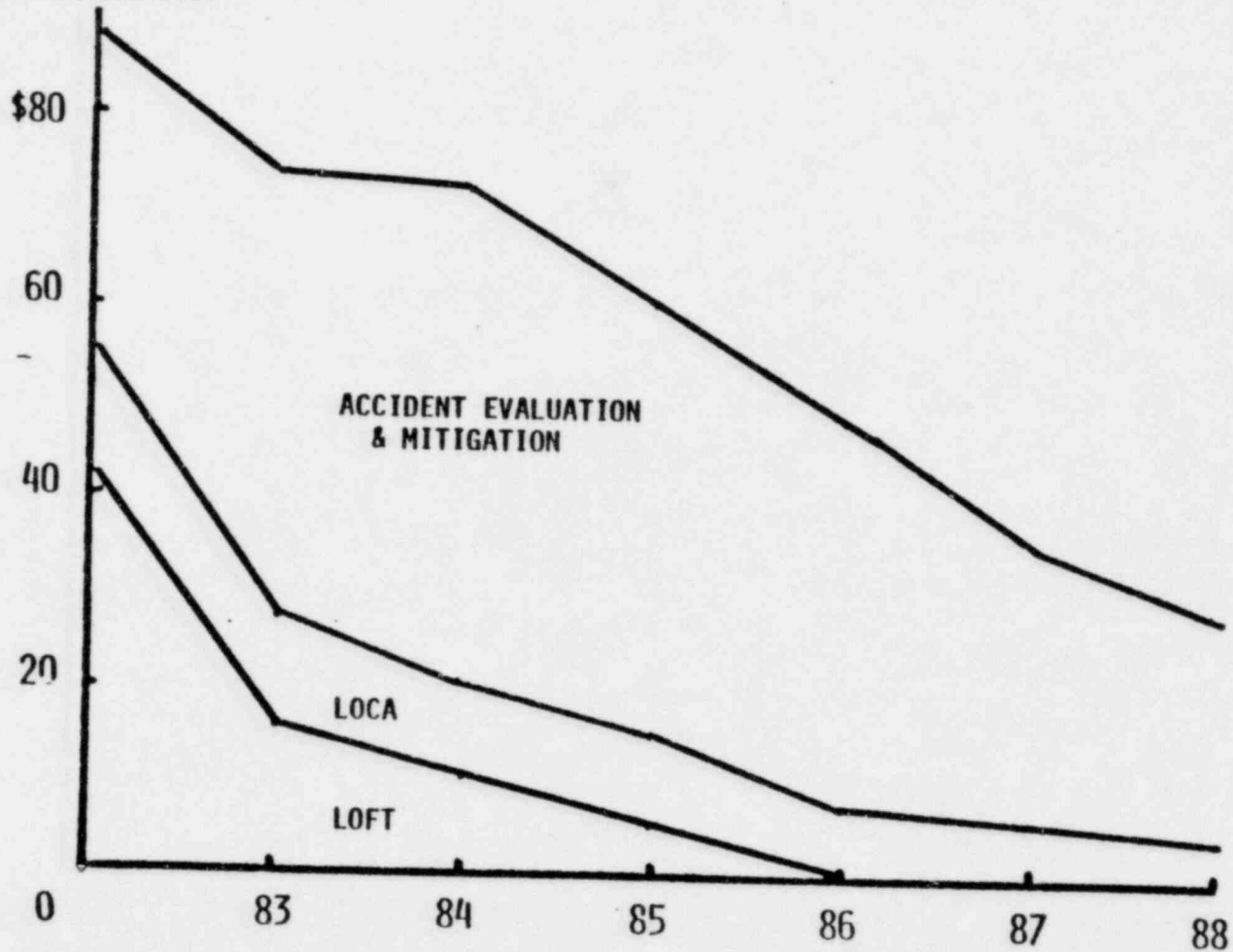
# NUCLEAR REGULATORY RESEARCH REACTOR/FACILITY SAFETY

(IN MILLIONS)



# NUCLEAR REGULATORY RESEARCH LONG RANGE RESEARCH PLAN REACTOR ACCIDENTS

(IN MILLIONS)



NUCLEAR REGULATORY RESEARCH  
1984-88 LRRP  
(DOLLARS IN MILLIONS)

	<u>FY 82</u>	<u>FY 83 CONG.</u>	<u>Δ</u>	<u>FY 84</u>	<u>FY 85</u>	<u>FY 86</u>	<u>FY 87</u>	<u>FY 88</u>
LOCA & TRANSIENT SEMISCALE	\$ 7.5	\$ 8.1	1.3	\$ 9.4	\$ 8.9	\$ 9.1	\$ 8.7	\$ 3.0
SEPARATE EFFECTS EXP. & MODEL DEV.	6.0	5.8	1.7	7.5	6.3	5.1	5.0	5.0
3-D PROGRAM	6.0	6.5	1.5	8.0	6.0	4.7	3.6	2.0
CODE APPLICATION & IMPROVEMENT	8.9	8.7	0.8	9.5	9.8	9.4	8.9	8.9
FUEL BEHAVIOR UNDER OPER. TRANSIENTS	<u>2.5</u>	<u>0.9</u>	<u>-0.5</u> 4.8	<u>.4</u>	<u>.4</u>	<u>0</u>	<u>0</u>	<u>0</u>
TOTAL PROG. SUPPORT	\$30.9	\$30.0		\$34.8	\$31.4	\$28.3	\$26.2	\$18.9

NUCLEAR REGULATORY RESEARCH  
1984-88 LRRP  
(DOLLARS IN MILLIONS)

	FY 82		FY 83 CONG.		FY 84	
	OT	LOCA	OT	LOCA	OT	LOCA
LOCA & TRANSIENT SEMISCALE	\$ 5.2	\$ 2.3	\$ 6.1	\$ 2.0	\$ 7.4	\$ 2.0
SEPARATE EFFECTS EXP. & MODEL DEV.	4.7	1.3	5.3	0.5	7.5	0
3-D PROGRAM	0	6.0	0	6.5	0	8.0
CODE APPLICATION & IMPROVEMENT	5.2	3.7	5.7	3.0	7.0	2.5
FUEL BEHAVIOR UNDER OPER. TRANSIENTS	2.5	0	0.9	0	0.4	0
TOTAL PROG. SUPPORT	\$17.6	\$13.3	\$18.0	\$12.0	\$22.3	\$12.5



LOCA AND TRANSIENTS

- ASSESSMENT OF TRAC-CODES COMPLETE FY 1984
- PRESSURIZED THERMAL SHOCK ANALYSIS COMPLETE FY 1984
- SEMISCALE LOCA/ECCS TESTS COMPLETE FY 1984
- LARGE SCALE FLOW TESTS COMPLETE FY 1984
- PWR PLANT ANALYZER COMPLETE FY 1985
- LWR STABILITY ANALYSIS COMPLETE FY 1985
- TESTS OF BWR TRANSIENTS IN FIST COMPLETE FY 1985
- WATER HAMMER TESTS COMPLETE FY 1985
- BWR PLANT ANALYZER COMPLETE FY 1986
- PLANT ANALYZER ASSESSMENT COMPLETE FY 1988
- SEMISCALE FOLLOW-ON PROGRAM COMPLETE FY 1988

2D / 3D

- SCTF CORE II TESTS COMPLETE FY 1985
- PKL II DATA ANALYSIS COMPLETE FY 1985
- SCTF CORE II TEST ANALYSIS COMPLETE FY 1987
- UPTF, SCTF CORE III ANALYSIS COMPLETE FY 1988

## LOCA AND TRANSIENT RESEARCH

### RESPONSE TO ACRS RECOMMENDATIONS

- A. ACRS - PURSUE INDUSTRY CONTRIBUTIONS FOR SEMISCALE MOD5  
RES - HAVE USER NEED LETTER - PROGRAM DEFINITION UNDERWAY
- B. ACRS - PHASE OUT FLECHT SEASET AFTER NATURAL CIRCULATION TESTS  
RES - COMPLETE TESTING BY 1982, ANALYSIS CY 1983
- C. ACRS - NRC SHOULD JOIN H.P. FACILITY PROGRAM IN JAPAN  
RES - NRC HAS TWO SITE REPRESENTATIVES, FORMAL ARRANGEMENT UNDERWAY
- D. ACRS - 2D/3D UPTF FUNDS SHOULD BE REDIRECTED  
RES - NRC HAS AGREED TO HONOR SIGNED AGREEMENT, UPTF SUPPORT NOW AT A MUCH REDUCED EFFORT
- E. ACRS - (1) CONTINUE CODE IMPROVEMENT AND MAINTENANCE, AND (2) COORDINATE LWR AND ADVANCE PROGRAMS  
RES - (1) AGREE, AND (2) SIMMER AND TRAC COORDINATED AT LANL, EVALUATING RELAP5 FOR CDA'S, COMMIX BEING USED ON LWRS
- F. ACRS - CONTINUE DEVELOPMENT AND ASSESSMENT OF TRAC AND RELAP5  
RES - AGREE
- G. ACRS - BROADEN AND ACCELERATE FAST RUNNING SYSTEMS CODES  
RES - HAVE MAJOR EFFORT ON PLANT ANALYZERS. FAST TRAC AND RELAP BEING DEVELOPED
- II. ACRS - LIMIT AND MONITOR CODE ASSESSMENT TO AVOID MASSIVE PROGRAM  
RES - AGREE, ARE DOING THAT

NUCLEAR REGULATORY RESEARCH  
 FY 1984-88 LRRP  
 (DOLLARS IN MILLIONS)

LOEI	FY 82	FY 83 CONG.	$\Delta$	FY 84	FY 85	FY 86	FY 87	FY 88
TEST OPER.-FAC. SUPPORT-SHUTDOWN	\$30.5	\$11.1	-9.2	\$ 1.9				
ENG. & ANALYSIS	8.3	2.0	2.5	4.5				
FUEL PROC. & EXAM.	3.2	1.2	0.6	1.8				
PROJECT CLOSE OUT	-	0.7	0.1	0.8	\$ 5.0*			
	<u>          </u>	<u>          </u>	-6.0	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>
TOTAL PROG. SUPPORT	\$42.0	\$15.0		\$ 9.0	\$ 5.0			

EXCLUDES POSSIBLE DECONTAMINATION PENDING THE OUTCOME OF CURRENT DISCUSSIONS OF ALTERNATIVE FUNDING

\*FUEL DISPOSAL/STORAGE \$3.7 MILLION

NUCLEAR REGULATORY RESEARCH  
 FY 1984-88 LRRP  
 (DOLLARS IN MILLIONS)

<u>ACCIDENT EVALUATION &amp; MITIGATION</u>	<u>EY 82</u>	FY 83 <u>CONG.</u>	$\Delta$	<u>EY 84</u>	<u>EY 85</u>	<u>EY 86</u>	<u>EY 87</u>	<u>EY 88</u>
BEHAVIOR OF DAMAGED FUEL	\$18.0	\$24.9	5.1	\$30.0	\$23.0	\$20.0	\$12.0	\$10.0
FUEL MELT	7.1	10.3	-2.0	8.3	8.9	7.2	6.6	5.8
FISSION PRODUCT RELEASE TRANSPORT	4.1	7.1	0.0	7.9	5.5	4.3	3.1	1.6
ACCIDENT MITIGATION	1.6	1.5	2.7	4.2	4.7	4.4	4.2	3.6
SASA	<u>2.3</u>	<u>3.4</u>	<u>0.1</u>	<u>3.5</u>	<u>3.6</u>	<u>3.6</u>	<u>3.6</u>	<u>3.6</u>
TOTAL PROG. SUPPORT	\$33.1	\$47.2	6.7	\$53.9	\$45.7	\$39.5	\$29.5	\$24.6

## ACCIDENT EVALUATION AND MITIGATION

### BEHAVIOR OF DAMAGED FUEL

- PBF PHASE ONE TESTS COMPLETE FY 1984
- SCDAP/MOD 1 COOLABILITY ANALYSIS COMPLETE FY 1984
- SCDAP - WHOLE CORE ANALYSIS PACKAGE COMPLETE FY 1985
- TEST PROGRAM COMPLETE FY 1986

### FUEL MELT

- HYDROGEN CONTROL ASSESSMENT COMPLETE FY 1984
- CORCON MOD 2 COMPLETE FY 1984
- LARGE SCALE RETENTION TESTS COMPLETE FY 1984
- CONTAIN COMPLETE FY 1984
- LARGE SCALE PROOF TESTS, EQUIP. SURVIVABILITY COMPLETE FY 1986
- FUEL DEBRIS-COOLANT-CONCRETE TESTS COMPLETE FY 1986



**ACCIDENT EVALUATION AND MITIGATION**

**EMISSION PRODUCT RELEASE AND TRANSPORT**

- **NUREG-0772 FOLLOW-ON** FY 1983
- **COMPLETE NSPP - AEROSOL - STEAM TESTS** FY 1984
- **ESF PERFORMANCE IN SEVERE ACCIDENTS** FY 1984
- **COMPLETE TRAP-MELT ASSESSMENT** FY 1986

**SEVERE ACCIDENT SEQUENCE ANALYSIS**

- **ASSESS OPERATOR GUIDELINES** FY 1984
- **MANAGEMENT STRATEGIES FOR SEVERE ACCIDENTS** FY 1986

## ACCIDENT EVALUATION AND MITIGATION

CHANGES FROM 83 - 87 LRRP

- INCREASED PBF FISSION-PRODUCT RELEASE TESTS.
- TERMINATED PLANNED DEFORMED CORE COOLABILITY (DECCA) PROGRAM (ACRS RECOMMENDATION)
- REDUCE SUPER-SAPA PROGRAM (ACRS RECOMMENDATION)
- FISSION PRODUCT PROGRAM MODIFIED BY NUREG-0772 STUDIES TO IMPROVE MODELING FOR TRAP-MELT, STUDY PAST ACCIDENTS (ACRS RECOMMENDATION), MORE F.P. CHEMISTRY AND COMM'L FUEL RELEASE EXPERIMENTS
- EXPERIMENTAL INVESTIGATION OF WATER FLOODING OF MELTS
- STABILITY AND COOLABILITY OF GRAVEL BEDS (BACK FITTING APPLICATION).
- ADD SEVERE ACCIDENT SEQUENCE ANALYSIS SUBELEMENT

## ACCIDENT EVALUATION AND MITIGATION

### RESPONSES TO ACRS RECOMMENDATIONS

- A. ACRS - REDIRECT PROGRAM TO RULEMAKING (OR ALTERNATE) SUPPORT  
RES - PROGRAM REDIRECTED TO ACCIDENT MANAGEMENT AND SASA
- B. ACRS - PHASE II PBF AND NRU TESTS SHOULD NOT START WITHOUT CLEAR NEED  
RES - AGREE, BUT PLANNING WILL CONTINUE UNTIL QUESTION OF NEED IS ANSWERED
- C. ACRS - DEFER ACRR EXPERIMENTS  
RES - ESSENTIAL TO SFD PROGRAM - DEBRIS COOLABILITY LIMIT DATA
- D. ACRS - ACCELERATE TMI-2 CORE EXAMINATION  
RES - PACE NOT CONTROLLED BY NRC - RES ON CORE EXAMINATION PLANNING GRP
- E. ACRS - REDUCE FUNDING AND ANALYZE ACCIDENT PROGRESSION DATA NEEDS IN FUEL MELT PROGRAM  
RES - PHENOMENA GOVERNING DAMAGE EVOLUTION NEEDED PRIOR TO ACCIDENT PROGRESSION ANALYSIS. NEED TO ESTABLISH CONTAINMENT LOADING FOR RISK ANALYSIS
- F. ACRS - TOO MUCH CODE DEVELOPMENT IN FUEL MELT PROGRAM, COORDINATE WITH DOE  
RES - CONTAINMENT INTEGRITY ANALYSIS CAPABILITY ESSENTIAL - COORDINATE WITH DOE
- G. ACRS - CONDUCT PEER REVIEW OF FISSION PRODUCT RELEASE AND TRANSPORT PROGRAM  
RES - AGREE - WILL CONDUCT COMPREHENSIVE PEER REVIEW
- II. ACRS - INTEGRATE H<sub>2</sub> MITIGATION RESEARCH WITH INDUSTRY - REDUCE NON-CORE MATERIAL GAS GENERATION RESEARCH  
RES - AGREE - PROGRAM REDUCED TO SPRAY MATERIAL INVESTIGATIONS

NUCLEAR REGULATORY RESEARCH

FY 1984-88 LRRP  
(DOLLARS IN MILLIONS)

	FY 82	FY 83 CONG.	△	FY 84	FY 85	FY 86	FY 87	FY 88
ADVANCED REACTORS								
FAST REACTORS	\$ 5.0	\$10.5	2.5	\$13.0	\$12.0	\$ 9.0	\$ 5.0	\$ 3.0
GAS-COOLED REACTORS	<u>2.5</u>	<u>2.5</u>	<u>0</u>	<u>2.5</u>	<u>2.5</u>	<u>0</u>	<u>0</u>	<u>0</u>
TOTAL PROG. SUPPORT	\$ 7.5	\$13.0	2.5	\$15.5	\$14.5	\$ 9.0	\$ 5.0	\$ 3.0

ADVANCED REACTORS  
(CHANGES IN PLAN)

- NEEDED FOR EARLY RESOLUTION OF CRBR ISSUES:
  - SODIUM/CONCRETE INTERACTIONS
  - AGGREGATE -- DOLOMITE VS LIMESTONE VS HIGH ALUMINA
- APPLICANT HAS PROPOSED -- CONTAINMENT INTEGRITY BASED ON TOTAL SODIUM/CONCRETE PENETRATION
- REINSTATE FAST FACILITY TO PROVIDE AEROSOL SOURCE TERM DATA UNDER SODIUM.
- RENEW ASSESSMENT AND SUPPORT FOR OTHER SAFETY ISSUES:
  - ENERGETICS - CORE COOLABILITY - DECAY HEAT -
  - POWER LOSS - SYSTEM FAILURES - SODIUM FIRES AND HYDROGEN GENERATION - RELIABILITY OF EQUIPMENT
- SCOPE - PROGRAM NOW SUPPORTS ONLY CRBR LICENSING

## ADVANCED REACTORS

### LMFBR

- CONTINUE SUPPORT OF CRBR LICENSING FY 84-88
- REFINE LMFBR RISK ANALYSIS FY 84
- INSTRUMENT AND CONTROL SYSTEM STUDIES FOR SYSTEM ANOMALY DETECTION FY 85
- CONTROL ROOM DESIGN AND HUMAN FACTOR STUDIES FY 85
- CONTAINMENT DESIGN CRITERIA FY 86
- COMPLETE FUEL MELT/CDA STUDIES FY 87

### HTGR

- PRE-APPLICATION REVIEW FY 83
- REVISE GENERAL DESIGN CRITERIA FY 84
- SOURCE TERM REVIEW FY 85



## REACTOR AND FACILITY ENGINEERING

### PAST EXPERIENCES AND ANTICIPATED FUTURE PROBLEMS

1. AGE-RELATED DEGRADATIONS
  - A. REACTOR VESSEL, STEAM GENERATOR TUBES, PIPING
  - B. OTHER MECHANICAL COMPONENTS
  - C. ELECTRICAL COMPONENTS
2. PRESERVICE AND INSERVICE INSPECTIONS
3. DESIGN, CONSTRUCTION AND COMPUTER CODE ERRORS
4. MISSING LOADS OR INCREASE IN DESIGN LOADS
5. CHANGING CRITERIA
6. DISCOVERY OF FAULTS OR INCREASE IN SEISMIC INPUT
7. EQUIPMENT NOT PROPERLY QUALIFIED
8. RISKS DUE TO EXTERNAL EVENTS
9. DECOMMISSIONING

# REACTOR AND FACILITY ENGINEERING

## PROGRAM DIRECTION

- EMPHASIS ON OPERATING REACTORS (SMALL BUT SIGNIFICANT EFFORT ON NEW FACILITIES)
- GENERAL DIRECTION
- TIME RELATED EFFECTS
  - COMPREHENSIVE AGING PROGRAM
  - PRIMARY SYSTEM INTEGRITY
    - AGING AND DEGRADATIONS
    - FLAW INITIATIONS AND FLAWS
    - MODIFICATIONS AND REPAIRS
  - ELECTRICAL AND MECHANICAL COMPONENTS
- NONDESTRUCTIVE EXAMINATION
- NEW AND CHANGING REQUIREMENTS
  - STRUCTURAL, MECHANICAL AND SEISMIC RESEARCH
  - FISSION PRODUCT CONTROL AND HYDROGEN BURN PREVENTION AND MITIGATION
  - FIRE PROTECTION
- PROBABILISTIC RISKS
- DECOMMISSIONING, SPENT FUEL STORAGE *(Dry Spent Fuel Storage)*
- QUALIFICATION OF ELECTRICAL AND MECHANICAL COMPONENTS
- STANDARD METHODS OF ANALYSIS

FACILITY OPERATIONS & SAFEGUARDS  
 FY 1984-88 LRRP  
 (DOLLARS IN MILLIONS)

	<u>FY 82</u>	<u>FY 83 CONG.</u>	<u>▲</u>	<u>FY 84</u>	<u>FY 85</u>	<u>FY 86</u>	<u>FY 87</u>	<u>FY 88</u>
HUMAN ENGINEERING	\$ 3.9	\$ 4.8	\$ 2.1	\$ 6.9	\$ 6.9	\$ 6.9	\$ 6.9	\$ 6.9
PLANT INST. & CONTROL	2.7	3.6	2.8	6.4	6.9	7.8	6.0	3.5
OCCUPATIONAL RAD. PROT.	2.0	2.1	0.4	2.5	2.3	2.2	2.0	2.0
EMERGENCY PREPAREDNESS	0.5	0.5	0.1	0.6	0.7	0.6	0.6	0.6
SAFEGUARDS	3.6	2.2	-0.2	2.0	2.0	2.0	2.0	2.0
QUALITY ASSURANCE	0.3	0.3	0.7	1.0	1.0	1.0	1.0	1.0
TOTAL PROG. SUPPORT	<u>\$13.0</u>	<u>\$13.5</u>	<u>\$ 5.9</u>	<u>\$19.4</u>	<u>\$19.7</u>	<u>\$20.6</u>	<u>\$18.5</u>	<u>\$16.0</u>

HUMAN ENGINEERING RESEARCH

F182:  
3.9

F184:  
6.9H

- HUMAN FACTORS
- LICENSEE QUALIFICATIONS
- PLANT PROCEDURES
- HUMAN RELIABILITY

PLANT INSTRUMENTS AND CONTROLS

- PLANT CONTROL, PROTECTION AND ELECTRIC SYSTEMS
- PLANT INSTRUMENTATION COMPONENTS
- DIAGNOSTIC INSTRUMENTATION METHODS
- ADVANCED CONCEPTS

## OCCUPATIONAL RADIATION PROTECTION RESEARCH

- OCCUPATIONAL ALARA
- HEALTH PHYSICS MEASUREMENTS IMPROVEMENT
- INTERNAL DOSE CONTROL
- PERSONNEL PERFORMANCE IMPROVEMENT
- DOSE RATE REDUCTION

## EMERGENCY PREPAREDNESS RESEARCH

- MONITORING RADIOLOGICAL RELEASES
- ORGANIZATIONAL AND INDIVIDUAL RESPONSIBILITIES/INTERFACES
- INFORMATION FLOW DURING INCIDENTS
- PROTECTING PUBLIC HEALTH AND SAFETY DURING A RADIOLOGICAL EMERGENCY

## SAFEGUARDS RESEARCH

- PROTECTION OF NUCLEAR MATERIAL FROM THEFT
- PROTECTION OF NUCLEAR FACILITIES FROM RADIOLOGICAL SABOTAGE

## QUALITY ASSURANCE RESEARCH

IMPROVE QUALITY ASSURANCE PROGRAM ACTIVITIES IN THE DESIGN,  
CONSTRUCTION AND OPERATION OF NUCLEAR FACILITIES

- GRADED QUALITY ASSURANCE PROGRAM
- QUALITY ASSURANCE PERSONNEL QUALIFICATIONS
- SYSTEMS RELIABILITY FOR QUALITY ASSURANCE



## FACILITY OPERATIONS AND SAFEGUARDS

### PROGRAM CHANGES (COMPARED WITH NUREG-0740)

PROGRAM CHANGES REFLECT CONSOLIDATION OF RES AND SD AND USER OFFICE RESEARCH PRIORITIES

- |   |  |
|---|--|
| HUMAN FACTORS                           | <ul style="list-style-type: none"><li>● NRR REQUEST FOR INCREASED EMPHASIS ON HUMAN FACTORS SAFETY RESEARCH</li><li>● LICENSEE QUALIFICATIONS AND MAINTENANCE</li></ul>  |
| INSTRUMENTATION<br>AND CONTROL          | <ul style="list-style-type: none"><li>● SAFETY IMPLICATIONS OF CONTROL SYSTEMS</li><li>● CONTROL SYSTEM/PLANT ELECTRICAL SYSTEM INTERACTIONS</li></ul>   |
| OCCUPATIONAL<br>RADIATION<br>PROTECTION | <ul style="list-style-type: none"><li>● IMPROVE HEALTH PHYSICS MEASUREMENTS; CONTROL OF DOSE FROM INTERNALLY DEPOSITED RADIOACTIVE MATERIAL; AND RADIATION PROTECTION PERFORMANCE OF LICENSEE PERSONNEL</li></ul>  |
| SAFEGUARDS                              | <ul style="list-style-type: none"><li>● TECHNICAL BASIS FOR SAFEGUARDS REQUIREMENTS FOR HIGH LEVEL WASTE STORAGE FACILITIES</li><li>● IDENTIFY ECONOMICAL SYSTEMS TO PROTECT REACTORS FROM SABOTAGE BY AN INSIDER</li><li>● DELETE SAFEGUARDS RESEARCH PROGRAM ADDRESSING PLUTONIUM REPROCESSING</li></ul> |
| EMERGENCY<br>PREPAREDNESS               | <ul style="list-style-type: none"><li>● RESOLVE LONG-TERM ISSUES RELATED TO MITIGATING CONSEQUENCES OF A RADIOLOGICAL EMERGENCY</li></ul>  |

RESPONSE TO ACRS COMMENTS IN NUREG-0864  
ON FACILITY OPERATIONS AND SAFEGUARDS

6.8.2 ACRS SPECIFIC RECOMMENDATIONS

- (A) PROCEDURES RELATED RESEARCH IS CONTINUING, BUT WITH RELIANCE ON INDUSTRY ACTIVITIES AND OTHER NRC PROGRAMS.
- (B) NRC RESEARCH IS FOCUSING ON REQUIREMENTS AND METHODS TO EVALUATE SPDS DESIGNS, RATHER THAN OPTIMIZING SPDS DESIGN.
- (C) WORK IS BEING DONE ON CRITERIA FOR JUDGING MANAGEMENT EFFECTIVENESS; RES PLANS TO VALIDATE EVALUATION CRITERIA BEING DEVELOPED.
- (D) INCREASED EFFORTS PLANNED TO INCORPORATE HUMAN FACTORS PRINCIPLES, PARTICULARLY FOR MAINTENANCE.
- (E) MORE WORK IS PLANNED ON HUMAN PERFORMANCE CONSIDERATIONS OUTSIDE THE CONTROL ROOM; HOWEVER, EFFORTS ON CONTROL ROOM DESIGN AND RISK MODELING WILL ALSO CONTINUE.
- (F) HIGH PRIORITY IS BEING GIVEN TO SAFETY IMPLICATIONS OF CONTROL SYSTEMS.
- (G) LIMITED EFFORT ON RELIABILITY REQUIREMENTS FOR DATA SUPPLIED TO THE CONTROL ROOM WILL CONTINUE.

- (H) RESEARCH EFFORTS TO REDUCE THE INDIVIDUAL AND COLLECTIVE DOSE TO WORKERS CONTINUES TO RECEIVE HIGH PRIORITY.
- (I) THE NRC SUPPORTS PROVIDING FEMA WITH FUNDS FOR EMERGENCY PREPAREDNESS RESEARCH.
- (J) RESEARCH WILL BE PERFORMED ON DESIGN AND/OR PROCEDURAL CHANGES TO PROTECT AGAINST SABOTAGE OF EXISTING PLANTS.

NUCLEAR REGULATORY RESEARCH

FY 1984-88 LRRP

(DOLLARS IN MILLIONS)

	EY 82	FY 83 CONG.	EY 84	EY 85	EY 86	EY 87	EY 88
WASTE MANAGEMENT							
HIGH LEVEL WASTE	\$ 5.6	\$ 6.1	\$ 7.0	\$ 7.5	\$ 8.0	\$ 8.0	\$ 8.0
LOW LEVEL WASTE	4.0	4.3	4.8	4.8	4.8	4.5	4.2
URAN. RECOVERY	<u>2.6</u>	<u>3.2</u>	<u>3.0</u>	<u>2.8</u>	<u>2.6</u>	<u>2.4</u>	<u>2.0</u>
TOTAL PROG. SUPPORT	\$12.2	\$13.6	\$14.8	\$15.1	\$15.4	\$14.9	\$14.2

RESPONSE TO ACRS COMMENTS  
ON FY83 BUDGET

7. WASTE MANAGEMENT RESEARCH

- NWSS HAS THE LEAD FOR CONSULTING WITH EPA
- DO NOT PLAN RESEARCH ON GLACIATION
- PROJECTS PLANNED FOR EXPANSION OR INITIATION IN FY83:
  - ACCEPTABILITY OF MATH MODELS FOR HILY
  - CRITERIA FOR DECOMMISSIONING SLB
  - ALTERNATIVES TO SLB
  - SURFACE HYDROLOGY FOR SLB
  - CHELATING AGENTS
  - VOLUME REDUCED WASTES
  - ALTERNATIVES TO CURRENT TAILS DISPOSAL

PROGRAM CHANGES FROM LAST YEAR'S LRRP

CHAPTER 9. SITING AND ENVIRONMENTAL

GEOLOGY AND SEISMOLOGY

- \$211 REDUCTION IN FY82 FULLY RESTORED BY FY85
- INCREASED EMPHASIS ON EASTERN U.S.

SITING AND ENVIRONMENT

- ZEROED ENVIRONMENTAL IMPACTS
- EXAMINE ISSUES IN SITING NON-REACTOR FACILITIES

HEALTH EFFECTS

- RESTORE TO \$3M IN FY84
- CENTER FOR HEALTH EFFECTS ASSESSMENTS

RESPONSE TO ACRS COMMENTS  
ON FY83 BUDGET

8. SITING AND ENVIRONMENTAL RESEARCH

- WORKING INTERNALLY AND WITH USGS TO DEVELOP A PROGRAM OF RELEVANT RESEARCH IN GEOLOGY AND SEISMOLOGY
- AN FY82 PROJECT ON OFFSITE CHANGES WILL CONTINUE IN FY83
- LOOKING FOR OPPORTUNITIES TO INCREASE HEALTH EFFECTS FUNDING IN FY83
- RESEARCH FROM EPA AND OTHER AGENCIES ON ENVIRONMENTAL IMPACTS



## RISK ANALYSIS RESEARCH OBJECTIVES

- o IMPROVE METHODS OF RISK ANALYSIS
- o DEVELOP METHODS TO USE RISK ANALYSIS
  - RESEARCH NEEDS
  - SAFETY REVIEW PRIORITIES
  - GENERIC AND SPECIFIC REGULATORY DECISIONS
- o IMPROVE REGULATORY PROCESS
- o TRANSFER INFORMATION
  - TRAINING
  - RESEARCH RESULTS
  - PUBLIC INFORMATION

## MAJOR TRENDS IN RISK ANALYSIS RESEARCH

1982 - 1983 (REACTORS)

### PLANT RISK

- o COMPLETE FIRST FULL SET OF TRIAL IREP CASES AND REVISE IREP GUIDE
- o COMPLETE IEEE/ANS NREP PROCEDURES GUIDE
- o ASSIST NRR IN STARTING NREP
- o FAST AND GAS RISK FOR INPUT TO RESEARCH AND LICENSING

### METHODOLOGY

- o FOLLOW UP ON SAFETY GOALS AND DECISION METHODS
  - ACCIDENT SEQUENCE DELINEATION
  - CONSEQUENCE MODEL IMPROVEMENT
  - RULEMAKING ANALYSES
- o METHODS AND DATA IMPROVEMENTS

## MAJOR TRENDS IN RISK ANALYSIS RESEARCH

1982 - 1983 (TRANSP, & MAT'LS)

### WASTE MANAGEMENT

- o BEDDED SALT HLW METHOD NEARING COMPLETION
- o BASALT, DOMED SALT, WELDED TUFF BEGINNING
- o MODIFYING HLW METHODS TO LLW

### TRANSPORTATION

- o WINDING DOWN, STANDARDS AND DOT SUPPORT

### MATERIALS

- o REFERENCE APPRAISALS OF FUEL CYCLE FACILITIES

## SEVERE ACCIDENT RISK RESEARCH

- o ACCIDENT SEQUENCE EVALUATION PROGRAM
  - SEQUENCE PROBABILITIES
  - PRECURSORS
- o RISK CODE DEVELOPMENT
  - MARCH 1.1/CORRAL-2/CRAC-2
  - MARCH 1.2/MATADOR/CRAC-2
  - MELCOR
- o REFERENCE STATEMENTS OF RISK
- o VALUE-IMPACT ANALYSIS
- o REGULATORY ANALYSIS
- o DECISION OPTIONS
  - PRELIMINARY - END OF 1982
  - FIRST FINAL - END OF 1983
  - 2<sup>ND</sup> OPTION - END OF 1984
  - 3<sup>RD</sup> OPTION - END OF 1985

*(Handwritten notes)*  
MELCOR  
MARCH 1.1  
MARCH 1.2

NUCLEAR REGULATORY RESEARCH

FY 1984-88 LRRP

(DOLLARS IN MILLIONS)

<u>SYSTEMS &amp; RELIABILITY</u> <u>ANALYSIS</u>	<u>FY 82</u>	<u>FY 83</u> <u>CONG.</u>	$\Delta$	<u>FY 84</u>	<u>FY 85</u>	<u>FY 86</u>	<u>FY 87</u>	<u>FY 88</u>
RISK METHODS & DATA EVAL.	\$ 7.0	\$ 7.0	1.6	\$ 8.6	\$ 8.5	\$ 8.0	\$ 7.2	\$ 6.6
REACTOR RISK & REL. ANAL.	6.6	7.4	3.0	10.4	10.5	9.1	7.5	5.0
TRANSPORTATION & MATL. RISK	<u>1.5</u>	<u>1.5</u>	<u>1.9</u> 6.5	<u>3.4</u>	<u>3.7</u>	<u>3.8</u>	<u>3.6</u>	<u>3.1</u>
TOTAL PROG. SUPPORT	\$15.1	\$15.9		\$22.4	\$22.7	\$20.9	\$18.3	\$14.7

## RISK ASSESSMENT

FY 1984 - FY 1988

### BACKGROUND

- o NREP UNDERWAY
- o PHASE I OF SEVERE ACCIDENT APPRAISAL NEAR COMPLETION
- o NEAR COMPLETION OF RISK APPRAISALS OF TRANSPORTATION AND MATERIALS

### TRENDS - TRANSPORT AND MATERIALS

- o COMPLETE RISK METHODOLOGY DEVELOPMENT
  - HLW
  - LLW
  - FUEL CYCLE
- o COMPLETE EVALUATION OF SEVERE TRANSPORT ACCIDENTS
- o DEVELOP REVISED REGULATORY APPROACHES

RISK ASSESSMENT

FY 1984 - FY 1988 (CONT.)

TRENDS - REACTORS

- o CONTINUE AND COMPLETE SEVERE ACCIDENT APPRAISAL
  - REFINED ACCIDENT SEQUENCES
  - IMPROVED CONSEQUENCE MODELS (MELCOR)
  - GENERIC VALUE-IMPACT ANALYSES
- o EXAMINATION OF REGULATORY ALTERNATIVES
  - RISK LIMITATION EFFECTIVENESS OF PRESENT REGULATORY STRUCTURES
  - RISK LIMITATION EFFECTIVENESS OF ALTERNATIVE REGULATORY STRUCTURES
  - POTENTIAL FOR LOOPHOLES OR OUTLIERS IN REGULATORY STRUCTURE
  - POTENTIAL FOR LOOPHOLES OR OUTLIERS IN RISK ASSESSMENT
- o REVISED REACTOR SAFETY STUDY

SYSTEMS AND RELIABILITY ANALYSIS LRRP

CHANGES FROM NUREG-0740

- o DELAYED: - UPDATE TO REACTOR RISK STUDY
- o REDUCED: - REGULATORY REFORM  
- TRANSPORTATION SAFETY\*
- o OMITTED: - GUIDE FOR NRC REVIEW OF NREP  
- RISK BASED GUIDELINES FOR IE INSPECTORS\*  
- TRADEOFF STUDIES ON OCCUPATIONAL EXPOSURE  
VS PUBLIC RISK\*
- o INCREASED: - SABOTAGE PROTECTION \*
- o ADDED: - MELCOR  
- LMFBR RISK ANALYSIS  
- HTGR SOURCE TERM  
- PRESSURIZED THERMAL SHOCK  
- ITERATIVE REACTOR RISK STATEMENTS/BENCHMARKS

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\*THESE ITEMS WILL RECEIVE MORE EMPHASIS IN THE FY 1984 BUDGET



## SYSTEMS AND RELIABILITY ANALYSIS

### ACRS COMMENT

#### GENERAL COMMENT

INCREASE FY 1983 BUDGET BY 3M

#### SPECIFIC COMMENTS

- A. STUDY UNCERTAINTIES IN FREQUENCIES OF  
MAXIMUM PROBABILITY FLOOD
- B. DEVELOP METHODOLOGY FOR ADDITIONAL RISK  
CONTRIBUTORS
- C. REMEDY SINGLE FAILURE CRITERION
- D. HELP FOCUS SAFETY IMPLICATIONS OF CONTROL  
SYSTEMS AND SYSTEMS INTERACTIONS
- E. DEVELOP METHODS FOR ESTIMATING COST AND  
HEALTH EFFECTS
- F. ASSIGN LOW PRIORITY TO DEVELOPMENT OF TOOLS  
FOR ESTIMATING PRESENT WORTH OF PROJECTED  
COSTS OF ACCIDENTS
- G. INCREASE RESEARCH ON CORE DAMAGE AND MELT  
PREVENTION AND CONCEPTUAL MITIGATION FEATURES
- H. PROVIDE BASES FOR POLICY DECISION ON POSSIBLE  
REGULATORY REQUIREMENTS SABOTAGE PREVENTION
- I. DEVELOP APPROACH TO MINIMIZE DESIGN ERRORS
- J. BROADEN ACCIDENT PRECURSOR PROGRAM TO INCLUDE  
SYSTEMATIC EVALUATION OF ACCIDENT INITIATORS
- K. EVALUATE FOREIGN REGULATORY REQUIREMENTS

### RES RESPONSE IN LRRP

- O BUDGET IS INCREASED IN FY 1984-85
- O STAFF INCREASE IS EQUALLY IMPORTANT

- A. INCLUDED
- B. INCLUDED
- C. INCLUDED
- D. RECOMMENDED COORDINATION AND  
FOCUSING IS INCLUDED
- E. INCLUDED
- F. DISAGREE; 1.3% OF SARA BUDGET
- G. INCLUDED, BUT POSSIBLY NOT AT  
LEVEL ACRS RECOMMENDS
- H. INCLUDED
- I. INCLUDED
- J. INCLUDED
- K. INCLUDED

SARA LRRP BUDGET

	<u>FY 82</u>	<u>FY 83</u>	<u>FY 84</u>	<u>FY 85</u>	<u>FY 86</u>	<u>FY 87</u>	<u>FY 88</u>
<u>SYSTEMS &amp; RELIABILITY ANALYSIS</u>	<u>15.1</u>	<u>15.9</u>	<u>22.4</u>	<u>22.7</u>	<u>20.9</u>	<u>18.3</u>	<u>14.7</u>
<u>REACTOR RISK ANALYSIS</u>	<u>6.6</u>	<u>7.4</u>	<u>10.4</u>	<u>10.5</u>	<u>9.1</u>	<u>7.5</u>	<u>5.0</u>
IREP/NREP	0.9	0.7	0.8	0.8	0.9	1.0	1.0
REVISED RSS	--	--	3.0	4.0	6.0	5.0	3.0
MELCOR CODE DEVELOPMENT	2.3	2.2	2.3	2.2	0.5	0.2	0.1
ACCIDENT SEQUENCE EVALUATION	0.9	1.0	0.7	0.6	0.2	0.1	0.1
PRECURSOR ANALYSIS	0.4	0.4	0.7	0.7	0.6	0.5	0.5
PRESS. THER. SHOCK & TRANSPORT HZD.	0.6	0.4	--	--	--	--	--
SEVERE ACCIDENT DESIGN ALT.	1.0	2.0	1.9	1.5	0.7	0.7	0.3
RELIABILITY ASSURANCE	0.5	0.7	1.0	0.7	0.2	--	--

SARA LRRP BUDGET (CONTINUED)

	<u>FY 82</u>	<u>FY 83</u>	<u>FY 84</u>	<u>FY 85</u>	<u>FY 86</u>	<u>FY 87</u>	<u>FY 88</u>
<u>RISK METHODOLOGY &amp; REG. ANALYSIS</u>	<u>7.0</u>	<u>7.0</u>	<u>8.6</u>	<u>8.5</u>	<u>8.0</u>	<u>7.2</u>	<u>6.6</u>
PRA & RELIABILITY MODELS	2.3	2.2	1.9	1.8	1.5	1.0	0.8
HUMAN RELIABILITY	1.3	1.3	2.3	2.2	2.1	2.0	2.0
DATA BASE SPEC. & DEVELOPMENT	1.0	1.0	1.1	1.0	0.9	0.8	0.8
V/I, SAFETY GOALS, & DEC. TH.	1.3	1.0	1.6	1.8	1.9	1.9	1.6
TECHNOLOGY TRANSFER	0.8	0.8	1.0	1.0	0.9	0.8	0.8
REGULATORY ANALYSIS	0.3	0.7	0.7	0.7	0.7	0.7	0.6
<u>TRANSPORTATION &amp; MATERIALS RISK</u>	<u>1.5</u>	<u>1.5</u>	<u>3.4</u>	<u>3.7</u>	<u>3.8</u>	<u>3.6</u>	<u>3.1</u>
FUEL CYCLE RISK	0.6	0.7	1.0	1.0	0.9	0.8	0.5
FUEL CYCLE RELIABILITY ASSURANCE	--	--	0.3	0.5	0.7	1.0	1.2
MATERIALS	0.2	0.3	1.0	0.8	0.7	0.5	0.4
TRANSPORTATION	0.7	0.5	0.7	0.9	0.9	0.7	0.5
RISK VALIDATION/VERIFICATION	--	--	0.4	0.5	0.6	0.6	0.5

DRA LRRP BUDGET SUMMARY

	<u>FY 82</u>	<u>FY 83</u>	<u>FY 84</u>	<u>FY 85</u>	<u>FY 86</u>	<u>FY 87</u>	<u>FY 88</u>
<u>SARA</u>	<u>15.1</u>	<u>15.9</u>	<u>22.4</u>	<u>22.7</u>	<u>20.9</u>	<u>18.3</u>	<u>14.7</u>
REACTOR RISK ANALYSIS	6.6	7.4	10.4	10.5	9.1	7.5	5.0
RISK METHODOLOGY & REG. ANAL.	7.0	7.0	8.6	8.5	8.0	7.2	6.6
TRANSPORTATION & MAT'LS RISK	1.5	1.5	3.4	3.7	3.8	3.6	3.1
(- HUMAN RELIABILITY)	(-1.3)	(-1.3)	(-2.0)	(-2.0)	(-2.0)	(-2.0)	(-2.0)
DRA SARA SUBTOTAL	13.8	14.6	20.4	20.7	18.9	16.3	12.7
<u>ADVANCED REACTORS</u>	<u>0.5</u>	<u>1.9</u>	<u>0.6</u>	<u>0.2</u>	<u>0.1</u>	<u>0.1</u>	<u>0.1</u>
<u>WASTE MANAGEMENT</u>	<u>1.1</u>	<u>0.9</u>	<u>1.3</u>	<u>1.3</u>	<u>1.1</u>	<u>1.1</u>	<u>0.9</u>
<u>FUEL CYCLE SAFETY</u>	<u>0.9</u>	<u>1.0</u>	<u>1.3</u>	<u>1.4</u>	<u>1.4</u>	<u>1.1</u>	<u>1.0</u>
TOTAL DRA	16.3	18.4	23.6	23.6	21.5	18.6	14.7

*Common to all  
1982-1988  
1989-1990*

## Comments on Chapter 2 of LRRP

by MSP

As stated in the report the integral systems program is based on Semiscale and FIST. The program appears to lack foresight, or imagination, or boldness. It is difficult to see how these integral systems will do what is needed either for Research or NRR in the latter's licensing needs. What is lacking is a program for a facility like the Japanese integral facilities, LSTF and TPFT (ROSA IV). At the least it would seem desirable to have a more formal access to the data and also to the formulation of the test program. At the same time it must be said that LSTF in its present form will not bear directly on the behavior of B&W or CE type reactors.

It should be evident at this time that secondary side upsets and steam generator tube leaks are significant problems with which the NRC will have to deal for a long time. It will also appear that our integral test facilities involved in the LRRP are quite inadequate. Finally, if there is not a reasonable possibility of a practical formal agreement with the Japanese regarding real participation in the ROSA IV program, or if there is no possibility of the NRC getting a similar facility of its own, the NRC should state frankly that they will not have the necessary integral facilities which are adequate for their urgent needs. It may be unnecessary to point out that the Code Development and Assessment Program would also profit greatly from an integral test facility with prototype pressure capability and with a size like that of LSTF.

It must be made very clear that LOFT is not the kind of integral facility that would serve the needs discussed here. First, the core geometry is distorted by being of reduced height, second, as a nuclear facility the cost of tests is very great and turn around time is long (the argument regarding deficiencies in electrically heated rods has lost its force with the developments made in Karlsruhe on the design of electrically heated rods); and finally, the LOFT facility was never designed to give adequate modeling of the secondary side. It might be mentioned that the cost of running LOFT for one year was quite a bit more than the total capital cost for LSTF and TPFT.

In quite another area, in connection with the development of fast running codes for LWRs it would seem necessary to have some specific plan for meeting this need. Presumably such a plan will indicate some relationship with the reactor vendors and with simulator developers.

Response to Dr. Plessett's Comments on the LOFT Chapter of the LRRP

The Office of Nuclear Regulatory Research (RES) agrees that a large multiloop integral systems facility of the ROSA IV type would be useful to have for the purpose of confirming conclusions drawn from the Semiscale and FIST test programs. However, the cost of such a large facility is too burdensome to support within the RES budget and RES has no plans to do so. Instead, to provide this confirmatory capability, RES is following two parallel paths: the ROSA IV path, recommended by Dr. Plessett, and the analysis of large plant upsets and accidents.

In the case of the ROSA IV program, RES has been informally involved, since the inception of the program. During that period, RES has supplied significant aid in designing the facility and continues to supply instrumentation and on-site staff needed in its operation. RES intends to continue this participation, with Japanese agreement, as the facility is completed and testing begins. Discussions between the U.S. Nuclear Regulatory Commission (USNRC) and the Japan Atomic Energy Research Institute (JAERI), are planned for late FY 1982, to determine whether or not a more formal arrangement for ROSA IV should be established.

In the case of large plant analysis, RES is continuing a program of analysis of all significant plant upsets and accidents. This program serves to develop our experience in the analysis of more probable events and increase our confidence in the accuracy of codes used for safety analysis.

On the question of fast running codes (as they are to be used for plant analyzers), the following information, presented to the ACRS at the January 6 and March 24, 1982 meetings, is still valid.

The plant analyzer is viewed as an important product of the NRC code development effort. The plan is to use existing NRC developed reactor safety system codes, such as TRAC-PWR, TRAC-BWR, RAMONA-3B and/or RELAP5, with current state-of-the-art computers to produce a fast-running interactive analysis capability with user oriented output display to analyze LWR plant transients. The software developed would be packaged with available display capability so that a user (including NRR personnel) could sit at a console and obtain answers to LWR safety problems expeditiously. Two plant analyzer configurations, one for PWR transients and the other for BWR transients, are being studied. A feasibility demonstration of the PWR plant analyzer is planned in FY 1985 and of the BWR plant analyzer in FY 1986.

A preliminary demonstration of using RELAP5 in an interactive mode has already been accomplished, and the RELAP5 program plan includes a continuation of the interactive mode and results display development. The RAMONA-3B code, a BWR system code with nuclear kinetics capability, is being converted to run on the AD-10 multiprocessor computer. This demonstration will be completed in FY 1983.

Proposals have been requested by April 1982 from LANL and INEL to develop plant analyzers for the computer codes they have developed. These codes have both 1-D and 3-D simulation capabilities and are being assessed against a wide variety of test data from various facilities. As the development and assessment of these NRC codes is nearing completion, more emphasis is being placed on making them readily accessible for use by NRC and other personnel. The plant analyzer program will provide a versatile, flexible and fast analysis capability for NRR personnel.