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

January 27, 1978

The Honorable Walter F. Mondale
The President of the Senate

The Honorable Thomas P. O'Neill, Jr.
The Speaker of the House

Gentlemen:

A copy of the Advisory Committee on Reactor Safeguards' report on the Safety Research Program of the United States Nuclear Regulatory Commission was forwarded to you on December 30, 1977, as required by Public Law 95-209. It has since been suggested that a summary of recommendations regarding the content of the program would be helpful in application of the report and one is therefore attached.

A copy of this summary is being sent to the Chairman of the Nuclear Regulatory Commission.

Respectfully submitted,

Stephen Lawroski

Stephen Lawroski
Chairman

Attachment:
Review and Evaluation of the
Nuclear Regulatory Commission
Safety Research Program - Summary

REVIEW AND EVALUATION OF THE NUCLEAR REGULATORY COMMISSION SAFETY RESEARCH PROGRAM - SUMMARY

The ACRS report addresses research projects underway in FY'77 and FY'78. Projects proposed for FY'79 have not been reviewed.

The ACRS concluded that the overall effort of the Division of Reactor Safety Research (RES) appropriately involves research necessary to provide the NRC with suitable bases for carrying out its regulatory responsibilities (1.2) */, but recommends that in addition to continuing such work, NRC should become more involved in research leading to improved safety system concepts (preface).

In order to provide a concise summary, a chapter-by-chapter listing of conclusions and recommendations has been compiled.

SYSTEMS ENGINEERING AND ANALYSIS DEVELOPMENT

The present program is directed toward NRC's needs in the area of Loss-Of-Coolant Accident (LOCA) analysis and Emergency Core Cooling Systems (ECCS). (2.3.1) Specific matters emphasized in this area are:

> The results of the programs to date have not indicated a need for full-scale LOCA testing of a nuclear power reactor. (2.3.1)
>
> The Systems Engineering program is obtaining useful results, but additional work in connection with ECC bypass and plenum fill is needed. (2.3.3)
>
> Further experimental verification of the thermal-hydraulic effects of various two-phase flow regimes is needed. This could profitably be pursued with small-scale tests. (2.3.4)

The Committee believes that additional study is needed regarding the usefulness of a large-scale ECC Bypass Test Facility. (2.3.4)

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*/ Section numbers in the ACRS report on the Safety Research Program, NUREG-0392, are shown in parentheses to allow ready cross-checking.

The ACRS concurs in the decision to terminate the Mark I containment tests at Lawrence Livermore Laboratory. (2.4)

There should be a more significant research effort on integrated system design in such areas as shutdown heat removal. (2.4)

Additional effort is needed in connection with more thorough planning for code verification, justifying scaling experiments, and more meaningful use of standard problems. (2.4)

FUEL BEHAVIOR

NRC research programs in this area are responsive to the Agency's regulatory needs and are without major gaps. (3.3.1) In particular, the experimental programs on zircaloy oxidation, irradiation effects, and elevated temperature mechanical properties are appropriate to the existing need and are expected to produce definitive answers within two years. (3.3.3)

The RES analytical and experimental programs which may provide a definitive model for predicting the behavior of molten core material in three to five years should be maintained at a high priority. (3.5.3)

Progress toward understanding the effects of departure from nucleate boiling, while limited, is satisfactory. (3.3.3)

Overall, progress in the area of fuel behavior is satisfactory and no new areas of research are recommended. Analysis of existing work and its incorporation into the licensing process should be emphasized at this time. (3.3.4) However, the work in support of studies of fission product behavior under accident conditions may warrant increased funding. (3.3.3)

METALLURGY AND MATERIALS

The ACRS believes that work in the Heavy Section Steel Technology program on fracture mechanisms and irradiation embrittlement should be carried through to completion. (4.3.3)

Added research should be funded in piping with emphasis on aspects pertaining to a quantification of reliability. (4.4.2)

It should be recognized that several of the current programs are a continuation of AEC programs that were aimed originally at a more fundamental understanding of damage mechanisms, which subsequently have continued as confirmatory research. The ACRS believes that this reoriented work continues to be justified regardless of whether it adheres to the definition of confirmatory research. (4.3.1)

SITE SAFETY

Research programs on site safety now underway or planned are all related to the needs of the NRC Staff to determine appropriate characteristics of natural events which might occur at the site of a nuclear facility, to evaluate the ability of structures to resist the effects of forces produced by such events, and to evaluate the consequences to the public of a release of radioactivity at a given site. (5.1)

The allocation of funds to site safety research is extremely modest when viewed in the context of the importance of site selection in the licensing process, and in the mind of the public. (5.2)

The program relating to the seismicity of the Eastern U.S. is needed to assure a suitable level of safety and to bring order to the licensing process. (5.3.1) In fact, the Committee was surprised at the lack of involvement in this work by other groups, including other agencies of the U.S. Government. (5.3.2) The relatively modest programs related to seismicity of the Western U.S. are considered appropriate for the present, in view of the more extensive knowledge that is already available concerning the seismicity of that region. The ACRS believes, however, that a program to quantify the margins inherent in current practices for designing plants to resist earthquakes is desirable and should have a high priority. (5.3.1) The ACRS also believes that a program similar to that being conducted in the Eastern U.S. should be considered for the Pacific Northwest. (5.3.4)

While agreeing that there is a need for a program of research to evaluate the resistance to seismically induced shear forces of certain reinforced concrete designs not conforming to current NRC criteria, the ACRS believes that such work might be performed by individual applicants rather than by NRC. (5.3.1)

The ACRS supports the work being done on atmospheric transport of accidentally released radioactive materials and on coastal flooding due to tsunamis or hurricanes. (5.3.1)

The ACRS believes that consequences of the release of large amounts of radioactivity to the liquid pathway may be deserving of further study in relation to the siting of land-based plants. (5.3.4)

Another site-related area that appears to be deserving of further research relates to emergency planning for evacuation or other interdictive actions.

ADVANCED REACTORS

The advanced reactor safety research program is meeting NRC's needs in a reasonable fashion on a generally timely basis. (6.4.1) This program includes needed generic safety research work on liquid metal fast breeder reactors. The current HTGR safety research program might be usefully broadened. (6.3.4)

The ACRS believes that the NRC should be encouraged in its efforts to reorient the ARSR program in an anticipatory direction in view of the possibility of changes in policy that may result from current non-proliferation efforts. (6.4.2)

FUEL CYCLE AND ENVIRONMENTAL

All of the health and environmental research sponsored by NRC addresses needs of the regulatory program. (7.3.1)

The relatively modest program related to mathematical modeling of doses due to environmental releases should be continued. (7.3.1) The NRC, however, should look to other agencies as a primary source of information on the short- and long-term health effects of radiation exposures such as might result from accidents in nuclear facilities. (7.3.1)

The research effort aimed at developing criteria for the long-term management of radioactive wastes, and in particular the research on the environmental transport of radionuclides, is important. (7.3.1)

The ACRS suggests that a research program on evaluating the health and safety problems associated with the development of the thorium and other alternate fuel cycles be initiated. (7.3.4)

The ACRS recommends that NRC begin programs of research into (a) requirements associated with the control of internal exposures of nuclear facility workers and (b) the development of ALARA criteria for the control of releases and related population exposures from uranium mines and mills, waste retention and disposal sites, and fuel fabrication plants. (7.3.4)

SAFEGUARDS

The ACRS believes that priorities within the program are generally sound and that the level of funding and the schedules have been addressed appropriately. (8.3.1) Some changes in program funding might be desirable, however, as noted below.

It is recommended that the program on independent model development be redirected so as to take advantage of available experience among law enforcement and military organizations.

Additional work should be directed to assessing the effectiveness of techniques being developed by others for the prompt detection of attempted diversion of SNM. The applicability of new techniques to alternate fuel cycles should also be studied. (8.3.4)

NRC should initiate and support research on design concepts to make sabotage more difficult and less likely to be harmful to the public. (8.4.2)

RISK ASSESSMENT

Research programs planned or underway in this area are all related to information needed by the RES Probabilistic Assessment Branch to develop and apply risk assessment methodology to light water and advanced reactor designs. (9.1)

Additional programs, however, should be planned in the following areas: testing new concepts for risk evaluation methodology; assessing the contribution of correlated or dependent failure paths to the probability of releases of radioactive materials; and evaluating potential risks of long-term storage of spent LWR fuel at locations remote from reactor sites. (9.4.2)

RESEARCH MANAGEMENT

The ACRS observed that the RES Staff is currently performing its many functions with difficulty because of the small size of the Staff in relation to the demands placed on it. (10.3)