ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
UNITED STATES ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

November 12, 1969

Honorable Glenn T. Seaborg
Chairman
U. S. Atomic Energy Commission
Washington, D. C. 20545

Subject: REACTOR SAFETY RESEARCH

Dear Dr. Seaborg:

The Advisory Committee on Reactor Safeguards wishes to reemphasize some previous recommendations concerning the need for safety research in several important areas in which the effort has not been sufficient. The Committee has been recently informed that overall reactor safety funding for FY 1970 and 1971 will be considerably below the AEC estimates of need for the water reactor safety research program, as well as for safety research on seismic effects, on sodium-cooled fast reactors, on high-temperature, graphite-moderated, gas-cooled reactors, and on environmental effects. As a consequence, many safety research activities have not been initiated, have been slowed, or have been terminated. The Committee reiterates its belief in the urgent need for additional research and development in these areas, and refers in the paragraphs below to earlier statements of the Committee on these subjects.

Water Reactors:

In its letter to Mr. Hollingsworth of March 20, 1969, the ACRS stated its belief that ". . . more effort should be devoted to gaining an understanding of modes and mechanisms of fuel failure, possible propagation of fuel failure, and generation of locally high pressures if hot fuel and coolant are mixed, and that effort should commence on gaining an understanding of the various mechanisms of potential importance in describing the course of events following partial or large scale core melting, either at power or in the unlikely event of a loss-of-coolant accident." The Committee has strongly recommended safety research of this kind several times during the last three years; the Regulatory Staff has also strongly supported such work. However, only small or modest efforts have been initiated thus far.

In its comments of March 20, 1969, the Committee also recommended that ". . . considerable attention be given now to the potential safety questions related to large water reactors likely to be proposed for construction during the next decade. Larger cores, higher power densities, and new materials of fabrication are some of the departures from present practice likely to introduce new safety research needs or major changes in emphasis in existing needs."

The Committee further recommended that consideration be given to ". . . research aimed specifically at improving the potential for siting of large water reactors in more populated areas than currently being utilized. For example, studies should be undertaken to develop reactor design concepts providing additional inherent safety or, possibly, new safety features to deal with very low probability accidents involving primary system rupture followed by a functional failure of the emergency core cooling system."

It appears that, because of funding limitations and for other reasons, the recommendations of the ACRS will not be implemented at this time.

Liquid-Metal-Cooled Fast Breeder Reactors (LMFBRs):

The ACRS, in its report on safety research of November 19, 1963, stated that "Recent renewed emphasis on the long range role of large fast breeder reactors points up the need for a well developed, long term, comprehensive research program on the safety of such reactors. A strong research program started now should develop information very useful to the first generation of very large fast reactors". The Regulatory Staff and the ACRS have recently undertaken a preliminary review of a proposed site to be used for construction of a 500 MWe LMFBR. Construction permit reviews of one or more LMFBRs are anticipated in the next few years.

While an extensive LMFBR safety program plan has been formulated, and a growing program in LMFBR safety has been started, many safety-related design decisions will have to be made by applicants and the regulatory groups without the benefit of needed safety research, in part, because of a lag in the implementation of studies of high priority matters.

High Temperature Gas-Cooled Graphite Reactors (HTGRs):

In its safety research report of October 12, 1966, the ACRS recommended that "Becuase the Commission may be called upon to consider proposals to construct reactors utilizing prestressed concrete pressure vessels, the nuclear industry and the AEC should promptly institute a very active safety research program into such vessels, including their design for seismic effects. This program should include research into anomalous failure modes of such vessels,

particularly under pneumatic loading. This work should encompass effects of potential structural defects or overloads and problems associated with closures, penetrations, and anchors." There are other safety questions with regard to HTGRs which also warrant safety research.

Studies on design methods for PCRVs, as well as a modest program of model studies on PCRV failure modes, have been underway. However, it appears that overall funding limitations have led to reduction or curtailment of this limited effort on failure modes.

Seismic Effects:

As low probability events having a considerable damage potential difficult to study in situ, earthquakes require greater study in connection with the use of nuclear power. The ACRS and the Regulatory Staff, as well as many distinguished scientific groups and expert individuals, have urged a greater level of seismic scientific and engineering research. Such seismic research has importance, of course, to many aspects of our society in addition to nuclear power.

A seismic safety program as strong as was recommended has not been implemented; furthermore, it now appears that a considerable reduction in effort will be effected due to overall funding limitations.

Environmental Effects:

In its March 20, 1969, letter, the Committee also called ". . . attention to the possible long-range need for improvements in knowledge of and methods for controlling the routine release of radioactivity to the environment and suggests that consideration be given to possible research bearing on this matter."

LOFT Integral Test Program:

In its letter of March 20, 1969, on the water reactor safety program plan, the ACRS stated that, ". . . in view of overall funding limitations, the considerable expenditures projected for the LOFT facility and its nuclear experimental program warrant re-evaluation with the benefit of a careful review of the specific objectives and anticipated accomplishments of this portion of the program." A document (IDO-17258K) describing a more detailed LOFT integral test program plan was provided to the Committee in June, 1969, and Safety Research Subcommittee meetings relevant to the LOFT integral program were held on September 27, 1969, and October 8, 1969, with representatives of the General Manager and the Director of Regulation.

Representatives of DRDT stated that the current LOFT integral test schedule provides for completing the reactor and facility by the end of calendar 1973 and shows the first experiments involving reasonably high fuel temperatures in 1975. This program will require a very substantial proportion of the limited funds currently available for reactor safety research. The ACRS believes that relevant arguments can be made both for and against continuation of the LOFT integral experiment program with the current budget limitations, and that a straightforward decision regarding implementation of this program is difficult.

Some of the arguments that favor the continuation of LOFT under current budget exigencies are as follows:

1. While the components of the LOFT integral facility are different from those employed in large water power reactors, and while there are large differences in scale that will be difficult to account for, the importance of proper function of emergency core cooling systems to the safety of large water-cooled reactors is sufficiently great that a full test through the entire accident sequence is important enough to warrant the considerable expenditures involved.

2. Confirmation of many out-of-pile, single and multiple effect measurements can be obtained; many effects, including nuclear heating, are simultaneously combined in the integral experiments, and some previously unanticipated events may be observed in this way. Also, the entire emergency core cooling system would be called upon to function in an accident environment.

Arguments against the continuation of LOFT under the current circumstances include the following:

1. Whereas the LOFT integral tests will provide some confirmatory results for the emergency core cooling system, no design-related or operation-related regulatory decisions for large water reactors have been identified that the LOFT integral experiments will resolve.

2. Reactor vendors have stated they will still have to rely primarily and directly on analysis to demonstrate the efficacy of their emergency core cooling system designs in large water reactors, even should the LOFT integral series be performed. The single- or few-effect, out-of-pile experiments concerning phenomena important to a loss-of-coolant accident have been stated to be more directly useful in confirmation of the analytical methods.

3. While many specific phenomena important to the course of a loss-of-coolant accident cannot be quantitatively predicted, both the reactor vendors and the Regulatory Staff and their consultants have stated their belief that those phenomena subject to examination in the LOFT integral test series can be bounded and handled by conservative design. Furthermore, the Idaho Nuclear Corporation representatives have stated that the area of greatest uncertainty, that relating to flow distribution of emergency core cooling water through the core prior to the accomplishment of reflooding, cannot be studied well or readily in the LOFT integral experiments.

Although opinion is divided along the lines discussed above, a majority of the Committee believes that, while the LOFT integral experiments would be useful, implementation of this program would not be appropriate if it leads to an inability to pursue adequately other, high priority safety research matters as described above.

The Committee is unanimous in its belief that, if the integral experiment program is to be implemented, every reasonable effort must be made to accomplish it on an improved time scale (to start high temperature tests before 1975), and at a reduced cost in order to make adequate funding available for other high priority safety research, even though this would require elimination of the least essential elements of the program.

In summary, the Committee again emphasizes the importance of safety research to the protection of the health and safety of the public and urges that adequate funding be provided to permit timely pursuit of work in all high priority areas.

Sincerely yours,

/s/

Joseph M. Hendrie
Acting Chairman