ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
UNITED STATES ATOMIC ENERGY COMMISSION
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ACRS COMMENTS ON A CORE RETENTION SYSTEM TO MITIGATE THE CONSEQUENCES OF A CORE MELTDOWN

The Advisory Committee on Reactor Safeguards appreciates the meeting with you, members of your staff, and representatives of Battelle Memorial Institute and E. I. du Pont de Nemours and Company, on January 8, 1971, to discuss the matter of postulated core meltdown accidents. As you know the Committee has had a continuing interest in this matter.

Following its meeting with you, the ACRS further reviewed the usefulness and feasibility of a core retention system to mitigate the consequences of a core meltdown. The Committee agrees with you that quality assurance, including assurance of proper functional performance, of present systems having safety functions is of primary importance. The Committee believes that the probability of meltdown with present systems is very low, and that more stringent application of principles of quality assurance will make the probability still lower. However, improvements to systems and system quality cannot lead to continued significant increase of safety without limit; external phenomena, unforeseen events of very low probability, common mode failures, and human error will set a practical limit to system reliability.

The Committee believes that even though a core retention system may not be effective for all causes and modes of core meltdown, it could, as an independent backup, decrease the probability of an untenable fission-product release to the environment by at least an order of magnitude, a result that becomes increasingly difficult to achieve by refinement of systems designed to preserve core integrity within the reactor vessel.

The Committee has found the work by Battelle and du Pont to be very helpful in its considerations. Both groups have separately concluded that it appears technically reasible to mitigate the consequences of a core meltdown accident. Both groups have recommended that, if work in this area is to be continued, the logical next step is to choose one or possibly two design approaches which appear to have the best potential of success, to evaluate this design in greater depth, and to pursue an associated research and development program organized so as to obtain information vital to the success or failure of the particular design approach. The ACRS believes that the results of the studies thus far are encouraging.

The Committee recognizes that physical and physicochemical properties of the molten fuel and structural materials would be required before a good conceptual design could be made, but it is believed that present knowledge of these properties may be sufficient to establish basic feasibility. However, there appear to be other major uncertainties that do affect basic feasibility. For example, sudden admission of a stream of molten fuel into water (even hot water), especially in a manner that can trap water under the fuel, as in steel retaining channels, could lead to a steam explosion of such violence as to make the entire scheme impractical. The Committee believes that, early in the program, such problems should be explored qualitatively; for example, with material that can be readily melted in conventional furnaces, but using quantities that are large enough to give confidence in the results.

The Committee believes that a program of conceptual design studies and analyses for a core retention system, coupled with the kind of exploratory experiments cited above, should be undertaken. One to two million dollars over a period of two to three years might be a reasonable estimate of the effort and time scale to accomplish this step. The Committee recommends that a program of this type be undertaken with a completion goal of 1973-1974 for this phase. The Committee believes it important that the group undertaking the task have considerable background and resources in practical engineering and metallurgy, as well as a strong research and development capability.

R. F. Fraley

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cc: R. E. Hollingsworth, GM
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