APR 1 0 1981

MEMORANDUM FOR: Chairman Hendrie
Commissioner Gilinsky
Commissioner Bradford
Commissioner Ahearne

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

THRU: William J. Dircks (Signed) William J. Dircks
Executive Director for Operations

SUBJECT: REQUIREMENTS FOR A MANUFACTURING LICENSE FOR THE FLOATING NUCLEAR PLANT

The staff initially proposed that the containment for the Floating Nuclear Plant (FNP) be strengthened to meet a design pressure of 60 psig, in addition to implementing effective hydrogen control, to significantly reduce the risks of severe accidents in this ice condenser plant. The choice of 60 psig for the containment design limit was based on the belief that it could be accommodated by modifications which would not alter the ice condenser design concept, and which could be accommodated by design, material, and construction techniques in use in the nuclear industry. Discussions with the applicant, Offshore Power Systems, have indicated that increasing the containment design strength to 60 psig would require major modifications to the conceptual design because of limitations of tying the cylindrical containment shell to the rectangular structural members of the barge. However, the containment could be modified by using a hemispherical head, increasing the wall thickness to a minimum of 1 inch, and making other modifications which would increase the design pressure to 25 psig. At this design level, the ultimate pressure capability was estimated to be 80 psig.

Based on an evaluation of severe accidents at the Sequoyah plant (ice condenser) by Sandia and the inclusion of an MgO core catcher and effective hydrogen control in the FNP, the applicant contends that additional protection afforded by a containment having a 60 psig design pressure is not warranted.

We have reviewed the accident sequences resulting in containment failure from overpressure identified by the Sandia staff (under contract to RES) for the Sequoyah plant. These sequences are small LOCAs with loss of core cooling and core and containment cooling, and total loss of feedwater (main and auxiliary). These sequences are based on a containment failure probability of 1.0 assuming hydrogen conflagration. An effective and reliable hydrogen control system should substantially reduce this mode of containment failure; however, containment failure could still occur because of steam pressures, either in the form of "spikes" or slower pressure buildups.

The replacement of the concrete pad below the reactor vessel with a magnesium oxide (MgO) ladle (i.e., a passive core catcher) will provide substantial resistance to a core melt through. Based on a best-estimate analysis, the MgO core ladle will retain the molten core debris for approximately 1 week before melt through of the FNP barge hull would occur (see NUREG-0054, Feb. 1980). In addition, the MgO pad eliminates the generation of large volumes of noncondensible and/or combustible gases (e.g., CO, CO_2, H_2) which would otherwise be generated from the interaction of the molten core with the concrete (before its replacement with the MgO); the elimination of these gases and the accompanying energy concurrently eliminates the associated increased loadings on the containment. Thus, as was said earlier, the major remaining threat to the containment (assuming the hydrogen threat has been eliminated) would come from steam released to the containment as the core degrades and proceeds to melt through the vessel and into the cavity below. The containment loadings would come either from steam pressure spikes or slower pressure buildup from the steam generation as the molten core comes into contact with water. The probability of eliminating this later threat can be substantially increased by the addition of dedicated core and/or containment heat removal system(s); the precise nature of such system(s) (which could be a passive system) would derive from a more detailed risk study which the ML applicant has committed to do.

It should finally be pointed out that the staff in its SER of the FNP noted the potential threat to containment from core meltdown sequences and committed the applicant and the staff to "perform more detailed, integrated studies that will involve modeling the containment and core ladle as a system to ascertain the system response to various core meltdown sequences" (NUREG-0054, pp 44-46). The ACRS in its letter of April 16, 1980 to the EDO on the subject of the "Floating Nuclear Plant (FNP) Core Ladle" agreed with the staff's evaluation and also noted the need for more detailed, integrated containment response studies which both the applicant and the staff have underway.

As a result of our evaluation, we believe that the use of effective and reliable hydrogen control, post-accident containment cooling, core catcher systems, and modified containment in a floating nuclear plant will reduce the likelihood of containment failure sufficiently and that increasing the containment design pressure in FNP to 60 psig may yield little risk reduction. We believe that the containment loading and mitigation system studies being performed at Brookhaven National Laboratory over the next year will confirm this conclusion.

These findings have been discussed with Commissioner Gilinsky during the week of March 2, 1981, and we want to apprise all the Commissioners of our belief that there is a viable alternative for reducing the risk in the FNP.

Original Signed by
H. R. Denton

Harold R. Denton, Director
Office of Nuclear Reactor Regulation

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