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



April 16, 1980

Mr. William J. Dircks, Acting
Executive Director for Operations
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

SUBJECT: FLOATING NUCLEAR PLANT (FNP) CORE LADLE

Dear Mr. Dircks:

During its 240th meeting, April 10-12, 1980, the Advisory Committee on Reactor Safeguards (ACRS) completed its review of Offshore Power Systems' (OPS) proposed core ladle design for the Floating Nuclear Plant (Topical Report No. 36A59). This Topical Report was also discussed at Subcommittee meetings on June 27, 1979 and November 17, 1979. During its review the Committee had the benefit of presentations by representatives of the NRC Staff and OPS.

OPS has agreed to the NRC Staff requirement to replace a previously proposed concrete pad below the reactor vessel with a magnesium oxide (MgO) ladle in order to satisfy the Floating Nuclear Plant (FNP) Final Environmental Statement, Part III. This statement requires that MgO or other equivalent refractory material be used to provide resistance to a core melt-through and to provide additional delay time so that interdictive measures can be taken. The NRC Staff has required a minimum delay time of two days for melt-through of the ladle and has required that the proposed refractory material and ladle design not compromise safety. OPS must obtain NRC approval of the final ladle design and the refractory material selected prior to construction of the major elements of the FNP hull structure. Final ladle design approval and material selection is not expected until after a detailed R&D program by OPS and safety research by the NRC Staff are completed.

Representatives of the NRC Staff have informed the ACRS that they have not found any disadvantages from the installation of the proposed MgO ladle. The ACRS was told that the proposed MgO ladle would significantly mitigate the temperature and pressure transients in the containment following a core melt accident and that it would significantly mitigate the amount of radioactive material sparged from the debris into the atmosphere of the upper containment. This would tend to reduce the airborne release.

Discussions have indicated, however, that there are still areas that need to be further developed to fully understand the heat transfer characteristics of the ladle, reactor vessel, and the surrounding structures. In addition, the Committee believes that further study is needed relative to the probability of and consequences if water should gain access to the ladle either before or after the molten core reaches it. For this and other reasons, it must be confirmed that the presently proposed design with the use of refractory material in the cavity, which would delay a core melt-through to the sea, does not, in fact, increase the risk to the public via the air pathway if the containment were to rupture due to overpressure.

The NRC Staff criterion requiring a minimum molten core holdup time of two days was developed prior to the recent Staff position as enunciated in the NRC Siting Policy Task Force report (NUREG-0625). This position specifies that, for land-based plants, 10 CFR Part 100 would be changed to require reasonable assurance that interdictive measures would be possible to limit groundwater contamination resulting from Class 9 accidents. The NRC, however, has not yet developed a specific approach with regard to possible implementation of this recommendation for land-based plants. As a result, it is difficult to ascertain whether, during the next few years, this recommendation is likely to lead to a significant alteration in the NRC's basis for its criterion for the FNP core ladle. If it does, this could necessitate a major change in the criterion itself.

Since the FNP uses an ice-condenser containment, the containment building has a low design pressure and a relatively small volume. This makes it more vulnerable to certain postulated accidents which involve the rapid combustion of released hydrogen or other phenomena which could cause the buildup of a large overpressure in the containment. The FNP may be able to take advantage of the presence of the ocean to serve as a filter for containment venting for some accident scenarios. However, an overall approach to coping with accidents beyond the current design basis for new ice-condenser plants has not been developed by the NRC or proposed by OPS. The Committee recommends that the NRC and OPS give priority to resolving this matter. It should not be left to a rulemaking procedure to be completed some time after issuance of a manufacturing license.

The Staff has not provided an opinion on what constitutes an acceptable frequency, with some confidence level, for an accident in which a molten core eventually reaches the ocean. The Committee suggests that an effort to establish such criteria could be worthwhile, however, it should not be mandatory for completion of the FNP review for a manufacturing license. The Committee also urges the NRC Staff to continue to work toward the establishment of criteria for limiting accidental liquid releases from nuclear power plants, in general.

The Committee believes the conceptual design presented by OPS can, with careful attention to thermal analysis and material properties, be developed to a system that has a reasonable probability of accomplishing its design purpose. To support such analyses, the Committee recommends that the NRC Staff engage the services of consultants expert in the design of high-temperature melting furnaces and the handling of high-temperature molten materials.

The Committee agrees that the proposed FNP core ladle design is adequate for the FNP manufacturing license; however, the planned tests and analytical programs must confirm present estimates of the operation of the ladle before the FNP is built and operated.

Sincerely,

Milton S. Plesset

Milton S. Plesset
Chairman