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October 4, 1982

NUCLEAR PRODUCTION DEPARTMENT

U. S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, D. C. 20555

Attention: Mr. Harold R. Denton, Director

Dear Mr. Denton:

SUBJECT: Grand Gulf Nuclear Station
Units 1 and 2
Docket Nos 50-416 and 50-417
License No. NPF-13
File 0260/L-814.2/M-087.0
SQRT - HPCS Service Water Pump, Request for Additional Information
AECM-82/435

References:
1. AECM-81/391, October 9, 1981
2. AECM-81/483, December 15, 1981
3. AECM-82/258, June 25, 1982
4. AECM-82/329, July 26, 1982
5. AECM-82/460, August 9, 1982
6. NRC Letter (MAEC-82/208), A. Schwencer to J. P. McGaughy dated September 8, 1982
7. Interim Report - "Seismic Analysis of the Grand Gulf HPCS Deep Draft Pump", dated August 17, 1982 by EG&G Idaho, Inc., Report No. EGG-EA-6007

Mississippi Power & Light Company (MP&L) has reviewed the NRC Staff concerns expressed in their letter (MAEC-82/208) from A. Schwencer to J. P. McGaughy, dated September 9, 1982 (Reference 6). The concerns expressed by the NRC Staff are addressed as follows:

1. Concern

The fundamental frequency of the pump assembly is extremely low (less than 1Hz); that makes the pump assembly exceedingly flexible. There are natural frequencies of the pump assembly that are close to the operating speed. It is conceivable that during some operating condition, the flow through the pump may induce vibration that's not considered in the present model, and amplify the effect due to resonance with the natural frequency close to the operating speed.

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Response

MP&L agrees that the fundamental frequency of the pump is extremely low (less that 1 Hz). However, this has no adverse consequence on the operation of the pump. Instead, it helps the pump's response during an earthquake event, because the seismic acceleration values are small at low frequencies of the response spectra in question.

MP&L also agrees there are natural frequencies close to the operating speed of the pump (30 Hz). However, analytical results by the NRC's consultant indicates that the participation of the first mode is more than 90% of the total response, while the participation of the modes close to the operating speed is extremely small (about zero), consequently the effect of the modes close to operating speed are negligible. The vibration induced due to the flow through the pump is caused by the pressure fluctuation as a result of flow turbulence, operating speed, and the impeller speed. These pressure fluctuation have a "pink" noise characteristic (the amplitude of the power spectra density function has an exponential decay shape with an increase in frequency). Considering that the participation of the mode is low at higher frequencies and the pink noise characteristics of the pressure fluctuation, it can be concluded that the flow induced vibration should not be a problem in the operation of the pump.

2. Concern

The maximum deflection at bottom of the pump is calculated to be 16.2" by INEL. Since the shaft is still rotating inside the casing, the operability of the pump under the condition when shaft is rotating and end point is deflected by 16.2" simultaneously can not be adequately addressed by the present model.

Response

This concern has been initiated due to the relatively large (16.2 inches) absolute displacement at the bottom of the shaft as predicted by EG&G's (INEL) analysis (Ref 7). The analysis conducted by EG&G has used a rubber bearing stiffness value of 20 lb/in. This value is based on a Franklin Research Center Report. MP&L firmly believes that this value of bearing stiffness is inappropriately low for this application. Independent evaluations by MP&L consultant's (McDonald Engineering and Nutech) have indicated that a rubber bearing stiffness of at least 20,000 lb/in should have been used in the analyses conducted by EG&G. The EG&G analysis indicated that a minimum value of 1275 lb/in was required to prevent contact between the pump housing and the impeller.

By virtue of the independent evaluations mentioned above, MP&L concludes that the assumption of 20 lb/in used by EG&G was incorrect. Furthermore, the values for stiffness arrived at by the independent evaluations are far in excess of the EG&G minimum value required to prevent pump damage.

3. To resolve the above concerns, the NRC Staff has proposed that MP&L either test the pump or restrain the pump. These NRC Staff recommendations are addressed as follows:

(a) Test

Perform a test to prove operability during an earthquake. This may be accomplished by applying a static bending at the bottom of the pump to simulate seismic deflection and rotating the shaft at operating condition simultaneously.

Response

Operability of the pump during an earthquake has been addressed by the vendor in his original design, and confirmed by the NRC consultant (Reference 7). The manufacturer has established deflection criteria for both the shaft and impeller to assure operability. According to the manufacturer's analysis, maximum relative deflection of the shaft with respect to the bearings over a five foot span due to the SSE seismic lateral load is 0.015 inches, which is considerably lower than the maximum allowable value of 0.05 inches.

(b) Restraints

Design and install lateral restraints to the casing at a location close to the bottom of the pump. This will effectively reduce the end deflection of the pump during earthquake, and at the same time increase the stiffness of the pump.

Response

MP&L agrees that the installation of lateral restraints close to the bottom of the pump will reduce the shaft end deflection. However, this may result in an increased deflection in the middle of the shaft, thereby further increasing the shaft bearing wear rate. The installation of lateral restraints will also stiffen the pump. This will cause a shift of the fundamental frequency into an area of the seismic spectra containing larger energy content. This may over stress the pump housing. Consequently, MP&L does not believe that the installation of a lateral restraint at the bottom of the pump will improve the pump operability. Instead, it may produce a more adverse effect. The advantages or disadvantages of this modification can not be easily established without further analysis of the concerns raised here.

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Conclusion

In summary, MP&L's evaluation of this matter indicates that additional testing or modifications of the HPCS service water pump is not required. These conclusions are based on evaluations conducted for MP&L by reputable experts in this area. In addition MP&L's evaluation of the EG&G report on this matter concludes that the report is generally consistent with the pump manufacturer's original design calculations and the recent analyses conducted by MP&L's consultants.

MP&L proposes that the information provided in this letter serve as a basis for further discussions in a meeting on this matter with members of Equipment Qualification Branch. This meeting is tentatively scheduled for October 8, 1982 in Bethesda, Maryland.

If you have any questions or require further information, please contact this office.

Yours truly,

L. F. Dale
Manager of Nuclear Services

RAB/JGC/JDR:sap

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