CENTERIOR ENERGY
Power Generation Group

Perry Nuclear Power Plant
10 Center Road
Perry, Ohio 44081

Mail Address:
P.O. Box 97
Perry, OH 44081

216-280-5915
FAX: 216-280-8029

Lew W. Myers
Vice President

August 15, 1997
PY-CEI/NRR-2203L

United States Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Perry Nuclear Power Plant
Docket No. 50-440
Response to NRC Concerns on Emergency Core Cooling System Suction Strainer Modifications

Ladies and Gentlemen:

On July 9, 1997, the NRC staff transmitted a letter discussing four concerns dealing with the proposed modification on the Emergency Core Cooling System suction strainers. The letter indicated that the NRC staff was not requiring a response to the concerns, but had included the concerns for consideration. Each of the four concerns and responses to the concerns were discussed during a telephone conference call conducted on August 1, 1997. The Attachment summarizes the responses to each of the concerns.

If you have questions or require additional information, please contact Mr. Henry L. Hegrat, Manager - Regulatory Affairs, at (216) 280-5606.

Very truly yours,

Lew W Myers

Attachment

cc: NRC Project Manager
NRC Resident Inspector
NRC Region III

A001 1/1

BACKGROUND

In a letter from the NRC staff (Hopkins) to the Centerior Service Company (Myers) dated July 9, 1997, "Emergency Core Cooling System Suction Strainer Program in Response to NRC Bulletin 96-03, Perry Nuclear Power Plant, Unit 1 (TAC No. M96162)," the NRC staff discussed concerns dealing with the proposed modification to the Emergency Core Cooling System (ECCS) suction strainers.

The enclosure to the referenced letter delineates concerns of the NRC staff regarding proposed modifications to the ECCS suction strainers. The concerns were identified following the March 24, 1997, Perry strainer design meeting with the staff, and a follow-up telephone call on May 6, 1997. Since that time, the analysis of the strainer design has evolved significantly. At the time of the March 24, 1997 meeting, acoustic methodology was planned to be used for a much greater portion of the analyses when dealing with the hydrodynamic loads on the strainers. Based in part on the meeting with the NRC staff, and the questions that were raised by the NRC staff, the modification analyses was re-reviewed using methods prescribed in the GESSAR II. The information presented in those earlier meetings has been augmented by the results of subsequent analyses and further reviews of the license basis for Perry, such that the NRC concerns are considered to be adequately addressed. The following paragraphs detail each of the NRC concerns and provide a summary of the technical information which addresses each concern:

CONCERN (1):

In its meeting with the staff on March 24, 1997, Perry provided a handout entitled, "ECCS Suction Strainer Program and Design Review." The handout discusses one of the advantages of the new Perry/Grand Gulf strainer design that it is "not conducive to air ingestion" assuming actuation of one or more SRV's. The staff is concerned about this statement because the new strainer design proposed by Perry and Grand Gulf would apparently infringe on an area commonly called the "exclusion zone." The exclusion zone is a cylindrical zone drawn around and above every quencher. The zone is a design requirement imposed by GE in the GESSAR II, the GE standard FSAR for Mark III, and BWR 6 designs. All Mark III's referenced the GESSAR II for the hydrodynamic loads portions of their plant FSAR during plant licensing. In Appendix 3b of the GESSAR II, GE provided guidance for the design engineer stating that the ECCS suction piping in the vicinity of the SRV quenchers should not penetrate the exclusion area. The exclusion area was defined in Section 3BA.7 as a clearance zone around each quencher maintaining a minimum clearance of 117 inches from any ECCS suction inlet. The purpose of this clearance is not expressly discussed in the text of the GESSAR; however, the staff believes its purpose is to prevent impingement of the jet emanating at the quencher holes on piping or structures.

If a structure is now placed in that jet path within the exclusion zone, the effects of the jet impingement acting upon the strainer surface should be evaluated for local effects such as deformation. The jet effect acting upon the near field strainer surface may exert sufficient force to damage the strainer perforated surface. An additional staff concern is related to the air plume discharge of the SRV becoming ingested into the

ECCS suction piping. The plume is created from the initial air clearing of the SRV tailpipe when the valve opens.

Perry stated during the March 24, 1997, meeting that their existing strainers violate this exclusion zone in one location. This particular strainer, therefore, does not meet that design basis requirement imposed by GE. The new proposed toroidal shaped strainer will not meet that design requirement in many locations around the strainer. The licensee stated that while they were aware of the exclusion zone, they did not believe there was an analysis to support the exclusion zone requirement, and have concluded that infringing on the zone with the new strainer design is acceptable. The staff believes that infringing upon the exclusion zone as described in the GESSAR II should be supported by analysis or test. If analysis is provided, they should address jet load and the potential for air ingestion into the ECCS systems.

The staff is concerned that the engineering assessment described by Perry during the March 24, 1997, meeting with the staff does not address these issues. The 117-inch minimum clearance as specified in the GESSAR II is not met for the recently modified strainer design that is currently in place, and would not be met for the new strainer design. This means that they would be infringing on many more quencher exclusion zones than their current design and, therefore, they may have a higher likelihood of subjecting the strainer to local jet loads not previously evaluated and also ingesting noncondensables into the strainer.

RESPONSE:

Loss of Coolant Accident (LOCA) vent clearing water jet loads have been evaluated, and these pressure loads were subsequently evaluated for their effects on the strainer perforated plate and structure. The strainer is not in the SRV clearing water jet zone of influence based on GESSAR analysis methods. Confirmatory computational fluid dynamics analysis shows that water jet loads on the strainer are not significant.

The Perry specific SRV air clearing bubble properties have been determined based on GESSAR II methods for as built SRV discharge line configuration and first actuation and second pop events. There is no contact between the SRV bubble on any portion of the strainer, and therefore, no possibility for air ingestion into the suction pipe. The design of the strainer is conducive to air release if any air is ever ingested. The low approach and flow velocities, internal ribs, and perforated plate on the center of the strainer at the suction tee all work to mitigate this phenomena.

The strainer design addresses the anticipated loads, such that there is no effect on the performance of the strainer. Further, since no air ingestion is expected to occur as the result of SRV actuations, and the strainer is conducive to air release if any air is ever ingested, the probability of air ingestion to the ECCS pumps is not increased.

CONCERN (2):

Also within the same handout, the Perry licensee discusses the use of acoustic wave methodology as a suitable method for calculating submerged structure loads. If reviewed, this method may be found suitable by the staff; however, both licensees believe this calculational change can be made under 10 CFR 50.59. The staff notes that the GESSAR II specifically discusses the calculation of submerged structure loads which are based on the Pressure Suppression Test Facility (PSTF) tests run 17 years ago. The GESSAR II also discusses the margin which exists in the current method. For example, GESSAR II states in Section 3BB.5 that expected loads from bulk pool swell (the air bubble phase of LOCA) are at most 60 percent of the design loads with 10-inch pipes never exceeding 30 percent of design value for drag loads.

With the proposed method of acoustics, the licensees stated that an order of magnitude reduction in the calculated loads on a submerged structure may be obtained. The staff believes that use of this alternative methodology appears to be reducing the safety margin and was not supported or compared with existing test data to determine the available margin that would exist using the proposed methodology. In addition, the staff is concerned that the use of acoustic wave methodology may not be an appropriate method when the originating event causes bulk fluid displacement. Under a postulated LOCA or SRV discharge, the initial air bubble generation causes large fluid displacement, and that subsequent motion generates drag forces on bodies restrained within the fluid. The licensee's approach does not appear to model the water acceleration drag forces.

It is not clear to the staff how the licensees concluded in their 10 CFR 50.59 evaluation that they are not reducing the margin to safety. Their discussion on March 24, 1997, did not address the subject of inherent margin in their method and what they believe is adequate margin between calculated loads versus design capability of the strainer device and its mounting.

RESPONSE:

Acoustic methodology is the primary analytical method only for chugging loads in the current strainer hydrodynamic loads analysis. The NRC indicates the application of acoustic methodology to address chugging loads is "very conservative" in resolution of Humphrey concerns 19.1 and 19.2 (ref. Perry Nuclear Power Plant Supplemental Safety Evaluation Report 8, Appendix R). The acoustic method was not used for SRV air bubble loads or condensation oscillation loads as stated in the Perry NRC Bulletin 96-03 response. These loads are determined using the GESSAR II method of images. Acoustic method calculations serve as independent verification of the GESSAR II method calculations for these loads. In these cases, the acoustic method calculations compare closely with the GESSAR II method analyses, and do not produce the order of magnitude load reductions indicated in the March 24 meeting. A confirmatory analysis has shown that the acoustic method with a GESSAR II based source provides conservative loads in the suppression pool as compared to Grand Gulf Nuclear Station SRV inplant test data.

The acoustic method was not used for LOCA bubble loads, SRV air clearing loads, or condensation oscillation loads. The acoustic method was only used for chugging loads, which have been determined to be an acoustic phenomena as documented in GESSAR and in documents related to closure of Humphrey concerns 19.1 and 19.2.

The use of the GESSAR II inputs for acoustic methodology has been compared to GESSAR II bases and assumptions to ensure the applicability of the load source. A confirmatory analysis using the acoustic method, a GESSAR II based source; and Grand Gulf Nuclear Station SRV inplant test data show the conservatism in this method and that adequate safety margin exists.

CONCERN (3):

Use of the new methodology for calculating air clearing loads has led both licensees to conclude that uplift loads would be insufficient to lift the strainer, and, therefore, no attachment to the floor or other vertical bracing is needed. The staff believes that a new event may need to be considered because of the proposed design of the strainer. Their proposed strainer is designed to have three hydraulically distinct regions within the toroid; however, because of the physical arrangement, the strainer has all ECCS suction piping mechanically tied together at the strainer.

The asymmetric load condition is an assumption used currently by the Mark III plants in the LOCA air bubble event. If the proposed Perry method for calculating air bubble/air clearing loads should underestimate the forces or an asymmetric force be generated, then the possibility exists that the strainer could rotate or move. This could lead to the possibility of disabling or reducing the performance of all of the ECCS systems if a hinge is formed in the ECCS piping. The reduction in ECCS performance may occur if the strainer rotates and partially collapses the ECCS suction piping. There was insufficient detail available at the meeting in order to address this potential issue in sufficient depth.

RESPONSE:

Asymmetric loading is a design consideration for the LOCA bubble and other applicable load cases. The air clearing loads are calculated according to the existing plant license basis. The strainer is restrained from movement by radial restraints symmetrically spaced around the strainer circumference. The strainer is additionally restrained from axial motion by bottom plate restraints that bear against the leak chase channels. No significant axial movement of the strainer is possible. Adequate margin exists between (conservatively) calculated uplift loads and weight of the strainer, considering buoyancy. The strainer design has been evaluated for common mode failure. The design has considered all applicable load combinations, such that the strainer design is structurally adequate to handle the applicable loads and load combinations.

CONCERN (4):

From a technical standpoint, the staff noted during the March 24, 1997 meeting that the method which the licensees propose, which is described in NEDE-24822 entitled, "Mark II Improved Chugging Methodology," and approved by the staff in NUREG-0808, does not currently address the use of the acoustic wave methodology for the air clearing portion of the event. That method was intended for the analysis of chugging and condensation oscillations induced loads as described in the NEDE and NUREG. In addition, since staff approval was based in large part on a comparison of analysis with test data, the licensees needed to demonstrate that their "new method" of using acoustic wave methodology for calculating LOCA air bubble and quencher air bubble loads will achieve a 95%-95% confidence level as was done for the original licensing submittal.

RESPONSE:

The acoustic method was never intended to be used and was not used for LOCA air bubble loads. The acoustic method was not used for SRV air bubble loads; GESSAR II methods were used appropriately. A confirmatory analysis using the acoustic method, a GESSAR II based source, and Grand Gulf Nuclear Station SRV inplant test data show the conservatism in this method and that adequate safety margin exists. The sources utilized as inputs to the acoustic method are from the GESSAR and have been reviewed for their applicability. The GESSAR sources were previously reviewed and accepted by the staff as exhibiting the 95%-95% level of confidence.

CONCLUSION

Based on the above evaluations of the NRC concerns and the discussion of these responses in the August 1 telephone conference call, it has been concluded that sufficient technical information exists to demonstrate the adequacy of the proposed ECCS suction strainer design, analytical methods, and margin of safety.