UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

MAY 30 1984

Docket Nos. 50-440/441

Mr. Murray R. Edelman
Vice President - Nuclear Group
The Cleveland Electric
Illuminating Company
P. O. Box 5000
Cleveland, Ohio 44101

Dear Mr. Edelman:

Subject: Request for Additional Information Concering Containment Drywell Wall Structural and Bypass Leakage Integrity for the Perry Nuclear Power Plant (Units 1 and 2)

During the NRC Construction Appraisal Team (CAT) August-September 1983 inspection of the Perry plant, a concern was identified by the CAT inspectors relative to the containment drywell wall structural and bypass leak tightness integrity, due to the installation of concrete expansion anchor bolts (Hilti-Kwik bolts). The CAT concern, when considering the number of anchor bolts (6000-8000) intended to be installed, and the potential for through-wall cracks during normal, test, transient and accident conditions, is whether the drywell wall is capable of meeting structural requirements and bypass leakage limits stated in SER Section 6.2.1.7. This concern was discussed with you and your staff during the CAT visit close-out meeting, and is documented in the CAT Inspection Report, Section V. B. 2, dated November 7, 1983.

Your letter to J. G. Keppler, NRC Region III Administrator, dated December 23, 1983, did not fully satisfy the CAT inspector's concern. As a consequence, the matter was referred to the NRC/NRR technical review staff and the Division of Licensing for followup action by the Region III and CAT inspectors.

Enclosure 1 contains, in greater specificity, the factors pertaining to the CAT concern, which was communicated to your licensing staff by the Perry Project Manager, John J. Stefano, in a conference call on April 13, 1984. Enclosure 2 contains questions formulated by the NRR technical staff, predicated

on the factors delineated in Enclosure 1, which you are requested to answer. Your response to those questions should be identified as responding to Q220.32 through Q220.36 for eventual documentation in the FSAR. The last question should also be identified as responding to Q480.54.

Please advise Mr. Stefano when we may expect to receive your responses within 5 days after receipt of this letter.

Sincerely,

ORIGINAL SIGNED BY:

B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing

Enclosures: As stated

cc: See next page

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PERRY

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ENCLOSURE 1

DRYWELL LEAK TIGHTNESS AT PERRY UNITS 1 AND 2

1. In the Perry FSAR (pp. 3.8-97a, 3.8-103, 3.8-118, and 6.2-36) it is stated that although the drywell liner is not relied on for structural strength, the liner is "inherently leak tight." In response to an audit question by Structural Engineering Branch, NRC, the statement was made by Gilbert Associates, Inc. (in late 1981) that the liner and the anchorage system was designed in accordance with ASME Section III, Division II, CC-3000 to utilize the liner's inherent leak tightness and achieve leak tight details at penetrations. In CC-3121 (1973 edition issued for trial use and comment), paragraphs 3121 (a) and (b) specify actions to prevent jeopardizing the liner's leak tight integrity. The applicant's method of anchor bolt installation seems to breach the liner's inherent leak tightness and therefore contradicts previous commitments and statements made to the NRC.

2. GE Topical Report, NEDO-10977, was referenced by the applicant as the basis for relying only on the concrete portion of the drywell wall as the leakage barrier. The GE Topical Report, issued in 1973, is a study of the extent and effects of potential cracking of the Mark III reinforced concrete drywell during operational and accident loadings. The Topical Report summarizes the total extent of through-wall cracking to be 1800 square inches or 12.5 square feet, including both vertical and horizontal cracks (NEDO-10977, pg. 4). The allowable bypass leakage limit for the Perry drywell is equivalent to 1.68 square feet (FSAR, pg. 6.2-34). In addition, the applicant must maintain the bypass leakage measured during testing to 10% of the allowable leakage (0.168 square feet). It appears that the topical report has postulated a bypass leakage area approximately 7.4 times the value allowed in the Perry design.

   The Topical Report states that the results do not include the effects of construction defects (such as honey-combing, cold joints, rock pockets, etc.) or local effects (such as stress concentrations, including embedments) and only includes the gross structural behavior of the drywell. In the numbers being installed (6000 to 8000), the Hilti bolts could contribute to crack initiation or propagation in seismic or dynamic loading conditions leading to through-wall cracking. Due to the large amount of concrete necessary for the drywell wall, many placements were used without special provisions at the construction joints other than normal cold joint practices of removing laitance and exposing aggregate for bonding. In addition, several (15-20) small areas of concrete voiding behind the drywell liner plate have been identified during the installation of the expansion anchor bolts. Although the voids have been found to be mostly close to the liner plate (no deeper than approximately 6-8 inches) and under the horizontal stiffeners, the voids may be indicative of difficulties in achieving full consolidation and complete fill inside the drywell wall. In addition, several voids have been recently identified in the drywell wall which are under review for reporting under 10 CFR 50.55(e).

It is not clear that the NRC has ever formally accepted the GE Topical Report. Based on discussions with Containment Systems Branch, NRC personnel (W. Butler and J. Kudrick) it seems that when the Topical Report was first presented to the NRC in 1973, applicants were encouraged to utilize the drywell liner as an additional barrier, although to this day no credit is given for the drywell liner for leak tightness. It is not clear that the Topical Report was at that time rejected or accepted.

3. Concrete cracking is a common phenomenon caused primarily by volumetric changes or loads. The American Concrete Institute (ACI) recognizes cracking and recommends limits on the allowable crack width for structures depending on their intended usage. The ACI Committee 224 report, "Control of Cracking on Concrete Structures" in Section 4.3, recommends the maximum allowable crack width for water retaining structures to be 0.004 inches. ACI 318-71 in Section 10.6 places limits on the crack width for exterior exposures to 0.013 inches (although not applicable to "structures subjected to very aggressive exposure or designed to be watertight; special precautions are required and must be investigated for such cases"). ACI 207.2R-73, "Effect of Constraint, Volume Change, and Reinforcement on Cracking of Massive Concrete", states in Section 5.2 that for massive reinforced concrete members, cracks of 0.009 inches will allow some leakage (water leakage being referred to).

   The GE Topical Report, NEDO-10977, in Section 2.1, postulates average through-wall crack widths to be 0.015 inches (vertical) and 0.007 inches (horizontal), with maximum crack widths of 0.025 inches and 0.010 inches for the vertical and horizontal directions respectively. It appears that the GE Topical Report has postulated crack widths which in some cases, significantly exceed those widths recommended by ACI for cases of water retaining structures (air leakage being an even more severe condition).

4. Drywell bypass leakage limits are stated in the Perry FSAR. The drywell is specifically tested for bypass leakage at the full design pressure (30 psi) during pre-operational testing and at a reduced pressure (3 psi) periodically. In addition, the drywell is subjected to a structural integrity test at the full design pressure to measure its response against the predicted response (deflections and cracking). However, these pressure tests may not represent the most critical loading conditions for the drywell wall. Other loading conditions, such as the SSE + LOCA, may be the controlling load case for the drywell wall elements (reinforcing steel and concrete). This loading condition would not be simulated in the proposed pressure tests.

   Since the periodic bypass leakage tests will be done at a reduced pressure, it is unclear whether deterioration of the leak tightness of the drywell for the 40 year life of the plant will be identified sufficiently before the point that there is gross excessive leakage. The items which may cause deterioration of leak tightness specifically attributable to the drywell wall are: initiation or propagation of through-wall cracks due to normal, test, transient, or accident loading conditions; deterioration of

the HVAC duct sealer tape material with time leading to the exposure of through-wall cracks not previously exposed to full pressure testing; any modification or repair work on the concrete expansion bolts in the drywell wall may expose new through-wall cracks not previously subjected to full pressure testing.

5. Using the allowable bypass leakage test limits of 0.168 square test of leakage area, this limit is equivalent to approximately 1.2% of the space between the postulated 8000 anchor bolts and the drywell liner plate contributing to bypass leakage. In other words, if only 1.2% of the annular area between anchor bolts and oversized drywell liner plate hole communicate with through-wall cracks, the allowable leakage limits will be exceeded, not even considering other bypass leakage paths (such as piping penetrations or personnel and equipment hatches).

6. The review of other Mark III containment design plants (River Bend and Grand Gulf) shows that River Bend uses a drywell liner similar to the Perry facility; however, anchor bolts are not being drilled through the drywell liner plate. For the Grand Gulf facility, a review of the FSAR shows that the reinforced concrete drywell wall is the pressure retaining barrier for the drywell. Specific crack analyses have been performed for Grand Gulf which demonstrate acceptable leakage rates can be achieved under the structural integrity test conditions.

Enclosure 2

Q220.32 Provide detail information on the installation of Hilti expansion concrete bolts in the drywell wall such as installing sequences, means for minimizing concrete cracks around the bolts, maximum size of bolt; procedures for achieving air tightness around the bolt, bolt paterns, maximum and minimum spacings of bolts, maximum bolt loads, and the capacity of the bolt.

Q220.33 Perry FSAR committed that drywell liner and the anchorage system were designed in accordance with the ASME Section III, Division 2 CC-3000 to utilize the liner's inherent leak tightness and achieve leak tight details at penetrations. In view of the 6000-8000 concrete expansion anchor bolts installed through the drywell liner into the concrete wall, provide a discussion to demonstrate that the applicable provisions of the code covering liner integrity and leak tightness are fully met. If the provisions are not fully met, list the deviations and the bases thereof.

Q220.34 With respect to the as-built drywell concrete wall, are there through wall concrete cracks? If yes, what are the extent of those cracks and their estimated crack dimensions? What are the potential for those cracks to form an interconnected crack network to the extent of affecting the functioning of the drywell as a pressure barrier under LOCA and SSE conditions?

If your assessment indicates that there should be no through cracks in the drywell wall, please provide the technical basis for the assessment.

Q220.35 Assuming that initially there are no through thickness cracks in the wall, would the presence of 6000 to 8000 expansion anchor bolts enhance the probability of initiating and propagating localized cracks into through wall cracks, thus, affecting the drywell pressure barrier function under LOCA plus SSE?

Q220.36
Q480.54 If no credit is claimed with respect to the liner elements and the drywell concrete is to be depended upon to maintain a leak tight barrier, provide a specific concrete crack analysis to demonstrate that the maximum effective allowable leakage area of 1.68 square feet is not exceeded (Perry SER Section 6.2.1.7), and also that the bypass leakage measured during the leak tightness tests will be maintained within the allowable leak rate (SRP Section 6.2.1.1 C-II.4.C.). The effects of potential construction defects such as voids, construction joints, rock pockets, and local effects such as, stress concentration must be considered in the above concrete crack analysis.