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August 30, 1984

Mr. R. C. DeYoung, Director
Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Byron Generating Station Units 1 and 2
Independent Design Inspection
NRC Inspection Report No. 50-454/83-32
NRC Docket Nos. 50-454 and 50-455

References (a): December 30, 1983 letter from Cordell Reed to R. C. DeYoung.

(b): June 19, 1984 letter from Cordell Reed to R. C. DeYoung.

Dear Mr. DeYoung:

This letter supplies revised responses to two findings and one unresolved item which were identified during the Byron integrated design inspection. These responses have been revised to address issues raised by NRC inspectors at a meeting on July 30, 1984 at Sargent and Lundy.

Enclosed are revised responses to findings 4-1 and 4-2 and unresolved item 4-2. These versions supersede the responses previously supplied in references (a) and (b).

Please address further questions regarding this matter to this office.

One signed original and fifteen copies of this letter and the enclosures are provided for NRC review.

Very truly yours,

D. L. Farrar
Director of Nuclear Licensing

lm

cc: J. G. Keppler

Enclosures

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FINDING 4-1: TRANSVERSE WALL LOAD CRITERIA

In Section 11.0 of the Project Design Criteria, page 11-4 contains a listing of transverse loads to be considered in the design of walls. This list omits horizontal seismic inertial loads, wind loads, and tornado differential pressures. This is not appropriate. It is considered to be a failure to follow Procedure GQ-3.04 of the Sargent & Lundy Quality Assurance Manual (Reference 1.36). The preparer of the design criteria did not include all "applicable design inputs" in that numerous horizontal loading sources were not listed within the list of transverse loads to be considered for wall design.

In view of the inappropriate criteria, in our judgment, a systematic check of all walls to see that all loads were considered should be made in resolving this item.

REVISED RESPONSE

This revised response has been prepared subsequent to a July 30, 1984, meeting between the NRC (IE) and Sargent & Lundy. As a result of the information exchanged at this meeting, this revised response supersedes the response to Finding 4-1 sent to the NRC on December 30, 1983, and the response to additional questions on Finding 4-1, which was sent to the NRC on June 19, 1984, by letters from Commonwealth Edison Company to Mr. R. C. DeYoung.

The Structural Design Criteria are organized such that all loadings are reviewed in one chapter (Chapter 10) and specific items such as shear wall design are outlined in the following chapters. Chapter 11 of the Structural Design Criteria on shear walls discusses the application of the controlling loads for shear wall design since these are of primary concern. Although design for wind and tornado pressure are not listed in Chapter 11, they are listed in Chapter 10 as being applicable to shear walls. Chapter 11 of the Structural Design Criteria will be updated to state that all loadings in Chapter 10 must be considered in shear wall design for in-plane and out-of-plane loading and that the loads listed in Chapter 11 are those loads which generally control shear wall design.

Transverse loads due to the combined effect of tornado wind pressure and tornado-generated missiles were considered in the original plant design (Calc. No. 7.12.7) using energy balance design techniques. It was demonstrated that the critical exterior shear wall panel was adequate for tornado-generated missiles and withstanding the tornado wind pressure.

Subsequent calculations have verified that out-of-plane seismic and tornado pressures are not controlling loads and that the structure is adequate for these loads. The transverse shear stresses in the walls due to these loads are well below the allowables in Section 11.4 and 11.6 of the ACI Code 318-71.

FINDING 4-2: SHEAR FRICTION METHOD

The Sargent and Lundy Structural Project Design Criteria (Reference 4.31) states that the shear friction concept shall be used to calculate the reinforcement required for transverse shear. This is contrary to Section 11.15.1 of ACI 318-71 (Reference 4.72) which the licensee committed to meet in FSAR Table 3.8-2. This is contrary to GQ-3.04 since the design criteria cited by the licensee in the FSAR was not incorporated within the project structural design criteria.

REVISED RESPONSE

This revised response has been prepared subsequent to a July 30, 1984, meeting between the NRC (IE) and Sargent & Lundy. As a result of the information exchanged at this meeting, this revised response supersedes the response to Finding 4-2 sent to the NRC on December 30, 1983, and the response to additional questions on Finding 4-2, which was sent to the NRC on June 19, 1984, by letters from Commonwealth Edison to Mr. R. C. DeYoung.

The Sargent & Lundy Structural Project Design Criteria has been clarified to more explicitly show that the shear wall design was performed in accordance with Sections 11.4 and 11.6 of ACI 318-71. The relevant sections of the Criteria are as follows:

A. Concrete Design Check

1. Nominal shear stress due to out-of-plane shear shall not exceed $2\sqrt{f'_c}$ (except as noted in the ACI Code for net compression or tension on the wall). When this value is exceeded, shear stirrups shall be provided in accordance with ACI 318.

2. Nominal shear stress due to in-plane shear shall not exceed $10\sqrt{f'_c}$.

3. Combined shear stress shall not exceed $12\sqrt{f'_c}$, where combined shear stress =

$$\left[(\text{In-plane shear stress})^2 + (\text{Transverse shear stress})^2\right]^{1/2}$$

A review of shear wall calculations conducted during the July 30, 1984, meeting between the NRC and Sargent & Lundy showed that the Project Criteria, as outlined above, had been followed. (The calculations examined were drawn from Calculation Books 7.12.4, 7.12.6, and 7.12.7.) In addition, a review of the original Design Control Summary showed that it was in agreement with the Project Criteria provisions noted above.

UNRESOLVED ITEM 4-2: TOP REINFORCING FOR SLABS

In the design of slab 4AS53, the boundary condition where the slab framed into a wall was considered hinged, while the actual boundary conditions are such that a fixed support would be more appropriate for design. Negative moment steel equal to that at the continuous support was provided, and the potential problem was avoided since the designer supplied more than adequate reinforcing steel. However, the Team was concerned since it found no criteria addressing this situation and this could lead to a situation where insufficient reinforcement would be provided. In the Team's judgment the licensee should verify that adequate top reinforcement was provided for all non-continuous slab supports.

REVISED RESPONSE

This revised response has been prepared subsequent to a July 30, 1984, meeting between the NRC (IE) and Sargent & Lundy. As a result of the information exchanged at this meeting, this revised response supersedes the response to unresolved item 4-2 sent to the NRC on December 30, 1983, and the response to additional questions on unresolved item 4-2, which was sent to the NRC dated June 19, 1984 by letters from Commonwealth Edison Company to Mr. R. C. DeYoung.

As shown on Sargent and Lundy Drawings S-690 and S-790 (IDI References 4.64 and 4.77), negative moment steel, equal to that at the continuous support was provided at the junction to the wall of slab 4AS53. This negative steel is not required by design, according to Calculation 7.43 but is typically provided at slab/wall junctions to increase the factor of safety for slabs. (This typical slab detailing is shown on Sargent & Lundy Drawing S-472.)

The design conservatively assumed that the junction of the slab and wall is hinged. By assuming a hinge with no moment capacity, the maximum possible positive moment in the center of the slab is considered. Steel reinforcement is provided for this positive moment, which is all that is required for a safe design. Any negative moment steel added at a wall or other noncontinuous support provides an additional factor of safety.

In addition, in order to demonstrate that the typical detailing referred to above was in fact followed in the design, a survey of the reinforcement provided in two-way slabs has been performed. The survey sample was made up of all of the two-way slabs supported at the shear wall along Column Line L (14 slabs in all, representing approximately 20% of the total number of two-way slabs supported by exterior walls). The survey showed that in each case, the negative reinforcement provided at the slab-wall junction was at least equal to that provided at the continuous support. (In one case, the reinforcement provided at the slab-wall junction was slightly greater.)