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Address Reply to: Post Office Box 767
Chicago, Illinois 60690 - 0767

September 7, 1988

Mr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Quad Cities Station Units 1 and 2
Dresden Station Units 2 and 3
"Response to NRR Request for Additional Information Pertaining to Flued Head Assessment Programs"
NRC Docket Nos. 50-237/249 and 50-254/265

Reference: Letter from B. Siegel to H.E. Bliss dated August 2, 1988

Dear Mr. Murley:

The above referenced letter requested additional information pertaining to the Flued Head Assessment Program at Quad Cities and Dresden Stations be transmitted within 30 days of receipt of the request. Attached, please find a copy of our response to the concerns raised by your contractor regarding this effort.

Please direct any questions you may have regarding this matter to this office.

Very truly yours,

I. M. Johnson
Nuclear Licensing Administrator

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Attachment

cc: A.B. Davis - NRC, Region III
B. Siegel - NRR - Dresden
T. Ross - NRR, Quad Cities
Dresden Resident Inspector
Quad Cities Resident Inspector

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2.0 PROGRAM SCOPE

Comment: This section concludes with "However, it is not clear what type of assessment will be performed for these additional anchors (i.e., will the anchors be inspected for as-built verification or analyzed for all loading combinations or both?)

Response: The anchors added to the program have been assessed using the same approach as those in the original scope of the program, i.e., they have been walked down to determine configuration deviations and the structural assessment of these anchors has been performed for the same loading combinations as the original scope anchors.

3.0 RESPONSE TO BNL COMMENTS ON S&L AND IMPELL CALCULATIONS

Comment #1: CECo's approach is not adequate. Possibility of direct pulling out of bolts along with grout (without forming failure cones) should also be investigated and an appropriate safety factor be used. Otherwise, manufacturer's recommended capacity should be used.

Response: The assessment and acceptance criteria selected for the rock anchors is conservative and consistent with the manufacturer's recommendations. The manufacturer has stated that tests which they have performed verify that

the expansion mechanism at the end of the rock bolts will develop the ultimate tensile capacity of the anchors. The capacity of this wedging mechanism is significantly greater than the shear capacity of the grout/concrete interface. Independent tests performed by Portland General Electric and Houston Power and Light substantiate that the rock anchor ultimate failure mechanism is either attributed to the tensile failure of the anchor or the pullout of the concrete cone. The failure does not occur along the grout/concrete interface.

The factors of safety selected for the rock anchors are consistent with the manufacturer's recommendations. The manufacturer recommends a factor of safety equal to 2.0 against ultimate tensile failure ($A_s F_{ut}$) for <u>normal working</u> allowable loads. The Dresden/Quad Cities FSARs permit normal allowables to be increased to yield for extreme loads such as pipe break and SSE. The assessment criteria for rock anchors use an allowable load equal to 0.9 times the yield capacity (F_y) for SSE and pipe break loads. For the rock anchors under consideration, the ratio of the ultimate tensile strength (F_{ut}) to the yield strength (F_y) is

$$\frac{F_{ut}}{F_y} = 1.26$$

Therefore, the chosen allowable loads for rock anchors for pipe break and SSE are less than manufacturer's recommended values as illustrated below:

Using the conventional factor of 1.6 for extreme loads,

Mfgs. Criteria	D/Q Assessment Criteria
$\frac{1.6\ (A_s\ F_{ut})}{2.0}$	$0.90\ A_s F_y$

Substituting $1.26\ F_y$ for F_{ut},

$\frac{1.6\ (A_s\ 1.26\ F_y)}{2.0}$	$0.90\ A_s\ F_y$
Simplifying, $1.0\ A_s\ F_y$	$0.90\ A_s\ F_y$

Comment #2: CECo's approach is not adequate. The basis for the assumed embedment depth should be justified. Note that NRC IEB 79-02 requires field testing of expansion bolts if the proper embedment depth cannot be verified.

Response: The embedment depth selected for the reassessment for wedge type anchors was the shortest manufactured length for each diameter. This was established by reviewing the appropriate catalogs for wedge type anchors. This minimum depth is 4.5 anchor diameters for each diameter assessed. For shell type anchors only, one embedded

depth is manufactured for each diameter (approximately 4 anchor diameters). Therefore, the most conservative assumptions concerning minimum embedment depths were used for the reassessment.

With regard to field testing of expansion anchors, CECo has complied with all the requirements of I.E.B. 79-02 for Dresden and Quad Cities Station. During the assessment of anchors in response to I.E.B. 79-02, field inspections were performed on a large number of plate assemblies. The results obtained during the course of this inspection indicated with a high degree of confidence that the anchors were properly installed. Based on the positive results of the program, it was agreed with the NRC that any further field inspection of anchors could be discontinued at this intermediate stage. Based upon the conclusions reached during the 79-02 program, we believe that field inspection/testing of the expansion anchors specifically associated with the flued head anchors is not warranted since we have previously established and satisfied ourselves and the NRC that the existing anchors are properly installed.

Comment #3: CECo's approach is questionable. It appears that ACI 349, Appendix B, is not directly applicable for determination of the shear capacity of lugs grouted outside the reinforcing bars (i.e., in the clear cover

region) and in the presence of tensile loads. Testing may be required to demonstrate the shear capacity of lugs.

Response: ACI 349 Appendix B does not differentiate or qualify the design of shear lugs with respect to their depth in the clear concrete cover. Further, our review of ACI 349 does not indicate that the use of shear lugs grouted outside the clear cover is prohibited. In fact, the shear lugs are typically located within this region to avoid discontinuity in and interference with the reinforcing steel. A typical application of this exists in column base plates with shear lugs.

ACI 349, Appendix B, requires that the shear lugs be located in a compressive zone in order to be considered effective. Our calculations indicate that a state of biaxial global compression exists in the plane of the concrete element in the vicinity of shear lugs. Figure B.1-1 (Combination Embedments Type B) of ACI 349-85 clearly indicates the presence of tensile loads in combination with shear lugs.

The chosen approach is adequate and testing is not required to demonstrate the shear capacity of lugs.

Comment #4-10 The current criteria being used for new calculations are acceptable except otherwise mentioned in this evaluation. However, concerns were raised regarding the existing calculations. Therefore, the question is: are any old calculations being used to qualify the anchors? If so, how does CECo plan to address the concerns expressed in these comments (i.e., 4-10)?

Response: Sargent & Lundy has performed new structural analysis and design calculations for all the anchors in the program for the pipe break loading combination. Old S&L structural design calculations are not being used.

Impell had performed calculations for eight anchors during the RPR program for the OBE and SSE load combinations. S&L is now responsible for the calculations for six of these anchors. Impell's calculations for the remaining two anchors (X-116A and X-116B) are being reviewed for consistency with the current assessment criteria.

Comment #11: CECo did not address the concern. The comment was that AISC recommends a minimum factor of safety of 1.04 to 1.20 for compression members depending on the slenderness ratio, whereas CECo proposes to use a constant factor of 1.1.

Response: The current assessment program utilizes 1.6 x AISC allowables for the SSE and pipe break loading combinations. Since AISC allowables are based on a varying factor of safety of 1.67 to 1.92, using 1.6 x AISC allowables maintains the varying factor of safety 1.67/1.6 = 1.04 to 1.92/1.6 = 1.20.

S&L RECENT CALCULATIONS - PINNED VS. FIXED CONNECTIONS

Comment: Refer to discussions for comments #4-10 above.

Response: Appropriate connection rigidity/flexibility is incorporated in the current assessment program for all the original scope as well as added scope anchors.

IMPELL CALCULATIONS

Comment #1-5: If the Impell calculations are used for qualification of the anchors, CECo should address the concerns expressed in these comments.

Response: As indicated in response to comment #4 to 10 above, the only Impell calculations being used now for the qualification of anchors are those for anchors X-116A and X-116B for OBE and SSE load combinations. These Impell calculations are being reviewed for consistency with the current S&L assessment criteria.

August 31, 1988

GENERAL MEMO

Subject: Dresden Emergency Operating Procedures

The dual column format of Dresden Emergency Operating Procedures are being eliminated. In the past the operator has had the option of using either flow charts or text type procedures when executing DEOP's 010 through 400-4. To eliminate confusion and maintain consistency, only the flow charts will be used in the future. DEOP's 500-1 through 500-4 will continue to be presented and used in a text format.

Thomas Mohr
Dresden DEOP Coordinator

TM:rg

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DRESDEN STATION PROCEDURE ROUTING

(TRANSMITTAL RECEIPT)

Register No. 72
DM 9-1-88

REMOVE: DEOP 010— 400-4 Procedures

INSERT: DEOP 010 — 400-4 FLOW CHARTS

(Sign and return this form to the Procedures Coordinator.)

I hereby acknowledge receipt of the above.

Signed _____ Date _____

FORM 9-2A (Cont'd)

SEP 1 1988

A045 0/1 Document Drawings To: Reg Files

UNIT 2 AND 3

DEOP 010

Proc. No.	Title	Rev. No.	DOSR Date	Review Date
010	General Precautions	Rev. 3	5/88	5/90

50-237
LTR DW. 9/1/88
SUPERSEDED PER REV
TO EMERGENCY
OPERATING
PROCEDURE

LTR DW. 9/1/88

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