ATTACHMENT 9

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION '84 OCT -5 A11:25

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
COMMONWEALTH EDISON COMPANY	)	Docket Nos. 50-454 OL
	)	50-455 OL
(Byron Nuclear Power Station,	)	
Units 1 & 2)	)	

JOINT STATEMENT OF KENNETH J. GREEN
AND ROBERT W. HOOKS

1. The Integrated Design Inspection (IDI) report resulted from inspections performed by NRC's Office of Inspection and Enforcement from May 23 to June 10 and from June 20 to June 30, 1983. The inspections involved interviews with approximately 150 employees of Sargent & Lundy (S&L), Westinghouse Electric Co. and Commonwealth Edison Company (CECo), and a review of approximately 900 documents. As a result of the inspection, 66 findings were set forth in the IDI Report. These findings were perceived as deficiencies by the IDI Team. There were also 19 matters called "unresolved items," for which the IDI Team did not develop enough information to reach a conclusion and 11 observations which consisted of general advisory information. Responses to all of the findings, unresolved items and observations were submitted to the IDI Team on December 30, 1983.

2. None of the matters raised in the IDI report are significant in the context of design adequacy of the Byron plant. They relate to documentation and analytical techniques,

and resolution required no physical changes to the plant. At counsel's request, this affidavit addresses only those findings affecting S&L that are referenced in Intervenors' motion to reopen the Byron hearing records. The discussion of those findings appear below.

IDI Finding 2-5: Calculation Concerning Flow Measuring Orifices (Mr. Green)

3. In their Motion at page 11, the Intervenors state that the "IDI team also found a calculation concerning flow measuring orifices in the auxiliary feedwater recirculation line that had been signed as reviewed and approved although the calculation had not been completed." Intervenors base this criticism on Finding 2-5 of the IDI report. The IDI Team stated in Finding 2-5 that contrary to S&L's QA procedures, a calculation supporting the design of an orifice plate was approved before it had been completed. A response was submitted to the finding in a letter from Mr. Cordell Reed of CECo to NRC's Mr. De Young (hereinafter referred to as "CECo's IDI response letter"). That response is explained below.

4. The IDI Team found the incomplete calculation after reviewing the S&L Control and Instrumentation Division (CID), Byron Project, safety-related calculation book which contained twenty calculations. Upon further investigation, it was explained to the IDI Team that the calculation in question was preliminary and incorrectly classified as safety-related.

5. I agree with the conclusion of the IDI Team that an approval signature on an incomplete safety-related calculation would be contrary to S&L QA procedures. However, the orifice plate referenced in the calculation is not safety related, and therefore, the QA procedures do not apply. Subsequently, it was determined that the applicable non-safety-related calculation for the recirculating orifice plate was filed in the non-safety-related calculation book. No question exists with respect to the adequacy of this non-safety related calculation. As a follow-up to the IDI team review, S&L performed an additional review of the remaining safety-related CID calculations and confirmed that all of the calculations were complete and related to safety-related equipment.

The incomplete orifice calculation represents an isolated and insignificant error. The calculation has been removed from the safety-related calculation book and nullified.

IDI Finding 2-6: Net Positive Suction Head (Mr. Green)

6. In their Motion at page 11, the Intervenors state that "problems were also noted in design calculations within the mechanical system design such as the calculations concerning net positive suction head available for the auxiliary feedwater pumps which contained numerous deficiencies and did not support the adequacy of the design." Intervenors base this criticism on Finding 2-6 of the IDI

Report. The IDI Team stated that S&L Calculation AFJD-1 is deficient as a documented basis for dete.mining that adequate Net Positive Suction Head (NPSH) is available to the auxiliary feedwater pumps and violates S&L QA Procedure GQ-3.08. A response was submitted to this finding in CECo's IDI response letter. That response is explained below.

7. The Auxiliary Feedwater Pumps provide feedwater to the steam generators for decay heat removal in the event of loss of Main Feedwater flow. Net Positive Suction Head is the available pressure at the pump inlet. If NPSH falls below a minimum requirement, cavitation may occur in the pump which could result in pump damage and/or failure.

8. NPSH is specified in feet (head) of water and is one of the parameters evaluated in selecting a pump. The original specification prepared in 1976, for the Auxiliary Feedwater pump, called for a minimum NPSH of 20 feet. In 1979 the pump manufacturer revised the minimum required NPSH to 23 feet based on test results. Calculation AFJD-01 was prepared in June 1979 to review the existing NPSH to determine if the system should be redesigned. The calculation established that NPSH would be adequate if at least two feet of water was in the 45 foot tall condensate storage tank. NPSH is maintained above the minimum by an automatic switchover to the Essential Service Water System (SX) as a water source if the suction pressure is reduced to near the mini-

mum NPSH. As a result, the specific condensate storage tank level required to provide the necessary NPSH is not a safety concern. Nevertheless, to limit switchover to SX, a design change was made in 1979, based upon the results in calculation AFJD-1 to increase the capability of the SX to maintain the required NPSH from the condensate storage tank.

9. Although we agree that the 1979 calculation (AFJD-01) was not as well documented as the present S&L QA procedures require, these documentation deficiencies did not affect the validity of the calculation nor did they result in a design deficiency. This determination was confirmed by the performance, in June 1983, of a superseding calculation, AFTH-01, which was reviewed by the IDI Team. This calculation was based on the as-built condition of the auxiliary feedwater system, and it was determined that the original calculation, AFJD-1, conservatively represented the NPSH capability of the system.

IDI Finding 2-8: "Missing" Calculation For Containment Spray (Mr. Green)

10. In their Motion at page 12, Intervenors adopt the IDI Team's Finding 2-8 as a criticism of the adequacy of the Byron Station design. In this respect, Intervenor's quote the following paragraph from the IDI report:

> FSAR Section 6.5.2 provides a detailed discussion of the NPSH required and available for the B train containment spray pump. This discussion was extensively revised in January 1979. No calculation

> was available to support the revision. PMD personnel stated that, for this revision, an updating of CS-5 had been performed; however, it could not be located during this inspection. A calculation should have been performed to support the FSAR description changes. The lack of an available calculation was contrary to Procedure GQ 3.08 (Reference 1.36), which states that revisions to design calculations shall be prepared, reviewed and approved in accordance with the requirements in GQ 3.08 for the original design calculations. (Finding 2-8.)

A response was submitted to the finding in CECo's IDI response letter. That response is explained below.

11. The information in Section 6.5.2 of the FSAR was not intended as the basis supporting the design of the containment spray system but was rather a description of that system and its function. A calculation, CS-5, performed in 1975 formed the central basis for the system design. The update of calculation CS-5 for the 1979 FSAR revision was performed to incorporate changes in the containment spray system design. Since the results of the updated calculation did not decrease the conservatism in calculation CS-5, it was not formalized and incorporated in CS-5. The adequacy of calculation CS-5 to support the final design of the containment spray system was confirmed by calculation CS-2 which was performed in mid-1983, at the time of the IDI Team review.

IDI Finding 2-9: FSAR Description of Containment Spray (Mr. Green)

12. In their Motion at pages 11-12, Intervenors adopt

the IDI Team's Finding 2-9 as a criticism of the adequacy of the Byron Station design. In this respect, Intervenors quote the following paragraph from the IDI report:

> In addition, the following discrepancies were noted in relation to the FSAR discussion: (1) the length of 24-in. piping is indicated to be 69 ft., whereas it is 85 ft. in the current design; (2) a 16-in. gate valve in the current design was omitted; and (3) there is no consideration of partial blockage of the screen, in accordance with Regulatory Guide 1.82. Although these specific items did not constitute deficiencies of technical significance, the FSAR description and the design should be consistent. (Finding 2-9)

A response was submitted to the Finding in CECO's IDI response letter. That response is explained below.

13. I agree with the conclusion of the IDI team that the FSAR description and the design should be consistent. I also agree that the noted deficiencies are not of technical significance. Section 6.5.2 of the FSAR has been revised to eliminate outdated information.

<u>IDI Finding 2-11: Maximum Piping Pressure (Mr. Green)</u>

14. In their Motion at page 13, Intervenors adopt the IDI Team's Finding 2-11 as a criticism of the design adequacy of the Byron Station. In this respect, Intervenors quote the first two paragraphs of the IDI report on this subject. These are quoted below along with the third paragraph which I believe provides further insight into the thrust of the IDI Finding.

We found several different values used for the auxiliary feed pump discharge piping maximum pressure, as follows:

(1) Design Criteria . . . . 2080 psig

(2) Mechanical Department piping list (an uncontrolled document) . . . . 2080 psig

(3) Piping contractor wall thickness calculation (Reference 2.65). . . . . 1830 psig

(4) S&L wall thickness calculation (Reference 2.8). . . . . 1750 psig

The wall thickness calculations were based on non-conservative values. In addition Sargent & Lundy had not performed a calculation to determine the maximum anticipated pressure of the system and assure that it does not exceed piping capability. The latter is contrary to the ASME Code, Section III, Subsection ND-3612.4, which states that pump discharge piping shall be designed for the maximum pressure exerted by the pump. (Finding 2-11.)

The value of 2080 psig cited in the design criteria corresponds to the case of minimum pump flow. The team would consider it more appropriate to use, concurrently, a condition where suction is taken from the essential service water system, which would result in a pressure of about 2165 psig. However, the installed piping is adequate since it is rated for 2367 psig based on the allowable working pressure listed in Sargent and Lundy Standard MES-2.5 for 6-in. schedule 120 pipe. (Reference 2.64.)

A response was submitted to this Finding in CECo's IDI response letter. That response is discussed below.

15. I do not agree that the wall thickness calculations for the auxiliary feed pump discharge piping were based on non-conservative values and that the maximum pressure had not been properly calculated as required by the

ASME Code. I will address first the different values for pressure identified in the IDI Report:

(1) The Design Criteria for the piping system established a maximum pressure of 2080 psig. This pressure was based on the pump curve for the Auxiliary Feedwater pump. The calculated value is consistent with Section ND-3612.4(g) of the applicable code (ASME Section III, 1974, Summer 1974 addenda), and it corresponds to the pump discharge piping pressure at minimum flow during a test condition.

(2) The Mechanical Department Piping List shows a maximum pressure of 2080 psig (in accordance with (1)), and also indicates the piping design pressure to be 1750 psig. Design pressure is defined in section ND-3112.1 of the Code as the highest pressure expected during normal operation. The design pressure of 1750 psig was established based on the auxiliary feedwater system supplying water to the steam generator which is the normal function for the system. As was noted by the IDI Team, S&L Standard MES-2.5 provides allowable working pressures that can be used to establish the adequacy of piping for the intended use. In this instance 6 inch schedule 120 pipe which is rated for 2367 psig was selected from the Standard.

(3) The piping contractor wall thickness calculation, which was referenced by the IDI Team, was not performed to design the piping wall thickness. The contractor calculation was based on the piping list design pressure at the time of the calculation which was 1830 psig. This calculation was not used for design purposes and it should be disregarded.

(4) The S&L wall thickness calculation referred by the IDI Team also was not performed to design the piping wall thickness. The S&L calculation was part of a group of calculations to reverify the minimum wall calculations based on design pressure. The piping design remained unchanged and the rated pressure of 2367 psig for the pipe provides significant margin over the calculated maximum pressure of 2080 psig. The maximum anticipated pump discharge pressure is based on the system design and pump performance, and is consistent with Subsection ND-3612.4 of the Code.

The minimum wall thickness calculations were based on the actual value of the design pressure of 1750 psig. However, the actual wall thickness for the piping rated at 2367 psig is obviously conservative when all that is needed is a wall thickness sufficient to withstand the design pressure and the maximum anticipated pressure of 1750 and 2080 psig respectively. Finally, the pump discharge piping pressure value of 2165 psig identified by the IDI Team is well below the 2367 psig rating. S&L continues to believe that a discharge piping pressure value of 2165 psig will never be reached during any predicted operating mode.

IDI Findings 2-16 and 2-17: Postulated Breaks in High and Moderate Energy Lines (Mr. Green)

16. In their Motion at page 11, Intervenors state that the IDI review of the feedwater system revealed deficiencies in the analysis related to postulated cracks and breaks in high and moderate energy lines and internal flooding. They then reference the portion of the IDI which stated:

> In the mechanical systems area there were deficiencies in the analyses related to postulated cracks and breaks in high and moderate energy lines and internal flooding. The effects of postulated cracks in moderate energy lines had not be examined (Finding 2-17) and effects of jets from postulated breaks in high energy lines had not been examined (Finding 2-16). In both cases, there are specific licensing commitments to provide appropriate protection. The design cannot be adequate until the effects have been systematically examined and protection has been provided where the examination indicates that it is necessary. For the moderate energy crack effects, it did not appear that the work was programmed to be done. For the high energy break jets, Sargent & Lundy personnel indicated that they had intended to do the work later; however, the team was concerned because it was late in the project and this work was not addressed in formal Sargent & Lundy instructions for the Byron and Braidwood project.

(IDI, p. 1-4.)

A response to those findings was submitted in CECo's IDI response letter. That response beginning with Finding 2-16 is discussed below.

17. The main criticism of the IDI Team was that up to the time of their audit, S&L had not made any examination of (i) the effects of postulated cracks in moderate energy lines and (ii) the effects of jets from postulated breaks in high energy lines in the design of Byron. This criticism is incorrect. Both effects had been considered early in the design process for Byron.

18. The need to accommodate the jet effects of high energy line breaks was recognized at the initiation of the Byron design in 1971. The methodology used to provide protection from jet effects was to protect systems utilized for safe shutdown by either separation or by barriers from the effects of jets from high energy line breaks. That is, the plant was designed such that jet impingement would not damage components to the extent that the capability to safely shutdown the plant was adversely affected. Thus, in accordance with section 3.6.1 of NRC's Standard Review Plan, Byron was designed and protected from the jet effects of high energy line breaks such that safe shutdown could be accomplished in the event of a postulated break.

19. Although the foregoing design process was not completely documented, the NRC Staff in its safety review of the Byron Station was able to determine that the jet effects from high energy lines had been accommodated in the Byron

design and that design work performed by S&L was adequate. The results of the Staff's evaluation is set forth in section 3.6 of Supplement No. 2 of the Byron Safety Evaluation Report (NUREG-0876, dated January 1983), and it is based on information furnished by S&L in section 3.6 of the Byron FSAR and the response to NRC question 10.40. Bechtel Power Corporation during its independent design review of the Byron design also concluded that this matter had been addressed early in the design of Byron.

20. Consistent with the comments of the NRC IDI Team and Bechtel, I would agree that further documentation was necessary to demonstrate that the early design work had addressed in all respects, the jet effects from high energy line breaks and it is in this sense that S&L indicated to the IDI team that further "work" was intended to take place later in the design process. This effort was planned but not completed prior to the IDI. A comprehensive review has now been completed, and it is documented in a report entitled "Byron 1 Confirmation of Design Adequacy For Jet Impingement Effects." That study addressed all potential jet sources and all components required to safely shut down the plant. It demonstrated that safe shutdown capability is retained following any postulated high energy line break and resulting jet impingement. The results of the study establish that no design changes are required, and thereby indicate that the original design approach, although not completely

documented, was effective in preventing the potential for unacceptable damage due to high energy jets.

21. Finding 2-17 concerned the effects of postulated cracks in moderate energy lines. The IDI team found that these effects had not been considered in the design of the Byron Station. As explained in CECo's IDI response letter, the effects of moderate energy line breaks were adequately accommodated in the Byron design. The NRC Staff's safety evaluation report supports this conclusion as well as the independent design review performed by Bechtel.

IDI Finding 3-9: Vendor's Static Analysis of Auxiliary Feedwater Pumps (Mr. Green)

22. At page 13, Intervenors state that the Auxiliary Feedwater pump vendor's static analysis (Report K-479), which showed the incorrect usage of forces relating to suction and discharge nozzles, was reviewed and approved by S&L. Intervenors based this criticism on Finding 3-9 of the IDI. That finding addressed the use of an incorrect nozzle load coordinate system by the auxiliary pump vendor due to the failure to define the correct system in the equipment specification. However, the finding goes on to state, "This error had no effect on the pump design and resulted in a small increase in pump stresses, still well within ASME allowables." Additionally, the response in the December 30, 1983 submittal by CECo indicated that actual piping loads from the formal piping analysis have been checked and deter-

mined to be less than the piping nozzle loads used by the vendor in the pump seismic report. All safety-related S&L specifications on the Byron/Braidwood projects have been reviewed and it has been determined that the nozzle load coordinate system was correctly specified or that loads were used correctly in the seismic report.

IDI Finding 4-1: Traverse Wall Load Criteria (Mr. Hooks)

23. In their Motion at page 14, Intervenors adopt the IDI Team's finding 4-1 as a criticism of the adequacy of the Byron Station design. In this respect, Intervenors quote from the IDI report as follows:

> 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.

A response to this finding was submitted in CECo's IDI response letter of December 30. Additional information was provided in letters dated June 19, 1984 and August 30, 1984 in response to additional questions from the IDI Team. This response is discussed below.

24. The IDI team concluded that certain loads were omitted from the information set forth in Chapter 11 of the Byron Structural Project Design Criteria. The loads listed in Chapter 11 were those that controlled the design of shear walls. For this reason, the loads referred to by the IDI Team, wind and tornado loads and seismic inertial loads, are not listed in Chapter 11. Wind and Tornado loads are found in Chapter 10 and they are considered in the design. Seismic inertial loads are not considered because their effect on design is negligible. Chapter 11 has been revised to reference the wind and tornado loadings in Chapter 10. In addition as requested by the IDI team, a systematic check of all walls in the auxiliary and fuel handling building was made. This evaluation verified that seismic inertial loads are negligible and that these loads and the wind and tornado loads are not controlling loads and that the structure is adequately designed.

Finding 4-2: Shear Friction Method (Mr. Hooks)

25. In their Motion at page 14, Intervenors adopt the IDI Team's finding 4-2 as a criticism of the adequacy of the Byron Station design. In this respect, Intervenors quote from the IDI report as follows:

> On page 11-5 it is stated that the shear friction concept shall be used to calculate the reinforcement required for transverse shear. This would allow the use of only horizontal and vertical reinforcing steel near the face of the wall. Such an

approach 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 Code states that shear friction . . . 'provisions apply where it is inappropriate to consider shear as a measure of diagonal tension.' Since it is not inappropriate to consider shear as a measure of diagonal tension in these walls, the code requires consideration of diagonal tension with transverse steel provided as needed. This conflicting information between the FSAR and the design criteria is contrary to the provisions of GQ-3.04, Design Criteria, of the Sargent & Lundy Quality Assurance Manual and (Reference 1.36). the preparer failed to incorporate the design criteria cited by the licensee in the FSAR within the project structural design criteria. This was a failure to reference 'applicable design inputs in the design criteria.' (Finding 4-2.)

We noted one wall calculation where transverse steel had been added, indicating that the designer had not taken advantage of the criteria. However, in view of the lack of written guidance, we can not preclude the possibility that elsewhere designers might have omitted the transverse steel required by ACI 318-71. If this did happen, it could represent a significant technical deficiency. Accordingly, in our judgment, a systematic check of all walls should be made in resolving the above finding.

A response to this finding was submitted in CECo's IDI response letter of December 30. Additional information was provided in letters dated June 19, 1984 and August 30, 1984 in response to additional questions from the IDI Team.

26. The IDI Team concluded that the structural design criteria for Byron did not implement the requirements of Section 11.15.1 of the ACI Code (ACI 318-71). The design criteria implementing the Code are found on pages 11-5 and

11-6 of the Byron Structural Project Design Criteria. A review of the relevant calculations confirmed that the S&L design had in fact met fully the requirements of ACI 318-71. The Byron design criteria have been revised to make it more clear, consistent with the comments of the IDI Team, that shear wall design was performed in accordance with the pertinent provisions of ACI 318-71 (Sections 11.4, 11.6 and 11.15).

Trends: (Mr. Green)

27. In their Motion at pages 2-3 and 11, Intervenors adopt the conclusion's in Bechtel's independent design review report regarding trends. In this respect, Intervenors quote from the report as follows:

> There were some negative trends identified by the IDR team analysis of the apparent root causes of the Observations requiring design or documentation changes for acceptable resolution. The trends observed were categorized into the following four areas:
>
> ° The use of undocumented judgments;
> ° Insufficient control of the FSAR;
> ° Insufficient review of changes;
> ° Noncompliance with Code requirements.
>
> These trends indicate that certain aspects of the design activities appear to have been controlled less systematically and regorously than currently appropriate; however, review of the specifics of the relevant Observations resulted in a judgment that these aspects are not sufficiently significant to justify further investigation.

28. S&L has reviewed the discussion on trends in the independent design review report prepared by Bechtel. This

matter has been carefully considered and S&L does not agree that the information gathered by Bechtel in connection with the topic characterized as "non-compliance with code requirements" is a trend. S&L does agree the results of the other trends are not sufficiently significant to justify further investigation. Each trend is addressed in the following discussions.

29. Standards have been issued by S&L in the Electrical, Structural, and Mechanical areas via Standards ESI-253, SAS-22, and MAS-22. These standards require engineering judgments to be documented. The FSAR is being updated for all Observation Reports requiring FSAR update. Other minor updates will be made in future amendments as appropriate.

30. Design changes are addressed under existing procedures. S&L Quality Assurance Procedure GQ-3.07 requires that the reviewer of the drawing, review the drawing for technical adequacy in accordance with departmental standards. Other Quality Assurance Procedures cover design activities other than S&L drawings. These procedures also require that revisions be prepared, reviewed, and approved, in accordance with the same procedures as the original activity.

31. Bechtel concluded "The review of the S&L design process indicated that each of these processes was controlled, but IDR Observations were made for each area related to reviewing changes and coordinating them within S&L. This

indicated that certain minor deficiencies may exist in the S&L process but does not lead the IDR to conclude that the process is generally inadequate."

32. S&L has, however, made the IDR Report available to the Design Directors in the Mechanical, Electrical, and Structural disciplines and has requested that the Design Directors emphasize the requirements for the review of design changes to design personnel.

33. Sargent & Lundy recognizes that code compliance is required and has addressed and resolved the Observation Reports noted by Bechtel. However, Sargent & Lundy does not consider this topic establishes a trend of noncompliance with code requirements.

34. The code circumstance identified in Observation Report 8.16 was recognized by S&L prior to the IDR and corrective action was being pursued. The partial penetration weld of Observation Report 8.31 is considered to be an isolated case. Observation Report 8.49 involves a difference of opinion on an interpretation of what the code requires. None of the Observation Reports have resulted in a question of design adequacy including Observation Report 8.49. Consequently, it does not appear that the Observations established a negative trend.