U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Reports No. 50-456/86035(DRS); 50-457/86027(DRS)

Docket Nos. 50-456; 50-457 Licenses No. CPPR-132; CPPR-133

Licensee: Commonwealth Edison Company
Post Office Box 767
Chicago, IL 60690

Facility Name: Braidwood Station, Unit 1 & 2

Inspection At: Braidwood Site, Braidwood, IL
Sargent & Lundy, Chicago, IL

Inspection Conducted: July 1-3 and July 8-11, 1986

Inspector: for W. C. Liu — 7/25/86 Date

for J. A. Gavula — 7/25/86 Date

Approved By: D. H. Danielson, Chief
Materials and Processes Section — 7/25/86 Date

Inspection Summary

Inspection on July 1-3 and 8-11, 1986 (Reports No. 50-456/86035(DRS); 50-457/86027(DRS))
Areas Inspected: Unannounced special safety inspection concerning allegations associated with the design of structural steel columns.
Results: No violations or deviations were identified.

DETAILS

1. Persons Contacted

Commonwealth Edison Company (CECo)

*E. Fitzpatrick, Station Manager
*N. Kaushal, Project Field Engineering Manager
*L. Davis, Assistant Superintendent
*D. Paquette, Assistant Superintendent
*P. Barnes, Regulatory Assurance Supervisor
*C. Schroeder, Services Superintendent
*W. Marcis, QA Engineer

Sargent and Lundy Engineers (S&L)

*R. Hooks, Assistant Head, Structural Engineering Division
*R. Marshalla, Supervising Design Engineer
*F. Shallwani, Senior Structural Engineer
*R. Johnson, Site QA Coordinator

NRC Inspectors

*T. Taylor, Resident Inspector, Operations

The inspectors also contacted and interviewed other contractor employees.

*Denotes those attending the final exit interview on July 11, 1986.

2. Followup on Allegation RIII-86-A-0107

a. Allegation

(1) The initial design did not take into account various mechanical, electrical, piping and beam modifications.

(2) To date no program has been started to analyze the columns for these additional loads and reinforce accordingly.

(3) The structure is now seeing many new dead and live loads that were not originally found in the design.

b. NRC Review

(1) Overall Program

The NRC inspectors reviewed various design documents at Sargent & Lundy Chicago Engineering Office in conjunction with structural analysis/design. The relevant portions of the following design documents associated with structural analysis were reviewed for design adequacy.

- Structural Project Design Criteria, DC-ST-03-BY/BR, Revision 20, May 13, 1986.

- Technical Training Design Package, Final Load Check of Containment Building Internal Structures and Auxiliary Building Open Structural Steel, TTDP-SED-12-BY2/BR, Revision 2, June 12, 1986.

- Technical Training Design Package, Final Load Check of Structural Components in the Auxiliary Building, TTDP-SED-04-BY/BR, Revision 7, January 21, 1986.

- Project Instruction, Documentation of Hanger Loads, P.I.-BB-34, Revision 4, June 10, 1985.

- Calculation Book No. 18.1.52, Elevation 395 Braidwood Containment Building Final Load Check Phase 1 and 2 Steel Framing.

- Calculation Book No. 18.1.50, Design Control Summary for Final Load Check.

- Calculation Book No. 18.1.53, Elevation 399 Braidwood Containment Building Final Load Check Phase 1 and 2 Steel Framing.

- Calculation Book No. 18.1.59, Section 1-9, and Section 11-17, Column Analysis.

- Calculation Book No. 18.1.59, Section 10, Pipe Supports on Columns.

- Calculation Book No. 18.3.1.5, Braidwood Auxiliary Building Final Load Check Steel Columns Area 5.

- Calculation Book No. 18.5.6.1, Braidwood Auxiliary Building Area 1, Elevation 426.

- Calculation Book No. 18.5.6.2, Braidwood Auxiliary Building Areas 2, 3 and 6, Elevation 426.

- Calculation Book No. 18.5.7.2, Braidwood Auxiliary Building, Elevation 439.

- Calculation Book No. 18.5.8.2, Braidwood Load Monitoring System/Final Load Check for Auxiliary Building, Steel Framing.

The relevant portions of the aforementioned documents were reviewed with respect to the methods and procedures utilized in the structural analysis. The inspectors noted that the Sargent & Lundy's (S/L) practices with regard to the designing of structural members and the process to monitor the latest design

loads such as pipe hangers, cable tray supports, conduits, equipment, etc., are adequate and acceptable. The basis for this conclusion follows:

(a) S/L added a contingency load of 50 kips during the initial design phase (prior to initiating a final load check) of all Category I columns. This is a very conservative consideration in determining the column size.

(b) The final load check (FLC) program of the Byron/Braidwood projects was initiated in the fall of 1982 for structural steel, and has been a continuous design effort since that time. The final load check of each structure is initiated when final loads are available and is updated on a continual basis for significant load changes which occur after the final load check. This update is referred to as load monitoring and is used to insure that structural members are capable of withstanding any and all load changes made throughout the life of the plant. This can be accomplished through the use of Sargent & Lundy's computer program called Load Monitoring System (LMS).

(c) The requirements of the Braidwood structural project Design Criteria and S/L's structural engineering standards for final load verification are implemented in each design area as required by the use of a Design Control Summary. The design control summary is established for each design area in order to detail the specific design requirements for each type of structure such as structural steel beams and steel columns, etc.

(d) The methods and assumptions used in the structural analysis are conservative. Calculation Book No. 18.1.59 for example, states that all design loads are assumed to act in the same direction, at the same time, and at their peak seismic acceleration. Further, full live loads have been used in the design of steel columns when in fact these live loads could have been reduced in accordance with the AISC code.

(e) All related loads such as pipe hangers, cable tray supports, conduit supports, equipment, etc. have been included in the design of structural beams and columns during the course of the final load check program.

(2) Sample Calculations Review

The NRC inspectors randomly selected 30 structural steel beams and 26 structural steel columns to verify whether these beams and columns are adequately designed.

(a) 26 Structural Columns

Containment Building:

R1	R5	R10	R14	R18
R2	R7	R11	R15	R19
R3	R8	R12	R16	R20
R4	R9	R13	R17	R21

Auxiliary Building - Area 5

S-12, S-13, S.7-12, S.7-13, V12.7, V.9-12.9

(b) 30 Structural Beams

Containment Building:

20304, 21703, 22010, 20701, 21310,
21504, 30412, 31912, 31681, 32012

Auxiliary Building:

6AB-30, 6AB-45, 7AB-3, 7AB-67, 7AB-91 7AB-123,
8AB-12, 8AB-81, 8AB-96, 8AB-132, 8AB-189,
8AB-294, 6AB-101, 6AB-103, 6AB-210, 4.3AB22N,
4AB53N, 4ABIN-6, 4AB40N, 4.3AB46N

The design calculations for the above beams and columns associated with the final load check were partially reviewed for conformance to analysis criteria, applicable codes, NRC requirements and licensee commitments. Further, the design loads with respect to pipe hangers, cable trays, conduit, and equipment were partially verified to ensure that these loads were adequately included in the design of the structural beams and columns. Design loads under seismic conditions were also verified for the selected beams and columns. The inspectors noted that computer applications were extensively used in the analysis of the structural beams and columns. The calculations for the aforementioned structural members appear to be adequate in terms of using conservative assumptions, design input, references, units (dimension, force and moment), equations, tables and sketches.

Results of the structural analysis indicate that all the aforementioned structural beams and columns have been safely designed and all calculated stresses are less than the allowable stresses for all design conditions.

During the inspection, the NRC inspectors identified inconsistencies for six columns in the Containment Building. These inconsistencies were the differences between the design loads contained in the calculation book and the computer analysis.

Subsequent evaluations were performed by S/L engineering personnel regarding the above concerns. Results of the engineering evaluation revealed that the inconsistencies

contributed less than 0.2% of the design capacity. The calculated stresses for the six columns are much less than the allowable stresses. Therefore, the inconsistencies were considered to be insignificant in terms of overall design requirements.

(3) Field Inspection

The NRC inspectors verified portions of the following structural beams and columns for conformance to design analysis.

Beams in Containment Building:

22010, 20701, 21310, 21504, 30412, 31681, 21912, 32012

Beams in Auxiliary Building:

8AB12, 8AB81, 8AB96, 8AB132, 8AB189, 8AB294, 7AB3, 7AB91, 6AB103, 4ABIN-6, 4AB40N

Columns:

R16, R19, V.9-12.9

The above beams and columns were inspected with respect to the number of attachments to the structural members. These attachments were associated with pipe hangers, cable tray supports, conduit supports, instrument line supports, and equipment supports. No discrepancies were identified during the NRC field inspection.

(4) Interviews

The NRC inspector held discussions with each of ten structural engineers who were randomly selected from S/L's Final Load Check group. The discussions were focused on the safe design of structural members such as beams and columns. All the structural engineers interviewed expressed the following:

- They feel very comfortable with respect to the methods/procedures used in the designing of structural members such as beams and columns.
- They agree that many conservative considerations/assumptions are used in the area of structural analysis/design.
- Its their opinion that all related loads such as pipe hangers, cable tray supports, conduit supports, and equipment are included in the designing of structural members during the final load check program.
- They believe that the structural members are very safely designed/analyzed.

As suggested in the allegation the NRC inspector also held discussions with each of five structural engineers who were randomly selected from the site structural engineering group. Results of the interview revealed the following:

- They know of no structural columns that are overstressed.
- They are aware that the S/L has an established program such as the load monitoring system (LMS) to design/analyze the structural steel members.
- They feel very comfortable with respect to the methods/ program that S/L is implementing.
- They are aware that all related loads such as pipe hangers, cable tray supports, conduit supports, equipment supports, etc. are included in the designing of structural members during the final load check program.
- They believe that the structural members are very safely designed and installed.

c. Conclusion

(1) Program Review

Sargent & Lundy has an established program (since 1982) to monitor and analyze structural members such as beams and columns under various loading (including dead, live and other) conditions. The program appears to be well developed in terms of monitoring the latest design loads during the final load check processes.

(2) Calculations Review

A review of the 26 structural columns and the 30 structural beams indicates that the calculated stresses for each of the structural members are less than the allowable stresses set by the applicable codes. Design loads (including dead, live and other) associated with pipe hangers, cable tray supports, conduit supports, and equipment supports have been included in the design of structural members in accordance with the final load check program.

(3) Field Inspection

Attachments to the structural members were partially verified with respect to the design drawings and design analysis. These attachments are the supports in conjunction with pipe hangers, cable trays, conduits, equipment, etc. No discrepancies were identified during the field inspection.

(4) Interview

All the 15 structural engineers interviewed were very satisfied with their work activities in terms of sound engineering design/analysis. The responses were very positive regarding the safe design of structural beams and columns. They know of no structural columns that are overstressed.

On the basis of the above inspection, the NRC inspectors concluded that the allegations are not substantiated.

3. Exit Interview

The inspector met with site representatives (denoted in Persons Contacted paragraph) at the conclusion of the inspection. The inspector summarized the scope and findings of the inspection noted in this report. The inspector also discussed the likely informational content of the inspection report with regard to documents or processes reviewed by the inspector during the inspection. The licensee did not identify any such documents/processes as proprietary.