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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

INTEGRATED PLANT SAFETY ASSESSMENT REPORT (IPSAR)

SECTION 4.10 DESIGN CODES, DESIGN CRITERIA, AND LOAD COMBINATIONS

DRESDEN UNIT 2

DOCKET NO. 50-237

1.0 INTRODUCTION

Current design criteria for nuclear power plant structures contain requirements that were not in effect when older plants were designed and licensed. Consequently, one aspect (designated Topic III-7.B) of the implementation of NRC's Systematic Evaluation Program (SEP) required licensees to review changes that have occurred in structural design criteria since their plant was built and also to review the loads and load combinations used for plant structures by comparing them with the loads and load combinations now specified for current construction. The licensee for Dresden 2, Commonwealth Edison Company (CECo), was requested to assess the impact that these changes may have on margins of safety for Dresden 2 structures as they were originally perceived and as they would be perceived under current criteria.

By letter dated August 2, 1982 (Reference 1) CECo provided information regarding the applicability of the identified code changes to the Dresden 2 plant and an assessment of the as-built safety margins. Although the NRC staff reviewed CECo's assessment the findings were not reported in Section 4.10 of the Integrated Plant Safety Assessment Report (IPSAR) for Dresden 2, NUREG-0823, February 1983 (Reference 2).

The staff, with assistance from the Franklin Research Center (FRC), further reviewed the design code changes and more specific load combination issues for Dresden 2. CECo responded to NRC/FRC requests in a letter dated July 11, 1984 (Reference 3). FRC issued a Technical Evaluation Report (TER-C5506-425) dated June 3, 1986, that summarized the findings and the unresolved issues for Dresden 2 (Reference 4). CECo subsequently responded to these concerns in a letter dated August 30, 1989 (Reference 5). The staff has reviewed all information provided to date on the outstanding issues concerning design codes, design criteria, loads and load combinations for Dresden 2. This Safety Evaluation Report resolves and closes all the remaining issues.

2.0 DISCUSSION

In a letter dated August 2, 1982 (Reference 1), CECo provided the following information related to Dresden 2.

a. A list of structural elements examined as a result of changes in design codes and criterion to assess the safety margins, with comments by Sargent and Lundy engineers.

b. A comparison of loading combination criteria for various major structures including the reactor building, spent fuel pool, intake and discharge structure, and diesel generator portions of the turbine building. The tables of comparison were prepared by the Franklin Research Center in TER-C5257-321 and there are comments by Sargent and Lundy engineers.

c. A summary of results from the draft report (dated May 14, 1982) by NCT Engineering which reviewed the structural integrity of the drywell containment when subjected to the combination of dead weight, SSE seismic loads, accident and temperature due to LOCA, and main steam line break, with comments by Sargent and Lundy engineers.

In a letter dated July 11, 1984, (Reference 3) CECo responded to NRC requests based on the FRC draft Technical Evaluation Report (TER-C5506-425) dated November 15, 1983.

The response included discussions in the following areas:

1. Reassessment Activities
2. AISC Code Requirements
3. ACI Code Requirements
4. ASME Code Requirements
5. Load and Load Combinations (Draft TER-C5506-425, Section 5.2)

Based on the review of the information provided by CECo, the staff concurred with FRC's findings addressed in the final supplementary report, "Review of Licensee Responses to SEP Topic III-7.B. Design Codes, Design Criteria, and Loading Combinations," TER-C5506-425, dated June 3, 1986 (Reference 4). This report identified several issues that required additional information from CECo that were requested by the staff in a letter dated July 26, 1989.

In a letter dated August 30, 1989, CECo submitted a report that responded to the staff's request for additional information concerning the unresolved issues addressed in the 1986 Technical Evaluation Report by the FRC. This response (Reference 5) which addressed all the remaining issues, permitted the staff to complete its review and to close SEP Topic III-7.B for Dresden 2.

3.0 EVALUATION

The staff concurs with its consultant's findings stated in FRC's final supplementary report TER-C5506-425 dated June 3, 1986 (Reference 4). Form sheets summarizing the review findings concerning technical aspects of the implementation of SEP Topic III-7.B and impact of design code changes have been provided in FRC's Report. CECo's previous submittals (References 1 and 3) were reviewed and based on the assurances provided therein, many of the issues of concern relating to SEP Topic III-7.B were considered resolved. However, the submittals did not provide sufficient information to fully resolve all issues.

The issues still remaining open were:

a. Code changes:

AISC 1.5.1.2.2 - Coped beam connections
AISC 11.15.7 - Walls subject to punching shear (SEP load combinations)
ACI 7.10.3 - Column splices where stress reversal may occur
ACI Appendix A - Transient thermal loads
ACI Appendix B - Design of Embedments

b. Loads and Load Combinations:

Accident load cases requiring simultaneous consideration of SSE and LOCA
Extreme environmental snow loads on roof

On August 30, 1989, CECo, in response to the staff's request for additional information, responded to the above open issues by submitting a report entitled, "SEP Topic III-7.B Response to Nuclear Regulatory Commission/Franklin Research Center Requests of TER-C5506-425 dated June 3, 1986," with attached drawings. The licensee's responses concerning the open issues are evaluated as follows:

a. Code Changes

(1) Cope Beams - In the Dresden Drywell Steel Evaluation for Units 2 and 3, a total of 1341 connections were assessed. Of this total, 25 required modification to bring them within FSAR allowables and have been installed. Of these 25 connections only a very small percentage required modifications based on AISC 1980 Section 1.5.1.2.2 cope criteria. Considering that the design criteria including the analysis methods used to define the loads are conservative, the few discrepancies identified are judged as acceptable. Therefore, the requirements of AISC 1980 Section 1.5.1.2.2 are considered satisfied.

(2) Walls Subject to Punching Shear - During the course of review of additional loading imposed on various structures, a punching shear check had been performed for the vast majority of the loads considered as part of the review of structural integrity. Furthermore, the loads to be checked for punching shear were commonly applied to the wall through an expansion anchor plate or through a concrete embedment. In the vast majority of cases, the attachment plate would be the critical design item and the punching shear check would not control the design. Since the design codes and design criteria are generally conservative, the few cases of discrepancy are considered as acceptable. Therefore, the provisions of ACI 349-76 Section 11.15.7 are satisfied.

(3) Embedment Plates - The scope of several reassessment programs for embedment plates was quite extensive. These assessment programs involved approximately 1000 baseplates, 2000 pipe supports, 150 pieces of equipment, 1100 embedments and 1857 attachments. The

number of items requiring modification to remain within FSAR requirements were small in comparison with the number of embedded items considered. Since the design codes and criteria are basically conservative, the few cases of inconsistency are judged as acceptable. Based on the results of these programs and the results of other ongoing work at the Dresden Station, the requirements of ACI 349-76 Appendix B are considered as satisfied.

(4) Adequacy of Spliced Reinforced Columns - The staff's concern is the capacity of columns to resist stress reversals during a strong earthquake or severe wind loadings. The licensee contends that since the vertical seismic acceleration is small and since lateral loads are carried by the shear wall system, the possible stress reversal in the column should not occur. In addition, tensile splice capacity is not required for overall structural stability since all lateral loads are carried by the shear wall system. Forty-eight column splices in the Dresden Unit 2 Reactor Building had been evaluated using the requirements of the ACI 349-76 Code. Only 3 of the 48 splices had interaction factors greater than 1 and less than 1.6. Potential overstresses of column splices are, therefore, considered as of secondary importance. Considering that the design criteria, including the analysis methods used to define the loads, are conservative, the few discrepancies identified are judged to be acceptable.

(5) Adequacy of Concrete Regions Subject to Accident Temperatures and Thermal Transients - The staff is concerned about the potential effects of accident conditions and the thermal transients associated with them. The design basis accident temperature for Dresden is approximately 350°F. Two fires occurred at Dresden Unit 3 on January 20, 1986 and on June 4, 1988. A temperature of 450°F was recorded during the first fire. An evaluation of the effects of each fire on the structure was performed by CECo and no detrimental effects to the integrity of the Dresden structure was demonstrated. The high temperature and transient nature of these two fires were similar to thermal loadings during accident conditions. Therefore, the staff has concluded that the structure can withstand thermal stresses from accident events.

b. Loads and Load Combinations

(1) Extreme Environmental Snow Load - The Reactor Building, Turbine Building, and Crib House roof parapets at Dresden have been modified to reduce the amount of water that can be retained on the roof. The attached drawings to the response submittal (Reference 5) show the roof details and parapet modifications. Summer probable maximum precipitation has been considered in design. Based on the review of this information the staff concludes that the modification is acceptable.

(2) Simultaneous SSE and LOCA - The Dresden Updated FSAR, Section 12.1.2.3, contains the required loading combination for Class 1 structures. The primary containment (including penetrations) is designed for simultaneous SSE and LOCA, including LOCA pressure and LOCA thermal loads. This load combination is in compliance with the staff position and is, therefore, acceptable.

During the course of review of various loading conditions the staff has looked into the cases that involved wind loads. Specifically, the pipe reaction loads and thermal loads were considered in combination with wind loads (including tornadoes and tornado missiles) under Topic III-7.B. This load combination is acceptable because it provides reasonable assurance that structural integrity is maintained and that the structure meets the intent of current design criteria. It therefore forms the basis of acceptance of SEP Topic III-2, Wind and Tornado Loadings. See SER to IPSAR, Section 4.3. Wind and Tornado Loadings for Dresden 2 (Reference 6).

4.0 CONCLUSION

As discussed above, the remaining unresolved issues were mainly due to incomplete responses to previous staff requests for additional information and clarification. Since then, full responses and clarifications have been provided and all open issues have been adequately addressed. Based on the results of review, the staff finds that CECo's explanation and clarification of load and load combinations are acceptable and, therefore, considers that all issues associated with SEP Topic III-7.B are resolved.

Principal Reviewer: Sai Chan

Dated: August 23, 1990

References

1. Letter from Rausch (CECo) to O'Connor (NRC), Subject: Dresden 2 SEP Topic: III-7.B, Design Codes, Design Criteria, and Loading Combinations, dated August 2, 1982.

2. NUREG-0823, "Integrated Plant Safety Assessment, Systematic Evaluation Program, Dresden Nuclear Power Station, Unit 2" Final Report, U.S. NRC February 1983.

3. Letter from Rybak (CECo) to Gilbert (NRC), Subject: Dresden Station Unit 2, Systematic Evaluation Program, IPSAR Section 4.10, Topic III-7.B, Design Codes, Design Criteria, and Load Combinations, dated July 11, 1984.

4. Franklin Research Center, Technical Evaluation Report (TER-C5506-425), "Final Supplementary Report, Review of Licensee Responses to SEP Topic III-7.B, Design Codes, Design Criteria and Loading Combinations. Dresden Nuclear Power Station Unit 2," June 3, 1986.

5. Letter from Silady (CECo) to Murley (NRC), transmitting a report entitled, "SEP Topic III-7.B Response to Nuclear Regulatory Commission/Franklin Research Center Requests of TER-C5506-425 dated June 3, 1986," dated August 30, 1989.

6. Memorandum from Bagchi (NRC) to Craig (NRC), Subject: Integrated Plant Safety Assessment Report (IPSAR), NUREG-0823, Sections 4.3, Wind and Tornado Loadings, and 4.5 Tornado Missiles - Dresden Unit 2 (TAC 49363) (enclosing SER), dated September 13, 1989.