



UNITED STATES
NUCLEAR REGULATORY COMMISSION
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EVALUATION BY OFFICE OF NUCLEAR REACTOR REGULATION

SEP TOPIC III-6, SEISMIC DESIGN CONSIDERATIONS

PALISADES PLANT

INTRODUCTION

In Section 2.4, Topic III-6, "Seismic Design Considerations," of Supplement No. 1 to the Palisades Integrated Plant Safety Assessment Report (IPSAR) (Reference 1), the staff identified a total of six issues related to the seismic design of the plant. These issues relate to the adequacy of input earthquake motions used for the evaluation of equipment items, additional amplification of floor response spectra due to the out-of-plane vibration of floors and walls, and structural integrity of control room panels, motor control centers, switchgear, and electrical cable trays. The licensee submitted its responses to Items 1, 2, 3, and 6 of Section 2.4 of IPSAR Supplement No. 1 through its letter dated April 3, 1984 (Reference 3). The purpose of this report is to summarize the staff's evaluation of these issues based on the review of the licensee's responses submitted and to reemphasize the staff's concerns of the other open issues. The following sections are numbered with the corresponding item numbers in Reference 1 to allow cross reference.

EVALUATION

1. Input Earthquake Motions for the Evaluation of Equipment

In response to the staff's concern about the adequacy of input motions used for the evaluation of equipment open items (Reference 2), the licensee made the following statements in Reference 3 based on its interpretation of NUREG/CR-1833 results:

- a. The floor response spectra developed originally, based upon modified-Taft spectra, for use in the Palisades Plant equipment qualification, did not deviate from the NUREG/CR-1833 curves significantly.
- b. Current acceptance criteria (NUREG/CR-0098) permit higher damping values and the spectra in general have lower peak responses.
- c. Subsequent efforts made by Consumers Power Company in response to the open issues listed in Enclosure 2 of NUREG/CR-1833 showed that the essential mechanical equipment, which qualified under the original Palisades response spectra, meets the current criteria of NUREG/CR-0098.

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The staff finds no bases for making statement "a" and does not understand statement "b". As discussed on page 95 of NUREG/CR-1833, based on the comparison results of NUREG/CR-1833 floor response spectra and the corresponding original design floor response spectra, the staff found that the load ratios for equipment in the rigid range are expected to be approximately 0.71 to 0.86 for the containment building and approximately 0.71 to 0.9 for the auxiliary building, and for the flexible equipment with frequencies of about 4 Hz or less, load ratios as low as 0.34 for the containment building and 0.23 for the auxiliary building can occur.

Based on the discussion above, the licensee's responses are not acceptable to the staff. Regarding statement "c", the staff would like to review, in detail, any subsequent efforts made by the licensee in response to the open items, if they are available. At this time, the adequacy of input motion is still considered as an open item.

2. Additional Amplification of Floor Response Spectra Due to the Out-of-Plane Vibration of Floors and Walls

The licensee provided its responses to this item through the letter dated April 3, 1984 (Reference 3). For the case of floor out-of-plane vibration, the licensee stated that sample evaluation of the plant equipment, based on Palisades original floor response spectra and the method stipulated in the FSAR, indicated that the concern over out-of-plane amplification is not warranted. The staff would like to review the aforementioned evaluation results before close out of this item. For the case of wall out-of-plane vibration, the staff's major concern is that there would be some safety related equipment supported by masonry walls (reinforced or un-reinforced). Based on the staff's review experience, the amplification factor due to wall out-of-plane vibration can be as high as 1.5 at center of the wall. The licensee can either demonstrate that the amplification effect of masonry wall is insignificant in the Palisades plant or inform the staff that there is no safety related equipment supported by the masonry wall. The item remains open.

3. Control Room Panels C-11A, C-126, and Switchgear 1D

The licensee provided its responses in Reference 3. As a result of review, the staff's findings and evaluation are summarized below:

3.1 Control Room Panel C-11A

- a) A finite element analysis was performed to evaluate this cabinet. The modeling technique and the analysis method appear reasonable. Furthermore, the analysis established the fundamental frequency at 18.2 Hz, which justified the equivalent static analysis subsequently performed.

- b) Acceleration values of 0.5g horizontal and 0.14g vertical were used. These were taken from the floor response spectra at Elevation 625.0 ft of the auxiliary building with 5% damping. The licensee should provide justification to demonstrate that the spectral accelerations used are either more conservative than the corresponding acceleration values shown in the NUREG/CR-1833 or, as a minimum, higher than those obtained from the floor response spectra generated using the Palisades site-specific spectrum as input ground motion.
- c) Stresses were calculated by a square root of the sum of the squares combination of the responses resulting from accelerations applied independently in the three orthogonal directions. These were compared to allowable stresses defined to be 90% of yield strength. The minimum safety factor obtained was 1.1. With one exception, the analysis was done to acceptable criteria and methodology. The exception concerns the use of an allowable stress of 90% of the yield strength for connections such as bolts and welds. The ASTM Specification for A307 bolting material, a typical material used in cabinet anchorages, does not specify a yield strength. It is not clear how the criteria can be applied for bolts. This allowable stress for shear in welds is high compared to the values used for the other cabinets (1.6 times the AISC Specification allowable stress) and needs justification.

3.2 Control Room Panel C-126

- a) An equivalent static analysis was performed to qualify this panel and its electrical device anchorages. Applied accelerations for the panel of 2.76g horizontal and 0.3g vertical were calculated by applying a factor of 1.5 to the peaks of the original spectra for the 625 ft elevation of the auxiliary building with 5% damping. The method of calculating the equivalent static load appears acceptable. However, it is not clear how the 2.76g horizontal acceleration was calculated. The horizontal floor response spectra at Elevation 625 ft of auxiliary building need to be provided for review. As discussed in the NUREG/CR-1833 (P. 95), no vertical floor response spectra was generated in the original auxiliary building analysis. It is not explained how the 0.3g vertical acceleration was calculated.
- b) Two load cases were calculated, the vertical acceleration applied simultaneously with each of the horizontal accelerations. The results of these calculations were enveloped and compared to allowable stresses obtained by applying a factor of 1.6 to AISC and AISI Specification allowable stresses. The criteria and methodology are acceptable.

- c) The qualification of in-cabinet devices was the same, except that an additional factor was applied to the accelerations in consideration of cabinet structure and floor slab amplification, with resulting accelerations of 4.47g horizontal out-of-plane, 2.76g horizontal in-plane, and 0.63g vertical. The method for calculating the static load is acceptable. Again, verification should be provided to demonstrate how these accelerations were calculated as discussed in Item (a) above.
- d) Results of the analysis indicated that the cabinet and its electrical device anchorages are adequate, except for the cabinet anchorage which the licensee has decided to modify based on the analysis results. The licensee has not yet indicated that this has been done.

3.3 Switchgear 1D

The results of the evaluation of switchgear 1D were not presented in Reference 3. This remains as an open item.

4. Justification for Qualifying Panel C-33 by Comparison

The licensee was requested to provide justification for qualifying control room panel C-33 by comparison to MCC-1 and 2 (Reference 2). The concern was based on differences in the two structures. Since this was not reported in Reference 3, it remains an open item.

5. Use of Unacceptable Vertical Acceleration in Motor Control Center Analysis

The licensee was requested to calculate natural frequencies for the in-cabinet devices of MCC-1 and 2 and to apply these to the appropriate floor spectra to develop accelerations for reevaluation of the devices located in MCC-1 and 2 (Reference 2). Since Reference 3 does not report this as being done, it remains an open item.

6. Electrical Cable Tray

This item will be resolved during the implementation of the NRC Unresolved Safety Issue (USI) A-46.

CONCLUSIONS

As a result of the staff's review of Reference 3, the following items remain open:

1. The adequacy of input earthquake motions used for the evaluation of equipment items.
2. Additional amplification of floor response spectra due to the out-of-plane vibration of structural floor and walls.
3. Structural integrity of control room panels C-11A, C-126, and C-33, switchgear 1D, and motor control centers 1 and 2.

REFERENCES

1. "Integrated Plant Safety Assessment Systematic Evaluation Program Palisades Plant, NUREG-0820, Supplement No. 1" dated November 1983.
2. Letter from D. M. Crutchfield, NRC, to D. J. Vandewalle, CPCo; "Palisades Plant - IPSAR Section 4.10, Seismic Design Considerations," dated September 6, 1983.
3. Letter from B. D. Johnson, CPCo to D. M. Crutchfield, NRC, dated April 3, 1984.
4. Letter from K. A. Toner, CPCo, to D. M. Crutchfield, NRC, dated January 18, 1983.