NRC Structural Audit Apr. 20, 1981
MIDLAND
K6/83

The safety factors are defined in the following relationship:

$$\text{Factor of Safety} = \frac{A_s \text{ provided}}{A_s \text{ required}}$$

where

A_s = cross-sectional area of reinforcing steel

Item j: Verify that the reactor pressure vessel upper lateral support is considered in the design analyses.

Status: Due to modifications in the reactor vessel support system, Babcock & Wilcox is currently repeating the analysis for the NSSS. When the loads from that analysis are available, Bechtel will evaluate the supports based on the revised loads. Bechtel meanwhile has included the effects of the modified reactor vessel support system in the containment building seismic analysis to assess the possible change in structural response. Changes in the responses and a description of the new model will be provided in an FSAR revision.

Item k: Provide shear values for all tabulations included in the NRC Structural Technical Audit responses.

Status: The affected pages have been revised to include shear values, where applicable.

AUXILIARY BUILDING

The modification scheme using caissons (described in the audit response) is being revised. Therefore, some questions are not directly applicable. The modification schemes adopted will be provided by FSAR revision.

Item a: Check for possible additional loading on the control tower due to the effects of caissons.

Status: The effect of possible additional loading to the control tower due to caissons will be addressed, if applicable.

Item b: Assess the effect of bending on the wing foundation due to the outer caissons.

Status: If the revised modification scheme uses caissons, the effect of bending will be assessed.

Item c: Consider concrete and soil in combination to determine caisson stiffness.

Status: If caissons are used in the revised modification, concrete and soil will be considered in combination to determine the stiffness.

Item d: Determine whether friction between the caissons is required to develop full load.

Status: This question will be addressed, if applicable.

Item e: Ensure that the foundation design will be based on a subgrade modulus calculated from actual tests.

Status: The soil input will be developed using actual soil parameters and/or observed settlements.

Item f: Vendor calculations relative to the fuel racks must be checked. Determine how the impact factor was applied to the fuel racks. Ensure that the possibility of tipping the fuel racks has been considered.

Status: Documentation provided by the vendor indicates the fuel pool rack calculations were checked prior to the audit. A request will be made that the vendor provide information concerning impact factors and verify through analysis that the fuel racks will not tip over under design conditions.

Item g: Provide an explanation of the approach used to obtain shear values for shear walls.

Status: A revision of Volume 5, Page 24a of the NRC Structural Technical Audit is attached (Attachment E). The response indicates the method used to obtain the shear values. The calculation pages provided with Attachment E are for information only.

Item h: Explain how through-cracks will affect load capacity.

Status: Through-cracks will be considered in accordance with the Midland concrete crack position in Attachment J.

Item i: Assess the effects of long-term settlement on the control tower versus main section of the auxiliary building.

Status: Significant long-term differential settlement between the control tower and the main auxiliary building will be addressed by FSAR revision.

Item j: Ensure that the same method used to analyze the through-cracks will be used to verify the capacity of an isolated typical section.

Status: A portion of the diesel generator building will be examined using a finite element cracked section analysis (Refer to Page 4 of Attachment J).

DIESEL GENERATOR BUILDING

Item a: Verify spring constants used in the analysis and design of the diesel generator building.

Status: It has been verified that the spring constants used in structural analyses are based upon the information provided by the Bechtel geotechnical group.

Item b: Estimate stresses associated with the cracking and consider the widening of cracks.

Status: Cracks will be considered in accordance with the Midland concrete crack position in Attachment J, Appendix C.

Item c: Verify that reversal effects of seismic loads are considered relative to cracking.

Status: Cracks will be considered in accordance with the Midland concrete crack position in Attachment J. (Refer to Pages 1, 3, 5, and 13 and Appendix A of Attachment J).

Item d: Coordinate modifications of the pedestal with the diesel generator vendor providing the pedestal design and the seismic qualifications for the diesel generators.

Status: The modified design of the pedestals has been coordinated with the vendor. The vendor was also informed that the pedestals were leveled before setting the diesel generators. A new seismic analysis for the diesel generator building was performed, and the design basis spectra will be incorporated in the revised applicable specification for the seismic qualification of all equipment.

Item e: Evaluate the influence of through-cracks on structural capacity.

Status: Cracks will be considered in accordance with the Midland concrete crack position in Attachment J.

Item f: Evaluate the effects of a tornado missile on a wall with cracks.

Status: The effects of a tornado missile on a wall with cracks will be evaluated in accordance with the Midland concrete crack position in Attachment J. (Refer to Appendix B of Attachment J)

SERVICE WATER PUMP STRUCTURE

Item a: Provide for monitoring of cracks in the service water pump structure.

Status: Monitoring of cracks in the service water pump structure is an ongoing activity.

Item b: Evaluate the effects of hydrodynamic loads on interior walls.

Status: Interior walls have been checked for hydrodynamic loads. The method used follows that outlined in the Technical Information Document TID-7024. The walls satisfy FSAR acceptance criteria.

Item c: Provide a factor of safety for the bearing capacity of the new wall foundation.

Status: The safety factor will meet or exceed the FSAR acceptance criteria. The actual factor of safety will be provided in an FSAR revision when the modification scheme is finalized.

Item d: Establish a monitoring program for settlement of the service water pipes.

Status: The service water pipes will be monitored for differential settlement relative to the structure from inside the building during the underpinning construction activities. The differential settlement will be monitored at points where the pipes cross the exterior wall. This monitoring will be conducted on a weekly basis for the duration of the underpinning activities and will be continued every two weeks for 6 months after completion of the underpinning activities.

BORATED WATER STORAGE TANKS

Item a: Provide details of the final design, in particular, the connection between the inner and outer foundation walls

Status: These details will be documented in the FSAR when the design is finalized.

Item b: Verify vendor acceptance of tank foundation modifications.

Status: The vendor will perform structural analyses of the tanks under the present foundation condition and the predicted future condition after the foundations are modified. Based on the results of these analyses, the acceptance of the tanks will be determined. Acceptability and its basis will be provided in an FSAR revision.

Item c: Establish a monitoring program for pipes in the valve pit.

Status: Item c is closed because Seismic Category I piping was cut outside the pit before the load test. A monitoring program will be established if the pipes are reconnected prior to the completion of the modification.

Item d: Monitor high stress points for cracks after implementation of remedial soils actions.

Status: This item will be considered as a part of the soils remedial actions.

BURIED PIPES AND TANKS

Item a: Verify that postulated earthquake loadings will be considered in tank piping connection design.

Status: The analysis for seismically induced forces in buried piping will identify nozzle loads. These loads will be added to the values already established for thermal and settlement effects. The total will be compared to the acceptance criteria. This is further addressed in the revised responses provided in the NRC structural technical audit (Volume 10) which have been attached (Attachment F).

Item b: Describe the routing of the air supply entering the control room from the control room pressurization tanks.

Status: Air supply lines are connected to nozzles at the top of both control room pressurization tanks in the accessway. Lines come out of the accessway wall at el 628'-4-3/4", turn down, and run toward the auxiliary building at el 625'-0". Both lines from the tanks are connected to a common header just outside the auxiliary building. Link seals exclude moisture at both places where lines come out of the accessway and enter the auxiliary building. A line runs through the auxiliary building into the control room area and finally terminates in the heating, ventilating, and air conditioning duct (see Attachment G).

Item c: Control room tanks should be monitored for displacements.

Status: The applicable design drawing is being revised to indicate settlement markers for the control room pressurization tank foundations.

GENERAL

Item a: Provide a schedule for soils remedial actions.

Status: The schedules of service water pump structure and auxiliary building remedial actions, as presented during the audit, are shown in Attachment H. Design of the borated water storage tank modification will be completed by July 30, 1981.

Item b: Provide a copy of the calculation index for the remedial actions.

Status: The complete index is included as Attachment I.

NRC STRUCTURAL AUDIT

PRELIMINARY LIST OF OPEN ITEMS

Containment

a. Review Numbers on Page 21, Table 3.8-1

b. Verify that torsion was used on components and internal structures.

c. Membrane shear allowable in equipment hatch area shear allowable (400 psi) needs verification

d. Bijlaard: Show that this technique is applicable for containment shell

e. Check adequacy of baseslab shear reinforcement #9's on vertical wide flanges.

f. Impact effect of 1/32 inch gap steam generator needs to be assessed

g. Allowable membrane tension, $3\sqrt{f'_c}$ and $6\sqrt{f'_c}$ - which load combination in tension and bending and where does it apply

h. Want to know the actual yield stress for reinforcement in the primary shield.

i. Explain Mu and Vu along with safety factor; Page 57

j. Reactor pressure vessel upper lateral support is this considered in analysis

k. To tabulate shear values in all tables

Auxiliary Building

a. Check for possible additional loading on control tower due to the effects of caissons

b. Bending on foundation of wing due to revised outer caissons must be assessed

c. Stiffness of caissons should consider concrete and soil together

d. Is friction between the caissons required to develop full load

e. Subgrade modulus should be calculated from tests for use in the foundation design

f. Fuel rack calcs-unchecked (vendor calc) impact factor used between fuel racks, and pool walls from tipping needs to be studied

(Resolved) g. Calcs for shear wall should be explained showing approach used

h. How does thru cracks affect load capability

i. Effect of long-term settlement on control tower versus main section of auxiliary building

j. Use same method to analyze the thru cracks, to verify capacity of an isolated typical section.

Diesel Generator Building

a. Verify spring constants

b. Cracks: estimate stress; also consider widening of cracks

c. Cracks should include reversal effects of seismic loads

d. Co-ordinate with vendor on pedestal design and seismic qualification for diesel generators

e. Want commitment to evaluate cracks influence on structural capacity

f. Present evaluation of tornado missile effects on a wall with cracks

Service Water Pump Structure

a. Monitor cracks

b. Hydrodynamic loads on interior walls

c. Foundation bearing capacity of new wall needs identified factor of safety

d. Commit to monitor service water pipes for settlement effects.

Borated Water Storage Tanks

a. Provide details of final design, especially connection between the two foundation walls

b. Provide Vendor acceptance of tank foundation modifications

c. Pipes should also be monitored in the valve pit

d. Commit to monitor high stress points after implementation of fix for cracks

Buried Pipe and Tanks

a. Earthquake should be considered in tank piping connection design

b. Control room tanks should be monitored for displacements

c. Describe air supply lines to control room from tanks

General

a. Want schedule for design of remedial fixes

b. Want copy of calculation index for fixes

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