JAN 1 2 1979

DOCKET NOS. 50-361
AND 50-362

APPLICANTS: SOUTHERN CALIFORNIA EDISON COMPANY
SAN DIEGO GAS AND ELECTRIC COMPANY

FACILITY: SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3

SUBJECT: SUMMARY OF NRC STAFF AUDIT OF SEISMIC AND STRUCTURAL DESIGN CALCULATIONS

On December 4 through 8, 1978, members of the NRC staff met with the applicants and their contractors and consultants in Los Angeles, California to conduct the subject audit. Attendees are given in Enclosure 1. The audit agenda is given in Enclosure 2. As may be seen from the agenda, the audit covered each of the major safety-related structures at San Onofre 2 and 3.

The staff conducted the audit in order to accomplish the following objectives:

1. To investigate in detail the manner in which the applicants have implemented the structural and seismic design criteria that they committed to use, prior to obtaining Construction Permits for the facility.

2. To verify that the key structural and seismic design and verification calculations have been conducted in an acceptable way.

3. To identify and assess the safety significance of those areas where the plant structures were designed and analyzed using methods other than those recommended by the NRC staff's Standard Review Plan (NUREG-75/087).

The audit was conducted on the basis of the guideline forms transmitted to the applicants by the NRC letter dated September 21, 1978. As requested by the letter, the applicants provided the information requested by the guideline forms at the beginning of the audit.

11/4
GD

OFFICE ➤						
SURNAME ➤						
DATE ➤						

During the audit, the NRC staff identified a number of items that it desired to review, in addition to the information provided on the guideline forms. The staff requested that this information, which is listed in Enclosures 3 through 10, be provided on the docket. The applicants estimated that this information will be completely submitted by the end of March 1979. Upon receipt and review of these additional audit request items, the staff will be able to complete the audit.

Original Signed by
H. Rood

H. Rood
Light Water Reactors
Branch No. 2
Division of Project Management

Enclosures:
As Stated

ccs w/enclosures:
See next pages

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SURNAME	HRood:ab	RLBaer RLB				
DATE	1/12/79	1/12/79				

JAN 1 2 1979

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JAN 12 1979

ENCLOSURE 1

ATTENDANCE LIST
AUDIT OF SAN ONOFRE 2 AND 3 SEISMIC AND
STRUCTURAL DESIGN CALCULATIONS

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A. Lopez
L. M. Moon
H. Nazarian
K. S. Patel
T. E. Richardson
K. M. Schechter

SOUTHERN CALIFORNIA EDISON COMPANY

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J. Compas
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SAN DIEGO GAS AND ELECTRIC COMPANY

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S. P. Chan
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H. Rood

ENCLOSURE 2

JAN 12 1979

Meeting with NRC
Structural Audit
San Onofre Nuclear Generating Station
Units 2 & 3

I	Seismicity, Soils	J. A. Barneich (Woodward-Clyde)	Dec. 4
II	Auxiliary Intake Structure	J. Yann	Dec. 4
III	Offshore Conduits	A. Fohrer (SCE)	Dec. 5
IV	Intake Structure	H. Avedian	Dec. 5
V	Containment Structure & Polar Crane	K. Schechter	Dec. 6
VI	Auxiliary Bldg.	A. Lopez	Dec. 7
VII	Fuel Handling Bldg. & Cask Handling Crane	A. Lopez	Dec. 7 & 8
VIII	Safety Equipment Bldg.	Knu Patel	Dec. 8

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ENCLOSURE 3

NRC Audit Request Items
Offshore Circulating Water System

1. Provide more details of modeling techniques used in the CIDP analysis including boundary condition assumptions. Describe how the method accounts for varying stiffnesses of different structures.

2. Provide available data concerning longevity of the rubber joint gasket and joint wrapping material.

3. Document the capacitities of the offshore conduits when compared to current S.R.P. criteria as previously requested by the NRC Staff. In particular, address simultaneous load application in 3 principal directions by SRSS combination and use of 1.5 multiplier on peak amplified response.

4. Provide sample calculations for wave loadings on Auxiliary Intake Structure. Ref. Audit Form Item I.G. - p 2.

5. Provide back-up calculations for use of virtual water mass in developing externally applied hydro-dynamic loadings for Auxiliary Intake Structure riser. Ref. Audit Form Item I.H p 2.

6. Provide available data for E_c and f_c' from Auxiliary Intake Structure mix design. Ref. Audit Form Item II.A.1.a.(1) p.4.

7. Provide results of hand calculations showing effects of assumed minimum torsion for the Auxiliary Intake Structure. Ref. Audit Form Item B.1.b - p 15.

8. Provide back-up calculations for 2 typical values in FSAR Table 3.8-14a. Where applicable, the calculations will consider both the prestressed and conventionally reinforced conduit sections. Ref. Audit Form Item B.2.d - p. 16.

9. Provide back up calculations for DBE sliding and overturning analysis. Ref. Audit Form Item D.1 - p. 20.

ENCLOSURE 4

JAN 1 2 1979

NRC AUDIT REQUEST ITEMS
INTAKE STRUCTURE AND BOX CONDUIT
(Onshore Circ.Water System)

1. Provide comparative data with respect to simultaneous SRSS combination of loadings in both horizontal directions and the vertical direction which is representative of the intake structure. This data will be provided in response to Q131.31.

2. Provide basis for establishing the maximum ground water level used in determining hydrostatic pressures on structural walls. Ref. Audit Form Item I.H p.2.

3. Provide Tables L-1 and L-2 from Woodward-McNeill Soils Report. Ref. Audit From Item II.A.1.a (6) p.5.

4. Provide hand calculations assuming simplified structural model to approximate additional shear in exterior walls resulting from an assumed 5 percent eccentricity. Ref. Audit ~~From~~ FORM Item II.A.2.a p.5.

5. Provide hand calculation of natural frequency for typical interior pier, and stop gate enclosure wall, and salt water cooling pump support slab. These calculations will assume end fixity at the member supports. Ref. Audit Form Item II.A.4.d.

6. Provide an assessment of the structural capacity of 4 elements of the intake structure listed below. This assessment will be for DBE only including the 1.5 factor required for equivalent static analysis methodology or by the use of alternate acceptable analysis methodology.

   Elements:
   1. Critical section of basemat considering positive and negative bending
   2. Interior piers
   3. Critical exterior wall section
   4. Critical section of top slab.

7. Provide sample calculations including copies of computer output for the following structural elements of the intake structure:

   1. Exterior wall at column line 19
   2. Typical interior peir at traveling screens
   3. Basemat section at interior pier
   4. Basemat section between interior piers
   5. Saltwater pump support slab.

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ENCLOSURE 5

NRC Audit Request Items
Containment Structure

1) Provide a comparison of the effects of simultaneous consideration of 3 components of seismic response by SRSS combination on typical containment structure in structure response spectra. This comparison will be addressed in response to Q131.31 NRC staff will review the response to Q131.31, and, if necessary, will ask for additional information.

2) Provide results of hand calculations of shear stresses at the base of the containment shell and secondary shield walls assuming an eccentricity of 5 percent of the base width of the structure. Ref. Audit Form Item II (I) G.d. (I)a 2-p.19 and II (I) G.d. (I) b.b-p.20.

3) Provide available information concerning longevity of PVC electrical conduit material. Ref. Audit Form Item II (I) G.a-p.18.

4) NRC staff will review the response to Q131.26 and advise the applicant if additional comparative data is required with respect to S.R.P. load combinations for the containment interior structure. Ref. Audit Form Item II (I) G.d(I) b.d-p.20.

5) Provide additional information describing the non-linear energy equilibrium analysis for containment structure overturning. Ref. Audit Form Item II (I) G.d. (4)-p.24,25.

6) Provide results of a conventional analysis of safety factors for containment structure sliding and overturning. This request will be subject to future consideration by the NRC Staff following completion of the audit. Ref. Audit Form Item II (I) G.d. (4)D.b.-p.25.

7) Provide the factor of safety against overturning as calculated by the nonlinear energy equilibrium analysis methodology in addition to the factor of safety for bearing capacity provided in the audit form. Ref. Audit Item II (I) G.d. (4) D.b-p.25.

8) Provide a paragraph to page 33 to clarify the design basis for the equipment hatch including the reference year for ASME Code applied. Ref. Audit Item Part II-2-F p.33.

9) Provide computer output and backup calculations for sections 1,3,5,7,8,9, 10 and 12 on figure 131.7-2 to show stresses are within the allowable limits. Ref. Audit Item Part II 3C p.34.

10) Provide material specifications for the waterstop materials. Ref. Audit Item Part II 4E p.38.

11) Provide a sample calculation for the design for tangetial shear. Refer to Audit Item Part II, 5A p.40.

12) Provide a sample calculation for the design for the radial shear reinforcing on the dome. Refer to Audit Item Part II-6-C p.42.

13) Provide a statement that the primary shield wall meets the current criteria. Provide supporting justification for the statement Ref. Audit Item Part II 7-C p. 44.

14) Provide calculations for the operating deck slab in the reactor head laydown area. Refer to question 131.26-1 Ref. Audit Item II-8-C p.47.

15) Provide calculation pages 1-23 C257-7.01.01, the reactor vessel lower column supports. Ref. Audit Item Part II 10-C p.51.

16) Provide the calculation for steel column #10, supporting the operating deck slab. Ref. Audit Item Part II 14-C p.59.

17) Provide "Prestressing Calculations for Containment Structure, by VSL. Ref. Audit Item Post Tensioning System and Anchorage-4 P.61.

18) Provide calculations for the concretestresses beneath the bearing plat. Ref. Audit Item Post Tensioning System and Anchorage-5-f p.62.

ENCLOSURE 6

JAN 1 2 1979

NRC AUDIT REQUEST ITEMS
POLAR CRANE SUPPORTS

1. Provide a compairson of stresses calculated using 3 component SRSS to the design stresses for the polar crane girder. Ref. Audit Item Part I-(I)-F Page 2.

2. Provide calculation pages 1-18, C257-7.11, polar crane runway girder. Ref. Audit Item Part I-(II)-C page 3.

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ENCLOSURE 7

NRC AUDIT REQUEST ITEMS
AUXILIARY BUILDING

1. Provide comparison of results of modal combination methodology used for the Auxiliary Building with simultaneous combination of both horizontal responses and vertical response by SRSS. This comparison will be provided in response to Q131.31 and will discuss criteria for consideration of closely spaced modes.

2. Provide description of procedure used in design of the Auxiliary Building truss utilizing SMIS computer program considering multiple point response spectral input. Ref. Audit Form Item II.B.1.a page 12.

3. Provide justification for use of less than 5 percent accidental torsion in addition to actual geometric torsion which was considered. Ref. Audit Form Item II.B.1.b page 1w.

4. Provide results of a conventional analysis of safety factors for auxiliary building sliding and overturning. This request will be subject to future consideration by the NRC Staff following completion of the audit. Ref. Audit From Item II.D.4 page 19.

5. Provide an assessment of column moment capacity due to drift and in combination with differential loading.

6. Provide calculations and appropriate computer output for the analysis and design of the following structural elements:

   Exterior wall - radwaste area - 15 x 73'-5 (Table 131.18-2 Sh. 3)
   Control Area slab at Elev. + 50 (Table 131.18-2 Sh. 4) (OBE)
   Control Area slab at Elev. + 50 (Table 131.18-2 Sh. 4) (DBE)
   Main Girder at Elev 70 W33 x 220 (Table 3.8-9 Sh. 2)
   Bottom Chord of truss Elev. 50 (Table 3.8-8 Sh. 2)
   Column Supporting truss Elev. 70 (Table 3.8-8 Sh. 2)

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ENCLOSURE 8

NRC AUDIT REQUEST ITEMS
FUEL HANDLING BUILDING

1. Provide comparison of results of modal combination methodology used for the Fuel Handling Building with simultaneous combination of both horizontal responses and vertical response by SRSS. This comparison will be provided in response to Q131.31 and will discuss criteria for consideration of closely spaced modes.

2. Provide justification for use of less than 5 percent accidental torsion in addition to actual geometric torsion which was considered. Ref. Audit Form Item II.B.1.b. page 12.

3. Provide back-up calculations for methodology used in consideration of hydrodynamic loadings on the spent fuel pool walls.

4. Provide results of a conventional analysis of safety factors for Fuel Handling Building sliding and overturning. This request will be subject to future consideration by the NRC Staff following completion of the audit. Ref. Audit From Item II.D.4 page 19.

5. Provide back-up calculations for methodology used in design of cask handling area floor slab for cask drop including reference to appropriate Bechtel Topical Report. Ref. Audit Form Item II.C.2 page 26.

6. Provide back-up calculations for consideration of thermal effects in design of the spent fuel pool base ~~slba~~ SLAB. Ref. Audit From Item II.E.2 page 29.

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ENCLOSURE 9

NRC AUDIT REQUEST ITEMS
SPENT FUEL CRANE SUPPORTS

1. Provide sample calculations for the design of the wall bracket and the concrete crane rail support girder.

2. Provide a comparison of stresses calculated using 3 component SRSS combination to those calculated in design of the Spent Fuel Crane girders.

ENCLOSURE 10

JAN 1 2 1979

NRC AUDIT REQUEST ITEMS
SAFETY EQUIPMENT BUILDING

1) Provide a discription of the parametric study used to determine that 80 percent of DBE loads gives conservative values for OBE loads for the Safety Equipment Building.

2) Provide results of a hand calculation of shear stresses at the base of the exterior shear walls due to accidental torsion assuming an eccentricity of 5 percent of the base width of the structure.

3) Provide a comparison of the effects of simultaneous consideration of both horizontal responses and the vertical response simultaneously by SRSS combination with the 2D absolute combination utilized in the Safety Equipment Building. This comparison will be provided in response to Q131.31.

4) Provide results of a conventional analysis of safety factors for sliding and overturning of the Safety Equipment Building. This request will be subject to future consideration by the NRC Staff following completion of the audit. Ref. Audit Form Item II. D.4. p.19.

5) Provide sample calculations of design of structural elements to withstand impact of automobile tornado missile. Ref. Audit Form Item II. F1 p.21.

6) Provide drawings showing typical reinforcing steel details for critical sections of elements listed below. This package will include a description of the design methodology and back-up calculations and computer printouts applicable to the design of these elements.

   a) Component Cooling Water pump room base mat.
   b) East exterior wall of heat exchanger room between Elev-17 and Elev. + 8.
   c) Interior wall between heat exchanger rooms.
   d) Slab at Elev. 30'-6 at cable tray area.
   e) Roof slab at main steam line support.

Meeting Summary

Docket File ✓
NRC PDR
Local PDR
TIC
NRR Reading
LWR #2 File
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D. Skovholt
W. Gammill
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R. Vollmer
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