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SUBJECT: Provides addl info in form of Rev 2 to util "Spent Fuel Pool Reracking Licensing Rept 68308/9."

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June 1, 1989

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

Gentlemen:

Subject: Docket Nos. 50-361 and 50-362
Spent Fuel Pool Reracking (TAC No. 68308/9)
San Onofre Nuclear Generating Station
Units 2 and 3

Reference: March 10, 1989 letter from Kenneth P. Baskin (SCE) to Document Control Desk (NRC): Subject; Same as above

By letter dated May 19, 1989, Southern California Edison committed to provide additional information regarding abnormal thermal loads on the fuel handling building/spent fuel pool for San Onofre Units 2 and 3. The evaluation of the abnormal thermal loads assuming spent fuel pool boiling plus gamma heating of the spent fuel pool walls has been completed, and the stresses have been determined to be within allowables. Therefore, in accordance with this commitment, enclosed are nine (9) copies of this additional information which is provided in the form of Revision 2 replacement pages to the "Spent Fuel Pool Reracking Licensing Report, San Onofre Nuclear Generating Station, Units 2 and 3," dated March 1989, which was submitted to the NRC by the above reference.

If you have any questions or comments, please contact me.

Very truly yours,

Enclosure

cc: J. B. Martin, Regional Administrator, NRC Region V
F. R. Huey, NRC Senior Resident Inspector, San Onofre Units 1, 2 and 3

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INSTRUCTIONS FOR INSERTING REVISION 2

SPENT FUEL POOL RERACKING LICENSING REPORT

Revision 2 to the Spent Fuel Pool Reracking Licensing Report consists of insert pages.

The insert pages provide changes to the Licensing Report to incorporate the results of the spent fuel pool boiling analysis and are indicated by a bold line in the outside margin adjacent to the change. The date (5/89) and revision number (Revision 2) are provided at the bottom of each changed page.

In addition:

The revised List of Effective Pages (LOEP-1) replaces the existing LOEP in the manual behind the front cover.

LIST OF EFFECTIVE PAGES

This List of Effective Pages identifies those text pages and figures currently effective in the Licensing Report.

Page or Figure No.	Issue
LOEP-1	Rev 2
Description and Safety Analysis of Proposed Change NPF-10/15-287	
1	Rev 0
2	Rev 1
3 - 10	Rev 0
Attachment A	Rev 0
Attachment B	Rev 0
Attachment C	Rev 0
Attachment D	Rev 0
Attachment E	
i - vii	Rev 0
1-1 - 1-7	Rev 0
Fig 1-1	Rev 0
2.1-1 - 2.1-3	Rev 0
2.2-1 - 2.2-5	Rev 0
Fig 2.2-1 - 2.2-2	Rev 0
Fig 2.2-3	Rev 1
2.3-1	Rev 0
3.1-1 - 3.1-25	Rev 0
Fig 3.1-1 - 3.1-2	Rev 1
Fig 3.1-3 - 3.1-6	Rev 0
3.2-1 - 3.2-21	Rev 0
Fig 3.2-1 - 3.2-3	Rev 0
3.3-1 - 3.3-7	Rev 0
Fig 3.3-1 - 3.3-3	Rev 0
3.4-1 - 3.4-3	Rev 0
3.5-1 - 3.5-3	Rev 0
3.6-1 - 3.6-3	Rev 0
4.1-1 - 4.1-11	Rev 0
Fig 4.1-1 - 4.1-3	Rev 0
Fig 4.1-4	Rev 1
Fig 4.1-5 - 4.1-11	Rev 0
4.2-1 - 4.2-6	Rev 0
4.3-1 - 4.3-2	Rev 0
Fig 4.3-1 - 4.3-6	Rev 0

Page or Figure No.	Issue
4.4-1 - 4.4-2	Rev 0
4.4-3 - 4.4-4A	Rev 2
4.4-5 - 4.4-8	Rev 0
4.5-1 - 4.5-37	Rev 0
Fig 4.5-1 - 4.5-20	Rev 0
4.6-1 - 4.6-2	Rev 0
4.6-3	Rev 2
4.6-4	Rev 0
4.6-5 - 4.6-5A	Rev 2
4.6-6 - 4.6-7	Rev 0
4.6-8 - 4.6-8A	Rev 2
4.6-9 - 4.6-12	Rev 0
4.6-13 - 4.6-27	Rev 1
4.6-28 - 4.6-29	Rev 2
4.6-30 - 4.6-34	Rev 0
Fig 4.6-1 - 4.6-10	Rev 0
4.7-1 - 4.7-26	Rev 0
Fig 4.7-1 - 4.7-14	Rev 0
4.8-1 - 4.8-5	Rev 0
4.9-1 - 4.9-4	Rev 0
5.1-1 - 5.1-16	Rev 0
5.2-1 - 5.2-27	Rev 0
5.3-1 - 5.3-10	Rev 0
5.4-1	Rev 0
6-1 - 6-15	Rev 0

Pool Water	150F
Outside Ambient Air	40F
Outside Soil	40F
Inside Ambient Air	65F
Initial Installation (Zero Thermal Stress)	65F

D. Abnormal Thermal Load (T_a)

Abnormal thermal loads (temperature differences and temperature gradient) are produced due to the temperature distribution through the wall/basemat and liner plate during a full core off load and pool boiling (including 2
the effects of concrete gamma heating). These temporary thermal loads are evaluated for the concrete walls, basemat, and liner plate system of the three pools under the following two situations:

1. Spent fuel pool with water; transfer and cask pool empty
2. All three pools with water

The reinforced concrete temperature differences and gradients are determined based on an inside face temperature of 230F (water temperature of 212F and gamma 2
heating of 18F). For the liner plate the temperature of 216F was used. This lower temperature is used because the

effect of gamma heating on the liner plate is minimal due to the liner plate thickness and the cooling effect of the surrounding pool water. 2

E. Design Basis Earthquake (DBE) Load (E')

Three directional seismic loads are applied based on the site specific free field DBE response spectrum shown in the UFSAR figure 3.7-1. This spectrum is applicable to both horizontal components. The vertical-motion spectrum has the same shape as the horizontal, but is two-thirds times the horizontal. The resultant seismic load distributions used in the evaluation were established by a three-component square root of the sum of the squares (SRSS) combination technique considering seismic excitation in all three coordinate directions acting concurrently.

F. Operating Basis Earthquake (OBE) Load (E)

The free field OBE spectrum acceleration values are one-half the DBE values. Three directional seismic loads are applied and combined as discussed for the DBE case above.

4.4.1.2 Load Combinations

In the SFP analysis, the following load combinations, from the SONGS 2&3 UFSAR, paragraph 3.8.4.3.2 were considered. Load combination 8, tornado loading is not applicable to the area of the structure being evaluated.

1. North and south SFP walls
2. East SFP wall
3. West SFP wall
4. SFP basemat

The loading cases 6 and 7, which have large temperature gradients, have the most significant effect on concrete compressive stresses for both mat and wall locations. The utilization factors for the maximum stress are presented in table 4.6-1. The largest utilization factor for concrete section is 81.4% (at least a 18% margin remains against the section allowable), which resulted from loading case 6. The utilization factor is defined as the percentage of resistance of the reinforced concrete section that has been utilized relative to the zero curvature line. A utilization factor of 100% indicates that the section is fully utilized by the design load. 2

B. Liner and Anchorage

The existing liner plate system is evaluated for the new spent fuel rack induced loads and for two postulated load drops. Both local and overall effects on the liner plate system are evaluated. The ACI and AISC codes were used for the liner plate evaluation.

The original analysis for thermal effects on the SFP liner plate was based on conservative parameters with a pool temperature of 220F and an initial unstressed liner plate temperature of 60F resulting in a temperature differential of 160F. The actual governing maximum pool liner design basis temperature is 216F and the initial unstressed liner plate temperature is 65F (resulting in a temperature differential of 151F), which creates a less severe condition than that originally analyzed. Therefore, the results of the original analysis remain valid, (i.e., the liner plate will not buckle due to design thermal conditions), and the function of the liner plate system to serve as a leak-tight membrane is maintained for all applicable loadings, and all applicable load combinations. 2 2 2

Additionally, load drop evaluations were performed for lifted items to determine their effect on the liner plate. These items were the SFP gate, a test equipment load, and an empty spent fuel rack. The Region I type rack governs over Region II type rack because it is much heavier. A minimum water depth of 40 feet was assumed. The evaluation was performed in accordance with BC-TOP-9A.

The analysis indicates that the liner plate could be perforated due to a SFP gate drop (maximum concrete penetration about 1-1/2 inches deep by 31 square inches) or an empty spent fuel rack drop (maximum concrete

penetration about 5-3/4 inches deep by 63 square inches). The test equipment drop is enveloped by an empty spent fuel rack drop.

The governing results for this evaluation are compared against the governing UFSAR values given in the SONGS 2&3 UFSAR table 3.8-10. The table 4.6-2 comparison shows that the current evaluation of the SFP basemat and walls results in reduced section moments and membrane forces due to the refined analysis and design techniques discussed previously even though the loads due to the spent fuel racks increased.

The SONGS 2&3 UFSAR, table 3.8-10, lists a value of 224 kips/ft as the maximum computed basemat shear which corresponds to an allowable value of 304 kips/ft, resulting in a 26% margin. The shear value listed is for a cantilever portion of the basemat away from the SFP area and would not be affected (in shear) by the added mass within the pool which is bounded by heavy shear walls. However, the basemat shear within the pool boundary (pool floor) would be affected and the maximum computed value is 90 kips/ft which corresponds with an allowable of 119 kips/ft, resulting in a minimum 24% margin. 2

Table 4.6-2 shows that the current evaluation results in increased margins (differences between code allowables versus actuals). For example, the governing basemat load interactions per the UFSAR are at approximately 98% of capacity (a 2% margin) resulting from loading case 7, 2

whereas the corresponding value for the current evaluation is approximately 82% capacity (an 18% margin) resulting from loading case 6. 2

Table 4.6-1

CURRENT EVALUATION RESULTS FOR THE SPENT FUEL POOL WALLS AND BASEMAT

	Governing UFSAR Load Combination[a]	Utilization Factor (%)[b]
North and South Walls:		
Horizontal Reinforcement	7	71.6
Vertical Reinforcement	7	37.4
East Wall:		
Horizontal Reinforcement	7	22.3
Vertical Reinforcement	7	44.8
West Wall:		
Horizontal Reinforcement	7	24.0
Vertical Reinforcement	6	66.4
Basemat:		
North-South Reinforcement	7	51.7
East-West Reinforcement	6	81.4

2

a. Refer to Section 4.4.1.2.

b. The Utilization Factor is defined as the percentage of resistance of the reinforced concrete section that has been utilized relative to the zero curvature line.

Table 4.6-2

COMPARISON OF GOVERNING RESULTS FOR THE ORIGINAL DESIGN VERSUS THE CURRENT EVALUATION FOR THE SPENT FUEL POOL

Location in Spent Fuel Pool	(a)	Governing Load Combination (b)	Axial Load Pu (kips) (c)	Flexural Load Mu (K-ft/ft)	Max Flexural Load Mu(Max) (K-ft/ft) (d)	Mu/Mu(Max)	
7-Foot Thick Basemat in Pool Area (E-W Reinf)	UFSAR	7	-527	2604	2660	0.98	
	CURRENT EVALUATION	6	92	1465	1793	0.82	2
4-Foot Thick (N or S) Spent Fuel Pool Wall (Vert Reinf)	UFSAR	7	-404	445	947	0.47	
	CURRENT EVALUATION	7	-67	208	554	0.38	2
5-Foot Thick (West) Spent Fuel Pool Wall (Vert Reinf)	UFSAR	7	0	666	674	0.99	
	CURRENT EVALUATION	6	208	188	257	0.73	2

a. The UFSAR values are from UFSAR table 3.8-10. The current evaluations are the maximum values obtained and not necessarily at the previous locations.
b. Refer to Section 4.4.1.2. 2
c. Sign convention for Pu: Compression (-), Tension (+)
d. Maximum flexural interaction capacity (Mu(Max)) given the axial load shown (Pu).