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Committed to Nuclear Excellence

Palisades Nuclear Plant
Operated by Nuclear Management Company, LLC

June 2, 2004

10 CFR 50.90

U. S. Nuclear Regulatory Commission
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Palisades Nuclear Power Plant
Docket 50-255
License No. DPR-20

Responses to NRC Questions from Telecons on 5/25/04 & 5/27/04

By letter dated January 29, 2004, Nuclear Management Company, LLC (NMC) submitted a license amendment request on the spent fuel pool crane (L-3 crane) for the Palisades Nuclear Plant. By letter dated April 28, 2004, the Nuclear Regulatory Commission (NRC) issued a request for additional (RAI) information concerning the license amendment request. On May 14, 2004, NMC responded to the RAI.

Additional questions were raised during conference calls, which occurred on May 25, 2004, and May 27, 2004, between the NRC staff and NMC. The attached document and table provide the responses to the additional questions.

Summary of Commitments

This letter contains no new commitments and no revisions to existing commitments.

I declare under penalty of perjury that the foregoing is true and correct. Executed on June 2, 2004.

Daniel J. Malone
Site Vice President, Palisades Nuclear Plant
Nuclear Management Company, LLC

Enclosures (2)

CC Administrator, Region III, USNRC
Project Manager, Palisades, USNRC
Resident Inspector, Palisades, USNRC

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Stress Increase Factors (SIF)

The SIF factors are factors used to adjust normal load allowable stresses to maintain the relationship between the loads and allowable stresses as defined in Final Safety Analysis Report (FSAR) Section 5.9.1.1.2.

Input load combinations LC-1 and LC-2 are considered normal loads that are used for design in accordance with the American Institute of Steel Construction (AISC) Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, 1963 edition, allowable stresses. Therefore, the stress increase factor is:

$$SIF = 1.0$$

Analysis input load combinations LC-3, LC-4, LC-5, LC-6, LC-9, LC-10, LC-11, and LC-12 (combinations involving wind and operating basis earthquake loads) do not include the 1.25 load factors on the FSAR load combination equations for wind and operating basis earthquake (OBE) loads. If these load combinations were used without adjustment, the calculated stresses would be 1.0/1.25 = 0.8 of the stresses resulting from the FSAR load combination equations. This is acknowledged by reduction of allowable stresses through division by 1.25. In addition, FSAR, Section 5.9.1.1.2, Equations 1 through 5, indicate an allowable stress for steel of $\phi \times F_y$, where $\phi = 0.9$ for fabricated steel structures. Therefore, the allowable stress is increased by a 0.9/0.6 factor, where 0.6 comes from $0.6F_y$, a basic AISC allowable for flexure. Considering both the allowable stress reduction and the allowable stress increase results in the following stress increase factor:

$$SIF = (0.9/0.6)/1.25 = 1.2$$

Input load combinations LC-7, LC-8, LC-13, and LC-14 address safe shutdown earthquake (SSE) loads. Since FSAR, Section 5.9.1.1.2, Equations 4 and 5 have load factors of 1, no load factor reduction in allowable stress is required. To adjust from code allowable stress to FSAR allowable stress, the following stress increase factor is used:

$$SIF = (0.9/0.6) = 1.5$$

Load Combinations (LC)

The design of the steel frame structure over the spent fuel pool, the fuel handling building, was done by Bechtel in 1967, using hand calculations. Nuclear Management Company, LLC (NMC) has located some of these calculations, however, the entire original design basis for this structure has not been recovered. Therefore, it is not possible to determine, with any degree of certainty, what was used in the original design for a load factor not specifically called out in the FSAR, such as for the "portion of the live load" to be combined with the dead load. However, the entire fuel handling building structure was re-analyzed using a current-day structural analysis computer program, as discussed below in the Methodology section. For the load cases in the reanalyzed structure, the 0.5L live load factor, combined with the seismic load and full crane load, is considered to be conservative (see attached Table for load case comparison, and also reference last paragraph of write-up, below). Load cases and load factors are developed based on codes, standards and industry practice based on the likelihood of concurrent loads being present. For LC5 – LC8, the likelihood of full crane loads, in combination with full roof live loads and full seismic loads, is not considered credible, thus the 50% reduction in live load. However, the combination of full roof live load with wind load and crane impact load is considered a more credible load case as considered in LC1 – LC4.

The LCs used in the analysis were developed to meet the requirements of the load combinations in the Palisades Plant FSAR. The attached table provides a correlation between the FSAR load combinations and those explicitly used in the analysis. This table also includes discussion of each load combination used. Attached to the end of this write-up are the definitions of loads used in the LCs. As noted in the last paragraph below, we believe the load cases for the full crane load, combined with seismic loads, were not previously analyzed in the design of the fuel handling building, nor were required to be.

The Systematic Evaluation Program, SEP Topic III-7.b, Safety Evaluations and correspondence were reviewed with respect to any load combination changes/nuances. The only significant deficiency identified between the FSAR load combinations and those reviewed was the tornado wind load case. This issue was dispositioned and found acceptable through other SEP Topic reviews, and it is stated in the FSAR, Section 5.3.2.1, that this structure is not designed for tornado loads.

Allowable Stress versus Ultimate Strength Design

FSAR Section 5.9.1.1.states:

> "In general, reinforced concrete structures were designed using the ultimate strength method, and steel structures were designed using the working stress method."

FSAR Section 5.9.1.1.1 states that Class 1 structures were designed in accordance with provisions of:

- ACI 318-63, Building Code Requirements for Reinforced Concrete
- Part 1 of the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, 1963 edition

The analysis performed supports a design check against allowable stress. Because the Palisades Plant design basis considers load factors and increased allowable stresses for accident, wind, and seismic conditions (FSAR Section 5.9.1.1.2) that are not consistent with allowable stress design, the load combinations were normalized by removing load factors for the convenience of the analysis. The SIFs were then computed to adjust code allowable stresses to reflect the use of load factors and stress increases per the Palisades design basis.

Methodology

The entire Fuel Handling Building structure was modeled using a current-day structural analysis computer program, beam and element model. For calculating the seismic forces in various structural elements, modal response spectrum analysis has been performed. The seismic modeling and analysis techniques are consistent with FSAR, Section 5.7.2. The SAP90™ computer code was used for the seismic analysis, and has been verified and validated for the analysis of Class 1 structures. The analysis of the fuel handling building using a computer code versus the original Bechtel calculations does not represent a "change in methodology" in the realm of 10 CFR 50.59. Certainly, it represents the use of different tools, but the methodology is still in keeping with the FSAR.

Interaction Coefficients

In Attachment 2 of the NMC response to the request for additional information, dated May 14, 2004, Item 6 and 10 are from the same member. One value is for the member itself, the other is for the end connection (i.e. bolting). This member is part of the vertical wind bracing, and the high interaction is due to a calculated axial compression in that member. This condition will not actually occur due to the configuration of this cross-bracing, where the associated tension member will assume the load as the compression member buckles, since these members act in pairs. The maximum interaction in the cross-braced tension member is 0.72. However, the end connection detail, with the single angles bolted in single shear, does represent a calculated overstressed condition under the load combinations considered within this analysis.

Facility Change 976 is the modification package for the single failure proof crane upgrade. The functional description for that package notes: "*The single failure proof upgrade requires that the crane be able to support a critical load during OBE and SSE seismic events. The existing crane and Fuel Handling Building (FHB) was not qualified under this condition. EAs* (i.e. Engineering Analyses) *performed for this modification determined that minor structural steel modifications are required by this upgrade.*" This does not necessarily represent a change in "philosophy," but was seen as a change in requirements to meet the single failure proof criteria. The load case that resulted in the interactions noted above were a result of this additional load case that was not considered part of our original design basis.

Terminology for FSAR Load Combinations

Y = required yield strength of the structures.

ϕ = yield capacity reduction factor (see discussion on Subsection 5.8.5.2.4).

ϕ = 0.90 for reinforced concrete in flexure.

ϕ = 0.85 for shear (diagonal tension), bond and anchorage in reinforced concrete.

ϕ = 0.75 for spirally reinforced concrete compression members.

ϕ = 0.70 for tied reinforced concrete compression members.

ϕ = 0.90 for fabricated structural steel.

D = dead load of structure and equipment plus any other permanent loads contributing stress, such as soil or hydrostatic loads. In addition, a portion of "live load" is added when such load is expected to be present when the plant is operating. An allowance is also made for future permanent loads.

R = force and/or pressure on structure due to rupture of any one high-energy line. The following pipe rupture loads are included, as appropriate: pipe reactions, jet impingement, pipe whip and containment pressurization.

H = force on structure due to thermal expansion of pipes under operating conditions.

E = OBE loads resulting from a ground surface acceleration of 0.1g.

E' = SSE loads resulting from a ground surface acceleration of 0.2g.

Terminology for Additional Load Definitions

1. L = Roof live loads (In this case L is snow load.)
2. W_W = Wind loads for wind from the West.
3. W_E = Wind loads for wind from the East.
4. CN_W = Crane wheel loads from the normal operation including lifted load with impact and with lateral loads in the East ($+F_y$) direction.
5. CN_E = Crane wheel loads from the normal operation including lifted load with impact and with lateral loads in the West ($-F_y$) direction.
6. CS = Crane static wheel loads under seismic condition. This includes lifted load, but does not consider impact, which is consistent with ASME NOG-1 load combinations.

Assessment of Auxiliary Building Framing Above Elevation 649'-0" for Increased Loads (Loads and Load Combinations)

	FSAR LOAD COMBINATIONS	ANALYSIS LOAD COMBINATIONS	COMMENTS
NORMAL	Normal load combinations are not defined in the FSAR, but FSAR Section 5.9.1.1 states: CPCo Design Class 1 Structures were designed in accordance with the provisions of ACI 318-63, Building Code Requirements for Reinforced Concrete and Part 1 of the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, 1963 edition.	$LC1 = 1.0D + 1.0L + 1.0CN_W$ $LC2 = 1.0D + 1.0L + 1.0CN_E$	Since the FSAR does not present loading combinations for normal load cases, LC1 and LC2 were formulated for the normal load cases. These load cases do not include wind or seismic loads. ➢ Load combinations checked against AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, 1963 edition, normal allowable stresses.
OBE	1. $Y = 1/\phi(1.25D + 1.0R + 1.25E)$ 2. $Y = 1/\phi(1.25D + 1.25H + 1.25E)$ (a)	$LC5 = 1.0D + 0.5L + 1.0CS + E$ $LC6 = 1.0D + 0.5L + 1.0CS - E$ $LC11 = 0.72D + 1.0CS + E$ $LC12 = 0.72D + 1.0CS - E$ (Loads R and H are not applicable to this structure.)	Load combinations LC5 and LC6 capture maximum downward loads. The 0.5 factor on live load considers the unlikely event of full live load being present during cask loading activities, and is considered a conservative factor. A reduction in live load is consistent with the FSAR, which states that a portion of live load is added to dead load when such a load is expected to be present when the plant is operating. This is consistent with standard industry practice allowed under building codes. Load combination LC11 and LC12 capture maximum upward loads. Note (a) under the load combinations in FSAR Section 5.9.1.1.2 reads: "0.9D was used whenever the addition of the dead load stress reduced the critical stress." Since 0.9/1.25 = 0.72 where 1.25 is the dead load factor in the Equation in the FSAR Section 5.9.1.1.2, the 0.72 factor is used to reduce dead load in load combination LC11 and LC12 to capture maximum uplift due to OBE. The +E and –E captures reversible OBE load. ➢ Load combinations checked against 1.2 times AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, 1963 edition, normal allowable stresses.
WIND	3. $Y = 1/\phi(1.25D + 1.0H + 1.25W)$ (a)	$LC3 = 1.0D + 1.0L + 1.0CN_W + 1.0W_W$ $LC4 = 1.0D + 1.0L + 1.0CN_E + 1.0W_E$ $LC9 = 0.72D + 1.0CN_W + 1.0W_W$ $LC10 = 0.72D + 1.0CN_E + 1.0W_E$ (Load H is not applicable to this structure.)	Load combinations LC3, LC4, LC9 and LC10 consider the above normal load combinations LC1 and LC2 with wind added. Load combinations LC3 and LC4 were formulated to capture maximum wind load downward effects, and load combination LC9 and LC10 were formulated to capture maximum wind load upward effects. Note (a) under the load combinations in the FSAR Section 5.9.1.1.2 reads: "0.9D was used whenever the addition of the dead load stress reduced the critical stress." Since 0.9/1.25 = 0.72 where 1.25 is the dead load factor in Equation 3 in the FSAR Section 5.9.1.1.2, this 0.72 factor is used to reduce dead load in load combination LC9 and LC10 to capture maximum uplift due to wind. ➢ Load combinations checked against 1.2 times AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, 1963 edition, normal allowable stresses.
SSE	4. $Y = 1/\phi(1.0D + 1.0R + 1.0E')$ 5. $Y = 1/\phi(1.0D + 1.0H + 1.0E')$	$LC7 = 1.0D + 0.5L + 1.0CS + E'$ $LC8 = 1.0D + 0.5L + 1.0CS - E'$ $LC13 = 0.9D + 1.0CS + E'$ $LC14 = 0.9D + 1.0CS - E'$ (Loads R and H are not applicable to this structure.)	Load combinations LC7 and LC8 capture maximum downward loads. The 0.5 factor on live load considers the unlikely event of full live load being present, and is considered a conservative factor. (See discussion for OBE above) Load combinations LC13 and LC14 capture the maximum upward loads with the dead load factor based upon Note (a) under the load combination in FSAR Section 5.9.1.1.2. The +E' and -E' captures the reversible SSE load. ➢ Load combination checked against 1.5 times AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, 1963 edition, normal allowable stresses.

(a) 0.9D was used whenever the addition of dead load reduced the critical stress.