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SUBJECT: Discusses plant-specific use of Topical Rept CEN-372-P re fuel rod max allowable gas pressure.

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July 11, 1990

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00083

Gentlemen:

Subject: Docket Nos. 50-361 and 50-362
Plant-Specific Use of Topical Report CEN-372-P, "Fuel Rod Maximum Allowable Gas Pressure"
San Onofre Nuclear Generating Station
Units 2 and 3

Southern California Edison (SCE) requests approval of Topical Report CEN-372-P, "Fuel Rod Maximum Allowable Gas Pressure," (Reference 1) for plant-specific use. The NRC generically approved the topical report and issued a Safety Evaluation Report (SER) on April 10, 1990 (Reference 2). However, the SER requires that a licensee referencing CEN-372-P for plant-specific use provide:

- "... plant-specific LOCA [loss-of-coolant accident] analyses [to] determine the impact of maximum calculated rod pressures on cladding rupture timing and peak cladding temperatures, ..." and

- "... analyses for DNB [departure from nucleate boiling] propagation in postulated accidents if the bounding 14x14 [fuel design] steam line break is not applicable for calculating maximum cladding rupture strain and percent flow blockage for the licensee's application,..."

This letter provides the information required in the SER for use of the Topical Report on a plant-specific basis for San Onofre Units 2 and 3.

The Cycle 5 reload analysis, and possibly all future reload analyses for the San Onofre Nuclear Generating Station (SONGS) Units 2 and 3, references Topical Report CEN-372-P, and uses the fission gas "critical pressure" criteria. Previous reloads used the Standard Review Plan's (SRP's) criteria of "fuel rod fission gas pressure less than reactor coolant system (RCS) pressure." The SRP permits this change in criteria as long as justification is provided. Topical Report CEN-372-P provided the generic justification to the NRC for use of the "critical pressure" criteria for Combustion Engineering plants.

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DNB Propagation Analysis

The DNB propagation analysis cited in the SER for the 16x16 fuel assembly design is the plant-specific analysis for the SONGS 2 and 3 fuel. The SONGS specific evaluation was performed as part of the supporting analysis for the topical. The SER concludes that DNB propagation will not occur, and that the 14x14 steam line break, cladding strains and percent flow blockage, bound the SONGS 16x16 steam line break. This evaluation meets the SER requested plant-specific DNB propagation information.

LOCA Analysis

An emergency core cooling system (ECCS) performance analysis was performed for the Cycle 5 reload to demonstrate compliance with 10 CFR 50.46. This analysis also satisfies the SER requested plant-specific LOCA information.

The ECCS performance analysis consisted of an evaluation of the differences between Cycle 5 and the first extended burnup fuel cycle (Reference Cycle) for Unit 2 (Cycle 3). The significant core and system parameters for Cycle 5, the Reference Cycle, and the FSAR Cycle 1 are summarized in Table 1. The ECCS analysis input parameters are essentially the same for the three cycles. The differences that were evaluated include:

- the differences in fuel related parameters, including the revised maximum fission gas pressure methodology based on CEN-372-P,
- the introduction of a debris-resistant fuel design,
- a reduction in the system flow rate, and
- an increase in the CEA drop time.

The presence of debris-resistant fuel and the slight reduction in the flow rate were evaluated and do not have a significant impact on the analysis. The large break evaluation model (Reference 3) does not credit control element assemblies insertion. Instead, voiding shuts down the reactor. Thus, the blowdown and refill/reflood hydraulics calculations performed with the CEFLASH-4A and COMPERC-II codes (References 4 and 5) for the Reference Cycle are applicable to Cycle 5. The small break LOCA was determined to be non-limiting, and the long term cooling analysis of the Reference Cycle has been verified applicable to Cycle 5.

The hot rod clad temperature and clad oxidation calculations were performed with the STRIKIN-II and PARCH codes (References 6 and 7). The fuel performance calculations were performed using the FATES3B fuel evaluation model (References 8 through 10) together with the revised maximum fission gas pressure methodology described in Topical Report CEN-372-P.

The burnup dependent hot rod calculations were performed with STRIKIN-II to determine the initial fuel conditions that result in the highest Peak Clad Temperature (PCT) for the Double-Ended Guillotine at Pump Discharge

(1.0 DEG/PD) break. The study demonstrated that the burnup with the highest fuel stored energy results in the highest PCT. This occurred at a hot rod burnup of 1,000 MWD/MTU.

The ECCS performance analysis results are summarized in Table 2. For comparison, the results of the Reference Cycle and the FSAR Cycle 1 analyses are also presented. The Cycle 5 results slightly exceed the Reference Cycle, but are below the reported FSAR Cycle 1 values. The Cycle 5 results are slightly higher than the Reference Cycle due to an adverse hot assembly power distribution. The PCT, maximum local, and core-wide oxidation values, as summarized in Table 2, are below the 10 CFR 50.46 limits.

A review of the effects of initial operating conditions on these results was also performed. Over the ranges of initial operating conditions specified in the Technical Specifications, operation with a peak linear heat generation rate of 13.9 Kw/ft is acceptable for Cycle 5. The analysis has determined that the SONGS Units 2 and 3 Cycle 5 reloads meet the critical fission gas pressure criteria of CEN-372-P.

Summary

The SONGS Units 2 and 3 analyses provided herein fulfill the SER requirements for referencing Topical Report CEN-372-P. DNB propagation will not occur as a result of fuel rod fission gas pressure for the SONGS 16x16 fuel design. The LOCA analyses results remain valid at higher fission gas pressures and the results remain below the limits of 10 CFR 50.46. Therefore, SCE requests NRC approval to use Topical Report CEN-372-P for San Onofre Units 2 and 3. NRC approval is needed before SONGS Unit 2 Cycle 5 operation reaches 420 Effective Full Power Days (EFPD) on or about January 23, 1991. This date is significant because up until 420 EFPD, the SRP fission gas pressure criteria is met. Beyond 420 EFPD, the maximum fuel rod pressure will exceed the RCS pressure. However, Cycle 5 operation is acceptable beyond 420 EFPD because fuel rod fission gas pressures will remain below the critical pressure criteria of CEN-372-P.

If you have any questions, please feel free to contact me.

Very truly yours,

RM Rosenblum

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

Table 1

SONGS Units 2 and 3 Cycle 5 Core and System Parameters

Parameters (units)	Reference Cycle Unit 2 Cycle 3	Cycle 5	Cycle 1
Average Linear Heat Rate @ 102% of Nominal (kW/ft)	5.76	5.76	5.60
Peak Linear Heat Generation Rate (kW/ft)	13.9	13.9	13.9
Core Inlet Temperature (°F)	553	553	557.5
Core Outlet Temperature (°F)	613.5	616.4	618.6
System Flow Rate (10^6 lbm/hr)	148.0	140.6	148.0
Core Flow Rate (10^6 lbm/hr)	143.8	136.4	142.8
Gap Conductance(1) (BTU/hr-ft2-°F)	1639	1639	1639
Fuel Centerline Temperature(1) (°F)	3429	3378	3447
Fuel Average Temperature(1) (°F)	2156	2133	2188
Hot Rod Gas Pressure(1) (psia)	1141	1138	1177
Hot Rod Burnup (MWD/MTU)	1000	1000	674
Number of Steam Generator Tubes Plugged per Steam Generator	1000	1000	None
Minimum Initial Containment Pressure (psia)	13.7	13.7	14.4

(1) Initial value at the limiting hot rod burnup as calculated by STRIKIN-II at 13.9 kW/ft.

Table 2

SONGS Units 2 and 3 Cycle 5

ECCS Performance Analysis Results

Limiting Break Size (1.0 DEG/PD)

	Reference Cycle Unit 2 Cycle 3	Cycle 5	Cycle 1	10 CFR 50.46 Limits
Peak Linear Heat Generation Rate (kW/ft)	13.9	13.9	13.9	---
Peak Clad Temperature (°F)	2116	2129	2183	2200
Time of Peak Clad Temperature (Seconds)	264	267	268	---
Time of Clad Rupture (Seconds)	68.80	69.35	62.4	---
Peak Local Clad Oxidation (%)	10.1	9.22	16.4	17.0
Total Core-Wide Clad Oxidation (%)	< 0.68	< 0.68	< 0.68	1.0

REFERENCES

(1) CEN-372-P, "Fuel Rod Maximum Allowable Gas Pressure," Combustion Engineering, Inc., June 1988, Proprietary.

(2) Ashok C. Thadani, NRC, to A. E. Scherer, ABB-CE, April 10, 1990, Acceptance for Referencing C-E Topical CEN-372-P, "Fuel Rod Maximum Allowable Gas Pressure."

(3) CENPD-132, "Calculative Methods for the C-E large Break LOCA Evaluation Model," August 1974, Proprietary; Supplement 1, December 1974 Proprietary; and Supplement 2, July 1975, Proprietary.

(4) CENPD-133, "CEFLASH-4A, A FORTRAN IV Digital Computer Program for Reactor Blowdown Analysis," April 1974, Proprietary; and Supplement 2 (Modification), December 1974, Proprietary.

(5) CENPD-134, "COMPERC-II, A Program for Emergency Refill-Reflood of the Core," April 1974, Proprietary; and Supplement 1 (Modification), December 1974, Proprietary.

(6) CENPD-135, "STRIKIN-II, A Cylindrical Geometry Fuel Rod Heat Transfer Program," April 1974, Proprietary; Supplement 2 (Modification), February 1975, Proprietary; and Supplement 4, August 1976, Proprietary.

(7) CENPD-138 and Supplement 1 (P), "PARCH - A FORTRAN IV Digital Program to Evaluate Pool Boiling, Axial Rod and Coolant Heatup," February 1975, Proprietary; and Supplement 2 (P), January 1977, Proprietary.

(8) CENPD-139-P-A, "C-E Fuel Evaluation Model Topical Report," July 1974.

(9) CEN-161(B)-P, "Improvements to the Fuel Evaluation Model," April 1986; and Supplement 1-P, April 1986.

(10) S. A. McNeil, NRC, to J. A. Tierman, BG&E, "Safety Evaluation of Topical Report CEN-161(B)-P, Supplement 1-P, Improvement to Fuel Evaluation Model," February 4, 1987.