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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 1, 2012

Mr. Peter T. Dietrich
Senior Vice President and Chief Nuclear Officer
Southern California Edison Company
San Onofre Nuclear Generating Station
P.O. Box 128
San Clemente, CA 92674-0128

SUBJECT: SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3 - LICENSE AMENDMENT REQUEST RE: USE OF AREVA FUEL (TAC NOS. ME6820, ME6821, ME6822, AND ME6823)

Dear Mr. Dietrich:

By application dated July 29, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11215A090), Southern California Edison (SCE, the licensee), submitted a request for an exemption from the requirements of paragraph 50.46 of Title 10 of the *Code of Federal Regulations* (10 CFR), "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," and 10 CFR 50, Appendix K, "ECCS [Emergency Core Cooling System] Evaluation Models," and a license amendment request for unrestricted use of AREVA fuel at San Onofre Nuclear Generating Station, Units 2 and 3.

The U.S. Nuclear Regulatory Commission (NRC) staff has determined that additional information is needed for the NRC staff to complete its review of the exemption request and amendment. The enclosed request for additional information (RAI) was discussed with Ms. Linda Conklin of your staff and, by e-mail dated July 24, 2012, it was agreed that a response to all the RAIs, except RAI 11, would be provided within 30 days from the receipt of this letter. Your staff also noted that the response for RAI 11 would require coordination between the vendors and that the NRC staff would be advised after discussions with the vendors.

The NRC has determined that the enclosed RAI contains proprietary information pursuant to 10 CFR Section 2.390, "Public inspections, exemptions, requests for withholding." The proprietary version of the RAI is provided in Enclosure 1 with proprietary information identified by text within double brackets. A non-proprietary version of the RAI is provided in Enclosure 2, with redacted information identified by blank space within double brackets.

NOTICE: Enclosure 1 to this letter contains Proprietary Information: Upon separation from Enclosure 1, this letter is DECONTROLLED.

If circumstances result in the need to revise the requested response date, please contact me at (301) 415-1480 or via e-mail at kaly.kalyanam@nrc.gov.

Sincerely,

N. Kalyanam, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-361 and 50-362

Enclosures:
1. Request for Additional Information (proprietary)
2. Request for Additional Information (non-proprietary)

cc w/Encl 2: Distribution via Listserv

ENCLOSURE 2

REQUEST FOR ADDITIONAL INFORMATION

LICENSE AMENDMENT REQUEST FOR PERMANENT USE OF AREVA FUEL

AND FOR PERMANENT EXEMPTION TO USE M5 CLADDING

(NON-PROPRIETARY)

Proprietary information pursuant to Section 2.390 of Title 10 of
the *Code of Federal Regulations* has been redacted from this document.

Redacted information is identified by blank space enclosed within double brackets.

REQUEST FOR ADDITIONAL INFORMATION

LICENSE AMENDMENT REQUEST FOR PERMANENT USE OF AREVA FUEL

AND FOR PERMANENT EXEMPTION TO USE M5 CLADDING

SOUTHERN CALIFORNIA EDISON

SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3

DOCKET NOS. 50-361 AND 50-362

By application dated July 29, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11215A090), Southern California Edison (SCE, the licensee), submitted a request for an exemption from the requirements of paragraph 50.46 of Title 10 of the *Code of Federal Regulations* (10 CFR), "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," and 10 CFR Part 50, Appendix K, "ECCS [Emergency Core Cooling System] Evaluation Models," and a license amendment request for unrestricted use of AREVA fuel at San Onofre Nuclear Generating Station (SONGS), Units 2 and 3 (SONGS). The license amendment request (LAR) and proposed exemption would allow SCE to use AREVA 16x16 High Thermal Performance (HTP) fuel in SONGS, Units 2 and 3, on a permanent basis.

The scope of this application consists of:

- A request for a permanent exemption for SONGS, Units 2 and 3, from the requirements of 10 CFR 50.46(a)(l)(i) and 10 CFR Part 50, Appendix K that will allow SONGS to use AREVA fuel with M5 cladding (a temporary exemption was granted to support SONGS lead fuel assembly (LFA) program by letter dated December 17, 2009, available at ADAMS Accession No. ML090860392);

- Changes to SONGS Technical Specification (TS) 5.7.1.5, "Core Operating Limits Report (COLR)," methodology reference list to support the core design with the new AREVA fuel;

- Changes to TS 4.2.1, "Fuel Assemblies," to include the description of the new fuel cladding material, M5; and

- Updates to TS 2.1.1.2, "Reactor Safety Limits," to identify a fuel centerline melt safety limit with corresponding adjustments made to account for the burnable absorber fuel rods.

The NRC staff has performed a detailed review of the license amendment application and request for exemption. The staff has determined that the following additional information is needed in order to complete its evaluation.

License Amendment Request dated July 29, 2011 (LAR), Enclosure 2 (Proprietary)

1. Page 3

   (a) SCE stated, in part, that, "The number of fuel assemblies in the initial batch will be between eight fuel assemblies and approximately a half core of fuel assemblies." Please specify the number of AREVA fuel assemblies that are to be inserted into the SONGS core during the next cycle. Also, please specify which components of the AREVA fuel assemblies will be of M5 alloy material.

   (b) The licensee stated that the "exact reload core fuel management has not been defined" at the time of the LAR submittal. Please provide the details of the core reload management for the next cycle.

2. Section 3.2.1.1

   Please provide justification for continuing the use of Combustion Engineering (CE) methodologies, CENPD-382-P-A, "Methodology for Core Design Containing Erbium Burnable Absorbers," August 1993, and CENPD-275-P-A, Revision 1, "C-E Methodology for Core Designs Containing Gadolinia-Urania Burnable Absorbers," May 1988, in support of the fuel Safety Limits (SLs) in SONGS TS 2.1.1.2 in the specification of fuel centerline temperature variation with burnup and its adjustments with burnable poison.

3. Section 4.1.3

   (a) Please explain why there may be a need to retain the center assembly from the old vendor.

   (b) Please explain why the core will [[

   ]].

4. Section 4.1.4

   (a) Please provide details of how the two commitments that AREVA made to the NRC in the Topical Report, XN-NF-85-92(P)(A), "Exxon Nuclear Uranium Dioxide/Gadolinia Irradiation Examination and Thermal Conductivity Results," November 1986, have been implemented. The commitments are: (i) [[

   ]].

   (b) Please provide details of how the [[

   ]] (i.e., the details of the nuclear design analysis for a typical cycle).

5. Section 4.2

[[

]].

6. Section 4.2.1

Please provide typical calculations where the system parameter uncertainties and state parameter uncertainties are statistically combined to obtain the minimum DNBR limit [[ ]]. Please provide a list of all parameters with uncertainties that are used in the calculation which leads to the minimum DNBR limit.

7. Section 4.2.2

In Section 4.2.2, the licensee stated, in part, that [[

]] This section makes reference to Westinghouse methodology, AREVA methodology, and SCE methodology. Table 4.2 lists the SONGS rod bow penalty for AREVA fuel. Does this mean that the AREVA fuel type is the most limiting based on the thermal-hydraulics analysis? The NRC staff requests the licensee to clearly provide the details about which fuel type is most limiting, the appropriate methodology used to calculate the rod bow penalty, and how the penalty is applied [[

]].

8. Section 4.3.2

The licensee stated, in part, that [[

]]

(a) Due to the fact that [[

]], please explain how the results will be consistent.

(b) The first paragraph of Section 4.3.2 states, "Per Reference 8.34 [of Enclosure 2 of the LAR], currently SCE uses FATES3B to provide predictions of the steady-state response of fuel rods, and to model internal conditions of the fuel rods within the core from insertion to discharge. With the appropriate modeling of mechanical design data, power levels, and power distributions, these [[

]]. This statement appears to conflict with the last paragraph on page 28 of Enclosure 2 of the LAR, which states, [[

]]. Please clarify the apparently ambiguous or conflicting statements.

9. Section 4.3.3

The licensee has used the CE/Westinghouse legacy code, FATES3B for its fuel rod behavior analyses for generating input to non-LOCA transient and setpoint analyses. Specifically, the FATES3B code has been used to model [[

]]. Please provide the details of the results [[ ]]. Also, please justify the use of [[ ]].

10. Fuel Thermal Conductivity (Section 5.1.4)

An outstanding issue related to the mechanical and material design of UO2 fuel is the thermal conductivity of irradiated UO2 fuel considering the effects of burnup. The thermal conductivity of irradiated UO2 fuel is affected by changes that take place in the fuel during irradiation: solid fission product buildup (both in solution and as precipitates), porosity, and fission gas-bubble formation.

NRC Information Notice 2009-23, "Nuclear Fuel Thermal Conductivity Degradation," dated October 8, 2009 (ADAMS Accession No. ML091550527), notified licensees of nuclear power reactors of the thermal conductivity degradation (TCD) of uranium fuel pellets with increasing burnup. The significance of this effect was not included in the fuel thermal-mechanical performance codes approved prior to 1999.

NRC Information Notice 2011-21, "Incomplete Medical Testing For Licensed Operators," dated September 30, 2009 (ADAMS Accession No. ML092520457), notified the licensees of the impact of irradiation on fuel thermal conductivity and its potential to cause errors (specifically, in predicted peak clad temperature) in realistic ECCS evaluation models.

The regulations in 10 CFR Part 50, Appendix K, "ECCS Evaluation Models", Section I.A.1, stipulates

> *The Initial Stored Energy in the Fuel.* The steady-state temperature distribution and stored energy in the fuel before the hypothetical accident shall be calculated for the burn-up that yields the highest calculated cladding temperature (or, optionally, the highest calculated stored energy.) To accomplish this, the thermal conductivity of the UO2 shall be evaluated as a function of burn-up and temperature, taking into consideration differences in initial density, and the thermal conductance of the gap between the UO2 and the cladding shall be evaluated as a function of the burn-up, taking into consideration fuel densification and expansion, the composition and pressure of the gases within the fuel rod, the initial cold gap dimension with its tolerances, and cladding creep.

The CE/Westinghouse FATES3B code has been used for the evaluation of fuel thermal-mechanical performance at SONGS, Units 2 and 3. [[

]]

Thermal conductivity of UO2 fuel degrades with burnup, and as such, the NRC staff believes that each fuel vendor must have an explicit model to generate burnup dependent fuel thermal conductivity in their analyses to simulate transients and accidents.

(a) Please explain how the licensee applied the TCD with burnup in the FATES3B code for the fuel performance evaluation, addressing factors such as fission gas release, power-to-melt evaluation, and clad strain and fatigue. Please provide details of the fuel temperature calculations that are dependent on the effects of burnup as described above.

(b) Please explain how the impact of TCD with burnup has been addressed in the analyses of non-LOCA transients and postulated accidents, specifically but not limited to, the spectrum of control rod ejection accident analyses.

Fuel Design

11. The NRC staff intends to run FRAPCON-3.4* benchmark calculations of the resident CE 16x16 fuel rod design and the new AREVA HTP fuel rod design. Please provide the following input for both co-resident fuels at SONGS, Units 2 and 3.

    (a) Rod Power History, kilowatts per foot (KW/ft) as a function of GWd/MTU

        1. Bounding thermal-mechanical operating envelope (e.g., radial falloff curve)
        2. Discuss any application of rod power uncertainties
        3. Include power histories for different pellet designs (UO2, Gadolinium).

    (b) Axial Power Distribution (Fz at each axial node)

        1. Include axial power distributions (AXPDs) for different axial blanket configurations.

    (c) Fuel Rod Design Specifications and Manufacturing Tolerances

        1. Outer diameter
        2. Inside diameter
        3. Pellet diameter
        4. Stack length
        5. Plenum length
        6. Pellet height
        7. Dish radius
        8. Dish depth
        9. Spring outside diameter
        10. Spring wire diameter
        11. Number of spring turns
        12. Maximum U-235 enrichment (%)
        13. Average U-235 enrichment (%)
        14. Maximum gadolinia content (%)
        15. Water in pellet (ppm)
        16. Nitrogen in pellet (ppm)
        17. Pellet density (%TD)
        18. Open porosity (%)
        19. Pellet surface roughness (microns)
        20. Expected density increase (gms/cc)
        21. Sintering temperature (°F)
        22. Cladding Alloy = (Material name)
        23. Final thermal treatment = (RXA or ?)

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* U.S. Nuclear Regulatory Commission, NUREG/CR-7022, Volume 1, "FRAPCON-3.4: A Computer Code for the Calculation of Steady-State Thermal-Mechanical Behavior of Oxide Fuel Rods for High Burnup," and Volume 2, "FRAPCON-3.4: Integral Assessment," March 2011 (ADAMS Accession Nos. ML11101A005 and ML11101A006, respectively).

24. Cladding surface roughness (microns)
25. Cladding texture factor
26. Cladding Hydrogen content (ppm)
27. Fill gas pressure
28. Fill gas composition
29. Rate of CRUD accumulation factor (mils/hr)
30. CRUD thermal conductivity

(d) Coolant conditions

1. Coolant inlet temperature (°F)
2. Coolant mass flux (lbm/hr-ft2)
3. System pressure (psia)

Radiological Assessment

12. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 15.0.1, "Radiological Consequence Analyses Using Alternative Source Terms,," (ADAMS Accession No. ML003734190), states, in part, that: "The analysis methods and assumptions used by the licensee in determining the core inventory should be reviewed to ensure that they are based on current licensing basis rated thermal power, enrichment, and burnup."

Enclosure 2 to the submittal states that AREVA fuel is approved for Combustion Engineering PWRs for a maximum peak burnup of 62,000 megawatt-day per metric ton unit (MWD/MTU) (Section 4.4.2). The current fuel is designed to ensure the fuel does not exceed 60,000 MWD/MTU (Section 4.4.1).

A modification to the licensing basis fuel type can have the potential to change the core isotopic distribution and inventory assumed in post-accident conditions. The impacts regarding the core inventory due to changes other than the cladding (i.e. burnup) are not discussed in the proposed amendment. Please provide a justification to support that changes in the fuel design parameters do not significantly change the core isotopic distribution and magnitude (source term) for the design basis accidents analyzed.

13. Enclosure 2, Section 7.4.2.3, Table 7.4.9, and Attachment C (Table C.1) of the submittal provide text and tables describing events analyzed in the Updated Final Safety Analysis Report (UFSAR), the acceptance criteria for these events, and the impact of the use of AREVA fuel on these analyzed events. The NRC staff has the following questions concerning this information.

(a) The NRC staff compared this information to the current UFSAR discussion and noted several differences. For example, some of the events described in the submittal have different acceptance criteria from those stated in UFSAR Table 15.0-8 (i.e., 10 CFR Part 100 limits versus 10 CFR 50.67 limits). Please explain and justify why the acceptance criteria for certain events described in the submittal differ from those in the UFSAR.

(b) For some events, Attachment C states that the event is bounded by another event. The UFSAR is not consistent with some of these statements in Attachment C. For example, Attachment C states that the UFSAR Section 15.1.2.1 event is bounded by the Section 15.1.2.3 doses. UFSAR Section 15.1.2.1.5 states that the doses for this event are bounded not by Section 15.1.2.1, but by Section 15.1.2.4 events. Please explain why Attachment C is inconsistent with the descriptions of the bounding events provided in the UFSAR and state which is correct.

(c) In the column labeled "Impact of AREVA Fuel" of Attachment C to Enclosure 2 (for UFSAR Sections 15.7.3.4, and 15.7.3.9) it states: "As all pins in both the dropped and impacted assemblies are assumed to fail, there is no difference with use of AREVA fuel." A review of these UFSAR sections shows that the UFSAR analysis assumes 226 fuel pins fail which is less than all the fuel pins in 2 assemblies (472 fuel pins). Please resolve this inconsistency.

(d) Many of the evaluations of the impact of the AREVA fuel only address the impact of the change on fuel failure (source term). Per Appendices E-H of NRC Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Plants," dated July 2000 (ADAMS Accession No. ML003716792), the dose consequences of several accidents are dependent on both the source term and how the radioactivity is transported to the environment. A change in fuel has the potential for changing the release rate and the total amount of steam needed to cool down the plant after an accident. For accident analyses this steam is assumed to transport radioactivity to the environment. For those analyses that consider more than the source term (i.e. the main steam line break, steam generator tube rupture, locked rotor and rod ejection accidents) please address any impact of the AREVA fuel on the transport of radioactivity to the environment.

If circumstances result in the need to revise the requested response date, please contact me at (301) 415-1480 or via e-mail at kaly.kalyanam@nrc.gov.

Sincerely,

/RA/

N. Kalyanam, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-361 and 50-362

Enclosures:
1. Request for Additional Information (proprietary)
2. Request for Additional Information (non-proprietary)

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ADAMS Accession Nos.: Proprietary RAI ML12207A257; Redacted RAI ML12207A261
***RAI Memo dated**

OFFICE	NRR/DORL/LPL4/PM	NRR/DORL/LPL4/LA	NRR/DRA/AADB/BC
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DATE	7/27/12	7/27/12	5/3/12
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