10 CFR 50.12

A subsidiary of Pinnacle West Capital Corporation

Palo Verde Nuclear Generating Station

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102-05826-DCM/SAB/RKR
March 08, 2008

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Unit 1
Docket No. STN 50-528
Request for Temporary Exemption from the Provisions of 10 CFR 50.46 and 10 CFR 50, Appendix K for Lead Fuel Assemblies

Pursuant to 10 CFR 50.12, "Specific Exemptions," Arizona Public Service Company (APS) is requesting a temporary exemption from the requirements of 10 CFR 50.46 "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," and 10 CFR 50, Appendix K, "ECCS Evaluation Models," in order to use lead fuel assemblies (LFAs) in PVNGS Unit 1, Cycles 15, 16, and 17. The temporary exemption will allow up to eight LFAs manufactured by AREVA NP with fuel rods clad with M5 to be inserted into the PVNGS Unit 1 core during the next refueling outage (U1R14) in Fall 2008.

The use of M5 LFAs allows APS to evaluate cladding for future fuel assemblies that may need to be of a more robust design than current fuel assemblies to allow for possible higher duty or extended burnup. The regulations specify standards and acceptance criteria only for fuel rods clad with Zircaloy or ZIRLO. Thus a temporary exemption is required to use fuel rods clad with an advanced alloy that is not Zircaloy or ZIRLO. A detailed description of this exemption request and justification for the exemption are provided in Enclosure 1 to this letter.

APS requests approval of the temporary exemption by October 31, 2008. This temporary exemption request is similar to the temporary exemption approved by the NRC for Calvert Cliffs (Accession Number ML030640137), and to the amendment and related exemption for Three Mile Island Unit 1 (ML011300351).

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This letter contains commitments described in Enclosure 2. If you have any questions about this request, please contact Glenn A. Michael at (623) 393-5750.

Sincerely,

Scott Bauer for DCM

DCM/GAM/RKR/gt

Enclosures: 1. Request for Temporary Exemption from the Provisions of 10 CFR 50.46 and 10 CFR 50, Appendix K for Lead Fuel Assemblies
2. Commitments

cc:

E. E. Collins Jr.	NRC Region IV Regional Administrator
M. T. Markley	NRC NRR Project Manager
G. G. Warnick	NRC Senior Resident Inspector for PVNGS

ENCLOSURE 1

Request for Temporary Exemption from the Provisions of 10 CFR 50.46 and 10 CFR 50, Appendix K for Lead Fuel Assemblies

Introduction

The Palo Verde Unit 1 core consists of 241 Westinghouse (Combustion Engineering (CE)) System 80 fuel assemblies. Each fuel assembly consists of 236 fuel rods, 4 outer guide tubes, 1 center/instrument guide tube, an upper Inconel fuel rod spacer grid, 10 Zircaloy fuel rod spacer grids, and upper and lower end fittings. The rods are arranged in a square 16 x 16 array. The guide tubes, spacer grids, and end fittings form the structural frame of the fuel assembly. The four outer guide tubes are mechanically attached to the end fittings and the Zircaloy fuel rod spacer grids are welded to the guide tubes. The upper Inconel fuel rod spacer grid is mechanically attached to the guide tubes due to material differences.

In the Westinghouse (CE) System 80 fuel assembly, the fuel rods consist of slightly enriched uranium dioxide cylindrical ceramic pellets with a round wire stainless steel compression spring located at the top of the fuel column, encapsulated within a seamless ZIRLO tube with a Zircaloy end cap welded at each end. The uranium dioxide pellets are dished and chamfered on both ends to accommodate thermal expansion and swelling.

Part 50.46(a)(1)(i) of Title 10 of the Code of Federal Regulations [10 CFR 50.46(a)(1)(i)] states, "Each boiling or pressurized light-water nuclear power reactor fueled with uranium oxide pellets within cylindrical Zircaloy or ZIRLO cladding must be provided with an emergency core cooling system (ECCS) that must be designed so that its calculated cooling performance following postulated loss-of-coolant accidents conforms to the criteria set forth in paragraph (b) of this section. ECCS cooling performance must be calculated in accordance with an acceptable evaluation model and must be calculated for a number of postulated loss-of-coolant accidents of different sizes, locations, and other properties sufficient to provide assurance that the most severe postulated loss-of-coolant accidents are calculated." 10 CFR 50.46 continues on to delineate specifications for peak cladding temperature, maximum hydrogen generation, coolable geometry, and long-term cooling. Since 10 CFR 50.46 specifically refers to fuel with Zircaloy or ZIRLO cladding, the use of fuel clad with zirconium-based alloys that do not conform to either of these two designations requires an exemption from this section of the regulations.

10 CFR 50, Appendix K, paragraph I.A.5, states that "The rate of energy release, hydrogen generation, and cladding oxidation from the metal/water reaction shall be calculated using the Baker-Just equation." The Baker-Just equation presumes the use of Zircaloy or ZIRLO cladding. The use of fuel with zirconium-based alloys that do not conform to either of these two designations requires an exemption from this section of the regulations.

Pursuant to 10 CFR 50.12, "Specific Exemptions," Arizona Public Service Company (APS) is requesting a temporary exemption from the requirements of 10 CFR 50.46 "Acceptance criteria for emergency core cooling systems for light-water nuclear power

reactors" and 10 CFR 50, Appendix K "ECCS Evaluation Models" for Palo Verde Unit 1, Cycles 15, 16, and 17.

The temporary exemption will allow up to eight lead fuel assemblies (LFAs) manufactured by AREVA NP with fuel rods clad with M5 to be inserted into the Palo Verde Unit 1 core in non-limiting locations during the next refueling outage (U1R14) in Fall 2008. The use of M5 LFAs allows PVNGS to evaluate cladding for future fuel assemblies that need to be of a more robust design than current fuel assemblies to allow for possible higher duty or extended burnup. The regulations specify standards and acceptance criteria only for fuel rods clad with Zircaloy or ZIRLO. Thus a temporary exemption is required to use fuel rods clad with an advanced alloy that is not Zircaloy or ZIRLO.

Currently, eight US plants have used M5 clad fuel assemblies either in full batch or LFA programs including Arkansas Nuclear One, Crystal River, Davis Besse, North Anna 1 and 2, Sequoyah 1 and 2 and Ft. Calhoun. The introduction of M5 clad fuel into eight additional U.S. plants is pending. M5 clad fuel assemblies have been used extensively in European plants.

10 CFR 50.12, Specific Exemption

The standards set forth in 10 CFR 50.12 provide that the Commission may grant exemptions from the requirements of the regulations of this part for reasons consistent with the following:

- The exemption is authorized by law;
- The exemption will not present an undue risk to the public health and safety;
- The exemption is consistent with the common defense and security; and
- Special circumstances are present.

This exemption is authorized by law. The remaining standards for the exemption are also satisfied, as described below.

The exemption will not present an undue risk to public health and safety. The NRC-approved M5 topical report (Reference 1) demonstrates that the predicted chemical, mechanical, and material performance characteristics of the M5 cladding are within those approved for Zircaloy under anticipated operational occurrences and postulated accidents. The eight LFAs will be placed in non-limiting locations as required by Technical Specification (TS) 4.2.1 "Fuel Assemblies." In the unlikely event that cladding failures occur in the LFAs, the environmental impact would be minimal and is bounded by previous accident analyses. Therefore, the use of the advanced zirconium-based cladding material, M5, will not present an undue risk to the public health and safety.

The exemption is consistent with the common defense and security. The use of M5 LFAs allows PVNGS to evaluate cladding for future fuel assemblies that need to be of a more robust design than current fuel assemblies to allow for possible higher duty or extended burnup.

This request for an exemption involves special circumstances as set forth in 10 CFR 50.12(a)(2)(ii), which states that special circumstances are present whenever "Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule."

10 CFR 50.46 identifies acceptance criteria for ECCS system performance at nuclear power facilities. The effectiveness of the ECCS in Palo Verde Unit 1 will not be affected by the insertion of eight LFAs. Due to the similarities in the material properties of the M5 alloy to Zircaloy or ZIRLO as identified in the AREVA M5 topical report and the location of the LFAs in non-limiting locations, it can be concluded that the ECCS performance would not be adversely affected.

The intent of paragraph I.A.5 of Appendix K to 10 CFR 50 is to apply an equation for rates of energy release, hydrogen generation, and cladding oxidation from metal-water reaction that conservatively bounds all post-LOCA scenarios. The supporting documentation for the AREVA M5 topical shows that due to the similarities in the composition of the M5 cladding and Zircaloy or ZIRLO, the application of the Baker-Just equation will continue to conservatively bound all post-LOCA scenarios.

A strict interpretation of 10 CFR 50.46 and 10 CFR 50, Appendix K, would not allow the use of the M5 cladding on fuel rods in lead fuel assemblies since the cladding material does not fall within the strict definition of Zircaloy or ZIRLO even though the AREVA M5 topical shows that the intent of the regulations are met. Application of these regulations in this particular circumstance would not serve the underlying purpose of the rule and is not necessary to achieve the underlying purpose of the rule, so special circumstances exist.

Lead Fuel Assembly (LFA) Program Summary

APS is requesting this exemption in order to utilize eight LFAs manufactured by AREVA NP in the Palo Verde Unit 1 reactor during Cycles 15, 16 and 17. The AREVA NP mechanical design for the Palo Verde Unit 1 LFAs is similar to the standard AREVA NP designed CE 14 x 14 fuel pin lattice reload fuel with the primary differences being the 16 x 16 fuel pin lattice and the M5 cladding. The mechanical design evaluations for the LFAs will be performed with the standard reload mechanical design methods using the M5 cladding properties. The NRC has reviewed and approved (Reference 2) the M5 properties in topical report BAW-10227P-A (Reference 1).

The LFAs are currently scheduled for three cycles of irradiation in Palo Verde Unit 1 (Cycles 15, 16, and 17). The burnup achieved after three cycles of irradiation will be less than the current NRC approved (Reference 3) Palo Verde burnup limit of 60 MWd/kgU which is also less than the approved AREVA NP methodology peak rod limit of 62 MWd/kgU as described in report ANF-88-133(P)(A) (Reference 4). Poolside examinations will be performed following each cycle of irradiation to evaluate ongoing assembly and cladding performance (Commitments 1, 2, and 3).

The fuel management will place the LFAs in non-limiting power locations. Since these assemblies will not be in the highest core power density locations, the placement scheme will assure that the behavior of the LFAs is bounded by the safety analyses performed for the standard fuel rods.

Between APS, AREVA, and Westinghouse, evaluations will verify performance of the LFAs with respect to the safety analysis. The analyses will include thermal-hydraulic compatibility, loss-of-coolant accident (LOCA) and non-LOCA criteria, mechanical design, seismic and core physics. The evaluations will make use of the fact that the LFAs will be operated in non-limiting locations and will verify the reload analyses are not adversely impacted. In addition, an evaluation will be performed to verify the insertion of the AREVA LFAs does not adversely impact the fuel performance and mechanical integrity of the co-resident fuel.

LFA Mechanical Design Description

The LFAs for the Palo Verde Unit 1 reactor will be the AREVA NP 16 x 16 CE design. The bundle uses ten M5 grid spacers of the high thermal performance (HTP) design and one Alloy 718 grid spacer of the high mechanical performance (HMP) design. The lower tie plate is the FUELGUARD design, and the upper tie plate is a reconstitutable AREVA NP design for Westinghouse fuel. The HTP spacer was generically reviewed and accepted by the NRC and has been used for reload designs for CE, Westinghouse, and Kraftwork Union reactors since 1991. The FUELGUARD lower tie plate has also been used in reload designs for CE, Westinghouse, and General Electric designs. The reconstitutable upper tie plate design has been in use for reloads for Plants with CE 14 x 14 fuel pin lattices since the early 1980's.

Each fuel bundle contains four corner guide tubes, 1 center guide tube/instrument tube, and 236 fuel rods. The corner guide tubes in the LFAs have the same nominal inside diameters (expanded region, central region, and dashpot region) and the fuel pins have the same pellet stack height and overall dimension as the co-resident Westinghouse fuel.

The primary differences between the resident Westinghouse fuel design currently used in Palo Verde Unit 1 and the AREVA fuel design include (1) the use of the different zirconium-based alloys for fuel rod cladding, fuel assembly structural tubing, and spacer grids; (2) the use of mixing (HTP) grids; and (3) the use of a different burnable absorber (gadolinia).

LFAs Non-Limiting

PVNGS TS 4.2.1 "Fuel Assemblies," states that "The reactor shall contain 241 fuel assemblies. Each assembly shall consist of a matrix of Zircaloy or ZIRLO fuel rods with an initial composition of natural or slightly enriched uranium dioxide (UO2) as fuel material," and "Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions. Other cladding material may be used with an approved exemption."

APS is planning to place up to eight LFAs in non-limiting power locations. The core design will limit the LFA predicted peak pin power to less than or equal to 0.95 of the predicted cycle maximum peak pin power in the core. The LFAs will, therefore, not contain the lead rod in the core and will have margin relative to the cycle maximum peaking and additional margin relative to the bounding peaking factors used in the safety analyses. Since the LFAs will not be in the highest core power density locations, the placement scheme assures that the behavior of the LFAs is bounded by the safety analyses performed for the co-resident fuel rods. Also, for the initial cycle of operation, the LFAs will be placed in nominal core inlet flow locations as opposed to low flow locations. The maximum LFA integrated fuel rod burnup will be maintained less than or equal to 60 MWd/kgU, the Palo Verde limit in Updated Final Safety Analysis Report (UFSAR) section 4.2.1.2.1 "Fuel Cladding Design Limits."

The AREVA LFAs will be modeled in the Palo Verde core physics models, including the gadolinia burnable absorber. As such, the impact of the LFAs will be included in the Palo Verde cycle-specific core physics calculations supporting the reload effort (Commitment 4).

AREVA LFA Analyses

AREVA will evaluate the performance of the AREVA LFAs with respect to the safety analysis. The analyses will include thermal-hydraulic compatibility, loss-of-coolant accident (LOCA) and non-LOCA criteria, mechanical design, thermal hydraulic, seismic, core physics, and neutronic compatibility of the AREVA LFAs in the Palo Verde Unit 1 core. The evaluations will make use of the fact that the LFAs will be operated in non-limiting locations and will verify the reload analyses are not adversely impacted. The results will be documented in a final design report (Commitment 5).

The thermal hydraulic compatibility analyses for the LFAs include evaluations of Departure from Nucleate Boiling (DNB) Performance, Guide Tube Heating, Core Bypass Flow, Fuel Centerline Melt, Rod Bow, and Loss of Coolant Accident (LOCA). The neutronic compatibility evaluation will compare design characteristics of the LFAs to ensure compatibility with the co-resident fuel. The mechanical compatibility evaluations for the LFAs include both the fuel rod thermal-mechanical calculations and the fuel structural calculations. Results are provided for normal operation and anticipated

transient conditions. The mechanical design analyses will show LFA compatibility with the Palo Verde reactor interfaces and co-resident fuel. These analyses will include tasks such as physical design, normal and faulted operations, growth calculations, pressure drop and flow testing, among others. In addition, AREVA will analyze the seismic performance of the LFAs by evaluating the seismic/LOCA time history supplied by Westinghouse with respect to the strength of the AREVA spacer.

Co-Resident Fuel Compatibility Analyses

Westinghouse will perform a compatibility study to ensure that insertion of the AREVA LFAs will not cause the remaining Westinghouse fuel to exceed its operating limits and ensure there is no adverse impact on the fuel performance or mechanical integrity. The results of the compatibility study will be documented in a final design report (Commitment 6).

In order to ensure compatibility, the study will perform detailed evaluations in several functional areas. These areas will include Structural / Seismic analyses, Emergency Core Cooling System performance, LOCA Dose Assessment, Thermal Hydraulics, and Mechanical Design. The presence of the LFAs in the Palo Verde Core will be evaluated to determine the impact, if any, on the analyses-of-record.

Post Irradiation Examination

Poolside examinations of the LFAs will be performed at the end of each cycle of operation.

Following each cycle of operation and upon discharge at end-of-life, a poolside examination to assess key performance measures will be conducted. Examinations will include, as a minimum, 4-face full inspections of the highest burn LFAs. Based on results of the inspection, additional scope may be desired. Additional scope inspections could include but are not limited to additional visuals, oxide/crud lift-off measurements, fretting and diameter measurements, shoulder gap, assembly length and guide tube wear measurements.

Precedent

This temporary exemption request is similar to the temporary exemption approved by the NRC for Calvert Cliffs (Accession Number ML030640137), and to the amendment and related exemption for Three Mile Island Unit 1 (ML011300351).

References:

1. BAW-10227P-A, Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel, Framatome Cogema Fuels, February 2000

2. NRC Revised Safety Evaluation (SE) for Topical Report BAW-10227P: "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel" (TAC NO. M99903) dated February 4, 2000

3. NRC Generic Approval Of C-E Topical Report CEN-386-P, "Verification of the Acceptability of a 1-Pin Burnup Limit of 60 MWD/kg for Combustion Engineering 16x16 PWR Fuel (TAC No. M82192)" dated June 22, 1992.

4. ANF-88-133(P)(A) and Supplement 1, Qualification of Advanced Nuclear Fuels' PWR Design Methodology for Rod Burnups of 62 GWd/MTU, Advanced Nuclear Fuels Corporation, December 1991

ENCLOSURE 2

Commitments

Commitments

1. Prior to startup for Unit 1 Cycle 16, poolside examinations will be performed following each cycle of irradiation to evaluate ongoing assembly and cladding performance. (CRAI 3139874, Due 4/30/2010)

2. Prior to startup for Unit 1 Cycle 17, poolside examinations will be performed following each cycle of irradiation to evaluate ongoing assembly and cladding performance. (CRAI 3139875, Due 10/30/2011)

3. After completion of Unit 1 Cycle 17, poolside examinations will be performed following each cycle of irradiation to evaluate ongoing assembly and cladding performance. (CRAI 3139876, Due 6/30/2013)

4. The AREVA LFAs will be modeled in the Palo Verde core physics models, including the gadolinia burnable absorber. As such, the impact of the LFAs will be included in the Palo Verde cycle-specific core physics calculations supporting the reload effort. (CRAI 3139880, Due 10/30/2008)

5. Evaluations will verify performance of the AREVA LFAs with respect to the safety analysis. The analyses will include thermal-hydraulic compatibility, loss-of-coolant accident (LOCA) and non-LOCA criteria, mechanical design, thermal hydraulic, seismic, core physics, and neutronic compatibility of the AREVA LFAs in the Palo Verde Unit 1 core. The evaluations will make use of the fact that the LFAs will be operated in non-limiting locations and will verify the reload analyses are not adversely impacted. The results will be documented in a final design report. (CRAI 3139886, Due 10/30/2008)

6. A compatibility study will be performed to ensure that insertion of the AREVA LFAs will not cause the remaining Westinghouse fuel to exceed its operating limits and ensure there is no adverse impact on the fuel performance or mechanical integrity. The results of the compatibility study will be documented in a final design report. (CRAI 3139887, Due 10/30/2008)