10 CFR 50.12

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Palo Verde Nuclear Generating Station

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

Dear Sirs:

Subject: **Subject: Palo Verde Nuclear Generating Station (PVNGS) Unit 3**
Docket No. STN 50-530
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 3, Cycles 16, 17, and 18. The temporary exemption will allow up to eight LFAs manufactured by Westinghouse with fuel rods clad with Optimized ZIRLO™ to be inserted into the PVNGS Unit 3 core during the Fall 2010 refueling outage (U3R15).

The use of Optimized ZIRLO™ 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 and/or extended burnup. The regulations specify standards and acceptance criteria only for fuel rods clad with Zircaloy or ZIRLO™. The exemption request is required since Optimized ZIRLO™ has a slightly different composition than Zircaloy or ZIRLO™. A detailed description of this temporary exemption request and justification for the exemption are provided in Enclosure 1 to this letter.

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Topical Report WCAP-12610-P-A & CENPD-404-P-A, Addendum 1-A "Optimized ZIRLO™," prepared by Westinghouse, addresses Optimized ZIRLO™ and demonstrates that Optimized ZIRLO™ has essentially the same properties as currently licensed ZIRLO™. The Topical Report has been approved by the U.S. Nuclear Regulatory Commission (NRC) in NRC Safety Evaluation dated June 10, 2005.

APS requests approval of the temporary exemption by July 1, 2010. This temporary exemption request is similar to the temporary exemption approved by the NRC for Waterford 3 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML042110407) to allow the use of Optimized ZIRLO™ fuel rod cladding in four lead test assemblies.

This letter contains commitments described in Enclosure 2. Should you need further information regarding this submittal, please contact Russell A. Stroud, Licensing Section Leader, at (623) 393-5111.

Sincerely,

TNW/RAS/RKR/gat

Enclosures 1. Request for Temporary Exemption from the Provisions of 10 CFR 50.46 and 10 CFR 50, Appendix K for Unit 3 Lead Fuel Assemblies
2. Commitments

cc: E. E. Collins Jr. NRC Region IV Regional Administrator
J. R. Hall NRC NRR Project Manager
R. I. Treadway 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 Unit 3 Lead Fuel Assemblies

Introduction

The Palo Verde Nuclear Generating Station (PVNGS) Unit 3 core consists of 241 Westinghouse (Combustion Engineering (CE)) System 80 fuel assemblies. Each fuel assembly consists of 236 fuel rods, four outer guide tubes, one center/instrument guide tube, an inconel top grid, 10 Zircaloy mid grids, and upper and lower end fittings. The rods are arranged in a square 16 x 16 array. The outer guide tubes, 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 mid grids are welded to the guide tubes. The inconel top 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.

Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," requires, among other items, that "[e]ach 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 [(LOCAs)] conforms to the criteria set forth in paragraph (b) of this section." Appendix K to 10 CFR Part 50, "ECCS Evaluation Models," requires, among other items, 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 regulations of 10 CFR 50.46 and 10 CFR Part 50, Appendix K, make no provision for use of fuel rods clad in a material other than zircaloy or ZIRLO. Since the chemical composition of the Optimized ZIRLO™ alloy differs from the specifications for zircaloy or ZIRLO, a plant-specific exemption is required to allow the use of the Optimized ZIRLO™ alloy as a cladding material at PVNGS.

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 PVNGS Unit 3, Cycles 16, 17, and 18.

The temporary exemption will allow up to eight Lead Fuel Assemblies (LFAs) manufactured by Westinghouse with fuel rods clad with Optimized ZIRLO™ to be inserted into the PVNGS Unit 3 core in non-limiting locations during the Fall 2010 refueling outage (U3R15). The use of Optimized ZIRLO™ clad LFAs will allow APS to evaluate the design for possible higher duty and/or extended burnup assemblies.

Currently, seven U.S. plants have used Optimized ZIRLO™ clad fuel assemblies either in full batch or LFA programs including Arkansas Nuclear One (ANO) 2, Waterford 3, Byron 1,

Calvert Cliffs 2, Catawba 1, Millstone 3 and V.C. Summer.

10 CFR 50.12, Specific Exemption

Pursuant to 10 CFR 50.12, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR Part 50 when (1) the exemptions are authorized by law, will not present an undue risk to public health or safety, and are consistent with the common defense and security; and (2) when special circumstances are present.

This exemption is authorized by law. This exemption results in changes to the operation of the plant by allowing the use of LFAs with Optimized ZIRLO™ as fuel rod cladding material in lieu of zircaloy or ZIRLO. As stated above, 10 CFR 50.12 allows the NRC to grant exemptions from the requirements of 10 CFR Part 50. The NRC staff has previously determined that granting of this type of proposed exemption will not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission's regulations. Therefore, as required by 10 CFR 50.12 (a)(1), this requested exemption is "authorized by law."

The exemption will not present an undue risk to public health and safety. By letter dated June 10, 2005, the NRC staff approved Westinghouse Topical Report WCAP-12610-P-A & CENPD-404-P-A, Addendum 1 "Optimized ZIRLO™" (Reference 2). The Topical Report (Reference 1) provides the details and results of material testing of Optimized ZIRLO™ compared to standard ZIRLO™ as well as the material properties to be used in various models and methodologies when analyzing Optimized ZIRLO™.

APS will complete a core design and reload evaluation that will ensure acceptance criteria are met for the insertion of assemblies with fuel rods clad with Optimized ZIRLO™. These assemblies will be evaluated using NRC approved methods and models to address the use of Optimized ZIRLO™. 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, Optimized ZIRLO™, 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 Optimized ZIRLO™ LFAs allows APS 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 and/or extended burnup. Use of the LFAs will not affect plant operations and is consistent with common defense and security.

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 PVNGS Unit 3 will not be affected by the insertion of eight LFAs. Due to the similarities in the material properties of the Zircaloy or ZIRLO alloy to Optimized ZIRLO™ as identified in the Westinghouse Optimized ZIRLO™ Topical Report and the location of the LFAs in non-limiting locations, it can be concluded that the ECCS effectiveness 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 Westinghouse Optimized ZIRLO™ topical shows that due to the similarities in the composition of the Zircaloy or ZIRLO cladding and Optimized ZIRLO™, the application of the Baker-Just equation will continue to conservatively bound all post-LOCA scenarios.

The regulations of 10 CFR 50.46 and 10 CFR Part 50, Appendix K, make no provision for use of fuel rods clad in a material other than zircaloy or ZIRLO. Since the chemical composition of the Optimized ZIRLO™ alloy differs from the specifications for zircaloy or ZIRLO, a plant-specific exemption is required to allow the use of the Optimized ZIRLO™ alloy as a cladding material at PVNGS. The expected performance of Optimized ZIRLO™ clad material meets the intent of the regulations, as discussed in the Westinghouse Optimized ZIRLO™ Topical Report. Therefore, 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 Westinghouse in the PVNGS Unit 3 reactor during Cycles 16, 17 and 18. The Westinghouse Next Generation Fuel (NGF) mechanical design for the PVNGS Unit 3 LFAs is similar to the standard Westinghouse designed CE 16 x 16 fuel pin lattice reload fuel. The mechanical design evaluations for the LFAs will be performed with the standard reload mechanical design methods using the Optimized ZIRLO™ cladding properties. The NRC has reviewed and approved (Reference 2) the Optimized ZIRLO™ properties in Topical Report WCAP-12610-P-A (Reference 1).

The LFAs are currently scheduled for three cycles of irradiation in PVNGS Unit 3 (Cycles 16, 17, and 18). The burnup achieved after three cycles of irradiation will be less than the current NRC approved (Reference 3) PVNGS burnup limit of 60 MWd/kgU which is also less than the approved Westinghouse methodology peak rod limit of 62 MWd/kgU as described in Topical Report WCAP-12610-P-A (Reference 1). Poolside examinations will be performed following each cycle of irradiation to evaluate ongoing assembly and cladding performance.

Core design and fuel management (reload analysis) will place the LFAs in non-limiting power

locations. Since these assemblies will not be in the highest core power density locations, the environment in which the LFAs will operate will be bounded by the safety analyses performed for the standard fuel rods.

Between APS and Westinghouse, evaluations will verify performance of the LFAs with respect to the safety analysis. The analyses will include thermal-hydraulic compatibility, fuel performance, 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 Westinghouse LFAs does not adversely impact the fuel performance and mechanical integrity of the co-resident fuel.

LFA Mechanical Design Description

The PVNGS NGF design is described as plant "D" in WCAP-16500-P, "CE 16x16 Next Generation Fuel Core Reference Report." The NRC has reviewed WCAP-16500-P and found the CE 16x16 NGF fuel assembly acceptable for use in region quantities (Reference 4). The PVNGS NGF design is based on the same assembly skeleton and fuel rod designs that are being irradiated as LFAs in Waterford-3 and have been delivered in region quantities for both Waterford 3 and ANO 2 in the Spring of 2008. However, for application of the NGF design in PVNGS, modifications are required to the top and bottom nozzles to ensure that the LFAs appropriately interface with the PVNGS reactor configuration. Additionally, the number of bulges in the center instrument guide tube will change to allow retention of the dimples for incore instrument support and the expanded region at the top of the outer guide tubes will be eliminated.

The assembly contains nine Optimized ZIRLO™ Advanced Mid grids with "I" spring rod supports, six of which have side supported mixing vanes at selected elevations. The assembly also includes a Westinghouse style top inconel grid, two Intermediate Flow Mixing (IFM) grids and continued use of the inconel Guardian™ grid at the bottom. The Westinghouse advanced Optimized ZIRLO™ 0.374" OD rod contains axial annular pellets and zirconium di-boride Integral Fuel Burnable Absorber (IFBA).

The PVNGS NGF uses Stress Relief Annealed (SRA) ZIRLO™ material for guide tubes and Optimized ZIRLO™ material for cladding and grid straps to improve corrosion resistance and dimensional stability.

An anti-rotation joint between guide tubes and the top nozzle prevent damage to spacer grids and grid to guide tube joints during guide post (top nozzle assembly component) removal and assembly.

The thimble screw in the lower end fitting has been redesigned to eliminate the welding of a locking disk. The thimble screw will be crimped into pockets for rotational locking of the

screw. The thimble screw features a drain hole.

The bottom nozzle has been revised to add crimp pockets for receiving the thimble screw. The pockets are created by drilling holes from the top of the nozzle into bosses that have been added at the Outer Guide Thimble locations. There are two pockets to receive two opposing crimps.

An Adapter has been threaded and tack welded to the Bottom Nozzle to guide/restrain the center Instrument Tube.

LFAs Non-Limiting Locations

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 non-limiting 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 peak 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 environment in which the LFAs will operate will be 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 PVNGS limit in Updated Final Safety Analysis Report (UFSAR) Section 4.2.1.2.1 "Fuel Cladding Design Limits."

The Westinghouse LFAs will be modeled in the PVNGS core physics models, including the zirconium di-boride IFBA. As such, the impact of the LFAs will be included in the PVNGS cycle-specific core physics calculations supporting the reload effort for each cycle during use of the LFAs.

APS and Westinghouse LFA Analyses

APS and Westinghouse will evaluate the performance of the PVNGS NGF LFAs with respect to the safety analysis. The analyses will include fuel performance, thermal-hydraulic compatibility, loss-of-coolant accident (LOCA) and non-LOCA criteria, mechanical design,

thermal hydraulics, seismic, core physics, and neutronic compatibility of the PVNGS NGF LFAs in the PVNGS Unit 3 core. The evaluations will make use of the fact that the LFAs will be operated in non-limiting locations and will verify the analyses-of-record are not adversely impacted. The results will be documented in a final design report.

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 co-resident fuel to ensure compatibility.

The mechanical compatibility evaluations for the LFAs include both the fuel rod thermal-mechanical calculations and the fuel assembly structural calculations. Results are provided for normal operation and anticipated transient conditions. The mechanical design analyses will show LFA compatibility with the PVNGS 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, Westinghouse will analyze the seismic performance of the LFAs by evaluating the seismic/LOCA time history with respect to the strength of the Westinghouse NGF grid.

Co-Resident Fuel Compatibility Analyses

Westinghouse will perform a compatibility study to ensure that insertion of the 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. 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 Westinghouse NGF LFAs in the PVNGS Unit 3 Core will be evaluated to determine there is no impact 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 visual 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 Waterford 3 (Accession No. ML042110407) to allow the use of Optimized ZIRLO™ fuel rod cladding in four lead test assemblies for the NGF design.

References:

1. Westinghouse Electric Company, LLC (Westinghouse) Topical Report WCAP-12610-P-A & CENPD-404-P-A, Addendum 1-A "Optimized ZIRLO™", July 2006

2. Letter from H. N. Berkow (USNRC) to J. A. Gresham (Westinghouse), "Final Safety Evaluation for Addendum 1 to Topical Report WCAP-12610-P-A and CENPD-404-P-A, 'Optimized ZIRLO™, (TAC No. MB8041)," June 10, 2005

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. Letter from Ho K. Nieh (USNRC) to J. A. Gresham (Westinghouse), "Final Safety Evaluation for Westinghouse Electric Company (Westinghouse) Topical Report (TR) WCAP-16500-P, Revision 0, 'CE [Combustion Engineering] 16X16 Next Generation Fuel [(NGF)] Core Reference Report' (TAC No. MD0560)," July 30, 2007.

ENCLOSURE 2

Commitments

Commitments

1. Prior to startup for Unit 3 Cycle 17, poolside examinations will be performed to evaluate ongoing assembly and cladding performance. (RCTSAI 3359872, Due 04/30/2012)

2. Prior to startup for Unit 3 Cycle 18, poolside examinations will be performed to evaluate ongoing assembly and cladding performance. (RCTSAI 3359883, Due 10/30/2013)

3. After completion of Unit 3 Cycle 18 (the third and final irradiation cycle), poolside examinations will be performed to evaluate assembly and cladding performance. (RCTSAI 3359885, Due 06/30/2015)

4. The Westinghouse NGF LFAs will be modeled in the PVNGS core physics models, including the Zirconium di-boride integral fuel burnable absorber (IFBA). As such, the impact of the LFAs will be included in the PVNGS cycle-specific core physics calculations supporting the reload effort for each cycle during use of the LFAs. (RCTSAIs 3359888, Due 10/30/2010; 3399288, Due 04/30/2012; and 3399295, Due 10/30/2013)

5. Evaluations will verify performance of the Westinghouse NGF 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 LFAs in the PVNGS Unit 3 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. (RCTAI 3359890, Due 10/30/2010)

6. A compatibility study will be performed to ensure that insertion of the Westinghouse NGF LFAs will not cause the remaining Westinghouse fuel to exceed its operating limits and ensure there is no adverse impact on fuel performance or mechanical integrity. The results of the compatibility study will be documented in a final design report. (RCTSAI 3359892, Due 10/30/2010)