



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

January 23, 2018

Mr. Robert S. Bement  
Executive Vice President Nuclear/  
Chief Nuclear Officer  
Mail Station 7602  
Arizona Public Service Company  
P.O. Box 52034  
Phoenix, AZ 85072-2034

SUBJECT: PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3 –  
EXEMPTION FROM THE REQUIREMENTS OF 10 CFR PART 50,  
SECTION 50.46 AND APPENDIX K (CAC NOS. MF8079, MF8080,  
AND MF8081; EPID L-2016-LLE-0001)

Dear Mr. Bement:

The U.S. Nuclear Regulatory Commission (NRC) has approved the enclosed exemption from specific requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.46, "Acceptance criteria for emergency core cooling systems [ECCS] for light-water nuclear power reactors," and 10 CFR Part 50, Appendix K, "ECCS Evaluation Models," for Palo Verde Nuclear Generating Station (PVNGS), Units 1, 2, and 3. This action is in response to Arizona Public Service Company's (APS, the licensee) application dated July 1, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16188A336), as supplemented by letter dated June 2, 2017 (ADAMS Accession No. ML17153A373) that requested exemption from the above regulations to use Optimized ZIRLO™ cladding in lead test assemblies.

The proposed request relates to the specific fuel cladding materials expressly subject to the above regulations, namely zircaloy and ZIRLO™. In particular, APS has requested an exemption for PVNGS, Units 1, 2, and 3 to allow application of 10 CFR 50.46 and 10 CFR Part 50, Appendix K to fuel clad with a different material, namely Optimized ZIRLO™. Concurrently, APS has requested a license amendment to allow transition to Combustion Engineering 16x16 Next Generation Fuel (which is clad with Optimized ZIRLO™). The NRC staff's review of the fuel transition license amendments has been completed and is documented in a separate safety evaluation (ADAMS Accession No. ML17319A107).

Enclosure 2 to this letter contains Proprietary information. When separated from Enclosure 2, this letter is DECONTROLLED.

R. Bement

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The exemption is provided in Enclosure 1. The NRC staff has determined that the safety evaluation provided in Enclosure 2 contains proprietary information pursuant to 10 CFR 2.390, "Public inspections, exemptions, requests for withholding." Accordingly, the NRC staff has prepared a redacted version of the safety evaluation, which is provided in Enclosure 3.

The exemption is being forwarded for publication to the Office of the Federal Register.

If you have any questions, please contact me at 301-415-1564 or via e-mail at [Siva.Lingam@nrc.gov](mailto:Siva.Lingam@nrc.gov).

Sincerely,



Siva P. Lingam, Project Manager  
Plant Licensing Branch IV  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-528, STN 50-529,  
and STN 50-530

Enclosures:

1. Exemption
2. Safety Evaluation (Proprietary)
3. Safety Evaluation (Nonproprietary)

cc w/o Enclosure 2: Listserv

## **ENCLOSURE 1**

EXEMPTION FOR USE OF OPTIMIZED ZIRLO™ CLADDING

ARIZONA PUBLIC SERVICE COMPANY

PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3

DOCKET NOS. 50-528, 50-529, AND 50-530

# **NUCLEAR REGULATORY COMMISSION**

**Docket Nos. STN 50-528, STN 50-529, and STN 50-530**

**Arizona Public Service Company**

**Palo Verde Nuclear Generating Station, Units 1, 2, and 3**

## **I. Background**

Arizona Public Service Company (APS, the licensee) is the holder of Renewed Facility Operating License Nos. NPF-41, NPF-51, and NPF-74, which authorizes operation of Palo Verde Nuclear Generating Station (PVNGS), Units 1, 2, and 3, respectively. The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the U.S. Nuclear Regulatory Commission (NRC) now or hereafter in effect. The facility consists of a pressurized-water reactor located in Maricopa County, Arizona.

By application dated July 1, 2016, as supplemented by letter dated June 2, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML16188A336 and ML17153A373, respectively), APS, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.12, "Specific exemptions," requested an exemption from certain requirements of 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems [ECCS] for light-water nuclear power reactors," and 10 CFR Part 50, Appendix K, "ECCS Evaluation Models," for PVNGS, Units 1, 2, and 3. This exemption request relates solely to the specific types of cladding materials for which 10 CFR 50.46 and 10 CFR Part 50, Appendix K are expressly applicable, namely zircaloy and ZIRLO™. Since these regulations specifically refer only to zircaloy and ZIRLO™, an exemption would be required to apply them to fuel clad with other materials, such as Optimized ZIRLO™.<sup>1</sup> Therefore, APS has requested

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<sup>1</sup> "Optimized ZIRLO" and "ZIRLO" are trademarks or registered trademarks of Westinghouse Electric Company, LLC.

such an exemption to support transition to the Combustion Engineering (CE) 16x16 Next Generation Fuel (NGF) design, which uses Optimized ZIRLO™ cladding. The proposed request would not exempt PVNGS, Units 1, 2, and 3 from the requirements of 10 CFR 50.46 or 10 CFR Part 50, Appendix K regarding acceptance criteria, evaluation model features and documentation, reporting of changes or errors, etc.

The submittal from APS described above also contains the fuel transition license amendment request that is necessary to support batch loading of NGF. This exemption is specific to the Optimized ZIRLO™ cladding material exemption request only. The fuel transition and associated technical specification (TS) changes are subject to a concurrent review that is being documented in the safety evaluation (SE) with the license amendments (ADAMS Accession No. ML17319A107).

The NRC has previously approved exemption requests similar to that requested by APS, including a temporary exemption (ADAMS Accession No. ML101900254) for NGF lead test assemblies at PVNGS, Unit 3, which will be replaced by this permanent exemption. Precedent exemptions have also been approved for other CE plants including Arkansas Nuclear One, Unit 2 (ADAMS Accession No. ML080370012), and Waterford Steam Electric Station, Unit 3 (ADAMS Accession No. ML042110407).

## **II. Request/Action**

Pursuant to 10 CFR 50.12, APS by letter dated July 1, 2016, as supplemented by letter dated June 2, 2017, requested exemption from the requirements of 10 CFR 50.46, and 10 CFR Part 50, Appendix K. The proposed exemption request would permit the application of 10 CFR 50.46 and 10 CFR Part 50, Appendix K to fuel rods clad with Optimized ZIRLO™ at

PVNGS, Units 1, 2, and 3. Since the requirements in 10 CFR 50.46 and 10 CFR Part 50, Appendix K, are predicated upon the use of fuel clad with zircaloy or ZIRLO™, an exemption is necessary to apply these requirements to fuel rods clad with Optimized ZIRLO™.

The Optimized ZIRLO™ fuel cladding is different from standard ZIRLO™ in two respects: (1) the tin content is lower and (2) the microstructure is different. These differences can affect some material properties, and Westinghouse Electric Company, LLC (Westinghouse) committed to provide post-irradiation data necessary for validating fuel performance models for Optimized ZIRLO™ ahead of achieving burnups in batch application where sufficient validation data does not exist.

Topical Report CENPD-404-P-A, Addendum 1-A, "Optimized ZIRLO™" (ADAMS Accession Nos. ML062080563 and ML062080569), 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 fuel clad with Optimized ZIRLO™. Topical Report CENPD-404-P-A, Addendum 2-A, "Westinghouse Clad Corrosion Model for ZIRLO and Optimized ZIRLO" (ADAMS Accession No. ML13308B412), describes the Westinghouse fuel rod cladding corrosion model that replaces the original ZIRLO™ corrosion model and is applicable to both ZIRLO™ and Optimized ZIRLO™.

### **III. Discussion**

The regulation in paragraph 50.46(a)(1)(i) of 10 CFR states, in part:

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.

Since 10 CFR 50.46 specifically refers to fuel with zircaloy or ZIRLO™ cladding, its application to fuel clad with zirconium-based alloys other than zircaloy or ZIRLO™ requires an exemption from this section of the regulations.

The regulation in paragraph I.A.5, “Metal – Water Reaction Rate,” of 10 CFR Part 50, Appendix K, states, in part:

The rate of energy release, hydrogen generation, and cladding oxidation from the metal/water reaction shall be calculated using the Baker-Just equation (Baker, L., Just, L.C., “Studies of Metal Water Reactions at High Temperatures, III. Experimental and Theoretical Studies of the Zirconium-Water Reaction,” ANL-6548, page 7, May 1962).

The Baker-Just equation presumes the use of zircaloy or ZIRLO™ cladding. Therefore, application of 10 CFR Part 50, Appendix K, to zirconium-based cladding material other than zircaloy or ZIRLO™ also requires an exemption.

The exemption request from APS relates solely to the particular types of cladding material specified in these regulations. As written, the regulations presume the use of zircaloy or ZIRLO™ fuel rod cladding. Thus, an exemption is necessary to apply 10 CFR 50.46 and Appendix K to 10 CFR Part 50 to a cladding alloy other than zircaloy or ZIRLO™. The proposed request would not exempt PVNGS, Units 1, 2, and 3 from the requirements of 10 CFR 50.46 or 10 CFR Part 50, Appendix K regarding acceptance criteria, evaluation model features and documentation, reporting of changes or errors, etc.

Section 50.12 of 10 CFR states that the Commission may grant exemptions from requirements of the regulations in 10 CFR Part 50 for reasons, which are (1) the exemption is authorized by law, (2) the exemption will not present an undue risk to the public health and safety, (3) the exemption is consistent with the common defense and security, and (4) special circumstances are present.

**A. The Exemption is Authorized by Law**

The NRC has the authority under Section 50.12 to grant exemptions from the requirements of Part 50 upon demonstration of proper justification. The fuel that will be irradiated at PVNGS, Units 1, 2, and 3 is clad with a zirconium-based alloy that is not expressly within the scope of 10 CFR 50.46 and 10 CFR Part 50, Appendix K. However, the NRC staff considers the acceptance criteria and methods of these regulations applicable to Optimized ZIRLO™, and the licensee will ensure that these regulations are satisfied for operation with fuel clad with Optimized ZIRLO™.

**B. The Exemption Presents no Undue Risk to Public Health and Safety**

The NRC-approved Optimized ZIRLO™ topical report has demonstrated that predicted chemical, thermal, and mechanical characteristics of the Optimized ZIRLO™-alloy cladding are bounded by those approved for ZIRLO™ under anticipated operational occurrences and postulated accidents. Reload cores are required to be operated in accordance with the operating limits specified in the TSs and core operating limits report. Acceptance criteria and analytical methods from 10 CFR 50.46 and Appendix K to 10 CFR Part 50 have been determined appropriate and will be applied to fuel clad with Optimized ZIRLO™. Thus, the granting of this exemption request will not pose an undue risk to public health and safety.



**C. The Exemption is Consistent with the Common Defense and Security**

The proposed exemption will allow the licensee to use an improved fuel rod cladding material. The licensee has documented compliance with all conditions and limitations of relevant NRC SEs supporting the use of Optimized ZIRLO™. The NRC staff has reviewed the licensee's justifications, and, in a separate SE, has documented the basis for its acceptability. Therefore, use of the Optimized ZIRLO™ fuel rod cladding at PVNGS, Units 1, 2, and 3 will not significantly change plant operations and is consistent with common defense and security.

**D. Special Circumstances**

Neither 10 CFR 50.46 nor 10 CFR Part 50, Appendix K, explicitly applies to fuel clad with Optimized ZIRLO™. However, the stated objective of 10 CFR 50.46 is to require that nuclear power reactors fueled with uranium oxide pellets within zircaloy or ZIRLO™ cladding be provided with an ECCS that is designed to provide adequate core cooling following postulated loss-of-coolant accidents. As discussed further below, Westinghouse has demonstrated in an NRC-approved topical report (i.e., CENPD-404-P-A), that the analytical methods used to demonstrate the effectiveness of the ECCS will not be adversely affected by a change from zircaloy- or ZIRLO™-clad fuel to Optimized ZIRLO™-clad fuel. Normal core reload safety analyses will further confirm on a cycle-specific basis that there is no adverse impact on ECCS performance for PVNGS, Units 1, 2, and 3. Therefore, granting the exemption to allow application of 10 CFR 50.46 and 10 CFR Part 50, Appendix K to fuel clad with Optimized ZIRLO™ would be consistent with achieving the underlying purpose of these regulations.

**E. Supplemental Information**

For more technical details, refer to ADAMS Accession No. ML17319A214 (Enclosure 3).

**F. Environmental Considerations**

The NRC staff determined that the exemption discussed herein meets the eligibility criteria for the categorical exclusion set forth in 10 CFR 51.22(c)(9) because it is related to a requirement concerning the installation or use of a facility component located within the restricted area, as defined in 10 CFR Part 20, and the granting of this exemption involves: (i) no significant hazards consideration, (ii) no significant change in the types or a significant increase in the amounts of any effluents that may be released offsite, and (iii) no significant increase in individual or cumulative occupational radiation exposure. Therefore, in accordance with 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the NRC's consideration of this exemption request.

#### IV. Conclusions

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12, the exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security. Also, special circumstances are present. Therefore, the Commission hereby grants APS an exemption from the requirements of 10 CFR 50.46 and 10 CFR Part 50, Appendix K, to allow the use of Optimized ZIRLO™ fuel rod cladding material at PVNGS, Units 1, 2, and 3. As stated above, this exemption relates solely to the cladding material specified in these regulations.

Dated at Rockville, Maryland, this 23<sup>rd</sup> day of January 2018.

For the Nuclear Regulatory Commission.

A handwritten signature in black ink, reading "Kathryn M. Brock". The signature is written in a cursive, flowing style.

Kathryn M. Brock, Deputy Director,  
Division of Operating Reactor Licensing,  
Office of Nuclear Reactor Regulation.

## **ENCLOSURE 3**

SAFETY EVALUATION RELATED TO 10 CFR 50.12 EXEMPTION FOR

USE OF OPTIMIZED ZIRLO™ CLADDING

ARIZONA PUBLIC SERVICE COMPANY

PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3

DOCKET NOS. 50-528, 50-529, AND 50-530

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**



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

SAFETY EVALUATION RELATED TO 10 CFR 50.12 EXEMPTION FOR  
USE OF OPTIMIZED ZIRLO™ CLADDING  
ARIZONA PUBLIC SERVICE COMPANY  
PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3  
DOCKET NOS. 50-528, 50-529, AND 50-530

1.0 INTRODUCTION

By application dated July 1, 2016 (Reference 1), as supplemented by letter dated June 2, 2017 (Reference 2), Arizona Public Service Company (APS, the licensee), pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.12, "Specific exemptions," requested an exemption from certain requirements of 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems [ECCS] for light-water nuclear power reactors," and 10 CFR Part 50, Appendix K, "ECCS Evaluation Models," for Palo Verde Nuclear Generating Station (PVNGS), Units 1, 2, and 3. This exemption request relates solely to the specific types of cladding materials for which 10 CFR 50.46 and Appendix K to 10 CFR Part 50 are expressly applicable, namely zircaloy and ZIRLO™. Since these regulations specifically refer only to zircaloy and ZIRLO™, an exemption would be required to apply them to fuel clad with other materials, such as Optimized ZIRLO™<sup>1</sup>. Therefore, APS has requested such an exemption to support transition to the Combustion Engineering (CE) 16×16 Next Generation Fuel (NGF) design, which uses Optimized ZIRLO™ cladding. The proposed request would not exempt PVNGS, Units 1, 2, and 3 from requirements of 10 CFR 50.46 or Appendix K to 10 CFR Part 50 regarding acceptance criteria, evaluation model features and documentation, reporting of changes or errors, etc.

The submittal from APS described above also contains the fuel transition license amendment request (LAR) that is necessary to support batch loading of NGF. This safety evaluation (SE) is specific to the Optimized ZIRLO™ cladding material exemption request only. The fuel transition and associated technical specification (TS) changes are subject to a concurrent review that is being documented in a separate SE (Reference 3).

The U.S. Nuclear Regulatory Commission (NRC) has previously approved exemption requests similar to that requested by APS, including a temporary exemption (Reference 4) for NGF lead test assemblies (LTAs) at PVNGS, Unit 3, which will be replaced by this permanent exemption. Precedent exemptions have also been approved for other CE plants including Arkansas Nuclear One, Unit 2 (Reference 5), and Waterford Steam Electric Station, Unit 3 (Reference 6).

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<sup>1</sup> "Optimized ZIRLO" and "ZIRLO" are trademarks or registered trademarks of Westinghouse Electric Company, LLC.

## 2.0 REGULATORY EVALUATION

### 2.1 10 CFR Part 50

Section 50.46(a)(1)(i) of 10 CFR states, in part:

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.

Since 10 CFR 50.46 specifically refers to fuel with zircaloy or ZIRLO™ cladding, its application to fuel clad with zirconium-based alloys other than zircaloy or ZIRLO™ requires an exemption from this section of the regulations.

Paragraph I.A.5, "Metal – Water Reaction Rate," of 10 CFR Part 50, Appendix K, states, in part:

The rate of energy release, hydrogen generation, and cladding oxidation from the metal/water reaction shall be calculated using the Baker-Just equation (Baker, L., Just, L.C., "Studies of Metal Water Reactions at High Temperatures, III. Experimental and Theoretical Studies of the Zirconium-Water Reaction," [Argonne National Laboratory] ANL-6548, page 7, May 1962).

The Baker-Just equation presumes the use of zircaloy or ZIRLO™ cladding. Therefore, application of 10 CFR Part 50, Appendix K, to zirconium-based cladding material other than zircaloy or ZIRLO™ also requires an exemption.

The exemption request from APS relates solely to the particular types of cladding material specified in these regulations. As written, the regulations presume the use of zircaloy or ZIRLO™ fuel rod cladding. Thus, an exemption is necessary to apply 10 CFR 50.46 and Appendix K to 10 CFR Part 50 to a cladding alloy other than zircaloy or ZIRLO™. The proposed request would not exempt PVNGS, Units 1, 2, and 3 from requirements of 10 CFR 50.46 or 10 CFR Part 50, Appendix K regarding acceptance criteria, evaluation model features and documentation, reporting of changes or errors, etc.

Section 50.12 of 10 CFR states that the Commission may grant exemptions from requirements of the regulations in 10 CFR Part 50 for reasons which are (1) the exemption is authorized by law, (2) the exemption will not present an undue risk to the public health and safety, (3) the exemption is consistent with the common defense and security, and (4) special circumstances are present. Adherence to these requirements is demonstrated in the Technical Evaluation in Section 3.0 of this SE.

## 2.2 NRC Staff Review Objectives

The objectives for the NRC staff's review of the exemption request are to:

1. ensure that the exemption is granted in adherence with the requirements of 10 CFR 50.12, which are summarized in Section 2.1 above.
2. ensure that the acceptance criteria and prescribed methods in 10 CFR 50.46 and Appendix K to 10 CFR Part 50 are applicable to the Optimized ZIRLO™ fuel cladding material and that the implementation of the proposed exemption is in accordance with the conditions and limitations established in the NRC staff SEs for Optimized ZIRLO™, particularly Addenda 1-A, "Optimized ZIRLO™" (Reference 7) and 2-A, "Westinghouse Clad Corrosion Model for ZIRLO and Optimized ZIRLO" (Reference 8) to Topical Report (TR) CENPD-404-P-A.

## 3.0 TECHNICAL EVALUATION

### 3.1 Introduction

Pursuant to 10 CFR 50.12, APS requested an exemption from the requirements of 10 CFR 50.46, and 10 CFR Part 50, Appendix K. The proposed exemption request would permit the application of 10 CFR 50.46 and 10 CFR Part 50, Appendix K to fuel rods clad with Optimized ZIRLO™ at PVNGS, Units 1, 2, and 3. Since the requirements in 10 CFR 50.46 and 10 CFR Part 50, Appendix K, are predicated upon the use of fuel clad with zircaloy or ZIRLO™, an exemption is necessary to apply these requirements to fuel rods clad with Optimized ZIRLO™.

The Optimized ZIRLO™ fuel cladding is different from standard ZIRLO™ in two respects: (1) the tin content is lower and (2) the microstructure is different. These differences can affect some material properties, and Westinghouse Electric Company, LLC (Westinghouse) committed to provide post-irradiation data necessary for validating fuel performance models for Optimized ZIRLO™ ahead of achieving burnups in batch application where sufficient validation data does not exist. The post-irradiation data subsequently provided by Westinghouse is discussed further below in Sections 3.3.1.6 and 3.3.1.7 of this SE.

The TR CENPD-404-P-A, Addendum 1-A 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 fuel clad with Optimized ZIRLO™. The TR CENPD-404-P-A, Addendum 2-A describes the Westinghouse fuel rod cladding corrosion model that replaces the original ZIRLO™ corrosion model and is applicable to both ZIRLO™ and Optimized ZIRLO™.

### 3.2 Adherence to 10 CFR 50.12 Requirements

The exemption to apply 10 CFR 50.46 and 10 CFR Part 50, Appendix K to fuel clad with Optimized ZIRLO™ at PVNGS satisfies the requirements of 10 CFR 50.12 as described below:

- (1) *The exemption is authorized by law.* NRC has the authority under Section 50.12 to grant exemptions from the requirements of Part 50 upon demonstration of proper justification. The fuel that will be irradiated at PVNGS, Units 1, 2, and 3 is clad with a

zirconium-based alloy that is not expressly within the scope of 10 CFR 50.46 and 10 CFR Part 50, Appendix K. However, the NRC staff considers the acceptance criteria and methods of these regulations applicable to Optimized ZIRLO™, and the licensee will ensure that these regulations are satisfied for operation with fuel clad with Optimized ZIRLO™.

- (2) *The exemption will not present an undue risk to public health and safety.* The NRC-approved Optimized ZIRLO™ topical report has demonstrated that predicted chemical, thermal, and mechanical characteristics of the Optimized ZIRLO™-alloy cladding are bounded by those approved for ZIRLO™ under anticipated operational occurrences and postulated accidents. Reload cores are required to be operated in accordance with the operating limits specified in the TSs and core operating limits report (COLR). Acceptance criteria and analytical methods from 10 CFR 50.46 and Appendix K to 10 CFR Part 50 have been determined appropriate and will be applied to fuel clad with Optimized ZIRLO™. Thus, the granting of this exemption request will not pose an undue risk to public health and safety.
- (3) *The exemption is consistent with the common defense and security.* The proposed exemption will allow the licensee to use an improved fuel rod cladding material. The licensee has documented compliance with all conditions and limitations of relevant NRC SEs supporting the use of Optimized ZIRLO™. The NRC staff has reviewed the licensee's justifications, and, in a separate SE, has documented the basis for its acceptability. Therefore, use of the Optimized ZIRLO™ fuel rod cladding at PVNGS will not significantly change plant operations and is consistent with common defense and security.
- (4) *Special circumstances are present.* Neither 10 CFR 50.46 nor 10 CFR Part 50, Appendix K, explicitly applies to fuel clad with Optimized ZIRLO™. However, the stated objective of 10 CFR 50.46 is to require that nuclear power reactors fueled with uranium oxide pellets within zircaloy or ZIRLO™ cladding be provided with an ECCS that is designed to provide adequate core cooling following postulated loss-of-coolant accidents (LOCAs). As discussed further below, Westinghouse has demonstrated in an NRC-approved TR (i.e., CENPD-404-P-A), that the analytical methods used to demonstrate the effectiveness of the ECCS will not be adversely affected by a change from zircaloy- or ZIRLO™-clad fuel to Optimized ZIRLO™-clad fuel. Normal core reload safety analyses will further confirm on a cycle-specific basis that there is no adverse impact on ECCS performance for PVNGS. Therefore, granting the exemption to allow application of 10 CFR 50.46 and 10 CFR Part 50, Appendix K to fuel clad with Optimized ZIRLO™ would be consistent with achieving the underlying purpose of these regulations.

### 3.3 Optimized ZIRLO™ Applicability and Implementation

The primary objective of 10 CFR 50.46(b)(1), in conjunction with 10 CFR 50.46(b)(2), is to ensure the existence of sufficient fuel cladding ductility to accommodate thermal shock loads during the reflood phase of a LOCA, and thereby maintain the reactor core in a coolable geometry. Westinghouse referred in Addendum 1-A to CENPD-404-P-A to ring compression tests performed for Optimized ZIRLO™, among other evidence, to demonstrate satisfaction of ductility requirements. The NRC staff's SE for Addendum 1-A cited additional test results and evidence supporting this conclusion, ultimately agreeing that Optimized ZIRLO™ should maintain adequate ductility under LOCA conditions.



An additional objective of 10 CFR 50.46(b)(2) and (b)(3), and 10 CFR Part 50, Appendix K, paragraph I.A.5, is to ensure that cladding oxidation and hydrogen generation are appropriately limited during a LOCA and conservatively accounted for in ECCS evaluation models. Appendix K to 10 CFR Part 50 requires that the Baker-Just equation be used in the ECCS evaluation model to determine the rate of energy release, cladding oxidation, and hydrogen generation. Westinghouse has shown in Addendum 1-A to CENPD-404-P-A that the Baker-Just model is conservative in all post-LOCA scenarios with respect to the use of Optimized ZIRLO™ as a fuel cladding material.

Ultimately, the NRC staff concluded in its SE on Addendum 1-A to CENPD-404-P-A that the 10 CFR 50.46 ECCS performance criteria and 10 CFR Part 50, Appendix K Baker-Just correlation are applicable to Optimized ZIRLO™. Nevertheless, limitations and conditions associated with applying this methodology to PVNGS must be addressed on a plant-specific basis.

In this regard, the NRC staff notes that CENPD-404-P-A (Reference 9) is already included in PVNGS, Units 1, 2, and 3, TS 5.6.5.b and the PVNGS COLR list of analytical methodologies. Its application to PVNGS has thus already been approved and, therefore, does not need to be addressed in this SE. However, implementation of NGF requires the use of Addenda 1-A (Reference 7) and 2-A (Reference 8) to CENPD-404-P-A, which are to be added to the PVNGS, Units 1, 2, and 3 COLR list of analytical methodologies and do require review in this SE.

### 3.3.1 Treatment of Conditions and Limitations in Addendum 1-A to CENPD-404-P-A

CENPD-404-P-A, Addendum 1-A, "Optimized ZIRLO™" (Reference 7), describes an extension of the regulatory definition of ZIRLO™ to allow for the optimization of ZIRLO™ for enhanced corrosion resistance in more adverse in-reactor primary chemistry environments and at higher fuel duties with higher burnups. Since CENPD-404-P-A, Addendum 1-A, has been previously approved and the related cladding material wording change to TS 4.2.1 and the supporting LAR for PVNGS are being approved concurrently with this exemption request, the NRC staff finds CENPD-404-P-A, Addendum 1-A, to be applicable to PVNGS.

The NRC staff's SE for CENPD-404-P-A, Addendum 1-A, contains ten conditions and limitations. Licensees referencing Addendum 1-A to CENPD 404-P-A to implement Optimized ZIRLO™ are expected to ensure compliance with the ten conditions and limitations. The licensee has documented compliance with these ten conditions and limitations. Each condition and limitation is restated below along with the NRC staff's evaluation of APS's response. These evaluations are identical to those made as part of the related fuel transition LAR.

3.3.1.1 Condition and Limitation 1

**Exemption**

Until rulemaking to 10 CFR Part 50 addressing Optimized ZIRLO™ has been completed, implementation of Optimized ZIRLO™ fuel clad requires an exemption from 10 CFR 50.46 and 10 CFR Part 50 Appendix K.

Safety Evaluation for CENPD-404-P-A, Addendum 1-A  
Condition and Limitation 1

Because APS has submitted an exemption request for PVNGS, which is evaluated in this SE, the NRC staff has concluded that this condition and limitation has been satisfied.

3.3.1.2 Condition and Limitation 2

**Burnup Limit**

The fuel rod burnup limit for this approval remains at currently established limits: 62 GWd/MTU [gigawatt days per metric ton of uranium] for Westinghouse fuel designs and 60 GWd/MTU for CE fuel designs.

Safety Evaluation for CENPD-404-P-A, Addendum 1-A  
Condition and Limitation 2

Because PVNGS uses a CE fuel design (and not a Westinghouse fuel design) and APS has confirmed that PVNGS will continue to use a 60 GWd/MTU rod burnup, the NRC staff has concluded that this condition and limitation has been satisfied.

3.3.1.3 Condition and Limitation 3

**Corrosion Limit**

The maximum fuel rod waterside corrosion, as predicted by the best-estimate model, will [[  
of the fuel rod. ]] of hydrides for all locations

Safety Evaluation for CENPD-404-P-A, Addendum 1-A  
Condition and Limitation 3

This condition and limitation has been superseded by Condition and Limitation 1 of Addendum 2-A to CENPD-404-P-A. Therefore, the NRC staff has concluded that this condition and limitation is no longer applicable.

3.3.1.4 Condition and Limitation 4

**Conditions on Approved Methodologies**

All the conditions listed in previous NRC SE approvals for methodologies used for standard ZIRLO™ and Zircaloy-4 fuel analysis will continue to be met, except that the use of Optimized ZIRLO™ cladding in addition to standard ZIRLO™ and Zircaloy-4 cladding is now approved.

Safety Evaluation for CENPD-404-P-A, Addendum 1-A  
Condition and Limitation 4

Because APS has confirmed that future analysis using Optimized ZIRLO™ will continue to meet all conditions associated with approved methods, the NRC staff has concluded that this condition and limitation has been satisfied.

3.3.1.5 Condition and Limitation 5

**Application Domain**

All methodologies will be used only within the range for which ZIRLO™ and Optimized ZIRLO™ data were acceptable and for which the verifications discussed in Addendum 1 and responses to RAIs [requests for additional information] were performed.

Safety Evaluation for CENPD-404-P-A, Addendum 1-A  
Condition and Limitation 5

Because APS has confirmed that the application of Optimized ZIRLO™ will be consistent with the approach accepted in CENPD-404-P-A, Addendum 1-A, and that confirmation of these conditions is part of the normal reload design process, the NRC staff has concluded that this condition and limitation has been satisfied.

3.3.1.6 Condition and Limitation 6

**LTA Data**

The licensee is required to ensure that Westinghouse has fulfilled the following commitment: Westinghouse shall provide the NRC staff with a letter(s) containing the following information (Based on the schedule described in response to RAI #3):

- a. Optimized ZIRLO™ LTA data from Byron, Calvert Cliffs, Catawba, and Millstone.
  - i. Visual
  - ii. Oxidation of fuel rods
  - iii. Profilometry
  - iv. Fuel rod length
  - v. Fuel assembly length
- b. Using the standard and Optimized ZIRLO™ database including the most recent LTA data, confirm applicability with currently approved fuel performance models (e.g., measured vs. predicted).

Confirmation of the approved models' applicability up through the projected end of cycle burnup for the Optimized ZIRLO™ fuel rods must be completed prior to their initial batch loading and prior to the startup of subsequent cycles. For example, prior to the first batch application of Optimized ZIRLO™, sufficient LTA data may only be available to confirm the models' applicability up through 45 GWd/MTU. In this example, the licensee would need to confirm the models up through the end of the initial cycle. Subsequently, the licensee would need to confirm the models, based upon the latest LTA data, prior to re-inserting the Optimized ZIRLO™ fuel rods in future cycles. Based upon the LTA schedule, it is expected that this issue may only be applicable to the first few batch implementations since sufficient LTA data up through the burnup limit should be available within a few years.

Safety Evaluation for CENPD-404-P-A, Addendum 1-A  
Condition and Limitation 6

In a letter dated August 3, 2016, to Westinghouse (Reference 10), the NRC staff concluded that Westinghouse provided additional information from irradiation programs to comply with Conditions 6 and 7 of the SE in LTR-NRC-13-6 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13070A188) submitted in February 2013. Westinghouse provided additional information on February 9, 2015, in LTR-NRC-15-7. Westinghouse only intends to satisfy Conditions 6 and 7 through the information provided in LTR-NRC-13-6 and LTR-NRC-15-7. The data provided in LTR-NRC-13-6 and LTR-NRC-15-7 satisfy Conditions 6 and 7 and licensees no longer need to provide additional data when referencing WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A "Optimized ZIRLO" in future LARS.

Therefore, the NRC staff concludes that this Condition and Limitation has been met.

3.3.1.7 Condition and Limitation 7

**Cycle Data**

The licensee is required to ensure that Westinghouse has fulfilled the following commitment: Westinghouse shall provide the NRC staff with a letter containing the following information (Based on the schedule described in response to RAI #11):

- a. Vogtle growth and creep data summary reports.
- b. Using the standard ZIRLO™ and Optimized ZIRLO™ database including the most recent Vogtle data, confirm applicability with currently approved fuel performance models (e.g., level of conservatism in W rod pressure analysis, measured vs. predicted, predicted minus measured vs. tensile and compressive stress).

Confirmation of the approved models' applicability up through the projected end of cycle burnup for the Optimized ZIRLO™ fuel rods must be completed prior to their initial batch loading and prior to the startup of subsequent cycles. For example, prior to the first batch application of Optimized ZIRLO™, sufficient LTA data may only be available to confirm the models' applicability up through 45 GWd/MTU. In this example, the licensee would need to confirm the models up through the end of the initial cycle. Subsequently, the licensee would need to confirm the models, based upon the latest LTA data, prior to re-inserting the Optimized ZIRLO™ fuel rods in future cycles. Based upon the LTA schedule, it is expected that this issue may only be applicable to the first few batch implementations since sufficient LTA data up through the burnup limit should be available within a few years.

Safety Evaluation for CENPD-404-P-A, Addendum 1-A  
Condition and Limitation 7

In Reference 10, the NRC staff concluded that Westinghouse provided additional information from irradiation programs to comply with Conditions 6 and 7 of the safety evaluation in LTR-NRC-13-6 (ADAMS Accession No. ML13070A188) submitted in February 2013. Westinghouse provided additional information on February 9, 2015, in LTR-NRC-15-7. Westinghouse only intends to satisfy Conditions 6 and 7 through the information provided in LTR-NRC-13-6 and LTR-NRC-15-7. The data provided in LTR-NRC-13-6 and LTR-NRC-15-7 satisfy Conditions 6 and 7 and licensees no longer need to provide additional data when referencing WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A "Optimized ZIRLO" in future license amendment requests.

Therefore, the NRC staff concludes that this Condition and Limitation has been met.

3.3.1.8 Condition and Limitation 8

**Yield Strength [YS]**

The licensee shall account for the relative differences in unirradiated strength (YS and UTS [ultimate tensile strength]) between Optimized ZIRLO™ and standard ZIRLO™ in cladding and structural analyses until irradiated data for Optimized ZIRLO™ have been collected and provided to the NRC staff.

- a. For the Westinghouse fuel design analyses:
  - i. The measured, unirradiated Optimized ZIRLO™ strengths shall be used for BOL [beginning of life] analyses.
  - ii. Between BOL up to a radiation fluence of  $3.0 \times 10^{21}$  n/cm<sup>2</sup> [newton per square centimeters] ( $E > 1$  MeV [mega electron volt]), pseudo-irradiated Optimized ZIRLO™ strength set equal to linear interpolation between the following two strength level points: At zero fluence, strength of Optimized ZIRLO™ equal to measured strength of Optimized ZIRLO™ and at a fluence of  $3.0 \times 10^{21}$  n/cm<sup>2</sup> ( $E > 1$  MeV), irradiated strength of standard ZIRLO™ at the fluence of  $3.0 \times 10^{21}$  n/cm<sup>2</sup> ( $E > 1$  MeV) minus 3 ksi [kilopounds per square inch].
  - iii. During subsequent irradiation from  $3.0 \times 10^{21}$  n/cm<sup>2</sup> up to  $12 \times 10^{21}$  n/cm<sup>2</sup>, the differences in strength (the difference at a fluence of  $3 \times 10^{21}$  n/cm<sup>2</sup> due to tin content) shall be decreased linearly such that the pseudo-irradiated Optimized ZIRLO™ strengths will saturate at the same properties as standard ZIRLO™ at  $12 \times 10^{21}$  n/cm<sup>2</sup>.
- b. For the CE fuel design analyses, the measured, unirradiated Optimized ZIRLO™ strengths shall be used for all fluence levels (consistent with previously approved methods).

Safety Evaluation for CENPD-404-P-A, Addendum 1-A  
Condition and Limitation 8

PVNGS uses a CE fuel design, and therefore Condition and Limitation 8.a does not apply.

Because APS has stated that future analysis of Optimized ZIRLO™ will use the measured, unirradiated Optimized ZIRLO™ strengths for all fluence levels, the NRC staff has concluded that Condition and Limitation 8.b has been satisfied.

3.3.1.9 Condition and Limitation 9

**LOCBART or STRIKIN-II early Peak Cladding Temperature (PCT)**

As discussed in response to RAI #21 (Reference 3), for plants introducing Optimized ZIRLO™ that are licensed with LOCBART or STRIKIN-II and have a limiting PCT that occurs during blowdown or early reflood, the limiting LOCBART or STRIKIN-II calculation will be rerun using the specified Optimized ZIRLO™ material properties. Although not a condition of approval, the NRC staff strongly recommends that, for future evaluations, Westinghouse update all computer models with Optimized ZIRLO™ specific material properties.

Safety Evaluation for CENPD-404-P-A, Addendum 1-A  
Condition and Limitation 9

APS has confirmed that the ECCS method of analysis has been updated to model the specific material properties. Therefore, the NRC staff has concluded that this condition and limitation has been met.

3.3.1.10 Condition and Limitation 10

**Locked Rotor PCT**

Due to the absence of high temperature oxidation data for Optimized ZIRLO™, the Westinghouse coolability limit on PCT during the locked rotor event shall be  
[[ ]].

Safety Evaluation for CENPD-404-P-A, Addendum 1-A  
Condition and Limitation 10

This condition is specific to safety analysis methodologies used for Westinghouse pressurized-water reactors, which use a cladding temperature limit for the locked rotor analysis. This locked rotor peak clad temperature limit does not apply to the safety analysis methodologies for CE plants such as PVNGS. Therefore, the NRC staff concludes that this condition and limitation is not applicable.

3.3.2 Treatment of Conditions and Limitations in Addendum 2-A to CENPD-404-P-A

CENPD-404-P-A, Addendum 2-A describes the Westinghouse fuel rod cladding corrosion model for ZIRLO™ and Optimized ZIRLO™ that replaces the corrosion model developed when ZIRLO™ was first licensed. Since (1) CENPD-404-P-A, Addendum 2-A, has been previously approved, (2) the licensee has proposed to revise TS 4.2.1 to support use of Optimized ZIRLO™ (the NRC staff's review of which is documented in a separate SE) and (3) the licensee has proposed an exemption to allow use of Optimized ZIRLO™ cladding material at PVNGS, Units 1, 2, and 3 (as evaluated in this SE), the NRC staff finds CENPD-404-P-A, Addendum 2-A, to be applicable to PVNGS, Units 1, 2, and 3.

The NRC staff's SE for CENPD-404-P-A, Addendum 2-A, contains four conditions and limitations. Licensees referencing Addendum 2-A of CENPD-404-P-A are expected to ensure

compliance with the four conditions and limitations. The licensee has documented compliance with these four conditions and limitations. Each condition and limitation is restated below along with the NRC staff's evaluation of APS's response. These evaluations are identical to those made as part of the related fuel transition LAR that is documented in a separate SE.

3.3.2.1 Condition and Limitation 1

**Corrosion Limit**

The maximum TRDs [thermal reaction accumulated duties] are restricted to numbers corresponding to a cladding corrosion amount of 100 microns for licensing applications. The corrosion is defined as [[

]].

Safety Evaluation for CENPD-404-P-A, Addendum 2-A  
Condition and Limitation 1

Since APS has indicated that the licensing calculations performed for the PVNGS NGF performance analysis consider a [[ ]] clad oxide thickness limited to a peak value of 100 microns, the NRC staff concludes that this condition and limitation has been met.

3.3.2.2 Condition and Limitation 2

**Hydrogen Pickup Limit**

The NRC staff requires that a hydrogen pickup limit of [[ ]] be implemented for ZIRLO™ and Optimized ZIRLO™ cladding.

Safety Evaluation for CENPD-404-P-A, Addendum 2-A  
Condition and Limitation 2

APS has stated that the hydrogen pickup limit specified above from CENPD-404-P-A, Addendum 2-A, is used for ZIRLO™ and Optimized ZIRLO™ in the analysis done for PVNGS. Therefore, the NRC staff concludes that this condition and limitation has been met.

3.3.2.3 Condition and Limitation 3

**Single Corrosion Limit**

The NRC staff disapproves the Westinghouse assertion that a single corrosion limit could ensure cladding integrity without a separate hydrogen pickup limit. The hydrogen pickup limit in the current existing topical reports including [WCAP-12610-P-A and CENPD-404-P-A Addendum 1-A] for ZIRLO™ and Optimized ZIRLO™ cladding shall not be eliminated or replaced.

Safety Evaluation for CENPD-404-P-A, Addendum 2-A  
Condition and Limitation 3



APS has confirmed that the hydrogen pickup limit, as specified, was retained and evaluated in the PVNGS NGF licensing evaluation. Therefore, the NRC staff concludes that this condition and limitation has been met.

3.3.2.4 Condition and Limitation 4

**Condition Removal and FDI Corrosion Model**

Condition 4 in CENPD-404-P-A SE can be removed. And, the NRC staff disapproves the use of the [fuel-duty index] FDI-based corrosion model for any future licensing applications.

Safety Evaluation for CENPD-404-P-A, Addendum 2-A  
Condition and Limitation 4

APS confirmed that FDI based corrosion analyses were not used. Therefore, the NRC staff concludes that this condition and limitation has been met.

**4.0 ENVIRONMENTAL CONSIDERATIONS**

The NRC staff determined that the exemption discussed herein meets the eligibility criteria for the categorical exclusion set forth in 10 CFR 51.22(c)(9) because it is related to a requirement concerning the installation or use of a facility component located within the restricted area, as defined in 10 CFR Part 20, and the granting of this exemption involves: (i) no significant hazards consideration, (ii) no significant change in the types or a significant increase in the amounts of any effluents that may be released offsite, and (iii) no significant increase in individual or cumulative occupational radiation exposure. Therefore, in accordance with 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the NRC's consideration of this exemption request. The basis for the NRC staff's determination is discussed as follows with an evaluation against each of the requirements in 10 CFR 51.22(c)(9).

Requirements in 10 CFR 51.22(c)(9)(i)

The NRC staff evaluated the issue of no significant hazards consideration, using the standards described in 10 CFR 50.92(c), as presented below:

1. Does the proposed [exemption] involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.

The proposed change to TS Section 4.2.1 adds Optimized ZIRLO™ fuel rod cladding material as an acceptable material consistent with the permanent exemption request presented in Section 7 of this LAR.

The NRC approved topical report CENPD-404-P-A, Addendum 1-A and Addendum 2-A addresses Optimized ZIRLO™ and demonstrates that

Optimized ZIRLO™ has essentially the same properties as currently licensed ZIRLO®. The fuel cladding itself is not an accident initiator and does not affect accident probability. Use of Optimized ZIRLO™ fuel cladding has been shown to meet all 10 CFR 50.46 design criteria and, therefore, will not increase the consequences of an accident.

Therefore, the proposed change to TS Section 4.2.1 does not involve a significant increase in the probability or consequences of an accident previously evaluated.

The proposed changes to TS Section 5.6.5 have no impact on any plant configuration or system performance. Changes to the calculated core operating limits may only be made using NRC approved methodologies, must be consistent with all applicable safety analysis limits, and are controlled by the 10 CFR 50.59 process. The proposed changes to TS Section 5.6.5 will add the NRC approved topical reports, as described, to the list of referenced core operating analytical methods. APS has demonstrated that the limitations and conditions contained in the NRC Safety Evaluation for these topical reports, and their various supplements and revisions will be met as described in Attachment 5 to this enclosure.

Therefore, the proposed change to TS Section 5.6.5 does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed [exemption] create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No.

The proposed change to TS Section 4.2.1 adds Optimized ZIRLO™ fuel rod cladding material as an acceptable material consistent with the permanent exemption request presented in Section 7 of this LAR.

Use of Optimized ZIRLO™ clad fuel will not result in changes in the operation or configuration of the facility. Topical report CENPD-404-P-A demonstrated that the material properties of Optimized ZIRLO™ are similar to those of standard ZIRLO®. Therefore, Optimized ZIRLO™ fuel rod cladding will perform similarly to those fabricated from standard ZIRLO® thus precluding the possibility of the fuel becoming an accident initiator and causing a new or different type of accident.

Therefore, the proposed change to TS Section 4.2.1 does not create the possibility of a new or different kind of accident from any previously evaluated.

The proposed changes to TS Section 5.6.5 have no impact on any plant configuration or system performance. Changes to the calculated core operating limits may only be made using NRC approved methodologies, must be consistent with all applicable safety analysis limits, and are

controlled by the 10 CFR 50.59 process. The proposed changes to TS Section 5.6.5 will add the NRC-approved topical reports, as described, to the list of referenced core operating analytical methods. APS has demonstrated that the limitations and conditions contained in the NRC Safety Evaluation for these topical reports, and their various supplements and revisions as identified in Attachment 5 to this enclosure, will be met as described in Section 3.2.

Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed [exemption] involve a significant reduction in a margin of safety?

Response: No.

The proposed change to TS Section 4.2.1 adds Optimized ZIRLO™ fuel rod cladding material as an acceptable material consistent with the permanent exemption request presented in Section 7 of this LAR.

The proposed change will not involve a significant reduction in the margin of safety because it has been demonstrated that the material properties of the Optimized ZIRLO™ are not significantly different from those of standard ZIRLO®. Optimized ZIRLO™ is expected to perform similarly to standard ZIRLO® for all normal operating, transient, and accident scenarios, including both loss of coolant accident (LOCA) and non-LOCA scenarios. For LOCA scenarios, where the slight difference in Optimized ZIRLO™ material properties relative to standard ZIRLO® could have some impact on the overall accident scenario, plant-specific LOCA analyses using Optimized ZIRLO™ properties were performed. These LOCA analyses demonstrate that the acceptance criteria of 10 CFR 50.46 are satisfied when Optimized ZIRLO™ fuel rod cladding is implemented.

Therefore, the proposed change to TS Section 4.2.1 does not involve a significant reduction in a margin of safety.

The proposed changes to TS Section 5.6.5 have no impact on any plant configuration or system performance. The proposed changes to TS Section 5.6.5 will add the NRC-approved topical reports, as described, to the list of referenced core operating analytical methods. The proposed changes do not amend the cycle specific parameter limits located in the PVNGS unit specific COLR from the values presently required by the TS. The individual specifications continue to require operation of the plant within the bounds of the limits specified in PVNGS unit specific COLR.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, the NRC staff concludes that the proposed exemption presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and,

accordingly, a finding of no significant hazards consideration is justified (i.e., satisfies the provision of 10 CFR 51.22(c)(9)(i)).

Requirements in 10 CFR 51.22(c)(9)(ii)

The proposed exemption would allow the use of Optimized ZIRLO™ fuel rod cladding material in the reactors. Optimized ZIRLO™ has essentially the same properties as the currently licensed ZIRLO™. The use of the Optimized ZIRLO™ fuel rod cladding material will not significantly change the types of effluents that may be released offsite, or significantly increase the amount of effluents that may be released offsite. Therefore, the provision of 10 CFR 51.22(c)(9)(ii) is satisfied.

Requirements in 10 CFR 51.22(c)(9)(iii)

The proposed exemption would allow the use of the Optimized ZIRLO™ fuel rod cladding material in the reactors. Optimized ZIRLO™ has essentially the same properties as the currently licensed ZIRLO™. The use of the Optimized ZIRLO™ fuel rod cladding material will not significantly increase individual occupational radiation exposure, or significantly increase cumulative occupational radiation exposure. Therefore, the provision of 10 CFR 51.22(c)(9)(iii) is satisfied.

Based on the above, the NRC staff concludes that the proposed exemption meets the eligibility criteria for the categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, in accordance with 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the NRC's proposed issuance of this exemption.

## 5.0 CONCLUSIONS

Based on the NRC staff's regulatory and technical evaluation of the proposed exemption request, as documented above, and supported by the staff's review of PVNGS' compliance with the conditions and limitations applicable to Addenda 1-A and 2-A to CENPD-404-P-A, the staff concludes that (1) the acceptance criteria, analytical requirements, and other requirements in 10 CFR 50.46 and 10 CFR Part 50, Appendix K, are suitable for application to Optimized ZIRLO™ and (2) the intent of 10 CFR 50.46 and 10 CFR Part 50, Appendix K, will continue to be satisfied for the planned operation of PVNGS with Optimized ZIRLO™ fuel cladding. Additionally, based on the evaluation above, the NRC staff concludes that the requested exemption is authorized by law, will not present undue risk to public health and safety, and is consistent with the common defense and security. In addition, the NRC staff concludes that the underlying purpose of 10 CFR 50.46 and 10 CFR Part 50, Appendix K, is achieved through the proposed exemption. Therefore, pursuant to 10 CFR 50.12(a), the NRC staff concludes that the proposed exemption for PVNGS allowing application of 10 CFR 50.46 and 10 CFR Part 50, Appendix K, to fuel clad with Optimized ZIRLO™ is justified.

## 6.0 REFERENCES

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3. Lingam, S. P., U.S. Nuclear Regulatory Commission, letter to Mr. Robert S. Bement, Arizona Public Service Company, "Palo Verde Nuclear Generating Station, Units 1, 2, and 3 – Issuance of Amendments to Revise Technical Specifications to Support the Implementation of Next Generation Fuel (CAC Nos. MF8076, MF8077, and MF8078; EPID L-2016-LLA-0005)," dated January 23, 2018 (ADAMS Accession No. ML17319A107).
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5. Wang, A. B., U.S. Nuclear Regulatory Commission, letter to Entergy Operations, Inc., "Arkansas Nuclear One, Unit No. 2 – Exemption from Requirements of 10 CFR Section 50.46 and Appendix K to 10 CFR Part 50, to Allow Use of Optimized ZIRLO™ as Fuel Rod Cladding Material," dated March 19, 2008 (ADAMS Accession No. ML080370012).
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8. Gresham, J. A., Westinghouse Electric Company, "Submittal of the approved version of WCAP-12610-P-A & CENPD-404-P-A, Addendum 2-A, Revision 0 and WCAP-14342-A & CENPD-404-NP-A Addendum 2-A, Revision 0 'Westinghouse Clad Corrosion Model for ZIRLO and Optimized ZIRLO'" October 2013 (ADAMS Package Accession No. ML13308B412).
9. Richardson, P. W., Westinghouse Electric Company, letter to U.S. Nuclear Regulatory Commission, "Submittal of '-A' Accepted Version of CENPD-404-P, Rev. 0, 'Implementation of ZIRLO™ Cladding Material in CE Nuclear Power Fuel Assembly Designs,'" November 2001 (ADAMS Accession Nos. ML013270001, ML013270010 and ML013270095).

10. Hsueh, K., U.S. Nuclear Regulatory Commission, letter to James A. Gresham Westinghouse Electric Company, "Satisfaction of Conditions 6 and 7 of the U.S. Nuclear Regulatory Commission Safety Evaluation for Westinghouse Electric Company Addendum 1 to WCAP-12610-P-A & CENPD-404-P-A, 'Optimized ZIRLO™,' Topical Report," dated August 3, 2016 (ADAMS Accession No. ML16173A354).
11. Technical Specification Task Force (TSTF) Traveler 363, Revision 0, "Revise Topical Report References in ITS [Improved Technical Specification] 5.6.5, COLR," dated February 22, 2000 (ADAMS Accession No. ML040630088).

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Date: January 23, 2018

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SUBJECT: PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3 –  
EXEMPTION FROM THE REQUIREMENTS OF 10 CFR PART 50,  
SECTION 50.46 AND APPENDIX K (CAC NOS. MF8079, MF8080,  
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