UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the matter of	)	
	)	
ARIZONA PUBLIC SERVICE COMPANY, ET AL.	)	Docket No. 50-530
	)	
	)	
(Palo Verde Nuclear Generating Station, Unit No. 3)	)	

EXEMPTION

I.

Arizona Public Service Company (APS), et al. (the licensee) is the holder of Facility Operating License No. NPF-74, which authorizes operation of Palo Verde Nuclear Generating Station (PVNGS), Unit 3. The facility consists of a pressurized water reactor (PWR) at the licensees' site located in Maricopa County, Arizona. This license provides, among other things, that the licensee is subject to all rules, regulations, and Orders of the Commission now or hereafter in effect.

II.

Section 50.46 of Title 10 of the Code of Federal Regulations (10 CFR 50.46) contains acceptance criteria for emergency core cooling systems (ECCS) for light water nuclear power reactors fueled with uranium oxide pellets within cylindrical zircaloy cladding. Further, 10 CFR 50.46 states that ECCS cooling performance following postulated loss-of-coolant accidents must be calculated in accordance with an acceptable evaluation model. Appendix K to

10 CFR Part 50 contains the required and acceptable features for ECCS evaluation models. Finally, 10 CFR 50.44 contains requirements for the control of hydrogen gas that may be generated after a postulated loss-of-coolant accident in light water power reactors fueled with uranium oxide pellets within cylindrical zircaloy cladding.

III.

By letter dated December 20, 1991, APS submitted an amendment request for PVNGS Unit 3 to allow the substitution of up to a total of 80 fuel rods clad with advanced zirconium-based alloys, other than the conventional Zircaloy-4, in two fuel assemblies. These assemblies would be used for evaluation of in-reactor performance during fuel cycles 4, 5, and 6.

By letter dated December 20, 1991, APS also submitted an exemption request to 10 CFR 50.46, 10 CFR Part 50, Appendix K, and 10 CFR 50.44. These regulations refer to the use of zircaloy, but do not clearly specify what is considered zircaloy. Therefore, the use of advanced zirconium-based alloys, rather than conventional Zircaloy-4, may not be within the regulatory basis.

Pursuant to 10 CFR 50.12(a), "The Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of the regulations of this part, which are - (1) Authorized by law, will not present an undue risk to the public health and safety, and are consistent with the common defense and security. (2) The Commission will not consider granting an exemption unless special circumstances are present. Special circumstances are present whenever - ...(ii) 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...".

The Code of Federal Regulations at 10 CFR 50.46 states: "Each boiling and pressurized light-water nuclear power reactor fueled with uranium oxide pellets within cylindrical Zircaloy cladding must be provided with an emergency core cooling system (ECCS) that must be designed such 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." The Code of Federal Regulations at 10 CFR 50.46 then goes on to give specifications for peak cladding temperature, maximum cladding oxidation, maximum hydrogen generation, coolable geometry, and long term cooling. Since 10 CFR 50.46 specifically refers to fuel with Zircaloy cladding, the use of fuel clad with advanced zirconium-based alloys would, in effect, place the licensee outside the applicability of this section of the Code.

The underlying purpose of the rule is to ensure that facilities have adequate acceptance criteria for ECCS. The fuel rods clad with the advanced zirconium-based alloys will be identical in design and dimension to the fuel rods clad with conventional Zircaloy-4. The advanced cladding materials used in the demonstration fuel assemblies were chosen based on the improved corrosion resistance exhibited in ex-reactor autoclave corrosion tests in both high-temperature water and steam environments. Fuel rods clad with similar

types of advanced zirconium-based alloys have been successfully irradiated in high-temperature PWRs in Europe.

The mechanical properties of the clad made from the advanced zirconium-based alloys meet all the mechanical requirements of the conventional Zircaloy-4 procurement specifications. Thus, the cladding and structural integrity of the fuel rods and fuel assemblies that have the advanced zirconium-based alloys will be maintained.

Therefore, due to these similarities between advanced zirconium-based alloys and Zircaloy-4, the advanced alloys are expected to result in clad and fuel performance similar to Zircaloy-4, such that the 10 CFR 50.46 LOCA acceptance criteria will be satisfied for the advanced zirconium-based cladding. Thus, the underlying purpose of the rule has been met.

Strict interpretation of the regulation would render the criteria of 10 CFR 50.46 inapplicable to the advanced zirconium-based alloys, even though analysis shows that applying the Zircaloy criteria to the advanced zirconium-based alloys yields acceptable results.

A strict application of the regulation in this instance is not necessary to achieve the underlying purpose of the rule. Therefore, special circumstances exist to grant an exemption from 10 CFR 50.46(a)(1)(i) that would allow the licensee to apply the acceptance criteria of 10 CFR 50.46 to a reactor with 80 fuel rods clad with advanced zirconium-based alloys.

The Code of Federal Regulations at 10 CFR 50.44 provides requirements for control of hydrogen gas generated in part by Zircaloy clad fuel after a postulated loss-of-coolant-accident (LOCA). The intent of this rule is to ensure that an adequate means is provided for the control of hydrogen gas that may be generated following a LOCA.

The hydrogen produced in a post-LOCA scenario comes from cladding oxidation from a metal-water reaction. Most of the high temperature oxidation occurs in the β-phase since the diffusion coefficient for oxygen in β-phase of zirconium is significantly greater than that in α-phase zirconium.

The β-phase oxidation resistance of the alloys is expected to be as good as or better than that of Zircaloy-4. It is expected that the alloying element levels adjusted to improve the corrosion resistance of the α-phase of these alloys with respect to the α-phase of Zircaloy-4 will result in an improvement of the corrosion resistance of the β-phase of these alloys as well. It is therefore concluded that the β-phase oxidation rate of the alloys will be comparable to or lower than that of Zircaloy-4 and that the Baker-Just correlation will overpredict the β-phase oxidation of the alloys. A strict interpretation of the rule in this instance would result in the criteria of 10 CFR 50.44 being inapplicable to advanced zirconium-based alloys. Since application of the regulation is not necessary to achieve the underlying purpose of the rule, special circumstances exist to grant an exemption from 10 CFR 50.44 to a reactor containing 80 fuel rods clad with advanced zirconium-based alloys.

Paragraph I.A.5 of Appendix K to 10 CFR Part 50 states that the rates of energy release, hydrogen generation, and cladding oxidation from the metal-water reaction shall be calculated using the Baker-Just equation. However, since the Baker-Just equation presumes the use of Zircaloy clad fuel, strict application of the rule would not permit use of the equation. The intent of this part of the Appendix, however, is to apply an equation that conservatively bounds all post-LOCA scenarios. Due to the similarities in the composition of the advanced zirconium-based alloys and Zircaloy, the

application of the Baker-Just equation in the analysis of advanced zirconium-based clad fuel will conservatively bound all post-LOCA scenarios. Since the use of Baker-Just equation presupposes Zircaloy cladding and post-LOCA scenarios are conservatively bounded, the underlying purpose of the rule will be met. Thus, special circumstances exist to grant an exemption from Paragraph I.A.5 of Appendix K to 10 CFR Part 50 that would allow the licensee to apply the Baker-Just equation to advanced zirconium-based alloys.

IV.

Accordingly, the Commission has determined, pursuant to 10 CFR 50.12(a)(1), that an exemption as described in section III above 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. The Commission has determined, pursuant to 10 CFR 50.12(a)(2)(ii) that special circumstances exist, as noted in Section III above. Therefore, the Commission hereby grants Arizona Public Service Company, et al. an exemption from 10 CFR 50.46, 10 CFR Part 50, Appendix K, and 10 CFR 50.44.

Pursuant to 10 CFR 51.32, the Commission has determined that the granting of this exemption will not have a significant impact on the quality of the human environment (57 FR 24511).

This exemption is effective upon issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Bruce A. Boger, Director
Division of Reactor Projects III/IV/V
Office of Nuclear Reactor Regulation

Dated at Rockville, Maryland
this 17th day of July, 1992.