

July 25, 2005

Mr. Jeffrey S. Forbes  
Site Vice President  
Arkansas Nuclear One  
Entergy Operations, Inc.  
1448 S. R. 333  
Russellville, AR 72801

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT 1 - EXEMPTION FROM 10 CFR 50.46 AND  
10 CFR PART 50, APPENDIX K (TAC NO. MC4612)

Dear Mr. Forbes:

The Commission has approved the enclosed exemption from specific requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.46 and 10 CFR Part 50, Appendix K, for the Arkansas Nuclear One, Unit 1. This action is in response to your letter dated September 30, 2004, to allow use of the M5 advanced alloy for fuel rod cladding.

A copy of the exemption has been forwarded to the Office of the Federal Register for publication.

Sincerely,

**/RA/**

Thomas Alexion, Project Manager, Section 1  
Project Directorate IV  
Division of Licensing Project Management  
Office of Nuclear Reactor Regulation

Docket No. 50-313

Enclosure: Exemption

cc w/encl: See next page

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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION  
ENTERGY OPERATIONS, INC.  
ARKANSAS NUCLEAR ONE, UNIT 1  
DOCKET NO. 50-313  
EXEMPTION

1.0 BACKGROUND

Entergy Operations, Inc. (licensee) is the holder of Renewed Facility Operating License No. DPR-51 which authorizes operation of the Arkansas Nuclear One, Unit 1 (ANO-1) nuclear power plant. The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the Nuclear Regulatory Commission (NRC, Commission) now or hereafter in effect.

The facility consists of a pressurized water reactor located in Pope County, Arkansas.

2.0 REQUEST/ACTION

Title 10 of the *Code of Federal Regulations* (10 CFR) 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 at 10 CFR 50.46 and 10 CFR Part 50, Appendix K make no provisions for use of fuel rods clad in a material other than zircaloy or ZIRLO. Since the chemical composition of the M5 alloy differs from the specifications for zircaloy or ZIRLO, a plant-specific exemption is required to allow the use of the M5 alloy as a cladding material at ANO-1. Therefore, by letter dated September 30, 2004, the licensee requested the use of the M5 advanced alloy for fuel rod cladding at ANO-1.

### 3.0 DISCUSSION

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.

#### Authorized by Law

This exemption results in changes to the operation of the plant by allowing the use of the M5 alloy as fuel 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. In addition, the granting of the licensee's exemption request will not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission's regulations. Therefore, the exemption is authorized by law.

#### No Undue Risk to Public Health and Safety

The underlying purposes of 10 CFR 50.46 and 10 CFR Part 50, Appendix K, are to ensure that facilities have adequate acceptance criteria for the ECCS, and to ensure that cladding oxidation and hydrogen generation are appropriately limited during a LOCA and conservatively accounted for in the ECCS evaluation model, respectively. Topical Report (TR) BAW-10227P, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR

[pressurized-water reactor] Reactor Fuel,” which was approved by the NRC on February 4, 2000, demonstrated that the effectiveness of the ECCS will not be affected by a change from zircaloy fuel rod cladding to M5 fuel rod cladding. In addition, TR BAW-10227P demonstrated that the Baker-Just equation (used in the ECCS evaluation model to determine the rate of energy release, cladding oxidation, and hydrogen generation) is conservative in all post-LOCA scenarios with respect to M5 advanced alloy as a fuel rod cladding material. Based on the above, no new accident precursors are created by using M5 fuel cladding, thus, the probability of postulated accidents is not increased. Also, based on the above, the consequences of postulated accidents are not increased. In addition, the licensee will use NRC-approved methods for the reload design process for ANO-1 reloads with M5 cladding. Therefore, there is no undue risk to public health and safety due to using M5 cladding.

#### Consistent with Common Defense and Security

The exemption requested results in changes to the operation of the plant by allowing the use of the M5 alloy as fuel cladding material in lieu of zircaloy or ZIRLO. This change to the fuel material used in the plant has no relation to security issues. Therefore, the common defense and security is not impacted by this exemption request.

#### Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), 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.

The underlying purpose of 10 CFR 50.46 is to ensure that facilities have adequate acceptance criteria for the ECCS. On February 4, 2000, the NRC staff approved TR BAW-10227P in which Framatome demonstrated that the effectiveness of the ECCS will not be affected by a change from zircaloy fuel rod cladding to M5 fuel rod cladding. The analysis described in the TR also demonstrated that the ECCS acceptance criteria applied to reactors

fueled with zircaloy fuel rod cladding are also applicable to reactors fueled with M5 fuel rod cladding.

The underlying purpose of 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 the ECCS evaluation model. Appendix K 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. In TR BAW-10227P, Framatome demonstrated that the Baker-Just model is conservative in all post-LOCA scenarios with respect to the use of the M5 advanced alloy as a fuel rod cladding material, and that the amount of hydrogen generated in an M5-clad core during a LOCA will remain within the ANO-1 design basis.

The M5 alloy is a proprietary zirconium-based alloy comprised of primarily zirconium (~99 percent) and niobium (~1 percent). The elimination of tin has resulted in superior corrosion resistance and reduced irradiation-induced growth relative to both standard zircaloy (1.7 percent tin) and low-tin zircaloy (1.2 percent tin). The addition of niobium increases ductility, which is desirable to avoid brittle failures.

The NRC staff has reviewed the licensee's advanced cladding material, M5, for PWR fuel mechanical designs as described in TR BAW-10227P. In the safety evaluation for TR BAW-10227P dated February 4, 2000, the NRC staff concluded that, to the extent specified in the staff's evaluation, the M5 properties and mechanical design methodology are acceptable for referencing in fuel reload licensing applications. Therefore, since the underlying purposes of 10 CFR 50.46 and 10 CFR Part 50, Appendix K, Paragraph I.A.5 are achieved through the use of the M5 advanced alloy as a fuel rod cladding material, the special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of an exemption from 10 CFR 50.46 and 10 CFR Part 50, Appendix K exist.

## Summary

The staff has reviewed the licensee's request to use the M5 advanced alloy for fuel rod cladding in lieu of zircaloy or ZIRLO. Based on the staff's evaluation, as set forth above, the staff concludes that the exemption is authorized by law, will not present an undue risk to public health and safety, and is consistent with the common defense and security. In addition, the staff concludes that the underlying purposes of 10 CFR 50.46 and 10 CFR Part 50, Appendix K are achieved through the use of the M5 advanced alloy. Therefore, pursuant to 10 CFR 50.12(a), the staff concludes that the use of the M5 advanced alloy for fuel rod cladding is acceptable and the exemption from 10 CFR 50.46 and 10 CFR Part 50, Appendix K is justified.

## 4.0 CONCLUSION

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12(a), 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 Entergy Operations, Inc. an exemption from the requirements of 10 CFR 50.46 and 10 CFR Part 50, Appendix K to allow the use of M5 cladding at ANO-1.

Pursuant to 10 CFR 51.32, the Commission has determined that the granting of this exemption will not have a significant effect on the quality of the human environment (70 FR 37126).

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 25<sup>th</sup> day of July 2005.

FOR THE NUCLEAR REGULATORY COMMISSION

*/RA/*

Ledyard B. Marsh, Director  
Division of Licensing Project Management  
Office of Nuclear Reactor Regulation

Arkansas Nuclear One

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May 2005