[7590-01-P]

NUCLEAR REGULATORY COMMISSION

[NRC-2010-0062; Docket No. 50-261]

Carolina Power & Light Company

H. B. Robinson Steam Electric Plant, Unit 2

Exemption

1.0 BACKGROUND

Carolina Power & Light Company (the licensee) is the holder of Renewed Facility Operating License No. DPR-23, which authorizes operation of the H. B. Robinson Steam Electric Plant (HBRSEP), Unit 2. 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, the Commission) now or hereafter in effect. The facility consists of one pressurized-water reactor located in New Hill, North Carolina.

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," paragraph (a)(1)(i) provides requirements for reactors containing uranium oxide fuel pellets clad in either zircaloy or ZIRLO. Additionally, Appendix K to 10 CFR Part 50, "ECCS [Emergency Core Cooling System] Evaluation Models," specifies the use of zircaloy or ZIRLO fuel cladding when doing calculations for energy release, cladding oxidation, and hydrogen generation after a postulated loss-of-coolant accident. Therefore, both of these regulations either state or assume that either zircaloy or ZIRLO is used as the fuel rod cladding material.

By letter dated October 19, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML102980142), the licensee requested an exemption from the requirements of 10 CFR 50.46 and Appendix K to 10 CFR Part 50 to allow the use of fuel rods

clad with AREVA's M5 alloy. The advanced zirconium-based M5 alloy is a proprietary alloy and chemically different from zircaloy or ZIRLO fuel cladding materials, which are approved for use. The exemption request related solely to the specific 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 from the requirements of 10 CFR 50.46 and Appendix K to 10 CFR Part 50 is needed to support transition to the AREVA fuel design with advanced zirconium-based M5 alloy at HBRSEP Unit 2.

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. The requested exemption to allow the use of M5 advanced zirconium alloy rather than zircaloy or ZIRLO for fuel cladding material for reloads at HBRSEP, Unit 2, satisfies these requirements as described below.

Authorized by Law

This exemption would allow the use of M5 advanced alloy, in lieu of zircaloy or ZIRLO, for fuel rod cladding in fuel assemblies at HBRSEP, Unit 2. As stated above, 10 CFR 50.12 allows the NRC to grant exemptions from the requirements of 10 CFR 50.46 and Appendix K to 10 CFR Part 50. The NRC staff has determined that granting of the licensee's proposed exemption 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 purpose of 10 CFR 50.46 is to establish acceptance criteria for ECCS performance. In the approved topical report BAW-10227(P)(A), Revision 1, "Evaluation of

Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," dated June 18, 2003, Framatome ANP 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 topical report also demonstrated that the ECCS acceptance criteria applied to reactors fueled with zircaloy clad fuel are also applicable to reactors fueled with M5 fuel rod cladding.

The NRC staff's review and approval of topical report BAW-10227(P)(A), Revision1 addressed all of the important aspects of M5 with respect to ECCS performance requirements: (1) applicability of 10 CFR 50.46(b) fuel acceptance criteria; (2) M5 material properties including fuel rod ballooning and rupture strains; and (3) steam oxidation kinetics and applicability of Baker-Just weight gain correlation. A subsequent NRC-approved topical report, BAW-10240P-A, "Incorporation of M5 Properties in Framatome ANP Approved Methods," further addressed M5 material properties with respect to the loss-of-coolant accident (LOCA) applications.

Appendix K, paragraph I.A.5, of 10 CFR Part 50 ensures 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 topical report BAW-10227(P)(A), Revision 1, Framatome ANP demonstrated that the Baker-Just model is conservative in the evaluated 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 HBRSEP, Unit No. 2, design basis.

The M5 alloy is 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 advanced cladding and structural material, M5, for pressurized-water reactor fuel mechanical designs as described in BAW-10227(P)(A), Revision 1. In the safety evaluation for this topical report, the NRC staff concluded that, to the extent and limitations specified in the staff's evaluation, the properties of M5 and mechanical design methodology are acceptable for referencing in fuel reload licensing applications.

Based on the above, no new accident precursors are created by the use of M5 fuel cladding at HBRSEP, Unit 2; thus, the probability of postulated accidents is not increased. Also, based on the above, the consequences of postulated accidents are not increased. Therefore, there is no undue risk to public health and safety.

Consistent with Common Defense and Security

The proposed exemption would allow the use of M5 advanced alloy, in lieu of zircaloy or ZIRLO, for fuel rod cladding in fuel assemblies at HBRSEP, Unit 2. The M5 fuel rod cladding is similar in design to the current cladding material used at HBRSEP, Unit 2. This change in cladding material will not result in any changes to the security aspects associated with the control of special nuclear material. The change in cladding material is unrelated to other security issues. Therefore, the common defense and security is not impacted by this exemption.

Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12, 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 nuclear power facilities have adequately demonstrated the cooling performance of their ECCS. As discussed above, topical

report BAW-10227(P)(A), Revision 1 concluded that the effectiveness of the ECCS will not be affected by a change from zircaloy fuel rod cladding to M5 fuel rod cladding and also demonstrated that the ECCS acceptance criteria applied to reactors fueled with zircaloy clad fuel 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. Specifically, 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. Topical Report BAW-10227(P)(A), Revision 1, demonstrated that the Baker-Just model is conservative in the evaluated post-LOCA scenarios with respect to the use of the M5 advanced alloy as a fuel rod cladding material.

Based on the above, the underlying purpose of 10 CFR 50.46 and 10 CFR Part 50, Appendix K is still met and literal compliance is not necessary for use of M5 fuel rod cladding. Therefore, the special circumstances required by 10 CFR 50.12 for the granting of an exemption from 10 CFR 50.46 and Appendix K of 10 CFR Part 50 exist.

4.0 CONCLUSION

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 the licensee an exemption from the requirements of 10 CFR 50.46 and Appendix K of 10 CFR 50.

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 (October 26, 2011; 76 FR 6633). This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 31st day of October 2011.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

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