



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

December 29, 2011

Mr. Robert J. Duncan II, Vice President
Carolina Power & Light Company
H. B. Robinson Steam Electric Plant
Unit No. 2
3581 West Entrance Road
Hartsville, South Carolina 29550

SUBJECT: H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2 – ISSUANCE OF AN AMENDMENT ON TECHNICAL SPECIFICATIONS RELATED TO USE OF AREVA'S M5 ADVANCED ALLOY IN FUEL CLADDING AND FUEL ASSEMBLY COMPONENTS (TAC NO. ME4911)

Dear Mr. Duncan:

The Nuclear Regulatory Commission has issued the enclosed Amendment No. 227 to Renewed Facility Operating License No. DPR-23 for the H. B. Robinson Steam Electric Plant, Unit No. 2 (HBRSEP). This amendment changes the HBRSEP Technical Specifications (TSs) in response to your application dated October 20, 2010.

The amendment revises the HBRSEP, TS 4.2.1, "Fuel Assemblies," to permit the use of AREVA's M5 advanced alloy for fuel rod cladding and fuel assembly structural components in future operating cycles. Currently, as stated in TS 4.2.1, the HBRSEP fuel cladding is Zircaloy-4, therefore an amendment request is needed in order to use M5 fuel cladding. The proposed amendment also revises the HBRSEP TS 5.6.5.b, "Core Operating Limits Report (COLR)," to permit the reference of analytical methodologies for M5 material and the deletion of existing analytical methodologies which are no longer planned to be used by the licensee.

It should be noted for completeness that an exemption to the regulations was required in order to review this amendment request. In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.12, on October 19, 2011, the Carolina Power & Light Company, requested an exemption to the requirements of 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Nuclear Power Reactors," and 10 CFR Part 50, Appendix K, "ECCS [Emergency Core Cooling System] Evaluation Models." The NRC noticed in the *Federal Register* on October 26, 2011 (76 FR 66333) an environmental assessment and finding of no significant impact for the proposed action. On November 4, 2011, the NRC noticed in the *Federal Register* (76 FR 68512) the conclusion, made October 31, 2011, that 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 that special circumstances exist, and that the exemption request is granted. The notice also stated pursuant to 10 CFR 51.32, the determination that granting this exemption will not have a significant effect on the quality of the human environment.

R. Duncan

- 2 -

A copy of the related safety evaluation is enclosed. A notice of issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

A handwritten signature in black ink, appearing to read "WanCge for". The signature is written in a cursive, somewhat stylized font.

Brenda L. Mozafari, Senior Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-261

Enclosures:

1. Amendment No. 227 to DPR-23
2. Safety Evaluation

cc w/enclosures: Distribution via ListServ



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

CAROLINA POWER & LIGHT COMPANY

DOCKET NO. 50-261

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 227
Renewed License No. DPR-23

1. The Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment by Carolina Power & Light Company (the licensee), dated October 20, 2010, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in Title 10 of the *Code of Federal Regulations* (10 CFR) Chapter I;
 - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
 - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
 - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
 - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications, as indicated in the attachment to this license amendment; and paragraph 3.B. of Renewed Facility Operating License No. DPR-23 is hereby amended to read as follows:

B. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 227 are hereby incorporated in the license.

The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 60 days.

FOR THE NUCLEAR REGULATORY COMMISSION



Douglas A. Broaddus, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to Operating License No. DPR-23
and the Technical Specifications

Date of Issuance: December 29, 2011

ATTACHMENT TO LICENSE AMENDMENT NO. 227

RENEWED FACILITY OPERATING LICENSE NO. DPR-23

DOCKET NO. 50-261

Replace page 3 of Operating License No. DPR-23 with the attached revised page 3.

Replace the following pages of the Appendix A Technical Specifications with the attached revised pages:

Remove Pages

4.0-1
5.0-25
5.0-26
5.0-27

Insert Pages

4.0-1
5.0-25
5.0-26
5.0-27

The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

- D. Pursuant to the Act and 10 CFR Parts 30, 40 and 70, to receive, possess, and use in amounts as required any byproduct, source, or special nuclear material without restriction to chemical or physical form for sample analysis or instrument and equipment calibration or associated with radioactive apparatus or components;
- E. Pursuant to the Act and 10 CFR Parts 30 and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by operation of the facility.

3. This renewed license shall be deemed to contain and is subject to the conditions specified in the following Commission regulations: 10 CFR Part 20, Section 30.34 of 10 CFR Part 30, Section 40.41 of 10 CFR Part 40, Section 50.54 and 50.59 of 10 CFR Part 50, and Section 70.32 of 10 CFR Part 70; and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

A. Maximum Power Level

The licensee is authorized to operate the facility at a steady state reactor core power level not in excess of 2339 megawatts thermal.

B. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 227 are hereby incorporated in the license.

The licensee shall operate the facility in accordance with the Technical Specifications.

- (1) For Surveillance Requirements (SRs) that are new in Amendment 176 to Final Operating License DPR-23, the first performance is due at the end of the first surveillance interval that begins at implementation of Amendment 176. For SRs that existed prior to Amendment 176, including SRs with modified acceptance criteria and SRs whose frequency of performance is being extended, the first performance is due at the end of the first surveillance interval that begins on the date the Surveillance was last performed prior to implementation of Amendment 176.

4.0 DESIGN FEATURES

4.1 Site Location

The H. B. Robinson Steam Electric Plant, Unit No. 2 is located on the southwest shore of Lake Robinson, in northwest Darlington County, South Carolina. The site location is approximately 25 miles NW of Florence, 35 miles NNE of Sumter, and 56 miles ENE of Columbia, South Carolina.

4.2 Reactor Core

4.2.1 Fuel Assemblies

The reactor shall contain 157 fuel assemblies. Each assembly shall consist of a matrix of Zircaloy-4 or M5 fuel rods with an initial composition of natural or slightly enriched uranium dioxide (UO₂) as fuel material. Limited substitutions of zirconium alloy or stainless steel filler rods for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. 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 nonlimiting core regions.

4.2.2 Rod Cluster Control (RCC) Assemblies

The reactor core shall contain 45 full length RCC assemblies. The control material shall be silver-indium-cadmium, as approved by the NRC.

4.3 Fuel Storage

4.3.1 Criticality

4.3.1.1 The spent fuel storage racks are designed and shall be maintained with:

- a. Fuel assemblies having a maximum U-235 enrichment of 5.0 weight percent;

(continued)

5.6 Reporting Requirements (continued)

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

7. Axial Flux Difference (AFD) limits for Specification 3.2.3; and
 8. Boron Concentration limit for Specification 3.9.1.
- b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC. The approved version shall be identified in the COLR. These methods are those specifically described in the following documents:
1. Deleted
 2. XN-NF-84-73(P), "Exxon Nuclear Methodology for Pressurized Water Reactors: Analysis of Chapter 15 Events," approved version as specified in the COLR.
 3. XN-NF-82-21(A), "Application of Exxon Nuclear Company PWR Thermal Margin Methodology to Mixed Core Configurations," approved version as specified in the COLR.
 4. Deleted
 5. XN-75-32(A), "Computational Procedure for Evaluating Rod Bow," approved version as specified in the COLR.
 6. Deleted
 7. Deleted
 8. XN-NF-78-44(A), "Generic Control Rod Ejection Analysis," approved version as specified in the COLR.
 9. XN-NF-621(A), "XNB Critical Heat Flux Correlation," approved version as specified in the COLR.
 10. Deleted
 11. XN-NF-82-06(A), "Qualification of Exxon Nuclear Fuel for Extended Burnup," approved version as specified in the COLR.
 12. Deleted
 13. Deleted

(continued)

5.6 Reporting Requirements (continued)

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

14. Deleted
15. Deleted
16. ANF-88-054(P), "PDC-3: Advanced Nuclear Fuels Corporation Power Distribution Control for Pressurized Water Reactors and Application of PDC-3 to H. B. Robinson Unit 2," approved version as specified in the COLR.
17. ANF-88-133 (P)(A), "Qualification of Advanced Nuclear Fuels' PWR Design Methodology for Rod Burnups of 62 Gwd/MTU," approved version as specified in the COLR.
18. ANF-89-151(A), "ANF-RELAP Methodology for Pressurized Water Reactors: Analysis of Non-LOCA Chapter 15 Events," approved version as specified in the COLR.
19. EMF-92-081(A), "Statistical Setpoint/Transient Methodology for Westinghouse Type Reactors," approved version as specified in the COLR.
20. EMF-92-153(P)(A), "HTP: Departure from Nucleate Boiling Correlation for High Thermal Performance Fuel," approved version as specified in the COLR.
21. XN-NF-85-92(P)(A), "Exxon Nuclear Uranium Dioxide/Gadolinia Irradiation Examination and Thermal Conductivity Results," approved version as specified in the COLR.
22. EMF-96-029(P)(A), "Reactor Analysis System for PWRs," approved version as specified in the COLR.
23. EMF-92-116, "Generic Mechanical Design Criteria for PWR Fuel Designs," approved version as specified in the COLR.
24. EMF-2103(P)(A), "Realistic Large Break LOCA Methodology for Pressurized Water Reactors," approved version as specified in the COLR.

(continued)

5.6 Reporting Requirements (continued)

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

25. EMF-2310(P)(A), "SRP Chapter 15 Non-LOCA Methodology for Pressurized Water Reactors," approved version as specified in the COLR.
 26. BAW-10240(P)(A), "Incorporation of M5 Properties in Framatome ANP Approved Methods," approved version as specified in the COLR.
 27. EMF-2328(P)(A), "PWR Small Break LOCA Evaluation Model, S-RELAP5 Based," approved version as specified in the COLR.
- c. The core operating limits shall be determined such that all applicable limits (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, Emergency Core Cooling Systems (ECCS) limits, nuclear limits such as SDM, transient analysis limits, and accident analysis limits) of the safety analysis are met.
- d. The COLR, including any midcycle revisions or supplements, shall be provided upon issuance for each reload cycle to the NRC.

5.6.6 Post Accident Monitoring (PAM) Instrumentation Report

When a report is required by Condition B or G of LCO 3.3.3, "Post Accident Monitoring (PAM) Instrumentation," a report shall be submitted within the following 14 days. The report shall outline the preplanned alternate method of monitoring, the cause of the inoperability, and the plans and schedule for restoring the instrumentation channels of the Function to OPERABLE status.

(continued)



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 227 TO

RENEWED FACILITY OPERATING LICENSE NO. DPR-23

CAROLINA POWER & LIGHT COMPANY

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

DOCKET NO. 50-261

1.0 INTRODUCTION

By letter dated October 20, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML102990125, the Carolina Power & Light Company (licensee), doing business as Progress Energy Carolinas Inc. (PEC), submitted a license amendment request for Technical Specifications (TSs) revisions for H. B. Robinson Steam Electric Plant, Unit 2 (HBRSEP). The proposed changes would revise HBRSEP TS 4.2.1, "Fuel Assemblies," to permit the use of AREVA's M5 advanced alloy for fuel rod cladding and fuel assembly structural components in future operating cycles. Currently, as stated in TS 4.2.1, the HBRSEP fuel cladding is zircaloy-4; therefore an amendment request is needed in order to use M5 fuel cladding. The proposed amendment would also revise the HBRSEP TS 5.6.5.b, "Core Operating Limits Report (COLR)," to permit the reference of analytical methodologies for M5 material and the deletion of existing analytical methodologies which are no longer planned to be used by the licensee.

In order to accommodate the high burnups that are required for fuel management and core designs, AREVA has developed the M5 advanced fuel rod cladding and fuel assembly structural material. M5 is an alloy comprised primarily of zirconium (~99 percent) and niobium (~1 percent). The elimination of tin in M5 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 Nuclear Regulatory Commission (NRC)-approved AREVA topical report BAW-10227P-A, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," describes AREVA M5 fuel designs and provides justification for its use in pressurized-water reactor cores (Reference 1). The licensee has stated in its submittal that operating HBRSEP with M5 in the reactor core will continue to meet the plant's licensing limits of HBRSEP. The staff determined that the designation for the topical report "BAW-10227P-A, Revision 1" in the licensee's submittal is an error because the approved version of the topical report has no revision number.

2.0 REGULATORY EVALUATION

The regulations in Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.90, "Application for Amendment of License or Construction Permit," allow a licensee to amend or change the original license. Section 50.92, "Issuance of Amendment," of 10 CFR specifies that the staff will be guided by the considerations which govern the issuance of initial licenses to the extent applicable and appropriate in determining whether an amendment will be issued to the applicant. The licensee requests a license amendment to add M5 as an acceptable fuel rod cladding material in the TS.

The NRC staff reviewed the licensee's amendment request to ensure that operation with M5 clad fuel in the core in accordance with the proposed changes will be within the conditions of operation necessary for application of BAW-10227P-A, Revision 0, as amended, and that the licensee will continue to operate the plant within its design basis and comply with applicable regulatory requirements following implementation of the proposed changes. These include: 1) 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," 2) Appendix A, "General Design Criteria [GDC] for Nuclear Power Plants," to 10 CFR Part 50, GDC 4, 10, 33, 34, and 35; and 3) NRC's Standard Review Plan (NUREG-0800), Section 4.2, "Fuel System Design."

3.0 TECHNICAL EVALUATION

3.1 Addition of M5 Fuel Cladding

The license amendment request would revise the Design Features section of the HBRSEP TS, specifically Section 4.2.1, to include the allowance to use M5 advanced alloy as a fuel rod cladding and fuel assembly structural material. More specifically, Section 4.2.1 adds two words, "or M5," such that the revised TS would read, "Each assembly shall consist of a matrix of zircaloy or M5 fuel rods with an initial composition of natural or slightly enriched uranium dioxide (UO₂) as fuel material."

3.2 Addition of Small Break Loss-of-Coolant Accident (LOCA) Methodology

The staff audited calculations that were performed in accordance with the proposed methodology as described in EMF-2328(P)(A), "PWR Small Break LOCA Evaluation Model, S-RELAP5 Based," (Reference 2). The staff determined that the proposed methodology analyzed emergency core cooling system (ECCS) performance with a generically accepted evaluation model for a spectrum of break sizes, locations, and other properties, and the results were sufficient to provide assurance that the most severe postulated LOCA had been analyzed, consistent with the requirements specified at 10 CFR 50.46(a)(1)(i). The results of the plant-specific calculation demonstrated that the ECCS was capable of mitigating postulated small break LOCAs to within the acceptance criteria specified in 10 CFR 50.46(b). In addition, the licensee's calculations addressed recently identified issues with the analytic methodology described in the letter from AREVA to NRC dated June 24, 2011 (Reference 3). Based on the considerations that (1) the licensee is requesting to apply an acceptable ECCS evaluation model, (2) the evaluation model was acceptably applied as demonstrated by staff audit of plant-specific calculations, and (3) the results of the plant-specific evaluation demonstrated compliance with the 10 CFR 50.46(b) acceptance criteria, the staff finds the proposed

implementation of the EMF-2328 methodology acceptable for referencing in the HBRSEP COLR.

Use of EMF-2328(P)(A) is restricted by break size; however, the licensee analyzed additional break sizes to address issues discussed in Reference 3. The break size condition/limitation in EMF-2328(P)(A) is, therefore, found not to apply to this EMF-2328(P)(A) implementation.

3.3 Analyses and Evaluations

The approved topical reports BAW-10227P-A, Revision 0, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," and BAW-10240(P)(A), "Incorporation of M5 Properties in Framatome ANP Approved Methods," evaluate the material properties of the M5 alloy and conclude that M5 properties are similar or better than those of zircaloy-4 (Reference 4). BAW-10240(P)(A) listed BAW-10227P-A in the reference and was approved to 62 gigawatt days per metric ton of uranium (GWD/MTU) in the staff safety evaluation.

The licensee evaluated the performance of the M5 cladding for both LOCA and non-LOCA scenarios. The licensee's conclusion was that the results with M5 fuel would not be substantially different from the results obtained with only zircaloy in the core. This conclusion is consistent with the conclusions in AREVA topical reports BAW-10227P-A, Revision 0 and BAW-10240(P)(A). Based on the approved topical reports, the NRC staff concludes that the licensee may perform reload analyses to evaluate HBRSEP operation with cores including M5 fuel with its present NRC-approved models adjusted to compensate for the presence of M5 fuel.

3.4 TS Revisions

3.4.1 Section 4.2.1 Fuel Assemblies

The licensee proposes to add M5 as an acceptable fuel rod cladding material. The new sentences are stated as follows:

"Each assembly shall consist of a matrix of zircaloy or M5 fuel rods with"

Based on the approved M5 fuel, the staff concludes that this revision is acceptable for HBRSEP.

3.4.2 Section 5.6.5.b Core Operating Limits Report

The licensee proposes to add the approved AREVA topical reports, BAW-10240(P)(A), "Incorporation of M5 Properties in Framatome ANP Approved Methods," and EMF-2328(P)(A), "PWR Small Break LOCA Evaluation Model, S-RELAP5 Based," to the list of references in the COLR. Based on the approved reports, the staff concludes that the revisions are acceptable for HBRSEP.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the State of South Carolina official, Susan E. Jenkins was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (April 19, 2011; 76 FR 21921). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The staff has reviewed the licensee's license amendment request to permit the use of AREVA's advanced zirconium-based M5 alloy for fuel design. Based on the evaluation, the staff concludes that the M5 fuel design is acceptable to a peak rod average burnup limit of 62 GWD/MTU and the TS revisions are acceptable for HBRSEP.

The NRC has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the NRC's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

7.0 REFERENCES

1. BAW-10227P-A, Revision 0, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," February 2000, ADAMS Accession No. ML003686134.
2. EMF-2328(P)(A), "PWR Small Break LOCA Evaluation Model, S-RELAP5 Based," March 15, 2001.
3. Salas, P., AREVA, letter to NRC, "Pressurized Water Reactor Safety Analysis Licensing Topical Reports," Project 728, AREVA Reference NRC:11:063, June 24, 2011, ADAMS Accession No. ML11179A029.

4. BAW-10240(P)(A), "Incorporation of M5 Properties in Framatome ANP Approved Methods," May 5, 2004.

Principal Contributor: Shih-Lang Wu

Date: December 29, 2011

R. Duncan

- 2 -

A copy of the related safety evaluation is enclosed. A notice of issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

/RA by WGleaves for/

Brenda L. Mozafari, Senior Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-261

Enclosures:

1. Amendment No. 227 to DPR-23
2. Safety Evaluation

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*By memo

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