

**NUCLEAR REGULATORY COMMISSION**

**[Docket No. 50-389; NRC-2016-0085]**

**Florida Power & Light Company;**

**St. Lucie Plant, Unit No. 2**

**AGENCY:** Nuclear Regulatory Commission.

**ACTION:** Exemption; issuance.

**SUMMARY:** The U.S. Nuclear Regulatory Commission (NRC) is issuing an exemption in response to a December 30, 2014, request from Florida Power & Light Company for the use of a different fuel rod cladding material (AREVA M5®).

**ADDRESSES:** Please refer to Docket ID **NRC-2016-0085** when contacting the NRC about the availability of information regarding this document. You may obtain publicly-available information related to this document using any of the following methods:

- **Federal Rulemaking Web Site:** Go to <http://www.regulations.gov> and search for Docket ID **NRC-2016-0085**. Address questions about NRC dockets to Carol Gallagher; telephone: 301-415-3463; e-mail: [Carol.Gallagher@nrc.gov](mailto:Carol.Gallagher@nrc.gov). For technical questions, contact the individuals listed in the FOR FURTHER INFORMATION CONTACT section of this document.

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- **NRC’s PDR:** You may examine and purchase copies of public documents at the NRC’s PDR, Room O1-F21, One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852.

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## **I. Background**

Florida Power & Light Company (the licensee) is the holder of Renewed Facility Operating License No. NPF-16, which authorizes operation of the St. Lucie Plant, Unit No. 2 (PSL-2). The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the NRC now or hereafter in effect. The facility consists of a pressurized-water reactor (PWR) located in St. Lucie County, Florida.

## II. Request/Action

Pursuant to § 50.12, "Specific exemptions," of title 10 of the *Code of Federal Regulations* (10 CFR), the licensee, by letter dated December 30, 2014 (ADAMS Accession No. ML15002A091), requested an exemption from the 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," to allow the use of fuel rods clad with the AREVA M5<sup>®</sup> zirconium alloy in future core reload applications for PSL-2. The regulations in 10 CFR 50.46 contain acceptance criteria for the ECCS for reactors fueled with Zircaloy or ZIRLO<sup>™</sup> fuel rod cladding material. In addition, Appendix K to 10 CFR Part 50 requires that the Baker-Just equation be used to predict the rates of energy release, hydrogen concentration, and cladding oxidation from the metal-water reaction. The Baker-Just equation assumes the use of a zirconium alloy, which is a material different from the M5<sup>®</sup> zirconium alloy. The licensee requested the exemption because these regulations do not have provisions for the use of fuel rods clad in a material other than Zircaloy or ZIRLO<sup>™</sup>. Since the material designations of M5<sup>®</sup> zirconium alloy are different from the designations for Zircaloy or ZIRLO<sup>™</sup>, a plant-specific exemption is required to support the reload applications for PSL-2.

The exemption request relates solely to the cladding material specified in these regulations (i.e., fuel rods with Zircaloy or ZIRLO<sup>™</sup> cladding material). In its letter dated December 30, 2014, the licensee stated that this exemption was requested in order, "to allow the use of a zirconium alloy other than Zircaloy or [ZIRLO<sup>™</sup>] for fuel cladding material at St. Lucie Unit 2." This exemption would provide for the application of the acceptance criteria of 10 CFR 50.46 and Appendix K to 10 CFR part 50 to fuel assembly designs using M5<sup>®</sup> zirconium alloy fuel rod cladding material.

In addition to the exemption request in the letter dated December 30, 2014, the licensee also requested an amendment to revise the Technical Specifications (TSs) to allow for the use of AREVA fuel at PSL-2. The NRC staff has addressed the requested amendment in separate correspondence dated April 19, 2016 (ADAMS Accession No. ML16063A121).

### **III. Discussion**

Pursuant to 10 CFR 50.12, the Commission may, upon application by any interested person, grant exemptions from the requirements of 10 CFR Part 50, which are authorized by law, will not present an undue risk to the public health and safety, and are consistent with the common defense and security. Paragraph (a)(2)(ii) of 10 CFR 50.12 states that the Commission will not consider granting an exemption unless special circumstances are present, such as when application of the regulation in the particular circumstance is not necessary to achieve the underlying purpose of the rule.

#### **A. 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 is not necessary to achieve the underlying purpose of the rule. The underlying purpose of 10 CFR 50.46 and Appendix K to 10 CFR Part 50 is to establish acceptance criteria for ECCS performance. The regulations in 10 CFR 50.46 and Appendix K are not directly applicable to M5<sup>®</sup> cladding material because the M5<sup>®</sup> cladding material is not specified in 10 CFR 50.46 or presumed in the Baker-Just equation required by paragraph I.A.5 of 10 CFR Part 50, Appendix K. The evaluations described in the

following sections of this exemption, however, show that the intent of the regulation is met in that subject to certain conditions, the acceptance criteria are valid for M5<sup>®</sup> zirconium-based alloy cladding, the material is less susceptible to embrittlement, and the Baker-Just equation conservatively bounds scenarios following a loss-of-coolant accident (LOCA) for rods with M5<sup>®</sup> cladding material. Thus, a strict application of the rule (which would preclude the applicability of ECCS performance acceptance criteria to, and the use of, M5<sup>®</sup> clad fuel rods) is not necessary to achieve the underlying purposes of 10 CFR 50.46 and Appendix K of 10 CFR Part 50. The purpose of these regulations is achieved through the application of the requirements for the use of M5<sup>®</sup> fuel rod cladding material. Therefore, the special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of an exemption exist.

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

This exemption would allow the use of fuel rods clad with the AREVA M5<sup>®</sup> fuel rod cladding material in future core reload applications for PSL-2. Section 50.12 of 10 CFR allows the NRC to grant exemptions from the requirements of 10 CFR Part 50 provided that special circumstances are present. The NRC staff determined that granting the licensee's proposed exemption would 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.

**C. The Exemption Presents No Undue Risk to Public Health and Safety**

Section 50.46 of 10 CFR requires that each boiling or pressurized light-water nuclear power reactor fueled with uranium oxide pellets within cylindrical Zircaloy or ZIRLO<sup>™</sup> cladding

must be provided with an ECCS that must be designed so that its calculated cooling performance following postulated LOCAs conforms to the criteria set forth in paragraph (b) of that section. The underlying purpose of 10 CFR 50.46 is to establish acceptance criteria for adequate ECCS performance at nuclear reactors.

Framatome Cogema Fuels (AREVA) submitted topical report BAW-10227P-A, Revision 0, "Evaluation of Advanced Cladding and Structural Material (M5<sup>®</sup>) in PWR Reactor Fuel," to the NRC for review and approval by letter dated September 30, 1997. The NRC staff documented its approval of BAW-10227P-A, Revision 0 in a safety evaluation (SE) dated February 4, 2000 (ADAMS Accession No. ML003681490) and concluded that 10 CFR 50.46 and 10 CFR Part 50, Appendix K criteria are applicable to M5<sup>®</sup> fuel cladding, subject to compliance with specified burnup conditions. The NRC-accepted version of BAW-10227P-A, Revision 0 was submitted to the NRC by letter dated February 11, 2000 (ADAMS Accession No. ML003685828). BAW-10227P-A, Revision 1, dated June 2003, as noted by letter dated April 19, 2004 (ADAMS Accession No. ML15162B047), is a subsequent revision to BAW-10227P-A, Revision 0 and incorporated the portion of the NRC's approval provided in the NRC SE for BAW-10186P-A, Revision 1, Supplement 1, "Extended Burnup Evaluation," dated June 18, 2003 (ADAMS Accession No. ML031700090), in which the applicable restrictions on burnup were removed. Additionally, in an SE dated May 5, 2004 (ADAMS Accession No. ML041260560), the NRC staff approved topical report BAW-10240(P), "Incorporation of M5 Properties in Framatome ANP [AREVA] Approved Methods," which further addressed M5<sup>®</sup> material properties with respect to LOCA applications and included specified conditions.

The specific conditions that address the use of M5<sup>®</sup> under approved methods that were provided in the SE for BAW-10240(P) are: (1) the corrosion limit, as predicted by the best-estimate model, will remain below 100 microns for all locations of the fuel; (2) all of the

conditions listed in the NRC SEs for all AREVA methodologies used for M5<sup>®</sup> fuel analysis will continue to be met; (3) all AREVA methodologies will be used only within the range for which M5<sup>®</sup> data was acceptable and for which the verifications discussed in the applicable topical reports were performed; and (4) the burnup limit for implementation of M5<sup>®</sup> is 62 gigawatt-days per metric ton uranium metal (GWd/MTU). The staff determined that the licensee has satisfied these conditions. The corrosion limit stated in condition (1) is verified by the licensee for each reload as required by TS 6.9.1.11, "Core Operating Limits Report (COLR)." The conditions from NRC-approved SEs stated in condition (2) are incorporated as restrictions in AREVA design procedures and guidelines that will control the core reload designs for PSL-2, which are also verified for each reload as required by the COLR. The restrictions on the use of AREVA methodologies stated as condition (3) are also incorporated as restrictions in AREVA design procedures and guidelines that will control the core reload designs for PSL-2, which are also verified for each reload as required by the COLR. Finally, the burnup limit stated in condition (4) is currently part of AREVA's design processes (as stated by the licensee), and is also verified as part of the cycle-specific reload analysis as required by the COLR.

In the exemption granted for PSL, Unit No. 1, for the application and use of AREVA M5<sup>®</sup> fuel rod cladding material, dated March 31, 2014 (ADAMS Accession No. ML14064A125), the NRC staff described the applicable results from the LOCA research program completed at the Argonne National Laboratory. The results showed that cladding corrosion and associated hydrogen pickup had a significant impact on post-quench ductility. The research also provided further evidence of favorable corrosion and hydrogen pickup characteristics of M5<sup>®</sup> as compared with standard Zircaloy and that, due to its favorable hydrogen pickup, fuel rods with M5<sup>®</sup> zirconium-based alloy cladding are less susceptible to hydrogen-enhanced beta layer embrittlement, a new embrittlement mechanism. In addition, the exemption documented that

the 10 CFR 50.46(b) acceptance criteria (i.e., 2200 degrees Fahrenheit and 17-percent equivalent cladding reacted) remain conservative up to the current burnup limit of 62 GWd/MTU and that the acceptance criteria within 10 CFR 50.46 remain valid for the M5<sup>®</sup> alloy material. As a result, the NRC staff found that the underlying purpose of the rule – to maintain a degree of post-quench ductility in the fuel cladding material through ECCS performance criteria – would be met if an exemption were granted to allow those criteria to apply to M5<sup>®</sup> clad fuel. This conclusion remains valid for an exemption for PSL-2 for the application and use of AREVA M5<sup>®</sup> fuel rod cladding material.

In addition, as stated by the licensee in its application, “FPL [Florida Power & Light Company], in conjunction with AREVA NP Inc. (AREVA), will utilize NRC[-]approved methods for the reload design process, for PSL-2 reload cores containing M5<sup>®</sup> fuel rod cladding, to ensure safety analysis limits are met for operation within the operating limits specified in the Technical Specifications.” The licensee also stated that it will “ensure compliance with the respective acceptance criteria” and that “the intent of 10 CFR 50.46 and 10 CFR 50, Appendix K will continue to be satisfied.” Therefore, for the reasons stated above, granting the exemption request will ensure that the underlying purpose of the rule is achieved for PSL-2.

Paragraph I.A.5 of Appendix K to 10 CFR Part 50 states that the rate of energy release, hydrogen concentration, and cladding oxidation from the metal-water reaction shall be calculated using the Baker-Just equation. The approved AREVA topical reports show that due to the similarities in the chemical composition of the advanced zirconium-based M5<sup>®</sup> alloy and Zircaloy, the application of the Baker-Just equation in the analysis of the M5<sup>®</sup> clad fuel rods will continue to conservatively bound all post-LOCA scenarios. For the reasons stated above, granting the exemption request will ensure that the Baker-Just equation can be applied to M5<sup>®</sup> clad fuel and that the underlying purpose of the rule is achieved for PSL-2.



Based upon results of metal-water reaction testing and mechanical testing, which ensure the applicability of 10 CFR 50.46 acceptance criteria and 10 CFR Part 50, Appendix K, methods, the NRC staff finds it acceptable to grant an exemption from the requirements of 10 CFR 50.46 and Appendix K to 10 CFR Part 50 to allow these regulations to apply to, and enable the use of, fuel rods with M5<sup>®</sup> zirconium-based alloy at PSL-2. Therefore, the exemption presents no undue risk to public health and safety.

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

The licensee's exemption request is only to allow the application of the aforementioned regulations to an improved fuel rod cladding material. In its letter dated December 30, 2014, the licensee stated that all the requirements and acceptance criteria will be maintained and that it would continue to handle and control special nuclear material in the fuel product in accordance with its approved procedures. This change to the reactor core internals is adequately controlled by NRC requirements and is not related to security issues. Therefore, the NRC staff has determined that this exemption does not impact common defense and security and is consistent with the common defense and security.

**E. 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)(i) – (iii).

#### 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?

The proposed changes for PSL-2 revise TS 5.3.1 to include M5<sup>®</sup> cladding, delete the linear heat rate surveillance requirement with W(z) in TS 4.2.1.3, and include previously approved AREVA topical reports in the list of COLR methodologies in TS 6.9.1.11. [Another] change is in TS License Condition 3.N, which is related to future analysis of the current fuel and is considered an administrative change, all as a result of changing the fuel supplier.

The fuel assembly design is not an initiator to any accident previously evaluated. Therefore, there is no significant increase in the probability of any accident previously evaluated. However, the fuel design parameters and the correlations used in the analyses supporting the operation of PSL-2 with the new proposed AREVA fuel are dependent on the fuel assembly design. All the analyses, potentially impacted by the fuel design, have been re-analyzed using the correlations and the methodology applicable to the proposed fuel design

and previously approved by the NRC for similar applications. There are no changes to any limits specified in the TSs. M5<sup>®</sup> cladding to be used in the proposed AREVA fuel design has been previously approved by the NRC for PWR applications, including the St. Lucie Plant, Unit No. 1. The core design peaking factors remain unchanged from the current analyses values, except for the large break LOCA, which is shown to meet all the 10 CFR 50.46 criteria with the increased peak linear heat rate limit.

Therefore, the proposed changes do 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?

No new or different accidents result from utilizing the proposed AREVA CE [Combustion Engineering] 16x16 fuel design [and M5<sup>®</sup> cladding]. Other than the fuel design change, the proposed exemption does not involve a physical alteration of the plant or plant systems (i.e., no new or different type of equipment will be installed which would create a new or different kind of accident). The change to the linear heat rate surveillance requirement, when operating on excore detector monitoring system, and the use of M5<sup>®</sup> cladding do not affect or create any accident initiator. There is no change to the methods governing normal plant operation and the changes do not impose any new or different operating requirements. The core monitoring system remains unchanged.

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

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

The changes proposed in this exemption are related to the fuel design with M5<sup>®</sup> cladding and the methodology supporting the analysis of accidents impacted by the fuel design change.

The analysis methods used are previously approved by the NRC for similar applications. The change to the surveillance requirement for the linear heat rate does not change any accident analysis requirements. The fuel design limits related to the DNBR [departure from nucleate boiling ratio] and fuel centerline melt remain consistent with the limits previously approved for the proposed fuel design change. The overpressure limits for the reactor coolant system integrity and the containment integrity remain unchanged. All of the analyses performed to support the fuel design change meet all applicable acceptance criteria. The LOCA analyses, with the peak linear heat rate limit increase, continue to meet all of the applicable 10 CFR 50.46 acceptance criteria, and thus the proposed changes do not affect margin of safety for any accidents previously evaluated.

Therefore, the proposed changes do 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.

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

The proposed exemption would allow the use of M5<sup>®</sup> fuel rod cladding material in the PSL-2 reactor. M5<sup>®</sup> has essentially the same properties as the currently licensed Zircaloy fuel rod cladding. The use of the M5<sup>®</sup> 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 provisions of 10 CFR 51.22(c)(9)(ii) are satisfied.

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

The proposed exemption would allow the use of the M5<sup>®</sup> fuel rod cladding material in the PSL-2 reactor core. M5<sup>®</sup> has essentially the same properties as the currently used Zircaloy cladding. The use of the M5<sup>®</sup> fuel rod cladding material will not significantly increase individual occupational radiation exposure, or significantly increase cumulative occupational radiation exposure. Therefore, the provisions of 10 CFR 51.22(c)(9)(iii) are satisfied.

**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, as required by 10 CFR 50.12(a)(2)(ii), are present. Therefore, the Commission hereby grants the licensee an exemption from the requirements of 10 CFR 50.46 and Appendix K to 10 CFR Part 50, to allow the use of M5<sup>®</sup> fuel rod cladding material at PSL-2.

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 19<sup>th</sup> of April, 2016.

For the Nuclear Regulatory Commission.

**/RA/**

Anne T. Boland, Director,  
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