



[7590-01-P]

NUCLEAR REGULATORY COMMISSION

[Docket Nos. 50-321 and 50-366; NRC-2008-0585]

Southern Nuclear Operating Company, Inc.

Edwin I. Hatch Nuclear Plant, Units 1 and 2

Exemption

1.0 BACKGROUND

The Southern Nuclear Operating Company, Inc. (SNC, the licensee) is the holder of the Renewed Facility Operating License Nos. DPR-57 and NPF-5 which authorize operation of the Edwin I. Hatch Nuclear Plant, Units 1 and 2 (HNP). The licenses provide, among other things, that the facility is subject to the rules, regulations, and orders of the U.S. Nuclear Regulatory Commission (NRC) now or hereafter in effect.

The HNP facility consists of two boiling-water reactors located in Appling County, Georgia.

2.0 REQUEST/ACTION

Pursuant to § 50.12 of Title 10 of the *Code of Federal Regulations* (10 CFR), Specific Exemptions, SNC has, by letter dated April 23, 2013, requested an exemption from the fuel cladding material requirements in 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems [ECCS] for light-water nuclear power reactors," and Appendix K to 10 CFR Part 50, "ECCS Evaluation Models," (Appendix K).

The SNC's letter of April 23, 2013, constitutes the licensee's second request for an exemption from the above fuel cladding material requirements in order to irradiate two GE14

Lead Test Assemblies (LTAs) in the HNP. The LTAs include a limited number of fuel rods manufactured with an advanced cladding alloy, known as Global Nuclear Fuel (GNF) Ziron, which is outside of the cladding materials specified in the regulations (i.e. zircaloy or ZIRLO™). By letter dated November 7, 2008, the NRC approved an earlier SNC request for an exemption in order to irradiate these two GE14 LTAs in the HNP Unit 2 reactor for cycles 21, 22 and 23. These two LTAs have now completed operation in cycles 21 and 22; however, SNC decided not to include them in the Unit 2 cycle 23 core loading in order to allow sufficient time to perform pool-side inspections. Since the original exemption request applied only to the operation of the LTAs in the Unit 2 reactor for cycles 21-23, SNC has requested a second exemption in order to continue irradiation of the LTAs in either of the HNP reactors for one or more additional cycles, up to GNF's approved peak pellet exposure.

The regulation in 10 CFR 50.46 contains acceptance criteria for an ECCS for reactors fueled with zircaloy or ZIRLO™ cladding. In addition, Appendix K 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 exemption request relates 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 is needed to irradiate a lead test assembly (LTA) comprised of different cladding alloys at HNP.

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 the public health and safety, and are consistent with the common defense and security; and (2) when

special circumstances are present. Under 10 CFR 50.12(a)(2), special circumstances include, among other things, when application of the regulation in the particular circumstances would not serve, or is not necessary to achieve, the underlying purpose of the rule.

Authorized by Law

This exemption would allow the licensee to insert two lead test fuel assemblies with fuel rod cladding that does not meet the definition of zircaloy or ZIRLO,™ as specified by 10 CFR 50.46, and Appendix K, in either of the HNP reactors for one or more additional cycles, up to GNF's approved peak pellet exposure. As stated above, 10 CFR 50.12 allows the NRC to grant exemptions from the requirements of 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

In regard to the fuel mechanical design, the exemption request relates solely to the specific types of cladding material specified in the regulations. The underlying purpose of 10 CFR 50.46 is to establish acceptance criteria for ECCS. In Section VI of its letter dated April 23, 2013, SNC provides a technical basis supporting the applicability of the 50.46 Paragraph (b) fuel criteria to GNF-Ziron. Experimental results from tests conducted on GNF-Ziron samples exposed to loss-of-coolant accident (LOCA) conditions were provided by SNC. While these tests differ from the post-steam oxidized ring-compression testing (which forms the basis of the 10 CFR 50.46 post-quench ductility criteria), these results provide reasonable assurance that the 17 percent oxidation and 2200 degree Fahrenheit criteria are valid for GNF-Ziron and meet the underlying purpose of the rule, which is to maintain a degree of post-quench ductility in the fuel cladding material.

As discussed in the NRC Research Information Letter 0801, "Technical Basis for Revision of Embrittlement Criteria in 10 CFR 50.46," ADAMS Accession No. ML081350225, based on an ongoing LOCA research program at Argonne National Laboratory, cladding corrosion (and associated hydrogen pickup) has a significant impact on post-quench ductility. Post-irradiation examinations provided by the licensee demonstrate the favorable hydrogen pickup characteristics of GNF-Ziron as compared with standard zircaloy. Hence, the GNF-Ziron fuel rods would be less susceptible to the detrimental effects of hydrogen uptake during normal operation and their impact on post-quench ductility.

Paragraph I.A.5 of Appendix K to 10 CFR Part 50 states that the rate of energy release, hydrogen generation, and cladding oxidation from the metal/water reaction shall be calculated using the Baker-Just equation. Since the Baker-Just equation presumes the use of zircaloy clad fuel, strict application of the rule would not permit use of the equation for the LTA cladding for determining acceptable fuel performance. Metal-water reaction tests performed by GNF on GNF-Ziron, as described in the application for exemption, demonstrate conservative reaction rates relative to the Baker-Just equation. Thus, application of Appendix K, Paragraph I.A.5 is not necessary for the licensee to achieve its underlying purpose in these circumstances.

High temperature perforation test results were included in the application. These test results illustrate similar burst characteristics of GNF-Ziron as compared with standard zircaloy. In addition, the licensee provides further comparisons of material properties between GNF-Ziron and zircaloy. Based upon this comparison of material properties, GNF and SNC believe that currently approved methods and models are directly applicable to GNF-Ziron. Based upon the material properties provided in SNC's letter dated April 23, 2013, the NRC staff finds the use of current LOCA models and methods acceptable for the purpose of evaluating LTAs containing a limited number of GNF-Ziron fuel rods. The staff notes that Section V of GNF's technical basis document (Enclosure 2 of the April 23, 2013 application) states that the GNF fuel rod thermal

mechanical code PRIME03 is now being used to assess fuel rod performance. The PRIME03 code, which accounts for exposure-dependent fuel thermal conductivity, replaces the legacy GESTRM fuel rod performance code. While not explicitly approved for GNF-Ziron, the use of PRIME03 is consistent with the approved GNF reload methodology and therefore acceptable.

Through the mechanical testing and a comparison of material properties provided by SNC, the staff has reasonable assurance that anticipated in-reactor performance will be acceptable. Further, the licensee has demonstrated that the use of current methods and models are reasonable for evaluating the cladding's performance in response to anticipated operational occurrences and accidents. Nevertheless, as with any developmental cladding alloy, the NRC staff requires a limitation on the total number of fuel rods clad in a developmental alloy in order to ensure a minimal impact on the simulated progression and calculated consequences of postulated accidents. This limitation is directly related to the available material properties (both unirradiated and irradiated) used to judge the cladding alloy's anticipated in-reactor performance. Based on the material properties data presented within the application attachments, the NRC staff finds the HNP LTA program acceptable with respect to achieving the underlying purpose of 10 CFR 50.46 and Appendix K to 10 CFR Part 50.

Based upon results of metal-water reaction tests and mechanical testing which ensure the applicability of ECCS models and acceptance criteria, the limited number and anticipated performance of the advanced cladding fuel rods, and the use of approved LOCA models to ensure that the LTAs satisfy 10 CFR 50.46 acceptance criteria, 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 for the use of two LTAs in either of the HNP reactors for one or more additional cycles, up to GNF's approved peak pellet exposure.

Consistent with Common Defense and Security

The proposed exemption would allow the licensee to insert two lead test fuel assemblies with fuel rod cladding that does not meet the definition of zircaloy or ZIRLO™ as specified by 10 CFR 50.46, and Appendix K, into either of the HNP reactors for one or more additional cycles, up to GNF's approved peak pellet exposure. This change has no relation to 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 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 emergency core cooling system performance. The wording of the regulations in 10 CFR 50.46 and Appendix K is not directly applicable to Ziron, even though the evaluations discussed above show that the intent of the regulations is met. Therefore, since the NRC staff finds that the underlying purpose of 10 CFR 50.46 and Appendix K is achieved with the use of Ziron, the special circumstances required by 10 CFR 50.12 for the granting of an exemption from 10 CFR 50.46 and Appendix K exist.

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 SNC an exemption from the requirements of 10 CFR 50.46, and 10 CFR Part 50, Appendix K, to allow the limited use of two LTAs with selected rods clad with GNF-Ziron cladding in either of the HNP reactors for one or more additional cycles, up to GNF's approved peak pellet exposure.

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 (79 FR 4983; January 30, 2014).

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 4th day of February 2014.

FOR THE NUCLEAR REGULATORY COMMISSION

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