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SUBJECT: Requests exemption from certain requirements re cladding matls specified in 10CFR50.44,10CFR50.46 & 10CFR50,App K,per 10CFR50.12.Licensee intends to use M5 cladding at ONS, pending approval of exemption of associated license amend.

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September 15, 1999

U. S. Nuclear Regulatory Commission
Washington, D. C. 20555-0001

Attention: D. E. LaBarge

Subject: Oconee Nuclear Station, Units 1, 2, and 3
Docket Numbers 50-269, 50-270, and 50-287
Request for Exemption Pursuant to 10 CFR 50.12 - Exemption to the Cladding Material Specified in 10 CFR 50.44, 10 CFR 50.46 and 10 CFR 50 Appendix K

Pursuant to 10 CFR 50.12, Duke Energy Corporation ("Duke") requests an exemption from certain requirements of 10 CFR 50.44, "Standards for Combustible Gas Control in Light-Water-Cooled Power Reactors," 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Nuclear Power Reactors," and Appendix K of 10 CFR 50, "ECCS Evaluation Models." The exemption requested relates solely to the specific types of cladding material specified in these regulations for use in light water reactors. As written, these regulations presume the use of Zircaloy or ZIRLO™ fuel rod cladding. In order to use a different cladding material, a limited exemption to these regulations is needed.

As demonstrated in the attachment to this letter, the exemption requested is authorized by law, presents no undue risk to public health and safety, is consistent with common defense and security and is supported by special circumstances.

In accordance with Duke internal procedures and the Quality Assurance Program Topical Report, this request for exemption has been reviewed and approved by Oconee's Plant Operations Review Committee and the Duke Corporate Nuclear Safety Review Board.

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Pending approval of this exemption and an associated license amendment related to changes in the fuel design, Duke intends to use M5 cladding at the Oconee Nuclear Station

(ONS). The first anticipated use of M5 cladding is for ONS Unit 1 Cycle 20. The license amendment for this cycle is planned to be submitted in February of 2000. ONS Unit 1 Cycle 20 is scheduled to start in December 2000, with a fuel order date of December 1999. In order to avoid a delay in fuel fabrication, Duke requests that the NRC issue the requested exemption by December 15, 1999. If there are any questions regarding this request, please contact Edwin Price Jr. @ (864) 885-4388.

Very truly yours,

W. R. McCollum Jr.
Vice President Oconee Nuclear Site

Attachment

cc:

U.S. Nuclear Regulatory Commission Document Control Desk

L.A. Reyes, Regional Administrator
Region II

D.E. Billings, Acting Senior Resident Inspector
Oconee Nuclear Site

D.E. LaBarge, Senior Project Manager
NRR

Attachment
Exemption Request for the Oconee Nuclear Station from 10 CFR 50.44, 10 CFR 50.46, and 10 CFR Part 50, Appendix K Regarding the Proposed Use of the M5 Advanced Alloy Fuel Rod Cladding

In accordance with 10 CFR 50.12, Duke Power requests an exemption from the requirements of 10 CFR 50.44, 10 CFR 50.46, and 10 CFR Part 50, Appendix K related to the specific cladding material for the Oconee Nuclear Station (ONS). This exemption request pertains to the proposed use of the M5 advanced alloy material for the ONS fuel rod cladding.

Background

10 CFR 50.44, 10 CFR 50.46, and 10 CFR Part 50, Appendix K specifically contemplate the use of Zircaloy or ZIRLO™ as the fuel rod cladding material. Framatome Cogema Fuels (FCF) developed the M5 advanced fuel rod cladding material to accommodate higher fuel rod burnups and to increase the performance margins with respect to fuel rod corrosion and fuel rod growth. M5 is an alloy comprised primarily of zirconium and niobium. M5 cladding has demonstrated superior corrosion resistance and reduced irradiation induced growth compared to standard and low-tin Zircaloy. The chemical composition of the M5 advanced alloy differs slightly from the specification of both Zircaloy and ZIRLO™. The regulations set forth at 10 CFR 50.44, 10 CFR 50.46, and 10 CFR Part 50, Appendix K contain acceptance and analytical criteria regarding the light water nuclear reactor system performance during and following a postulated loss-of-coolant-accident (LOCA). Since these regulations assume the use of only two types of cladding material - Zircaloy and ZIRLO™ - a narrow exemption permitting the use of a more advanced cladding material is necessary in order to analyze system performance for a cladding material other than Zircaloy or ZIRLO™.

In 1997, the NRC proposed a rule change (RM #449) to eliminate the need for licensees to seek exemptions from the regulations to take advantage of advancements in cladding materials. Given that this rule change has not been enacted, an exemption from these regulations is necessary.

Discussion

10 CFR 50.12 allows the Nuclear Regulatory Commission to grant exemptions provided three conditions are met. The

three conditions are: 1) the exemption is authorized by law, 2) the exemption will not present an undue risk to the health and safety of the public, 3) the exemption is consistent with the common defense and security. In addition, the Commission will not consider granting an exemption unless special circumstances are present. Special circumstances are present, for example, when 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; 10 CFR 50.12(a)(2)(ii).

The requested exemption to allow the use of M5 cladding material rather than Zircaloy or ZIRLO™ in fuel to be supplied to ONS satisfies these criteria as described below.

1. This exemption request is authorized by law

The selection of a specific cladding material in 10 CFR 50.44, 10 CFR 50.46, and implied in 10 CFR Part 50, Appendix K, was adopted at the discretion of the Commission consistent with its statutory authority. No statute required the NRC to adopt this specification. The NRC has the authority under Section 50.12 to grant exemptions from the requirements of Part 50 upon showing proper justification. As such, this requested exemption is "authorized by law", as required by 10 CFR 50.12 (a)(1).

It should be noted that, by submitting this exemption request, Duke Power does not seek an exemption from the acceptance and analytical criteria of 10 CFR 50.44, 10 CFR 50.46, and 10 CFR Part 50, Appendix K. The intent of the request is solely to allow the use of criteria set forth in these regulations for application to the M5 cladding material.

2. Granting this exemption request will not present an undue risk to public health and safety

As demonstrated below, the acceptance criteria of 10 CFR 50.44 and 10 CFR 50.46 are appropriately applicable to M5 cladding. In addition, the Baker-Just equation, required by Appendix K of 10 CFR Part 50, is also shown to conservatively predict the oxidation rate for M5 cladding. The reload safety analysis will continue to ensure that these acceptance criteria are met following the implementation of M5 cladding. Fuel using M5 cladding will be evaluated using NRC approved analytical methods and will specifically address the changes in cladding material properties. The safety analysis for the Oconee Nuclear Station will be supported by the applicable Technical

Specifications. Cores utilizing M5 cladding will continue to be operated in accordance with the operating limits specified in the Technical Specifications. Thus, the granting of this exemption request will not pose an undue risk to public health and safety.

3. Granting this exemption request is consistent with common defense and security

As noted above, the exemption request is only to allow the application of the aforementioned regulations to a different, more advanced, cladding material. All of the requirements and acceptance criteria will be maintained. Accordingly, the grant of such a request is consistent with the common defense and security.

Special circumstances support the issuance of an exemption

10 CFR 50.12(a)(2) allows the NRC to grant an exemption to the regulations when special circumstances are present. The special circumstances described in 10 CFR 50.2 (a)(2)(ii) are present in that application of these regulations in the particular circumstances described is not necessary to achieve the underlying purpose of the rule.

The underlying purpose of 10 CFR 50.46 is to ensure that light-water nuclear power reactors have an adequate emergency core cooling system (ECCS) to mitigate a LOCA event (62 Fed. Reg. 6564 (1997)). To assess the adequacy of the ECCS design, 10 CFR 50.46 establishes five acceptance criteria.

The first two of these criteria, peak cladding temperature less than 2200 °F and maximum local cladding oxidation below 17%, were established by the NRC to preclude the possibility that the cladding would shatter as a result of the thermal stress imposed during core quench (Reference 1). These criteria were developed from testing on Zircaloy cladding material and are not *a priori* valid for other materials. To establish that these criteria are valid for the M5 alloy cladding, Framatome Technologies, Inc. (FTI) had brittle fracture tests conducted. The test results are summarized in Reference 2, currently under NRC review. The test results demonstrate that the performance of the M5 alloy is essentially equivalent to Zircaloy relative to brittle fracture. Therefore, these acceptance criteria for ECCS calculations are valid for application to M5 alloy cladding.

The third and fourth criteria, 1% core wide oxidation and core coolable geometry are, as criteria, not dependent on the characteristics of the cladding. The 1% core wide oxidation criterion is concerned with limiting the amount of

hydrogen generated. The coolable geometry criterion is to ensure that the core temperatures will remain low provided adequate ECCS injection is provided to the core. While certain cladding performance is required in order to meet the acceptance criteria, the acceptance criteria themselves are not dependent on the cladding material. Therefore, these acceptance criteria are applicable to the M5 cladding material just as they are applicable to Zircaloy or ZIRLO™.

The fifth criterion, long-term cooling, is designed to ensure the cladding temperatures will remain low following a LOCA and that the decay heat from the long-lived radionuclides will be removed for the extended period required (60 Fed. Reg. 39021 (1995)). This requirement is an ECCS flow requirement and not related to the details of the cladding material or design. Therefore, the underlying purpose of this criterion will be met with the use of M5 cladding.

In summary, the five acceptance criteria identified in 10 CFR 50.46 and established for Zircaloy or ZIRLO™ cladding, are applicable to M5 cladding and the reload safety analysis will ensure that these criteria are met when M5 cladding is used at the Oconee Nuclear Station. Thus, strict application of the portion of 10 CFR 50.46 which refers solely to Zircaloy and ZIRLO™ as cladding materials is not necessary to achieve the underlying purpose of 10 CFR 50.46.

The Oconee Nuclear Station employs an ECCS evaluation model that conforms with the requirements of 10 CFR Part 50, Appendix K. Paragraph I.A.5 of 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. The Baker-Just equation is known to provide a conservative representation of Zircaloy cladding oxidation. To verify that the Baker-Just equation is similarly appropriate for application to M5 cladding, FTI conducted high temperature oxidation tests. At high temperatures the oxidation rates for M5 alloy and Zircaloy-4 are essentially the same. At lower temperatures, the M5 oxidation (corrosion) rate is substantially lower than Zircaloy-4. For both cladding materials, the Baker-Just equation conservatively bounds the data. Therefore, the required cladding oxidation model (Baker-Just equation) is appropriate for application to M5 advanced alloy cladding material. (Note: The details of the LOCA calculations to be used for M5 cladding are presented within Reference 2 and are currently under review by the NRC for incorporation into the LOCA evaluation model.) Therefore, strict application of the portion of 10 CFR Part 50, Appendix K which refers solely to Zircaloy and ZIRLO™ as cladding materials is not necessary to achieve the underlying purpose of 10 CFR 50.46.

The underlying purpose of 10 CFR 50.44 is to ensure there are adequate means of controlling the combustible gas generated during and following a LOCA (62 Fed. Reg. 6564 (1997). One of the sources of combustible gas (hydrogen) is the metal-water reaction involving the fuel cladding and the reactor coolant. 10 CFR 50.44 focuses primarily on the combustible gas control system. 10 CFR 50.44(d)(1) provides requirements for the assumed hydrogen produced from core metal-water reaction. The contribution by core metal-water reaction shall be assumed to be five times the total amount of hydrogen calculated in demonstrating compliance with 10 CFR 50.46(b)(3). The intent of this requirement is to provide a design value for the hydrogen source from fuel cladding metal-water reaction during and following a design basis LOCA event. As previously described, the oxidation rates for the M5 alloy and Zircaloy-4 following a LOCA are essentially the same. Use of the Baker-Just equation in the LOCA analysis to show compliance with 10 CFR 50.46(b)(3) provides a conservative bounding representation of the core metal-water reaction (hydrogen production). Thus, the hydrogen production from the M5 fuel cladding metal-water reaction used to assess the means of controlling the combustible gas following a LOCA will be conservatively bounded. Therefore strict application of the portion of 10 CFR 50.44, which refers solely to Zircaloy and ZIRLO™ as cladding material, is not necessary to achieve the underlying purpose of 10 CFR 50.44.

Conclusion

As required by 10 CFR 50.12, the requested exemption is authorized by law, does not present undue risk to public health and safety, is consistent with common defense and security and is clearly supported by special circumstances. In addition to the fact that the exemption request satisfies the requirements of Section 50.12, granting this exemption will allow Duke to use an advanced cladding material with fuel performance characteristics anticipated to be superior to those of Zircaloy-4 cladding. Therefore, granting this exemption request will give the Commission an important role in supporting the continued improvement of nuclear fuel performance consistent with existing safety and health criteria. For the reasons set forth herein, Duke respectfully requests the Commission grant this narrow exemption from the requirements of 10 CFR 50.44, 10 CFR 50.46 and 10 CFR 50 Appendix K, Paragraph I.A.5.

References

1) NUREG-0933, "A Prioritization of Generic Safety Issues, Issue 170: Damage Criteria for High Burnup Fuel," December 1997.

2) Framatome Cogema Fuels (FCF) Topical Report BAW-10227P, " Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," September 1997.