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Georgia Power
the southern electric system

June 3, 1991

Docket Nos. 50-424
50-425

ELV-02823
0965

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555

Gentlemen:

VOGTLE ELECTRIC GENERATING PLANT
REQUEST FOR TECHNICAL SPECIFICATIONS CHANGE
ZIRLO™ CLAD FUEL RODS

In accordance with the provisions of 10 CFR 50.90 and 10 CFR 50.59, Georgia Power Company (GPC) proposes to amend the Vogtle Electric Generating Plant (VEGP) Units 1 and 2 Technical Specifications, Appendix A to Operating Licenses NPF-68 and NPF-81. The proposed change to Technical Specifications section 5.3.1 allows the use of two fuel assemblies, each containing up to twelve (12) fuel rods clad with ZIRLO™. The NRC has previously approved the similar use of ZIRLO™ clad fuel at other nuclear plants. Selected fuel rods in the two assemblies will be clad with ZIRLO™ to obtain additional operational experience with the cladding's improved corrosion-resistant performance under VEGP-specific reactor conditions.

Enclosure 1 provides a description of the proposed change and the basis for the change. Enclosure 2 provides the basis for a determination that the proposed change does not involve significant hazards considerations. Enclosure 3 provides instructions for incorporating the proposed change into the Technical Specifications.

GPC requests approval of this Technical Specifications revision by August 15, 1991, to support the loading of the two fuel assemblies containing the ZIRLO™ clad fuel rods with the first reload of VANTAGE-5 VEGP fuel in Unit 1, scheduled for late September 1991.

In accordance with 10 CFR 50.91, the designated state official will be sent a copy of this letter and the enclosures.

A001 1/1

Georgia Power

Mr. C. K. McCoy states that he is a Vice President of Georgia Power Company and is authorized to execute this oath on behalf of Georgia Power Company and that, to the best of his knowledge and belief, the facts set forth in this letter and enclosures are true.

GEORGIA POWER COMPANY

By: C. K. McCoy

Sworn to and subscribed before me this 3 day of June, 1991.

Teresa Marino
Notary Public

MY COMMISSION EXPIRES JAN. 2, 1994

CKM/HWM:BCA/gmb

Enclosures:
1. Basis for Proposed Change
2. 10 CFR 50.92 Evaluation
3. Instructions for Incorporation and Revised Page

c(w): Georgia Power Company
Mr. W. B. Shipman
Mr. P. D. Rushton
Mr. M. Sheibani
NORMS

U. S. Nuclear Regulatory Commission
Mr. S. D. Ebneter, Regional Administrator
Mr. D. S. Hood, Licensing Project Manager, NRR
Mr. B. R. Bonser, Senior Resident Inspector, Vogtle

State of Georgia
Mr. J. D. Tanner, Commissioner, Department of Natural Resources

ENCLOSURE 1

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BASIS FOR PROPOSED CHANGE

Proposed Change

The Vogtle Units 1 and 2 Technical Specifications, Design Features section 5.3.1 has the following text:

> "The core shall contain 193 fuel assemblies with each fuel assembly containing 264 fuel rods clad with Zircaloy-4. Each fuel rod shall have a nominal active fuel length of 144 inches. The initial core loading shall have a maximum enrichment not to exceed 3.2 weight percent U-235. Reload fuel shall be similar in physical design to the initial core loading and shall have a maximum enrichment not to exceed 4.55 weight percent U-235."

In order to allow for the insertion of two (2) Westinghouse VANTAGE-5 fuel assemblies, each containing up to twelve (12) fuel rods clad with the advanced zirconium alloy cladding material ZIRLO™ into Vogtle reload core designs, the following revision to Technical Specifications Design Features section 5.3.1 is proposed:

> "The core shall contain 193 fuel assemblies with each fuel assembly containing 264 fuel rods clad with Zircaloy-4 except for two fuel assemblies which may each contain up to twelve (12) fuel rods clad with ZIRLO™. Each fuel rod shall have a nominal active fuel length of 144 inches. The initial core loading shall have a maximum enrichment not to exceed 3.2 weight percent U-235. Reload fuel shall be similar in physical design to the initial core loading and shall have a maximum enrichment not to exceed 4.55 weight percent U-235."

Basis

In order to implement a long-term fuel management strategy planned by Georgia Power Company (GPC) for the Vogtle Electric Generating Plant (VEGP) Units 1 and 2, two (2) Westinghouse VANTAGE-5 fuel assemblies, each containing up to twelve (12) fuel rods clad with the advanced zirconium alloy cladding material ZIRLO™, will be utilized in VEGP reload core designs. This long-term strategy includes the implementation of high-energy, 18-month fuel cycles with high capacity factors, low leakage loading patterns, and extended fuel burnups. The two VANTAGE-5

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fuel assemblies will have selected fuel rods clad with ZIRLO™ to obtain additional operational experience with ZIRLO™ cladding's improved corrosion performance at VEGP-specific reactor conditions. GPC has requested the change to VANTAGE-5 fuel in letter ELV-02166, dated November 29, 1990, for both VEGP Units 1 and 2.

The two Westinghouse VANTAGE-5 fuel assemblies, each containing up to twelve (12) fuel rods clad with ZIRLO™, will be utilized in VEGP Unit 1, beginning with Cycle 4, which is scheduled for startup in the fourth quarter of 1991. Cycle 4 will be the first reload cycle containing VANTAGE-5 fuel.

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10 CFR 50.92 EVALUATION

Pursuant to 10 CFR 50.92, Georgia Power Company (GPC) has evaluated the attached proposed amendment and has determined that operation of the facility in accordance with the revised Technical Specifications will not involve a significant hazards consideration. The basis for this determination is as follows.

Background

GPC plans to insert two (2) Westinghouse VANTAGE-5 fuel assemblies, each containing up to twelve (12) fuel rods clad with the advanced zirconium alloy cladding material ZIRLO™, into Vogtle reload core designs. This will involve a change to the Technical Specifications Design Features section 5.3.1 (enclosures 1 and 3). The two fuel assemblies will have selected fuel rods clad with ZIRLO™ to obtain additional operational experience with ZIRLO™ cladding's improved corrosion performance at VEGP-specific reactor conditions. GPC has requested the change to VANTAGE-5 fuel in letter ELV-02166 (reference 9) for both Vogtle Units 1 and 2.

Licensing approval for the use of this advanced alloy cladding in two demonstration fuel assemblies for the North Anna Unit 1 reactor core was given in an NRC letter dated May 13, 1987 (reference 1). The information required to support the licensing basis for the use of the ZIRLO™ clad fuel rods is given in WCAP-12610 (reference 2) This WCAP serves as a reference core design report for a fuel assembly design using ZIRLO™ clad fuel rods. It presents the information necessary to support the licensing basis for the use of fuel assemblies containing ZIRLO™ clad fuel rods for fuel reload regions. It includes mechanical, nuclear, thermal-hydraulic, accident and radiological evaluations. It also includes appendices to document ZIRLO™ material properties, and support fuel rod performance and to provide LOCA models and evaluations. The two fuel assemblies will be utilized in Vogtle Unit 1, beginning with Cycle 4, which is scheduled for startup in the fourth quarter of 1991.

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Analysis

Previous Irradiation Experience

Fuel rods clad with ZIRLO™ have been previously irradiated in a foreign reactor at linear power levels up to 17 kw/ft and burnups greater than those planned for the Vogtle fuel assemblies. Corrosion and hydriding data obtained on the ZIRLO™ cladding were compared with the reference Zircaloy-4 cladding of fuel rods irradiated as controls in the same test assemblies. Based on the irradiation results of the test assemblies in the foreign reactor, the Vogtle ZIRLO™ cladding waterside corrosion and hydriding will be less than that expected for the Zircaloy-4 fuel rods. Irradiation test results also showed lower clad irradiation growth ($\Delta L/L$) and creepdown for the ZIRLO™ clad fuel rods compared to Zircaloy-4.

Two demonstration fuel assemblies, containing ZIRLO™ clad fuel rods, began irradiation in the North Anna Unit 1 reactor in June 1987. The ZIRLO™ clad fuel rods achieved over 21,000 MWD/MTU burnup in their first cycle (completed during February 1989). Visual inspection during refueling showed no abnormalities, and one demonstration assembly with ZIRLO™ clad fuel rods underwent a second cycle of irradiation and achieved over 37,000 MWD/MTU burnup (completed January 1991). Visual inspections were completed in May 1991. These and future irradiation results will be considered to assure that all the current fuel rod design bases are satisfied for the planned irradiation life of the two Vogtle fuel assemblies.

Chemical/Mechanical Properties

The chemical composition (table 1) of the ZIRLO™ cladding on selected fuel rods in the two Vogtle fuel assemblies is similar to Zircaloy-4 except for slight reductions in the content of Tin (Sn), Iron (Fe), Chromium (Cr), and Zirconium (Zr), and the addition of a nominal one percent Niobium. This nominal amount of Niobium provides significantly greater corrosion resistance as compared to Zircaloy-4. The physical and mechanical properties are very similar to Zircaloy-4 while in the same metallurgical phase. However, the temperatures at which the metallurgical phases change are different for Zircaloy-4 and ZIRLO™.

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(Continued)

These differences are considered in the evaluations discussed below for cladding behavior under non-LOCA and LOCA conditions. Further aspects of the ZIRLO™ clad performance under LOCA conditions are given in reference 2. Evaluations have been performed using the NRC approved fuel rod performance code (reference 7) to verify that the fuel rod design bases and design criteria are met for assemblies containing ZIRLO™ clad fuel rods. The fuel rod design bases and criteria which are particularly affected by the ZIRLO™ clad are described in reference 2.

TABLE 1

NOMINAL COMPOSITION OF
ZIRLO™ AND ZIRCALOY-4

Element	Zircaloy-4 (wt %)	ZIRLO™ (wt %)
Sn	1.6	1.0
Fe + Cr	0.31	0.1
Nb	0.0	1.0
Zr	> 97.0	> 97.0

Neutronic Performance

The design and predicted nuclear characteristics of each fuel rod clad with ZIRLO™ are similar to those of VANTAGE-5 (reference 5). The evaluations (reference 2) have shown that the nuclear design bases for fuel clad with ZIRLO™ are satisfied, and that the change to ZIRLO™ will not affect the use of standard nuclear design analytical models and methods to accurately describe the neutronic behavior of fuel clad with ZIRLO™. Furthermore, the safety limit characteristics of the VANTAGE-5 fuel design (reference 5) are not affected.

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Thermal and Hydraulic Performance

The thermal and hydraulic design bases for the fuel rods clad with ZIRLO™ are identical to those of the VANTAGE-5 design (reference 5). Since the use of the ZIRLO™ clad fuel does not represent changes of any magnitude affecting the parameters which are major contributors in this area (i.e., DNB, core flow, and rod bow), the design bases of the VANTAGE-5 design (reference 5) remain valid.

Cladding Performance Under Non-LOCA Conditions

The two non-LOCA accidents potentially affected by the use of ZIRLO™ clad material are the locked rotor/shaft break and RCCA ejection accidents. For the locked rotor/shaft break accident, it was determined that the ZIRLO™ cladding results in a very small increase in peak clad temperature (approximately 2°F PCT), and the effect on the metal-to-water reaction rate is negligible when compared to Zircaloy-4. Sufficient margin exists in the Vogtle safety analysis to accommodate the small PCT increase. For the RCCA ejection accident, the ZIRLO™ cladding results in a small reduction in both the fraction of fuel melting at the hot spot and the fuel peak stored energy when compared to the results for Zircaloy-4. Thus, the conclusions in the Vogtle FSAR for the two affected non-LOCA accidents remain valid.

Cladding Performance Under LOCA Conditions

The loss of coolant accident analyses for the VANTAGE-5 fuel in the Vogtle units were performed using the 1981 Evaluation Model with BASH (large break LOCA) and the NOTRUMP Evaluation Model (small break LOCA). Revisions to those evaluation models for use in analyses of fuel with ZIRLO™ cladding have been identified and reported in reference 2. The revisions include the cladding specific heat, high-temperature creep (swelling), burst temperature, burst strain, and assembly blockage. Calculations performed with the revised evaluation models have shown that the effects of ZIRLO™ cladding on large break and small break LOCA analysis results are relatively minor (appendix G of reference 2).

Prior to insertion of the two fuel assemblies, the fuel rod heatup analyses for the limiting large break and small break cases from the Vogtle VANTAGE-5 fuel analyses will be verified as part of the standard reload design process. This verification will reflect the behavior of the ZIRLO™ clad material during a loss of coolant accident as described in WCAP-12610. These analyses will consider the actual expected peaking factor margin between the ZIRLO™ clad fuel rods and the Zircaloy-4 fuel rods and will meet the 10 CFR 50.46 acceptance criteria.

Results

Based on the information discussed above, the following conclusions can be reached with respect to 10 CFR 50.92.

1) The probability or consequences of an accident previously evaluated are not significantly increased. The two VANTAGE-5 fuel assemblies containing selected ZIRLO™ clad fuel rods meet the same fuel assembly and fuel rod design bases (references 2, 3, 4, and 5) as other VANTAGE-5 fuel assemblies in the same fuel region. In addition, the 10 CFR 50.46 criteria will be applied to the ZIRLO™ clad fuel rods. The use of these two fuel assemblies will not result in a change to the proposed Vogtle VANTAGE-5 reload design and safety analysis limits (reference 9). Since the original design criteria is being met, the ZIRLO™ clad fuel rods will not be an initiator for any new accident. The ZIRLO™ clad material is similar in chemical composition and has similar physical and mechanical properties as that of Zircaloy-4. Thus, the cladding integrity is maintained and the structural integrity of the fuel assembly is not affected. The ZIRLO™ clad fuel rod improves corrosion performance and dimensional stability. No concerns have been identified with respect to the use of an assembly containing a combination of both Zircaloy-4 and selected ZIRLO™ clad fuel rods. Since the dose predictions in the Vogtle safety analyses are not sensitive to the fuel rod cladding material used, the radiological consequences of accidents previously evaluated in the Vogtle safety analyses remain valid. Therefore, the probability or consequences of an accident previously evaluated are not significantly increased.

2) The possibility for a new or different kind of accident from any accident previously evaluated is not created since the two VANTAGE-5

fuel assemblies containing selected ZIRLO™ clad fuel rods will satisfy the same design bases (references 2, 3, 4, and 5) as that used for other VANTAGE-5 fuel assemblies in the same fuel region. All design and performance criteria will continue to be met and no new single failure mechanisms have been defined. In addition, the use of the two fuel assemblies does not involve any alterations to plant equipment or procedures which would introduce any new or unique operational modes or accident precursors. Therefore, the possibility for a new or different kind of accident from any accident previously evaluated is not created.

3) The margin of safety is not significantly reduced, since the two VANTAGE-5 fuel assemblies containing selected ZIRLO™ clad fuel rods do not change the proposed Vogtle VANTAGE-5 reload design and safety analysis limits (reference 9). The use of the two fuel assemblies will take into consideration the normal core operating conditions allowed for in the Technical Specifications. For each cycle reload core, the two fuel assemblies will be specifically evaluated using standard reload design methods (reference 6) and approved fuel rod design models and methods (references 2, 7, and 8). This will include consideration of the core physics analysis peaking factors and core average linear heat rate effects. Therefore, the margin of safety as defined in the bases to the Vogtle Technical Specifications and VANTAGE-5 Licensing Amendment Request (reference 9) is not significantly reduced.

Conclusion

Based upon the preceding analysis, GPC has determined that the proposed change to the Technical Specifications Design Features section 5.3.1 meets the requirements of 10 CFR 50.92 (c) and does not involve a significant hazards consideration.

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References

1. "Safety Evaluation by the Office of Nuclear Regulation Related to Amendment No. 94 Facility Operating License No. NPF-4 Virginia Electric and Power Company Old Dominion Electric Cooperative North Anna Power Station, Unit No. 1, Docket No. 50-338," dated May 13, 1987.

2. Davidson, S. L., and Nuhfer, D. L. (Ed.), "VANTAGE+ Fuel Assembly Report," WCAP-12610, June 1990.

3. Davidson, S. L., and Iorii, J. A., "Reference Core Design Report - 17x17 Optimized Fuel Assembly," WCAP-9500-A, Volume 2, May 1982.

4. Letter from T. M. Anderson (Westinghouse) to J. R. Miller, Chief (NRC), NS-TMA-2366, Answer to Question 231.2 (4.2.1), dated January 1, 1981.

5. Davidson, S. L. (Ed.), "VANTAGE-5 Fuel Assembly Reference Core Report," WCAP-10444-P-A (Proprietary), September 1985.

6. Davidson, S. L. (Ed.), et al., "Westinghouse Reload Safety Evaluation Methodology," WCAP-9272-P-A (Proprietary), July 1985.

7. Weiner, R. A., et al., "Improved Fuel Rod Performance Models for Westinghouse Fuel Rod Design and Safety Evaluations," WCAP-10851-P-A (Proprietary), August 1988.

8. Davidson, S. L. (Ed.), et al., "Extended Burnup Evaluation of Westinghouse Fuel," WCAP-10125-P-A (Proprietary), December 1985.

9. Letter from W. G. Hairston, III, (Georgia Power Company) to NRC Document Control Desk, "Vogtle Electric Generating Plant, Request for Technical Specifications Changes, VANTAGE-5 Fuel Design," ELV-02166, November 29, 1990, Docket Numbers 50-424 and 50-425.

ENCLOSURE 3

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INSTRUCTIONS FOR INCORPORATION

The proposed amendment to the Technical Specifications would be incorporated as follows:

Remove Page	Insert Page
5-3* and 5-4	5-3* and 5-4

* Overleaf page containing no changes