



UNITED STATES
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NOS. 204 AND 185 TO

FACILITY OPERATING LICENSE NOS. NPF-4 AND NPF-7

VIRGINIA ELECTRIC AND POWER COMPANY

OLD DOMINION ELECTRIC COOPERATIVE

NORTH ANNA POWER STATION, UNITS NO. 1 AND NO. 2

DOCKET NOS. 50-338 AND 50-339

1.0 INTRODUCTION

By letter dated September 4, 1996, as supplemented February 3, 1997, Virginia Electric and Power Company (VEPCO) submitted a request for exemption from the requirements of 10 CFR 50.44, 50.46, and Appendix K, license conditions, and technical specification (TS) changes for North Anna Units 1 and 2. The proposed exemption, license conditions, and TS changes will allow the licensee to insert four lead test assemblies (LTAs) into the North Anna 1 Cycle 13 core in the spring of 1997. These LTAs will incorporate several advanced design features including advanced debris filter bottom nozzle, mid-span mixing grids, floating top end grid, quick disconnect top nozzle, advanced alloy for assembly structural tubings, and advanced alloys for cladding. The advanced cladding alloys are zirconium-based alloys and designated as Alloy 4 and Alloy 5. The majority of the fuel rods will have cladding fabricated from Alloy 5, and only a limited number of fuel rods in two assemblies will have cladding fabricated from Alloy 4. The LTAs were manufactured by Framatome Cogema Fuels (FCF).

The purpose of the LTA program is to develop new cladding materials with improved corrosion resistance for increased fuel discharge burnups and longer duty cycles. Previously, the NRC staff has approved some LTAs with these two advanced cladding alloys in McGuire 1 and Three Mile Island 1. The four LTAs in North Anna 1 will be irradiated for three 18-month cycles to a burnup range of 55 to 60 GWd/MTU peak rod. The North Anna LTA design is mechanically similar to and compatible with the resident Westinghouse VANTAGE-5H fuel. Although the LTA program is currently planned for North Anna 1, the licensee requests NRC approval for both units to maximize the program flexibility.

10 CFR 50.44, "Standards for combustible gas control system in light-water-cooled power reactors," specifies requirements for the control of hydrogen gas generated after a postulated loss-of-coolant accident (LOCA) for reactors fueled with zircaloy or ZIRLO cladding. 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light water nuclear power reactors,"

contains acceptance criteria for emergency core cooling systems (ECCSs) for reactors fueled with zircaloy or ZIRLO cladding. In addition, Appendix K to Part 50, "ECCS Evaluation Models," 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. However, the Baker-Just equation assumes the use of zircaloy or ZIRLO cladding fuel. Therefore, an exemption from the requirements of 10 CFR 50.44, 50.46, and Appendix K is needed for North Anna 1 to irradiate a limited number of fuel rods clad with non-zircaloy or non-ZIRLO advanced materials. Our evaluation follows.

2.0 EVALUATION

2.1 Mechanical Properties

The mechanical properties of Alloys 4 and 5 are very similar to the zircaloy and ZIRLO mechanical properties since these alloys are basically zirconium-based materials with some slightly different chemical compositions. FCF has conducted various out-of-reactor tests to verify the mechanical performance. FCF also has irradiation data to support the LTA program. The irradiation data showed that the corrosion, rod growth, and cladding strain were all within the design limits. The staff has reviewed the alloy mechanical performance and concludes that the four LTAs will perform satisfactorily for the North Anna 1 Cycle 13 core.

2.2 Core Design

In Cycle 13, these four LTAs will be located in relatively high power regions. The licensee also indicated that the LTAs may be positioned in rodded locations in Cycle 14. Traditionally, the staff had two criteria for LTA programs, i.e., the number of LTAs should be limited and the core locations of LTAs should be non-limiting (not in the highest power regions). The licensee presented a Cycle 13 core design that showed that the power of the peak rod in each LTA is 95% or less than the peak rod of the resident Westinghouse fuel in the core in terms of FQ and F delta H values. Thus the licensee assures that the LTAs will not be in the highest power regions. The staff has reviewed the licensee's core design and concludes that the licensee's conservative analysis provides adequate safety margins for North Anna 1 Cycle 13, and thus satisfies the requirements of LTA criteria.

2.3 LOCA

The licensee analyzed the behavior of Alloys 4 and 5 under LOCA conditions. The licensee used NRC-approved methods to perform LOCA analyses. In addition to methods normally used to evaluate North Anna fuel, the licensee described four additional models in sections 7.1, 7.1.2, and 7.1.3 of their submittal dated September 4, 1996. These include: (1) RSG LOC-A-B&W LOCA evaluation model, (BAW 10168, Rev. 3), (2) RELAP5/MOD2-B&W code, (BAW 10164, Rev. 3), (3) the BEACH implementation of RELAP 5, (BAW-10166, Rev. 4), and (4) REFLOD3B (BAW-10171-PA, Rev. 3). The licensee documented calculations with these models which demonstrate that existing North Anna calculations based on the

current fuel design conservatively bound the LOCA performance of the demonstration assemblies calculated with the above models. The LOCA calculations for the demonstration assemblies were made with key plant operating parameters, such as power level, reactor coolant flow, ECCS flow, power peaking factor, steam generator tube plugging level and most severe fuel conditions, that were the same as for the LOCA calculations for the current fuel design. The peak cladding temperature (PCT) of these LTAs was significantly lower than the resident Westinghouse fuel. Using the Baker-Just equation, the LTA local cladding oxidation was less than 5%. Also, the maximum hydrogen generation did not alter even with the inclusion of the four LTAs. Thus, the coolable geometry was maintained following a LOCA.

Paragraph I.A.5 of Appendix K to 10 CFR Part 50 states that the rates of energy release, hydrogen concentration, 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 advanced zirconium-based alloys for determining acceptable fuel performance. The underlying intent of this portion of the Appendix, however, is to ensure that analysis of fuel response to LOCAs is conservatively calculated. Due to the similarities in the composition of the advanced zirconium-based alloys and Zircaloy/ZIRLO, the application of the Baker-Just equation in the analysis of advanced zirconium-based clad fuel will conservatively bound all post-LOCA scenarios. Thus, the underlying purpose of the rule will be met. Thus, special circumstances exist to grant an exemption from Appendix K to 10 CFR Part 50 that would allow the licensee to apply the Baker-Just equation to advanced zirconium-based alloys.

In summary, the licensee showed that the additional calculational methods, used with LTAs in North Anna, produce LOCA results which are bounded by the current LOCA calculations with existing fuel. The methodology is acceptable for the evaluation of the four lead test assemblies in North Anna. Also, the behavior of Alloys 4 and 5 is expected to be similar to or more conservative than that of conventional zircaloy-4 under LOCA conditions.

Although the staff has yet to review and approve the generic overall behavior of Alloys 4 and 5 for LOCA, the staff recognizes that these four LTAs are located at non-limiting core locations. Thus, the ECCS requirements will not be affected by these LTAs. Based on the staff evaluation and the fact of non-limiting core locations, the staff concludes that the licensee has demonstrated that the LTAs will perform adequately under LOCA conditions for North Anna 1 and 2.

2.4 Post-irradiation Examinations

The licensee proposed an LTA inspection and testing program for post-irradiation examinations (PIEs). The program will ensure that the LTAs fulfill the design objectives of high achievable burnups and better corrosion performance. The PIEs will collect a variety of data which include full length visual inspection, assembly length and bow measurements, holddown

spring compression testing, oxide thickness, shoulder gap, etc. The licensee will also perform drag testing at the end of each cycle of irradiation as the outage conditions permit. These PIE data will assist in confirming that the new alloys perform satisfactorily under irradiation conditions. Based on the licensee's proposal, the staff considers that the PIE program is acceptable for North Anna 1 and 2.

2.5 License Conditions

The licensee proposed license conditions 2.D.3(d) and 2.C(24) for Unit 1 and Unit 2, respectively. The license conditions will permit the use of up to four LTAs with the advanced zirconium-based alloys to be irradiated in the reactor cores during three cycles. Based on the staff evaluation, the staff considers that these license conditions are technically adequate and therefore acceptable for North Anna 1 and 2. The new license conditions are stated as follows:

Virginia Electric and Power Company may use up to four (4) fuel assemblies containing advanced zirconium based alloys as described in the licensee's submittal dated September 4, 1996, as supplemented February 3, 1997.

2.6 Technical Specification Changes

2.6.1 Section 5.3 REACTOR CORE, FUEL ASSEMBLIES 5.3.1

The licensee proposed to add a sentence to Section 5.3.1. The new sentence is stated as follows:

A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core locations.

The staff has two criteria governing the use of lead test assemblies: (1) the total number of demonstration assemblies in one core should be limited, and (2) the demonstration assemblies should not be loaded in limiting positions. These criteria ensure that the test assemblies represent only a small fraction of the reactor core so that they do not significantly change the core characteristics. In addition, they ensure that the safety limits, setpoints, and ECCS requirements are unchanged so that safe operation is preserved with the same margins of safety. Since the new sentence in Section 5.3.1 is consistent with the criteria, we conclude that this modification to Section 5.3.1 is acceptable for North Anna 1 and 2.

2.6.2 CORE OPERATING LIMITS REPORT, Section 6.9.1.7b

The licensee proposed to add a sentence to Section 6.9.1.7b. The new sentence is stated as follows:

Other approved methods may also be applicable as defined in supporting documentation for approved exemptions or license conditions.

The proposed sentence is not specific as to which methods may be applicable. If additional methods are used to establish core operating limits, they should be identified specifically, reviewed and approved by NRC, and listed in Section 6.9.1.7.e of the TS. Because the non-specific sentence does not specify methods used to determine core operating limits, the proposal is denied.

3.0 SUMMARY

We have reviewed the licensee submittal of proposed exemption, license conditions, and TS change for the use of four LTAs with new alloy designs.

Based on the staff evaluation, we conclude that the four demonstration assemblies that will be placed in the North Anna Unit 1 or Unit 2 reactor for three total operating cycles under constraints previously described meet the same design bases as the fuel in the reactor during previous cycles. No safety limits or setpoints have been altered as a result of the use of the four demonstration assemblies. The demonstration assemblies are limited in number, and will be placed in core locations that will not experience limiting power peaking during the operating cycles. The advanced claddings have been tested for corrosion resistance, tensile and burst strength, and creep characteristics. NRC-approved methods acceptable for use at North Anna have been used to perform calculations which demonstrate adequate performance of safety systems. The underlying purpose of applicable regulations, including 10 CFR 50.44, 10 CFR 50.46, and Appendix K to 10 CFR Part 50, has been achieved by the licensee. Under separate cover, the Commission has granted the licensee an exemption from the requirements of 10 CFR 50.44, 10 CFR 50.46, and Appendix K to 10 CFR 50.

The staff has concluded, based on the consideration 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, and (2) such activities will be conducted in compliance with the Commission's regulations, and issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Virginia State official was notified of the proposed issuance of the amendment. The State official had no comment.

5.0 ENVIRONMENTAL CONSIDERATION

These amendments change 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 amendments involve 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 these amendments involve no significant hazards consideration and there has been no public comment on such finding (61 FR 64396). The amendment also changes recordkeeping, reporting or administrative procedures or requirements. Accordingly, these amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9) and (c)(10). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

6.0 CONCLUSION

The Commission 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 Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: S. Wu

Date: May 9, 1997

UNITED STATES NUCLEAR REGULATORY COMMISSIONVIRGINIA ELECTRIC AND POWER COMPANYDOCKET NOS. 50-338 AND 50-339NOTICE OF PARTIAL DENIAL OF AMENDMENT TO FACILITY OPERATING LICENSE
AND OPPORTUNITY FOR HEARING

The U.S. Nuclear Regulatory Commission (the Commission) has partially denied a request by Virginia Electric and Power Company, (licensee) for an amendment to Facility Operating License Nos. NPF-4 and NPF-7 issued to the licensee for operation of the North Anna Power Station, Unit Nos. 1 and 2, located in Louisa County, Virginia. Notice of Consideration of Issuance of this amendment was published in the FEDERAL REGISTER on December 4, 1996 (61 FR 64396).

The purpose of the licensee's amendment request was to revise the Technical Specifications (TS) to permit the insertion of four demonstration fuel assemblies into the reactor core of either North Anna 1 or North Anna 2, as described in the licensee's submittal. The four lead test assemblies, fabricated by Framatome Cogema Fuels, will incorporate several advanced design features, including: a debris filter bottom nozzle, mid-span mixing grids, a floating top end grid, a quick disconnect top nozzle, and use of advanced zirconium alloys for fuel assembly structural tubing and for fuel rod cladding. A portion of the amendment request included a proposal to amend Section 6.9.1.7.b by adding one sentence. Because the non-specific sentence does not specify methods used to determine core operating limits, the proposal to add the sentence to the TS is denied.

The NRC staff has concluded that the licensee's request cannot fully be granted. The licensee was notified of the Commission's partial denial of the proposed change by a letter dated May 9, 1997.

By _____, the licensee may demand a hearing with respect to the denial described above. Any person whose interest may be affected by this proceeding may file a written petition for leave to intervene.

A request for hearing or petition for leave to intervene must be filed with the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, DC 20555, Attention: Docketing and Services Branch, or may be delivered to the Commission's Public Document Room, the Gelman Building, 2120 L Street, NW., Washington, DC, by the above date.

A copy of any petitions should also be sent to the Office of the General Counsel, U.S. Nuclear Regulatory Commission, Washington, DC 20555, and to Michael W. Maupin, Esq., Hunton and Williams, Riverfront Plaza, East Tower, 951 E. Byrd Street, Richmond, Virginia 23219, attorney for the licensee.

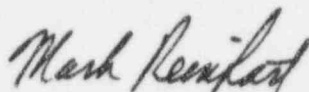
For further details with respect to this action, see (1) the application for amendment dated September 4, 1996, as supplemented February 3, 1997, and (2) the Commission's letter to the licensee dated May 9, 1997.

These documents are available for public inspection at the Commission's Public Document Room, the Gelman Building, 2120 L Street, NW., Washington, DC,

and at the local public document room located at the Alderman Library, Special Collections Department, University of Virginia, Charlottesville, Virginia 22903-2498.

Dated at Rockville, Maryland, this 9th day of May 1997.

FOR THE NUCLEAR REGULATORY COMMISSION



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