5.2 REACTOR

REACTOR CORE

1. The reactor core contains approximately 71 metric tons of uranium in the form slightly enriched uranium dioxide pellets. The pellets are encapsulated in Zircaloy - 4 tubing to form fuel rods. The reactor core is made up of 157 fuel assemblies. Each fuel assembly contains 204 fuel rods.

2. The average enrichment of the initial core is a nominal 2.50 weight percent of U-235. Three fuel enrichments are used in the initial core. The highest enrichment is a nominal 3.10 weight percent of U-235.

3. Reload fuel will be similar in design to the initial core.

4. Burnable poisons are in the form of rod clusters which are located in vacant rod cluster control guide tubes, or integral to the fuel design and are used for reactivity and/or power distribution control.

5. There are 45 full-length RCC assemblies and 8 partial-length* RCC assemblies in the reactor core. The full-length RCC assemblies contain a 144 inch length of silver-indium-cadmium alloy clad with the stainless steel. The partial-length* RCC assemblies contain a 36 inch length of silver-indium-cadmium alloy with the remainder of the stainless steel sheath filled with Al_2O_3.

REACTOR COOLANT SYSTEM

1. The design of the Reactor Coolant System complies with the code requirements.

2. All piping, components and supporting structures of the Reactor Coolant System are designed to Class I requirements and have been designed to withstand:

   a. The design seismic ground acceleration, 0.05g acting in the horizontal and 0.033g acting in the vertical planes simultaneously, with stress maintained within code allowable working stresses.

   b. The maximum potential seismic ground acceleration, 0.15g, acting in the horizontal and 0.10g acting in the vertical directions simultaneously with no loss of function.

3. The nominal liquid volume of the Reactor Coolant System, at rated operating conditions, is 9088 cubic feet.

* Any reference to part-length rods no longer applies after the part-length rods are removed from the reactor.

ATTACHMENT I

ADDENDUM I TO WCAP-10444

"EVALUATION OF IFBA IMPACT ON FUEL DESIGN FOR

ALL FUEL ROD ARRAYS"

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[illegible]

[illegible]

[illegible]

Westinghouse Electric Corporation

Water Reactor Divisions

Box 355
Pittsburgh Pennsylvania 15230-0355

NS-NRC-85-3090
December 23, 1985

Mr. Herbert Berkow
Standardization and Special Projects Directorate
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: Request for NRC to Review Addendum 1 (Non-Proprietary) to Westinghouse Topical Report, "Reference Core Report Vantage 5 Fuel Assembly", WCAP-10444-P-A and WCAP-10445-NP-A

ATTENTION: Harold Bernard, Project Manager
Standardization and Special Projects Directorate

Carl Berlinger, Reactor Systems Branch Chief
Division of PWR Licensing-A

Dear Mr. Berkow:

Enclosed are twenty-five (25) copies of Westinghouse Topical Report, "Reference Core Report Vantage 5 Fuel Assembly", WCAP-10444, Addendum 1 (Non-Proprietary). This document is submitted for your review and approval of the applicability of Integral Fuel Burnable Absorber (IFBA) design features to Westinghouse fuel rod arrays such as 14x14 and 15x15. Westinghouse received NRC approval of the IFBA design features for 17x17 fuel rod arrays in the July, 1985 Safety Evaluation Report (SER) of the subject topical.

Westinghouse concludes that the evaluation provides sufficient information to substantiate the extension of the 17x17 IFBA design evaluation in WCAP-10444-P-A and WCAP-10445-NP-A to other Westinghouse fuel rod arrays. Therefore, this Addendum may be referenced in future licensing evaluations using IFBA in fuel assembly designs other than the 17x17 OFA.

Very truly yours,

for E. P. Rahe, Jr., Manager
Nuclear Safety Department

ADDENDUM TO WCAP-10444

A new feature known as the Integral Fuel Burnable Absorber (IFBA) is described in Topical, WCAP-10444-P-A, "Reference Core Report VANTAGE 5 Fuel Assembly". IFBA received NRC approval in an SER issued on this Topical in July 1985. The IFBA employs a boride coating on the surface of the fuel pellets for partial or full length of the stack. Neutron absorption by the coating material provides a burnable absorber which is an integral part of the fuel rod. IFBAs provide both power peaking and moderator temperature coefficient control. In WCAP-10444-P-A Westinghouse presented the reference design and safety evaluation for VANTAGE 5 fuel, based on a 17x17 fuel rod array. It was noted that Westinghouse intended to apply the IFBA design features to other fuel rod arrays such as 14x14 and 15x15.

The intent of this Addendum is to provide the Staff with an explanation of (1) how the information presented in WCAP-10444-P-A is applied to fuel assembly configurations other than the 17x17 fuel assembly design, and (2) the basis for generic approval for the IFBA design application for other fuel rod arrays.

Fuel pellets having an absorber coating over the range of fuel rod sizes and fuel rod arrays shown in Table A1 will have no adverse impact on the fuel assembly performance. It has been shown in Section 2.4 of WCAP-10444-P-A that all licensing requirements of the fuel independent of the pellet size are met. These requirements are included in the following three categories: (1) fuel system damage mechanisms, (2) fuel rod failure mechanisms and (3) fuel coolability. The design basis for the 17x17 coated fuel is identical to those for other coated fuel rod arrays.

All IFBA coated fuel rod configurations meet the design basis as quantified in Section 2.4.2 of WCAP-10444-P-A. Table A2 provides a summary of the evaluation of the IFBA impact on the fuel assembly and fuel rod mechanical design, the nuclear, and thermal-hydraulic design and on accident analyses.

Additional support for the acceptability of IFBA when applied to fuel rod arrays other than 17x17 is provided by the test programs described in the Topical WCAP-10444-P-A. These programs include the post-irradiation examination of 17x17 BR-3 test rods having IFBA coatings representative of the VANTAGE 5 IFBA. The 17x17 test rods performed well with no apparent loss of coating integrity. To provide further confirmatory data, four 15x15 fuel rods have undergone irradiation in Turkey Point Unit 3. Reactivity and depletion characteristics of these rods have been successfully monitored through burnup levels representative of essentially complete coating depletion. The IFBA rods performed as predicted. A fresh assembly containing two 15x15 fuel rods having IFBA coating over approximately 115 inches of the stack length was also loaded in the Turkey Point Unit 3. Visual examinations after one cycle of irradiation indicated no anamolies. In addition, full scale demonstration IFBA fuel includes four 15x15 fuel assemblies in Turkey Point Unit 4 which started operation in May 1984 and four 17x17 fuel assemblies in V. C. Summer which started operation in December 1984.

Westinghouse concludes that the above evaluation provides sufficient information to substantiate the extension of the 17x17 IFBA design evaluation in WCAP-10444-P-A to other fuel rod arrays. Therefore, this Addendum may be referenced in future licensing evaluations using IFBA in fuel assembly designs other than the 17x17 OFA.

TABLE A1

COMPARISON OF 14x14 STD, 14x14 OFA, 15x15 STD, 15x15 OFA, 17x17 STD, 17x17 OFA and 17x17 VANTAGE 5 FUEL ASSEMBLY MECHANICAL DESIGN PARAMETERS

Parameter	14x14 STD	14x14 OFA	15x15 STD	15x15 OFA	17x17 STD	17x17 OFA	VANTAGE 5
Fuel Ass'y. Length, in.	159.710	159.710	159.710	159.765	159.8	159.8	160.1
Fuel Rod Length, in.	151.850	151.850	151.850	151.850	151.6	151.6	152.3
Assembly Envelope, in.	7.763	7.763	8.426	8.426	8.426	8.426	8.426
Fuel Rod Pitch, in.	.556	.556	.563	.563	0.496	0.496	0.496
No. of Fuel Rods/Ass'y.	179	179	204	204	264	264	264
No. of Guide Thimbles/Ass'y.	16	16	20	20	24	24	24
No. of Instrumentation Tube/Assembly	1	1	1	1	1	1	1
Fuel Tube Material	Zircaloy-4	Zircaloy-4	Zircaloy-4	Zircaloy-4	Zircaloy-4	Zircaloy-4	Zircaloy-4
Fuel Rod Clad OD, in.	.422	.400	.422	.422	0.374	0.360	0.360
Fuel Rod Clad Thickness, in.	.0225	.0225	.0225	.0225	0.0225	0.0225	0.0225
Fuel/Clad Gap, mil	7.5	7.0	7.5	7.5	6.5	6.2	6.2 (uncoated pellets)
Fuel Pellet Dia.(uncoated)in.	.3659*	.3444*	.3659*	.3659*	0.3225*	0.3088*	0.3088*
Coated Pellet Stack Length	**	**	**	**	**	**	**

* Coating thickness is typically the same as noted in Table 2-1 of WCAP-10444-P-A

** Coated Pellet Stack Length will vary depending on specific fuel rod application

TABLE A2

EVALUATION OF IFBA IMPACT ON FUEL DESIGN FOR ALL FUEL ROD ARRAYS

I. FUEL ASSEMBLY MECHANICAL DESIGN

Item	IFBA Impact	Explanation
a. Fuel Rod Growth	No IFBA Impact	The fuel assembly design incorporates enough initial growth gap to accommodate the fuel rod growth of both IFBA and non-IFBA fuel.
b. Fuel Rod Fretting Wear	IFBA Impact due to the increased pellet OD.	The increased pellet diameter with the IFBA coating reduces clad creepdown. This improves grid cell force and contact, resulting in less wear.
c. Fuel Ass'y. Structural Integrity	No IFBA Impact	This is not a significant effect since the addition of the thin boride coating to the pellets does not change the structural behavior of either the fuel rod or the fuel assembly.

TABLE A2 (Continued)

EVALUATION OF IFBA IMPACT ON FUEL DESIGN FOR ALL FUEL ROD ARRAYS

I. FUEL ASSEMBLY MECHANICAL DESIGN (Continued)

	Item	IFBA Impact	Explanation
d.	Fuel Ass'y. Shipping and Handling Loads	No IFBA Impact	The thin boride coating on the fuel pellets does not change the weight of the fuel assembly significantly. It does not affect the 4g load criteria.
e.	Fuel Ass'y. Structural Components	No IFBA Impact	The structural components are in no way affected by the addition of the thin boride coating to the pellets internal to the fuel rod.

II. FUEL ROD DESIGN

a.	Rod Internal Pressure	Impacts pressure due to helium gas release from boride coating	Fuel rod design analyses performed with the NRC approved PAD 3.3 code (modified to include the helium gas release from the boride coating) confirm that the rod internal pressure limits defined

TABLE A2 (Continued)

EVALUATION OF IFBA IMPACT ON FUEL DESIGN FOR ALL FUEL ROD ARRAYS

II. FUEL ROD DESIGN (Continued)

		in WCAP-10444, Section 2.4.2.1 are met for each IFBA fuel design.
b. Clad Stress and Strain	Affects stress and strain due to smaller pellet-clad gap, pellet OD is larger because of coating thickness	Analyses performed using the NRC approved PAD 3.3 code verify that clad stress and strain limits are met for each IFBA design. Westinghouse limits for stress and strain are defined in Sections 2.4.2.2 and 2.4.2.3, WCAP-10444.
c. Clad Temperature	IFBA Impact only on rod power history	Analyses performed using PAD 3.3 with power histories specific to the IFBA fuel design confirm that the Westinghouse clad surface temperature limits are met for each IFBA fuel design. The limits for clad surface temperature are summarized in WCAP-10444, Section 2.2.2.4.

TABLE A2 (Continued)

EVALUATION OF IFBA IMPACT ON FUEL DESIGN FOR ALL FUEL ROD ARRAYS

II. FUEL ROD DESIGN (Continued)

d. Centerline Fuel Temperature	IFBA changes fuel centerline temperature because the initial pellet to clad gap is reduced	Design analyses performed using the NRC approved PAD 3.3 code confirm that the maximum fuel temperatures for IFBA fuel are bounded by those generated for non-IFBA fuel.
e. Clad Fatigue	IFBA affects fatigue levels due to the smaller pellet-clad gap, coating thickness increases pellet OD	Analyses performed for the IFBA design using standard Westinghouse methodology indicate that the limits are met. Westinghouse fatigue limits are given in WCAP-10444, Section 2.4.2.7.
f. Clad Wear	See Item b under Fuel Assembly Mechanical Design	
g. Clad Flattening	IFBA Impact due to reduced helium prepressurization	Present Westinghouse design methodology confirms that the clad flattening criterion can be met. This is specified in Section 2.4.3.1, WCAP-10444.

TABLE A2

EVALUATION OF IFBA IMPACT ON FUEL DESIGN FOR ALL FUEL ROD ARRAYS

III. NUCLEAR DESIGN

The Nuclear Design methods and core models used in reload designs with fuel regions containing IFBA rods are discussed in WCAP-10444, Section 3.4. These methods and models which have been reviewed and approved by the NRC (WCAP-9272-P-A) have been consistently used in previous cycle designs for OFA and STD fuel cores. No changes in the nuclear design bases, methods or models, are necessary for the incorporation of the IFBA design.

IV. THERMAL AND HYDRAULIC DESIGN

Section 4.3.3 of WCAP-10444 addresses the IFBA impact on the axial fuel zoning. The effect was to flatten the axial distribution and reduce power peaking. The design axial power distribution used in the determination of the over-temperature ΔT setpoint conservatively covers any IFBA related effects on core power distribution. No changes in the thermal and hydraulic design bases, methods or models are necessary for the incorporation of the IFBA design.

V. SAFETY EVALUATION

IFBA impacts the safety evaluation because of the reduced pellet-clad gap and helium release from the boride coating. These affect the rod internal pressure and fuel centerline temperatures which are used as input to the safety evaluation analyses. These analyses which are done using the NRC approved thermal safety model in PAD 3.3 confirm that IFBA fuel meets safety evaluation limits including LOCA limits.

<u>ATTACHMENT II</u>

NO SIGNIFICANT HAZARDS

CONSIDERATION ANALYSIS

SAFETY AND NO SIGNIFICANT HAZARDS EVALUATION

The proposed amendment modifies the Technical Specifications, Section 5.2, Reactor, to allow the use of burnable poisons that are not in the form of discrete rod clusters but are integral to the fuel rods. Westinghouse Electric Corporation, Water Reactor Divisions, issued Topical WCAP-10444-P-A, "Reference Core Report VANTAGE 5 Fuel Assembly" and received NRC approval in SER dated July 1985. In addition, Westinghouse issued Addendum 1 to WCAP-10444-P-A and recieved NRC approval on March 12, 1986. Florida Power and Light Turkey Point Nuclear Units 3 and 4 have been offered the advantages of utilizing the VANTAGE 5 fuel assembly. One feature of the VANTAGE 5 fuel assembly is the feature known as the Integral Fuel Burnable Absorber (IFBA). This type of burnable poison is not in the form of a discrete cluster rods but a boron coating applied to the fuel pellet. Turkey Point Nuclear Units 3 and 4 have demonstrated, through test assemblies, that the IFBA design performs as predicted. However, to utilize the IFBA feature on a full core reload, Section 5.2.4 of the Technical Specifications will require an amendment.

Basis for No Significant Hazards Consideration Determination:

The Commission has provided standards for determining whether a significant hazards consideration exists (10 CFR 50.92(c)). A proposed amendment to an operating license for the facility involves no significant hazards consideration if operation of the facility in accordance with the proposed amendment would not: (1) involve a significant increase in the probability or consequences of an accident previously evaluated, or (2) create the possibility of a new or different kind of accident from any accident previously evaluated, or (3) involve a significant reduction in a margin of safety.

(1) This amendment will not significantly increase the probability of an accident since the configuration of the plant remains the same and the plant is operated in the same mode.

The consequences of an accident previously analyzed will not increase as demonstrated in Westinghouse Topical Report WCAP-10444-P-A and Addendum 1 to WCAP-10444-P-A as approved by the NRC.

(2) This amendment will not create the possibility of a new or different kind of accident not previously evaluated, since this change does not modify the configuration or mode of operation of the plant.

(3) This amendment will not involve a significant reduction in the margin of safety. As shown in the Westinghouse Topical Report, this design is bounded by the same margin of safety as previous designs.

[illegible]

[illegible] Visions, issue for [illegible] Mass [illegible]

[illegible]

[illegible]

[illegible] in the plan [illegible]

[illegible]

[illegible]

[illegible]

It is concluded that the amendment would not likely involve a significant hazard consideration. In addition, the Commission has provided guidance for the application of the criteria in 10 CFR 50.92 (as specified above) by providing examples of amendments that are not likely to involve a significant hazards consideration.

The proposed change to allow the use of Integral Fuel Burnable Absorber feature to reload core design is similar to example (iii) "a change resulting from a nulcear reactor core reloading, if no fuel assemblies significantly different from those found previously acceptable to the NRC for a previous core at the facility in question are involved."

Therefore, on the basis of the above discussion, operation of Turkey Point Units 3 and 4 in accordance with the proposed amendments would pose no threat to the public health and welfare, and would not involve a significant hazards consideration.