Westinghouse
Electric Corporation

Energy Systems

Nuclear Technology Division

Box 355
Pittsburgh Pennsylvania 15230-0355

January 17, 1997

AW-97-1062

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Attention: Mr. Eric W. Weiss

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: "Westinghouse Response to the Susceptibility of IFM Fuel for the Incomplete RCCA Insertion Issue" (Proprietary)

Dear Mr. Weiss:

The application for withholding is submitted by Westinghouse Electric Corporation ("Westinghouse") pursuant to the provisions of paragraph (b)(1) of Section 2.790 of the Commission's regulations. It contains commercial strategic information proprietary to Westinghouse and customarily held in confidence.

The proprietary material for which withholding is being requested is identified in the proprietary version of the subject report. In conformance with 10 CFR Section 2.790, Affidavit AW-97-1062 accompanies this application for withholding, setting forth the basis on which the identified proprietary information may be withheld from public disclosure.

Accordingly, it is respectfully requested that the subject information which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10CFR Section 2.790 of the Commission's regulations.

Correspondence with respect to this application for withholding or the accompanying affidavit should reference AW-97-1062 and should be addressed to the undersigned.

Very truly yours,

H. A. Sepp, Manager
Regulatory and Licensing Engineering

Enclosure

cc: Kevin Bohrer/NRC (12H5)

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

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COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared Henry A. Sepp, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Corporation ("Westinghouse") and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

Henry A. Sepp, Manager
Regulatory and Licensing Engineering

Sworn to and subscribed
before me this 17th day
of January, 1997

Notary Public

Notarial Seal
Janet A. Schwab, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires May 22, 2000
Member, Pennsylvania Association of Notaries

(1) I am Manager, Regulatory and Licensing Engineering, in the Nuclear Services Division, of the Westinghouse Electric Corporation and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rulemaking proceedings, and am authorized to apply for its withholding on behalf of the Westinghouse Energy Systems Business Unit.

(2) I am making this Affidavit in conformance with the provisions of 10CFR Section 2.790 of the Commission's regulations and in conjunction with the Westinghouse application for withholding accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by the Westinghouse Energy Systems Business Unit in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.790 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information which is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10CFR Section 2.790, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked as the "Westinghouse Responses to the Susceptibility of IFM Fuel for the Incomplete RCCA Insertion Issue", (Proprietary), being transmitted by Westinghouse Electric Corporation with Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk, Attention Mr. Eric W. Weiss. The proprietary information has been requested by the Nuclear Regulatory Commission and is being voluntarily provided by Westinghouse for review relative to the incomplete RCCA insertion phenomenon.

This information is part of that which will enable Westinghouse to:

(a) Provide documentation of the methods for evaluating the implementation of fuel assembly and RCCA tests and inspections.

(b) Establish applicable analytical technologies relative to inspections.

(c) Establish the procedures and guidelines for the examination of fuel assemblies and RCCAs.

Further this information has substantial commercial value as follows:

(a) Westinghouse plans to sell the use of similar information to its customers for purposes of meeting NRC requirements for licensing documentation.

(b) Westinghouse can sell support and defense of this information to its customers in the licensing process.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar evaluation services and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended for developing the procedures, guidelines and analytical methods.

Further the deponent sayeth not.

Westinghouse Response To The Susceptibility Of IFM Fuel For The Incomplete Rod Insertion Issue

INTRODUCTION

The purpose of this letter is to provide information to the NRC which shows that Westinghouse fuel assemblies with Intermediate Flow Mixers (IFM) are not susceptible to incomplete RCCA insertion with burnups within the current licensed range. The results of site tests as well as information provided by the Westinghouse Mechanical Model are used to provide the data which shows that Westinghouse IFM fuel assemblies are not susceptible to incomplete RCCA insertion within the burnup ranges that are currently licensed.

OBSERVATIONS

Since the South Texas 1 and Wolf Creek occurrences of incomplete RCCA insertion, Westinghouse and the WOG member utilities have conducted a significant amount of testing and monitoring. Westinghouse has been conducting extensive testing and analyses programs to determine the root cause of the incomplete RCCA insertions. Part of the testing program includes performing drag measurements of Westinghouse 12 foot fuel assemblies at Wolf Creek and eight other plant sites. These drag measurements were taken in a way which provided the drag in both the dashpot region and the upper guide thimble region of the fuel assembly. In addition to the drag testing performed by Westinghouse, utilities have also performed similar drag testing. In response to Bulletin 96-01, utilities have also performed rod drop timing tests as well as monitoring for complete RCCA insertion following a reactor trip.

Figure 1, provides a summary of recent RCCA insertions in WOG member plants utilizing Westinghouse fuel with IFMs. A compilation of the data which was used to prepare Figure 1 is provided in Table 1. As shown in Table 1, the data in Figure 1 is comprised from testing or reports of complete insertions during a reactor trip from 36 different tests/reports at 16 WOG utility plants. The data indicates there have been successful insertions in 1661 IFM fuel assemblies with assembly burnup up to approximately [ ]^{a,b,c} MWD/MTU. Additionally, it should be noted that there have been no reports of incomplete RCCA insertion during a reactor trip in any fuel assembly containing IFMs.

In addition to the above rod drop testing/monitoring for complete insertion, a significant amount of drag testing has been performed by WOG utility members as well as Westinghouse in its root cause efforts. Figures 2, 3, and 4 provide the results of this testing from 18 Westinghouse designed plant sites. A compilation of the data which was used to prepare these figures is provided in Table 2. These figures provide a graphic representation of the drag measurements from these tests. For consistency with the root cause evaluation, withdrawal drag has been used when both withdrawal and insertion drags have been measured. Also, Westinghouse interpretations of the testing charts of the drag measurements has been used in those cases where both Westinghouse and utilities have reviewed the data.

Figure 2 provides a plot of the upper thimble tube drag versus dashpot drag, Figure 3 provides a plot of dashpot (total) drag versus assembly burnup, and Figure 4 provides a plot of upper thimble tube drag versus burnup. A review of these figures indicates the following relative to the fuel which contains IFMs.

1. The upper thimble tube drag for the IFM fuel assemblies is typically significantly below the Westinghouse F-Specification criteria of [ ]^{a,b,c} pounds drag and only one fuel assembly out of the 586 IFM fuel assemblies tested had an upper thimble tube drag, 42 pounds, which exceeded the F Specification criteria of [ ]^{a,b,c} pounds drag. It should be noted that the utility performed a rod drop test

at the end of the cycle on this fuel assembly and its drop time was well within Technical Specification requirements and that full insertion occurred.

2. There are some instances in IFM fuel assemblies with a burnup of approximately [ ]^{a,b,c} MWD/MTU and greater where the drag in the dashpot is greater than the [ ]^{a,b,c} pound Westinghouse F-Specification criteria.

3. In no case has any fuel assembly with IFMs exceeded both of the Westinghouse F Specification criteria for drag in the dashpot and upper thimble tube regions. (In 12 foot fuel, all assemblies that had incomplete RCCA insertion were found to have drags that exceeded both F Specification criteria.)

Relative to item two above, a review of these fuel assemblies was conducted. The table below provides additional information relative to these assemblies.

a,b,c

Again, as shown by the above information, while the dashpot drag is greater than the dashpot F-Specification criterion, the upper thimble tube drag is well below its criterion. Additionally, assemblies 5G67 and 5G80, the two assemblies showing the highest dashpot drag, were in rodded locations during the operating cycle. Although a rod drop timing test was not performed at the end of the cycle, the plant was tripped from low power to end the cycle and the utility reported prompt and complete RCCA insertion for all core locations. Also, the K47 fuel assembly was in a rodded location and the utility also indicated that the rod fully inserted during the end of cycle rod drop timing test. It is noted that during the drag testing of the Vogtle fuel assemblies, the dummy RCCA would not completely insert in two assemblies, 5G68 and 5G84. The dummy RCCA passed easily through the upper thimble tubes in these fuel assemblies; however, the upper thimble drag was not quantified. The expected low drag in the upper thimble tubes is supported by single tube probe data for these two assemblies which had results comparable to other fuel assemblies which had low thimble tube drags. From this data, it is concluded that if all of these fuel assemblies were in rodded locations they would have experienced complete RCCA insertion due to their low upper thimble tube drag which permits normal dropping of the RCCA and sufficient kinetic energy to result in complete insertion.

It has been concluded by Westinghouse that the cause of the incomplete RCCA insertions at Wolf Creek is due to excessive compressive loads on the fuel assembly guide thimbles leading to excessive thimble tube distortion and that this compressive load is in part due to unusual fuel assembly growth. A detailed review by Westinghouse showed that the Wolf Creek assemblies that had exhibited incomplete insertion were somewhat unique in the power history behavior in that these assemblies operated for three cycles with relatively high power in the second and third cycles in a high temperature environment. The IFM fuel assemblies which are included in Figure 1 and Figure 2 were reviewed to determine which of these assemblies may have operated similar to Wolf Creek. This review provided the information in the Table 3 relative to assemblies which have operated for three cycles.

A review of Table 3 indicates that the VC Summer assemblies G57, G68, G61 and G65 had an operating temperature and burnup similar to the Wolf Creek assemblies which had incomplete RCCA insertion. Additionally, although the burnup is slightly lower than the Wolf Creek assemblies that had incomplete RCCA insertion, VC Summer fuel assemblies G41, G46, G52 and G56 had an operating temperature similar to Wolf Creek and a power history in the range of the power history for the Wolf Creek incomplete RCCA insertion fuel assemblies. On these eight assemblies, the utility has reported that complete insertion was observed during a trip of the reactor with the assemblies at the approximate burnup shown in the table. Therefore, it is demonstrated that a fuel assembly with IFMs will not be prone to incomplete insertion with a power history and operating temperature in the range of that experienced by the Wolf Creek assemblies which had incomplete RCCA insertion.

MECHANICAL ANALYSIS

Westinghouse has developed a mechanical model which predicts fuel assembly thimble tube bow. This model has been used to estimate the thimble tube bow for a Wolf Creek IFM fuel assembly, J32, which has been analyzed using the power history of Wolf Creek assembly H50, a fuel assembly which had incomplete RCCA insertion. Figures 5A and 5B provide the results of this analysis and the following can be obtained from this figure.

1. The fuel assembly growth for the IFM assembly is predicted to be approximately the same as the non-IFM assembly ([ ]^{a,b,c} %).

2. The dashpot bow (Span 1) is predicted to be less for the IFM fuel assembly (approximately [ ]^{a,b,c} %) than in the non-IFM assembly.

3. The top span bow in the IFM assembly (Span 10) is predicted to be slightly higher than the top span bow (Span 7) in the non-IFM assembly. However, the bow in all other spans in the guide thimble tube is significantly lower. While the top span bow predicted by the model is slightly higher for the IFM assembly, the overall bow in the guide thimble region is much lower for the IFM assembly. It is the combination of the top span bow, coupled with the bow of the remaining spans in the upper guide tube region which causes excessive drag in the upper thimble tube. Significantly higher bow is predicted for these spans in the non-IFM fuel assembly. In addition, the bow in the upper guide tube region predicted by

the model for the IFM assembly is consistent with the field data drag results of the IFM fuel assemblies. The drags measured for IFM assemblies in this region are small.

Thus, basically the IFMs decrease the thimble tube distortion for the following two reasons.

1. The upper (except for the top) span lengths (distance between supporting grids) are reduced by a factor of [ ]^{a,b,c} thereby increasing the stiffness and minimizing distortion.

2. The addition of IFMs increases the pressure drop and hydraulic lift force which in turn reduces the compression in the thimble tubes, particularly in Span [ ]^{a,b,c}.

Based on the above model results it is believed that a fuel assembly with IFMs will not experience incomplete RCCA insertion when subjected to the same power and temperature history as the Wolf Creek fuel assemblies which experienced incomplete RCCA insertion.

CONCLUSION

Westinghouse considers that there is sufficient data available from actual plant testing and analyses performed to permit the operation of Westinghouse fuel assemblies with IFMs to burnups within the current licensed range. The data which support this conclusion are summarized below.

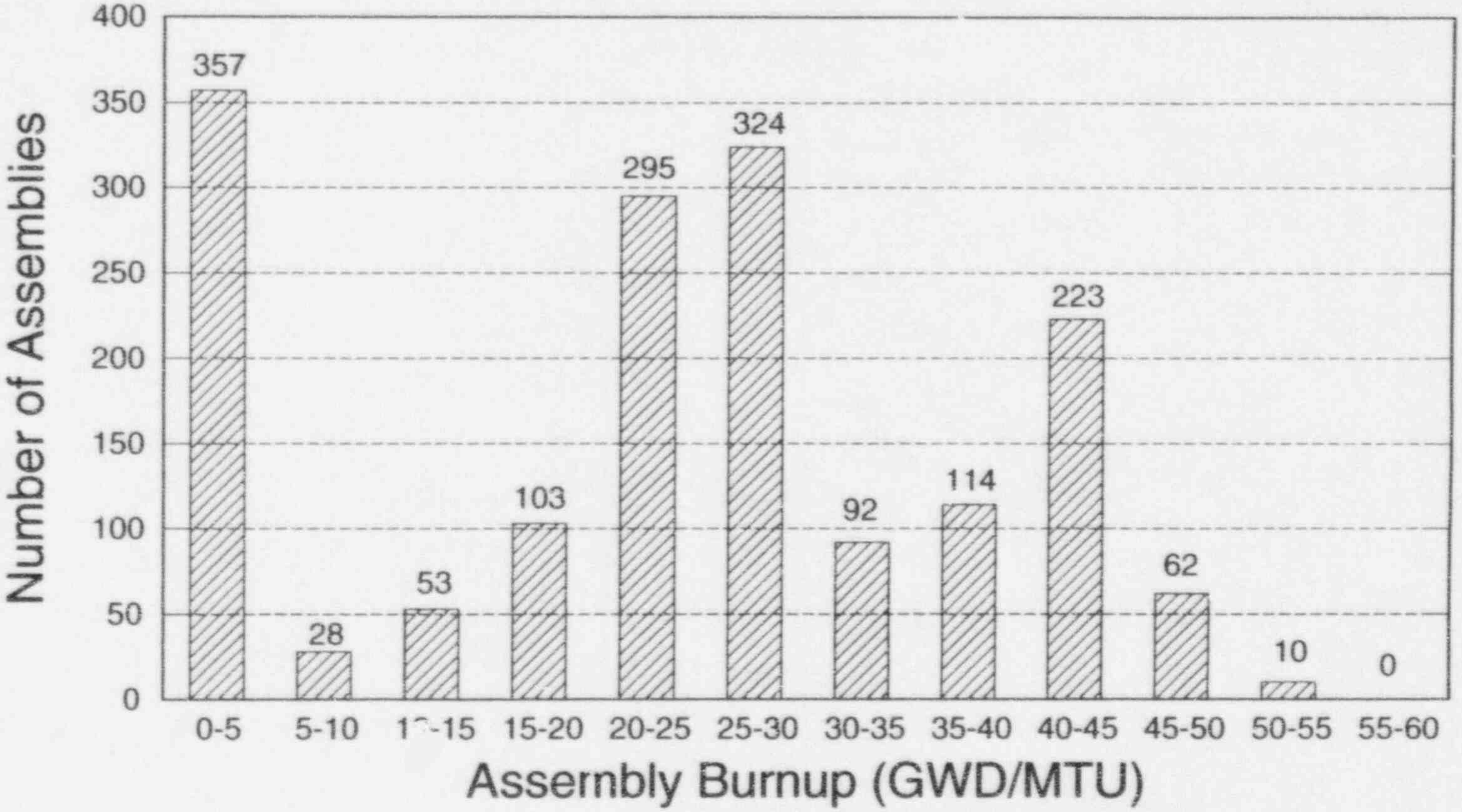
1. There have been no reports of incomplete RCCA insertion in fuel assemblies which have IFMs and have experienced a burnup up to approximately [ ]^{a,b,c} MWD/MTU.

2. Drag tests of fuel assemblies with IFMs have indicated that in no case has any IFM fuel assembly exceeded both of the Westinghouse F Specification criteria.

3. Successful RCCA insertion has been reported in IFM Fuel assemblies at VC Summer which have experienced operation with temperatures and burnups as well as power histories in the range of those fuel assemblies at Wolf Creek which had incomplete RCCA insertion.

4. The Westinghouse mechanical model predicts lower fuel assembly thimble tube bow for IFM fuel assemblies than the bow predicted for the Wolf Creek fuel assemblies that experienced incomplete RCCA insertion.

Figure 1 - Summary of RCCA Insertion Information - IFM Fuel



Westinghouse Non-Proprietary Class 3
Attachment to NSD-NRC-97-4944

Figure 2 - Upper Guide Thimble Drag vs. Dashpot Drag - Westinghouse Fuel

Upper Guide Thimble Drag (lbs.)

Dashpot Drag (lbs.)

a,b,c

Figure 3 - Dashpot Drag vs. Burnup - Westinghouse Fuel

Drag (lbs.)

Assembly Burnup (MWD/MTU)

a,b,c

Figure 4 - Upper Guide Thimble Drag vs. Burnup - Westinghouse Fuel

Drag (lbs.)

Assembly Burnup (MWD/MTU)

a,b,c

Figure 5A

a,b,c

Figure 5B

a,b,c

Table 1: Data Included In Figure 1 (Summary of RCCA Insertion Information - Westinghouse IFM Fuel)

Plant	Test	Fuel Type	Assembly Burnup Range (GWD/MTU)											
			0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60
Braidwood 1	6 M1	17OFA-I	12	0	0	0	8	24	9	0	0	0	0	0
	6 M2	17OFA-I	0	0	12	0	0	8	4	21	8	0	0	0
Braidwood 2	5 EOC	17OFA-I	0	0	0	0	8	0	8	4	32	1	0	0
	6 BOC	17OFA-I	16	0	0	0	31	5	1	0	0	0	0	0
Byron 1	7 BOC	17OFA-I	12	0	0	0	40	0	1	0	0	0	0	0
	7 EOC	17OFA-I	0	0	0	4	8	0	8	7	25	1	0	0
	8 BOC	17OFA-I	16	0	0	16	20	0	1	0	0	0	0	0
Byron 2	6 EOC	17OFA-I	0	0	0	0	8	4	0	8	19	13	1	0
	7 BOC	17OFA-I	12	0	0	0	25	11	5	0	0	0	0	0
Callaway	7 EOC	17OFA-I	0	0	0	0	12	28	0	8	0	5	0	0
	8 BOC	17OFA-I	40	0	0	0	0	13	0	0	0	0	0	0
	8 M1	17OFA-I	16	24	0	0	0	8	5	0	0	0	0	0
	8 M2	17OFA-I	0	0	8	32	0	0	8	5	0	0	0	0
	8 EOC	17OFA-I	0	0	0	0	0	40	0	8	0	5	0	0
DC Cook 2	10 BOC	17OFA-I	20	0	0	0	31	1	1	0	0	0	0	0
	10 EOC	17OFA-I	0	0	0	8	12	0	0	0	32	1	0	0
Diablo Canyon 1	8 BOC	17OFA-I	36	0	0	0	12	4	1	0	0	0	0	0
	8 M	17OFA-I	32	4	0	0	0	12	4	1	0	0	0	0

Table 1: Data Included In Figure 1 (Summary of RCCA Insertion Information - Westinghouse IFM Fuel)

Plant	Test	Fuel Type	Assembly Burnup Range (GWD/MTU)											
			0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60
Diablo Canyon 2	7 BOC	17OFA-I	32	0	0	4	4	12	0	1	0	0	0	0
	7 EOC	17OFA-I	0	0	0	0	12	20	0	8	4	8	1	0
	8 BOC	17OFA-I	28	0	0	4	0	20	0	1	0	0	0	0
Farley 2	11 EOC	17OFA-I	0	0	0	0	8	0	0	0	31	1	0	0
	12 BOC	17OFA-I	4	0	4	0	28	12	0	0	0	0	0	0
Indian Point 2	13 BOC	15V+I	12	0	0	0	0	0		0	0	0	0	0
	13 M1	15V+I	0	0	12	0	0	0	0	0	0	0	0	0
	13 M2	15V+I	0	0	4	8	0	0	0	0	0	0	0	0
Millstone 3	6 M	17V5H-I	0	0	13	12	11	0	20	4	0	0	0	0
Shearon Harris	7 M1	17OFA-I	0	0	0	0	0	0	0	0	4	4	0	0
	7 M2	17OFA-I	0	0	0	0	0	0	0	0	0	8	0	0
VC Summer	7 M	17OFA-I	0	0	0	4	0	0	8	16	12	4	4	0
	9 EOC	17P+&V+	0	0	0	0	8	16	0	12	10	2	0	0
Vogtle 1	6 EOC	17OFA-I	0	0	0	0	0	32	1	0	12	4	4	0
Vogtle 2	5 BOC	17OFA-I	36	0	0	3	5	9	0	0	0	0	0	0
	5 EOC	17OFA-I	0	0	0	0	0	34	2	2	10	5	0	0
	6 BOC	17OFA-I	33	0	0	0	4	11	5	0	0	0	0	0
Wolf Creek	8 EOC	17V5H-I	0	0	0	8	0	0	0	8	24	0	0	0
TOTALS			**357**	**28**	**53**	**103**	**295**	**324**	**92**	**114**	**223**	**62**	**10**	**0**

Table 2: Data Included in Figures 2 thru 4 (Westinghouse fuel)

Plant	Assembly Burnup Range (GWD/MTU)											
	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60
Non- IFM Fuel												
Beaver Valley 1 & 2	32	0	16	32	28	8	28	28	20	0	0	0
Comanche Peak 1 & 2	0	0	8	9	46	16	28	1	0	0	0	0
Farley 2	0	0	0	0	0	0	0	0	0	8	0	0
Ginna	1	0	12	4	0	8	1	4	1	0	0	0
Millstone 3	0	0	0	0	0	0	0	0	0	0	1	0
North Anna 1 & 2	0	0	0	1	6	0	0	15	27	33	2	0
Point Beach 1 & 2	16	0	24	8	0	13	0	0	9	1	8	0
Sequoyah 1 & 2	36	0	1	8	37	0	8	11	14	10	0	0
Surry 1 & 2	0	0	0	0	0	0	8	27	13	6	2	2
Turkey Point 4	0	0	0	0	0	8	16	0	12	8	1	0
Vogtle 1	0	0	0	0	0	0	0	0	0	1	0	0
Wolf Creek	0	0	0	0	0	0	2	2	3	6	5	0
Zion 2	0	0	0	0	28	0	12	8	4	1	0	0
Total Non-IFM Fuel	85	0	61	62	145	53	103	96	103	74	19	2
IFM Fuel												
Braidwood 2	0	0	0	0	8	0	8	4	32	1	0	0
Byron 1 & 2	28	0	0	20	31	15	14	15	44	14	1	0

Table 2: Data Included In Figures 2 thru 4 (Westinghouse fuel)

Plant	Assembly Burnup Range (GWD/MTU)											
	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60
Callaway	0	0	0	0	0	10	0	8	0	5	0	0
Diablo Canyon 2	0	0	0	0	12	20	0	8	4	8	1	0
Farley 2	0	0	0	0	8	0	0	0	31	1	0	0
Millstone 3	0	0	0	0	0	0	0	0	0	9	0	0
VC Summer	0	0	0	0	8	16	0	12	14	5	0	0
Vogtle 1 & 2	0	0	0	0	0	66	3	2	22	17	12	0
Wolf Creek	0	0	0	4	0	0	0	4	11	0	0	0
Total IFM Fuel	28	0	0	24	97	127	25	53	158	60	14	0

Table 3

a,b,c

* Wolf Creek assemblies with incomplete RCCA insertion