Attachment I
Proposed Technical Specification Change

5.2.1.2 REACTOR BUILDING

a. Nominal annular space = 5 feet.

b. Annulus nominal volume = 427,000 cubic feet.

c. Nominal outside height (measured from top of foundation base to the top of the dome) = 177 feet.

d. Nominal inside diameter = 125 feet.

e. Cylinder wall minimum thickness = 3 feet.

f. Dome minimum thickness = 2.25 feet.

g. Dome inside radius = 87 feet.

DESIGN PRESSURE AND TEMPERATURE

5.2.2 The reactor containment is designed and shall be maintained for a maximum internal pressure of 15.0 psig and a temperature of 250°F.

5.3 REACTOR CORE

FUEL ASSEMBLIES

5.3.1 The core shall contain 193 fuel assemblies with each fuel assembly nominally containing 264 fuel rods clad with Zircaloy-4* except that substitutions of fuel rods by filler rods consisting of Zircaloy-4 or stainless steel, or by vacancies, may be made in fuel assemblies if justified by cycle-specific reload analyses using NRC-approved methodology. Should more than 30 rods in the core, or 10 rods in any assembly, be replaced per refueling, a special report describing the number of rods replaced will be submitted to the Commission pursuant to Specification 6.9.2 within 30 days after cycle startup. Each fuel rod shall have a nominal active fuel length of 144 inches. Reload fuel shall be similar in physical design to the initial core loading and shall have a maximum enrichment of 4.0 weight percent U-235.

CONTROL ROD ASSEMBLIES

5.3.2 The core shall contain 53 full-length and no part-length control rod assemblies. The full-length control rod assemblies shall contain a nominal 142 inches of absorber material. The nominal values of absorber material for Unit 1 control rods shall be 80% silver, 15% indium, and 5% cadmium. The nominal values of absorber material for Unit 2 control rods shall be 100% boron carbide (B_4C) for 102 inches and 80% silver, 15% indium, and 5% cadmium for the 40-inch tip. All control rods shall be clad with stainless steel tubing.

* MCGUIRE UNIT 1 WILL USE TWO DEMONSTRATION ASSEMBLIES IN CYCLES 8, 9, AND 10. THESE ASSEMBLIES WILL CONTAIN ≥ 30 FUEL RODS EACH WHICH ARE CLAD WITH A ZIRCONIUM-BASED ALLOY OTHER THAN ZIRCALOY-4, AS DESCRIBED IN BAW-2133P.

Attachment II
Justification and Safety Analysis

Introduction

In the upcoming fuel cycle (Cycle 8) at McGuire Unit 1, Duke plans to insert two demonstration fuel assemblies to test a variety of advanced fuel rod cladding materials and fuel pellet designs. These fuel assemblies will be manufactured by B&W Fuel Company (BWFC), the supplier of the remainder of the reload fuel batch. The test assemblies will be irradiated for three fuel cycles, to demonstrate the performance of the advanced clad material with respect to corrosion, creep, and growth.

Technical Specifications currently require (see Specification 5.3.1) that fuel rods be clad with Zircaloy-4. Some of the fuel rods being considered for this demonstration project contain claddings whose compositions are outside the specification ranges of Zircaloy-4. Therefore, this Technical Specification (TS) change is needed to permit use of these assemblies at McGuire.

The two demonstration fuel assemblies will contain a maximum of 104 advanced-clad fuel rods, all located around the periphery of the two assemblies to permit inspection. A variety of cladding materials and fuel pellets will be used. A detailed description of the clad compositions, fuel pellet designs, and pellet/clad combinations can be found in the BWFC report which describes the advanced cladding demonstration program (see Attachment V). A summary description of the various clad types and pellet designs appears below in the safety analysis portion of this attachment.

Justification

In order to achieve higher fuel burnups without increasing the risk of fuel failure, analyses and tests are conducted to explore various options in fuel assembly design and materials. Duke has participated in three previous BWFC test programs, at both Oconee and McGuire. Valuable information has been obtained through each of these programs. The proposed program is expected to add significantly to the base of knowledge of how various clad materials react under in-reactor conditions.

The cladding compositions being considered for this demonstration have been chosen based on ex-core testing, theory, and previous irradiation programs. Each of the rods to be tested is expected to perform at least as well as the current fuel design. It is anticipated that the best-performing clad composition will become qualified for future use in fuel reloads.

The non-Zircaloy-4 clad types being considered in the demonstration have been tested for corrosion resistance, tensile and burst strength, and creep characteristics. Details concerning the test

programs that have been performed in support of this demonstration can be found in the attached BWFC report.

Safety Analysis

The safety significance of this change is considered minimal. The number of fuel rods involved is very small in comparison to the total core inventory. Failure of all of the advanced cladding fuel rods from a cause related to the demonstration would constitute significantly less than the 1% fuel failure postulated in FSAR Chapter 15 safety analyses. Failure of the fuel as a result of some unrelated phenomenon would not result in greater inventory release than non-demonstration fuel.

There are three groups of claddings being considered for this demonstration program: type B, type N, and type F. Each type represents a different strategy for obtaining better performance at higher burnups. Within each type, relatively minor variations in composition are present, to create a total of twelve different advanced claddings. The type B claddings are slight variations of the current cladding used by BWFC, and all are within the Zircaloy-4 specification range. The two of the type N claddings are within the Zirc-4 range and two are just outside. The type F claddings are further from the Zirc-4 range.

Five different pellet types will be used in the demonstration program. The pellet types NP1, NP2, and NP3 are intended to display a range of densification characteristics. These pellets will be used in type N claddings. Pellet type FP1 will be used in clad type F. The remaining pellets are standard BWFC-specification pellets. The dimensions of the type F clad correspond to the dimensions of the type FP1 pellet. The dimensions of the remaining pellets and clads correspond to the balance of the BWFC reload batch.

The demonstration assemblies meet the same design bases as the fuel which is currently in the reactor. No safety limits have been changed or setpoints altered as a result of the use of these assemblies. The FSAR analyses are bounding for the demonstration assemblies as well as the remainder of the core.

The demonstration assemblies will be placed in core locations which will allow them to accumulate approximately 45 to 50 GWD/MTU during three cycles of exposure. The assemblies will be placed in core locations which will not experience limiting power peaking in any cycle. Figure 1 shows the reload core map for McGuire Unit 1 Cycle 8, with the demonstration assembly locations identified. Figures 2 and 3 show power distributions at beginning and end of cycle, which show that the assembly and pin powers for the demonstration assemblies will not be limiting. These figures were taken from the final fuel cycle design report for M1C8. They will also be included in the reload submittal which will be submitted for NRC approval in early June, 1991.

Following each cycle, the demonstration assemblies will undergo a post-irradiation examination (PIE). The PIE will be conducted in the spent fuel pool, using a portable PIE rig. The examination will consider the visual and physical characteristics of the assemblies. The data will be used for more explicit modeling, as well as to compare the various advanced clad types.

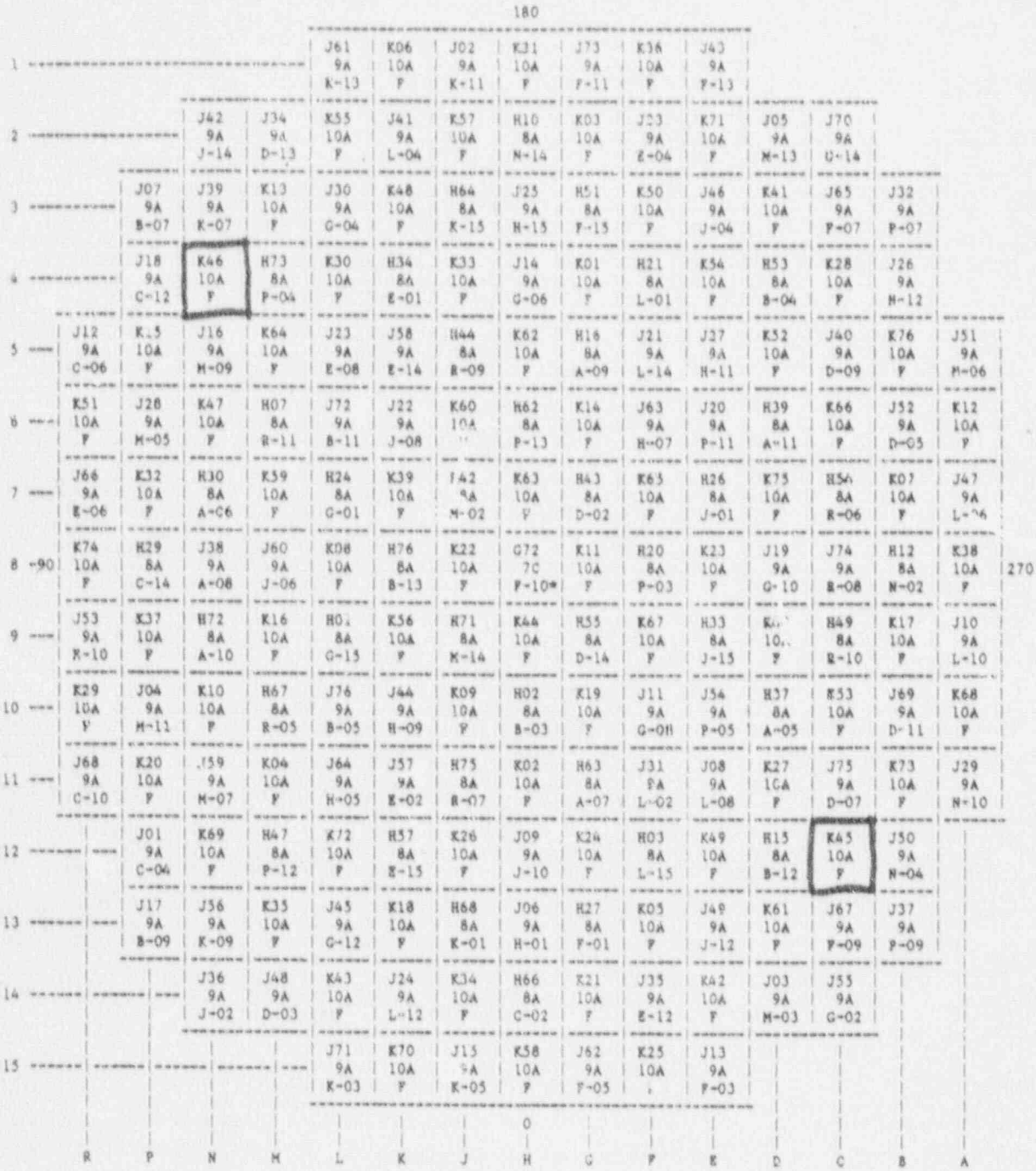
Conclusion

It is concluded that the Unit can operate safely with the demonstration program in place. The advanced zirconium-based alloys have been shown through testing to perform satisfactorily under conditions representative of a reactor environment. In addition, the relatively small number of fuel rods involved does not represent a prohibitively large inventory of radioactive material which could be released into the reactor coolant in the event of fuel failure.

FIGURE 1

M1C8 FULL CORE LOADING PATTERN

REGION REFERENCE NUMBERS
REGION NUMBERS
PREVIOUS CORE LOCATIONS



DEMONSTRATION ASSY LOCATIONS - N-4, C-12

M1C08 RADIAL POWER DISTRIBUTION

HFP, EQXE, 004 EFPD (≃ BOC)
THF ON, ARO, 1160 PPMB
JOBID/CASEID = AGAV/DPL004012A
DATE RUN = 03JUL90

	H	G	F	E	D	C	B	A
						1.2343	1.0078	.8392
8	.8768	1.2809	1.1332	1.3365	1.2221	1.3566	1.1188	1.1239
	1.0515	1.1401	1.0632	1.1133	1.0623	1.0991	1.1102	1.3391
	K P	Q Q	C M	P I	N L	D M	C M	C M
	1.1300	.9993	1.2010	1.0324	1.2325	1.0595	1.1996	.6523
9	1.2823	1.1030	1.3320	1.1221	1.3743	1.1553	1.3420	.9041
	1.1348	1.1038	1.1090	1.0868	1.1150	1.0904	1.1188	1.3862
	Q Q	M N	Q Q	E O	Q A	C E	B I	B L
	1.0713	1.2055	1.1546	1.1626	1.1054	1.2283	1.0372	.7977
10	1.1321	1.3370	1.2546	1.2779	1.2174	1.3596	1.1882	1.1105
	1.0567	1.1091	1.0866	1.0992	1.1014	1.1069	1.1456	1.3921
	M C	Q Q	E D	D E	N E	A Q	D E	C E
	1.2054	1.0355	1.1644	1.1286	1.2202	1.1210	1.1133	.4528
11	1.3410	1.1250	1.2811	1.2212	1.3585	1.2446	1.3261	.8057
	1.1125	1.0864	1.1002	1.0820	1.1134	1.1103	1.1911	1.7793
	I P	O E	E D	M N	Q A	E D	C H	A A
	1.1506	1.2324	1.1050	1.2183	1.0107	1.1263	.6374	
12	1.2168	1.3717	1.2159	1.3559	1.0724	1.3106	.9967	
	1.0575	1.1131	1.1004	1.1129	1.0610	1.1636	1.5638	
	L N	A Q	E N	A Q	N E	A A	A A	
	1.2315	1.0566	1.2255	1.1175	1.1237	.6990	.3439	
13	1.3532	1.1525	1.3569	1.2412	1.3099	.9348	.6818	
	1.0989	1.0908	1.1073	1.1108	1.1657	1.3374	1.9824	
	M D	E C	Q A	D E	A A	A A	A A	
	1.0050	1.1959	1.0339	1.1102	.6362	.3439	P (AVG)	
14	1.1233	1.3384	1.1841	1.3225	.9942	.6818	PEAK PIN	
	1.1177	1.1191	1.1454	1.1911	1.5625	1.9826	PEAK/ASS	
	M C	I B	E D	H C	A A	A A	PIN LOC	
	.8355	.6496	.7951	.4514				
15	1.1186	.9006	1.1068	.8032				
	1.3389	1.3864	1.3921	1.7795				
	M C	L B	E C	A A				

The maximum assembly power is 1.2343 at location C-8.

The maximum pin power is 1.3743 at location D-9.

The maximum pin to assembly factor is 1.9826 at location C-14.

M1C08 RADIAL POWER DISTRIBUTION

HFP, EQXE, 350 EFPD (≃ EOC)
THF ON, ARO, 100 PPMB
JOBID/CASEID = AGAV/DPL350370A
DATE RUN = 03JUL90

	H	G	F	E	D	C	B	A
	1.0043	1.3204	1.1231	1.2929	1.0892	1.1071	.9336	.8091
8	1.0298	1.3794	1.1836	1.3538	1.1351	1.2054	1.0084	1.0525
	1.0255	1.0447	1.0539	1.0472	1.0421	1.0888	1.0801	1.3008
	L M	Q I	D L	A I	D L	A I	B L	A I
	1.3231	1.0871	1.3047	1.0322	1.2605	1.0043	1.1428	.6534
9	1.3809	1.1398	1.3745	1.0713	1.3206	1.0865	1.2475	.8589
	1.0437	1.0484	1.0534	1.0379	1.0477	1.0819	1.0916	1.3145
	I Q	M N	A A	E O	A A	C M	A Q	B L
	1.1249	1.3066	1.0916	1.0763	1.0608	1.2496	.9736	.7829
10	1.1802	1.3754	1.1821	1.1485	1.1387	1.3139	1.0823	1.0499
	1.0491	1.0527	1.0829	1.0671	1.0734	1.0514	1.1116	1.3410
	L D	A A	E D	A A	N E	A Q	D E	A A
	1.2948	1.0335	1.0771	1.0534	1.2554	1.0628	1.0618	.4817
11	1.3560	1.0725	1.1499	1.1247	1.3136	1.1482	1.2409	.7652
	1.0472	1.0378	1.0675	1.0676	1.0463	1.0804	1.1688	1.5886
	I A	O E	A A	M N	Q A	D E	A A	A A
	1.0896	1.2607	1.0612	1.2551	1.0065	1.1459	.6806	
12	1.1418	1.3217	1.1386	1.3134	1.0453	1.2795	.9442	
	1.0479	1.0484	1.0730	1.0465	1.0386	1.1166	1.3873	
	L D	A A	E N	A Q	N E	A A	A A	
	1.1067	1.1036	1.2495	1.0622	1.1455	.7676	.4267	
13	1.2047	1.0858	1.3138	1.1478	1.2790	.9464	.7526	
	1.0885	1.0819	1.0515	1.0805	1.1166	1.2329	1.7635	
	I A	M C	Q A	E D	A A	C E	A A	
	.9336	1.1426	.9733	1.0618	.6809	.4271	P (AVG)	
14	1.0119	1.2473	1.0817	1.2409	.9443	.7531	PEAK PIN	
	1.0839	1.0916	1.1114	1.1687	1.3868	1.7635	PEAK/ASS	
	L B	Q A	E D	A A	A A	A A	PIN LOC	
	.8086	.6530	.7829	.4817				
15	1.0518	.8584	1.0498	.7652				
	1.3008	1.3145	1.3409	1.5887				
	I A	L B	A A	A A				

The maximum assembly power is 1.3231 at location H-9.

The maximum pin power is 1.3809 at location H-9.

The maximum pin to assembly factor is 1.7635 at location B-13.

Attachment III
Significant Hazards Analysis

The following analysis, required by 10 CFR 50.91, is provided to justify the determination that the proposed Technical Specification change will not create a Significant Hazards Consideration (SHC). The criteria of 10 CFR 50.92 are applied to the proposed change to support that determination.

1) The proposed change will not involve a significant increase the probability or consequences of any accident previously evaluated in the FSAR.

   The test assemblies with the zirconium-based claddings are mechanically and thermal-hydraulically similar to the remainder of the reload batch and the rest of the core, so no failure probability is increased, nor is any operational practice changed which could introduce a new initiator of an accident. The only credible event which could occur as a result of this demonstration is clad failure of the test fuel rods. The number of fuel rods involved is such a small percentage of the core inventory that even a postulated failure of all the demonstration fuel rods from a cause related to the demonstration would not result in dose consequences greater than existing limits. A failure of the fuel rods from a cause not related to the demonstration would not result in consequences greater than those which would have occurred had the assemblies not been demonstration assemblies.

2) The proposed change will not create the possibility of a new accident not previously evaluated.

   The mechanical and thermal-hydraulic similarity of the test assemblies to the remainder of assemblies in the core precludes the credible possibility of creating any new failure mode or accident sequence. The use of the demonstration assemblies does not involve any alterations to plant equipment or procedures which would introduce any new or unique operational modes or accident precursors

3) The proposed change will not involve a significant decrease in a margin of safety.

   The demonstration assemblies meet the same design bases as the remainder of assemblies in the core. Existing reload design and safety analysis limits are maintained, and the FSAR analyses are bounding. No special setpoints or other safety settings are required as a result of the use of these two test assemblies. The assemblies will be placed in locations which will not experience limiting peak power conditions.

Conclusion

The proposed change has been shown in the accompanying Justification and Safety Analysis (see Attachment II) to be transparent in terms of the operation of the plant. No new operational or safety considerations will be created, and no procedures or practices will be changed. The demonstration assemblies will be mechanically, neutronically, and thermal-hydraulically similar to the rest of the assemblies in the reload batch and the remainder of the core.

Based upon the above analysis, it is concluded that the proposed change will not involve a Significant Hazards Consideration.

Attachment IV
Application for Exemption From Requirement of 10 CFR 50.46 That Fuel Cladding Must Be Zircaloy

Introduction

The Code of Federal Regulations, 10 CFR 50.46, contains requirements for Emergency Core Cooling Systems (ECCS) at light-water nuclear power plants. Part 50.46(a)(1)(i) specifies that reactor fuel will consist of uranium oxide pellets enclosed in Zircaloy tubes. It does not define what is considered "Zircaloy". Therefore, it is not clear whether the deviations from the composition specifications of Zircaloy-4 of some of the fuel rods in the proposed demonstration program are within the regulatory basis of the "Zircaloy" specified in 50.46. In the absence of regulatory guidance on the definition of "Zircaloy" as used in 50.46, Duke Power requests that an exemption be granted to permit the use of those fuel rods whose compositions are outside the range of Zircaloy-4.

The criteria of 10 CFR 50.12 are addressed below to justify this exemption, to demonstrate the special circumstances which are required to be present for the granting of an exemption.

Special Circumstances

From 10 CFR 50.12:
"Special circumstances are present whenever -
(ii) 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."** (Emphasis added).
The underlying purpose of 10 CFR 50.46 is to establish requirements for ECC systems. The specification of Zircaloy as the clad material is an explicit assumption which does not have a defined basis in the regulation. Nevertheless, the purpose of the rule, the implementation of ECCS, has been accomplished.

Impact on the Environment

The will be no perceptible impact on the environment as a result of this exemption. No operational or safety considerations are introduced by this change. The advanced claddings are expected to perform at least as well as the cladding currently in use. The only credible consequence of this change would be a failure of the demonstration claddings. Even in the case of gross fuel failure, the number of rods involved (a maximum of 104 rods will use advanced clad compositions) is sufficiently small that environmental impact would be minimal, and is bounded by previous assessments.

Redress of Adverse Environmental Impact

As noted above, the potential for adverse environmental impact is minimal. Nevertheless, fuel failure is recognized as a possibility, and has been considered in plant analyses and design. The capability to deal with fuel failure has been demonstrated in the past, and the proposed change will not result in any environmental impact which could not be redressed.

Foreclosure of Subsequent Alternatives

Implementation of the proposed change will not foreclose the implementation of any subsequent alternatives. The only alternative to be considered would be to forgo the demonstration program and revert to using standard claddings. This alternative remains available in the event the demonstration program does not result in improved fuel rod performance.

Effect of Delay

There is not a quantifiable effect of delaying the demonstration program. Long range benefits may be expected from this program in terms of reduced incidence of fuel failure, longer operating cycles, and higher fuel burnups.

Attachment V
BWFC Demonstration Program Description
(BAW-2133P)

AFFIDAVIT OF JAMES H. TAYLOR

A. My name is James H. Taylor. I am Manager of Licensing Services in the B&W Nuclear Services Company (BWNS), which is a part of B&W Nuclear Technologies (BWNT). The B&W Fuel Company is administratively responsible to B&W Nuclear Technologies and utilitzes the BWNS Licensing Services. Therefore I am authorized to execute this Affidavit.

B. I am familiar with the criteria applied by B&W to determine whether certain information of B&W is proprietary and I am familiar with the procedures established within B&W, particularly the Nuclear Services Company, to ensure the proper application of these criteria.

C. In determining whether a B&W document is to be classified as proprietary information, an initial determination is made by the Unit Manager, who is responsible for originating the document, as to whether it falls within the criteria set forth in Paragraph D hereof. If the information falls within any one of these criteria, it is classified as proprietary by the originating Unit Manager. This initial determination is reviewed by the cognizant Section Manager. If the document is designated as proprietary, it is reviewed again by Licensing personnel and other management within BWNS as designated by the Manager of Licensing Services to assure that the regulatory requirements of 10 CFR Section 2.790 are met.

D. The following information is provided to demonstrate that the provisions of 10 CFR Section 2.790 of the Commission's regulations have been considered:

(i) The information has been held in confidence by B&W. Copies of the document are clearly identified as proprietary. In addition, whenever B&W transmits the

information to a customer, customer's agent, potential customer or regulatory agency, the transmittal requests the recipient to hold the information as proprietary. Also, in order to strictly limit any potential or actual customer's use of proprietary information, the following provision is included in all proposals submitted by B&W, and an applicable version of the proprietary provision is included in all of B&W's contracts:

> "Purchaser may retain Company's proposal for use in connection with any contract resulting therefrom, and, for that purpose, make such copies thereof as may be necessary. Any proprietary information concerning Company's or its Supplier's products or manufacturing processes which is so designated by Company or its Suppliers and disclosed to Purchaser incident to the performance of such contract shall remain the property of Company or its Suppliers and is disclosed in confidence, and Purchaser shall not publish or otherwise disclose it to others without the written approval of Company, and no rights, implied or otherwise, are granted to produce or have produced any products or to practice or cause to be practiced any manufacturing processes covered thereby.
>
> Notwithstanding the above, Purchaser may provide the NRC or any other regulatory agency with any such proprietary information as the NRC or such other agency may require; provided, however, that Purchaser shall first give Company written notice of such proposed disclosure and Company shall have the right to amend such proprietary information so as to make it non-proprietary. In the event that Company cannot amend such proprietary information, Purchaser

shall, prior to disclosing such information, use its best efforts to obtain a commitment from NRC or such other agency to have such information withheld from public inspection.

Company shall be given the right to participate in pursuit of such confidential treatment."

(ii) The following criteria are customarily applied by B&W in a rational decision process to determine whether the information should be classified as proprietary. Information may be classified as proprietary if one or more of the following criteria are met:

a. Information reveals cost or price information, commercial strategies, production capabilities, or budget levels of B&W, its customers or suppliers.

b. The information reveals data or material concerning B&W research or development plans or programs of present or potential competitive advantage to B&W.

c. The use of the information by a competitor would decrease his expenditures, in time or resources, in designing, producing or marketing a similar product.

d. The information consists of test data or other similar data concerning a process, method or component, the application of which results in a competitive advantage to Babcock & Wilcox.

e. The information reveals special aspects of a process, method, component or the like, the exclusive use of which results in a competitive advantage to Babcock & Wilcox.

f. The information contains ideas for which patent protection may be sought.

The document(s) listed on Exhibit "A", which is attached hereto and made a part hereof, has been evaluated in accordance with normal B&W procedures with respect to classification and has been found to contain information which falls within one or more of the criteria enumerated above. Exhibit "B", which is attached hereto and made a part hereof, specifically identifies the criteria applicable to the document(s) listed in Exhibit "A".

(iii) The document(s) listed in Exhibit "A", which has been made available to the United States Nuclear Regulatory Commission was made available in confidence with a request that the document(s) and the information contained therein be withheld from public disclosure.

(iv) The information is not available in the open literature and to the best of our knowledge is not known by Combustion Engineering, EXXON, General Electric, Westinghouse or other current or potential domestic or foreign competitors of B&W.

(v) Specific information with regard to whether public disclosure of the information is likely to cause harm to the competitive position of B&W, taking into account the value of the information to B&W; the amount of effort or money expended by B&W developing the information; and the ease or difficulty with which the information could be properly duplicated by others is given in Exhibit "B".

E. I have personally reviewed the document(s) listed on Exhibit "A" and have found that it is considered proprietary by B&W because it contains information which falls within one or more of the

AFFIDAVIT OF JAMES H. TAYLOR (Cont'd.)

criteria enumerated in Paragraph D, and it is information which is customarily held in confidence and protected as proprietary information by B&W. This report comprises information utilized by B&W in its business which afford B&W an opportunity to obtain a competitive advantage over those who may wish to know or use the information contained in the document(s).

JAMES H. TAYLOR

State of Virginia)
) SS. Lynchburg
City of Lynch' rg)

James H. Taylor, being duly sworn, on his oath deposes and says that he is the person who subscribed his name to the foregoing statement, and that the matters and facts set forth in the statement are true.

JAMES H. TAYLOR

Subscribed and sworn before me
this 16th day of April 1991.

Joyce C. Koss
Notary Public in and for the City
of Lynchburg, State of Virginia.

My Commission Expires April 5, 1992