

5.3 REACTOR

Applicability

Applies to the design features of the reactor core and reactor coolant system.

Objective

To define the significant design features of the reactor core and reactor coolant system.

Specification

5.3.1 REACTOR CORE

- 5.3.1.1 A fuel assembly normally contains 208 fuel rods arranged in a 15 by 15 lattice. The reactor shall contain 177 fuel assemblies. Fuel rods shall be clad with zircaloy, ZIRLO, or BWFC zirconium-based M4 or M5 alloy materials and contain an initial composition of natural or slightly enriched uranium dioxide as fuel material. Limited substitutions of zirconium alloy or stainless steel filler rods for fuel rods, in accordance with NRC-approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff-approved codes and methods, and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in non-limiting core regions. The details of the fuel assembly design are described in TMI-1 UFSAR Chapter 3.
- 5.3.1.2 The reactor core shall approximate a right circular cylinder with an equivalent diameter of 128.9 inches. The active fuel height is defined in TMI-1 UFSAR Chapter 3.
- 5.3.1.3 The core average and individual batch enrichments for the present cycle are described in TMI-1 UFSAR Chapter 3.
- 5.3.1.4 The control rod assemblies (CRA) and axial power shaping rod assemblies (APSRA) are distributed in the reactor core as shown in TMI-1 FSAR Chapter 3. The CRA and APSRA design data are also described in the UFSAR.
- 5.3.1.5 The TMI-1 core may contain burnable poison rod assemblies (BPRA) as and gadolinia-urania integral burnable poison fuel pellets as described in TMI-1 UFSAR Chapter 3.
- 5.3.1.6 Reload fuel assemblies and rods shall conform to design and evaluation data described in the UFSAR. Enrichment shall not exceed a nominal 5.0 weight percent of U_{235} .

5.3.2 REACTOR COOLANT SYSTEM

- 5.3.2.1 The reactor coolant system shall be designed and constructed in accordance with code requirements. (Refer to UFSAR Chapter 4 for details of design and operation.)

ATTACHMENT II

APPLICATION FOR EXEMPTION FROM REQUIREMENTS OF 10 CFR 50.46(a)(1)(i), 10 CFR 50.44(a), AND APPENDIX K TO 10 CFR PART 50 THAT FUEL CLADDING MUST BE ZIRCALOY OR ZIRLO

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. The Code of Federal Regulations, 10 CFR 50.44, provides requirements for control of hydrogen-gas generated in part by Zircaloy fuel after a postulated loss-of-coolant accident (LOCA). Paragraph I.A.5 of Appendix K to 10 CFR 50 states that the rates of energy release, hydrogen generation, and cladding oxidation from the metal-water reaction shall be calculated using the Baker-Just equation. The Baker-Just equation presumes the use of Zircaloy clad fuel.

These regulations do 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 these regulations. In the absence of regulatory guidance on the definition of "Zircaloy" as used in these regulations, GPU Nuclear requests that an exemption be granted to permit the use of advanced zirconium alloy fuel rod cladding material whose compositions are outside the range of Zircaloy-4, as described in BAW-2133P.

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."

The underlying purpose of 10 CFR 50.46 is to ensure that facilities have adequate acceptance criteria for ECCS. The specification of Zircaloy as the clad material is an explicit assumption which does not have a defined basis in the regulation. Strict interpretation of the regulation would render the criteria of 10 CFR 50.46 inapplicable to the proposed advanced zirconium-based alloy cladding material specified in BAW-2133P. Application of the regulation in this instance would not meet the underlying purpose of the rule for these test assemblies; therefore, special circumstances exist. The effectiveness of the ECCS will not be affected by a change from Zircaloy to the advanced zirconium-based alloy cladding material identified in BAW-2133P. Analysis described in BAW-2133P demonstrates that the criteria for ECCS applied to reactors fueled with Zircaloy clad fuel are also applicable to the ECCS for the specified advanced clad test assemblies at TMI-1. Thus, the underlying purpose of the rule is satisfied since analysis shows that applying the Zircaloy criteria to the advanced clad assemblies yields acceptable results. Therefore, the exemption being requested meets the special circumstances delineated in 10 CFR 50.12(a)(2)(ii).

The underlying purpose of 10 CFR 50.44 is to ensure that there is an adequate means of controlling generated hydrogen. The specification of Zircaloy as the clad material is an explicit assumption which does not have a defined basis in the regulation. A strict interpretation of the regulation would result in the criteria of 10 CFR 50.44 being inapplicable to the proposed advanced zirconium-based alloy cladding material specified in BAW-2133P. Application of the regulation in this instance would not meet the underlying purpose of the rule for these test assemblies; therefore, special circumstances exist. The hydrogen produced in a post-LOCA scenario comes from a metal-water reaction. Metal-water reaction rate, as determined by applying the Baker-Just equation has been shown to be conservative for these advanced cladding materials as described in Section 6.1.4 of BAW-2133P. Therefore, the amount of hydrogen generated by metal-water reaction in a core containing the advanced cladding materials specified in BAW-2133P will be within the design basis. Thus, the underlying purpose of the rule is satisfied since analysis shows that application of the Zircaloy criteria specified in 10 CFR 50.44 to the advanced clad assemblies is conservative and preserves the design basis. Therefore, the exemption being requested meets the special circumstances delineated in 10 CFR 50.12(a)(2)(ii).

The underlying purpose of 10 CFR 50 Appendix K, Paragraph I.A.5 is to apply an equation that conservatively bounds all post-LOCA scenarios for determination of rates of energy release, hydrogen generation, and cladding oxidation from metal-water reaction. The specified Baker-Just equation presumes the use of Zircaloy clad fuel. Since the use of the Baker-Just equation presupposes Zircaloy cladding, application of the regulation in this instance would not meet the underlying purpose of the rule for these test assemblies; therefore, special circumstances exist. The evaluation described in Section 6 of BAW-2133P demonstrates that the application of the Baker-Just equation in the analysis of the specified advanced cladding materials will conservatively bound all post-LOCA scenarios. Thus, the underlying purpose of the rule is satisfied since analysis shows that application of the Zircaloy criteria specified in Paragraph I.A.5 of Appendix K to the specified advanced clad materials is conservative and preserves the design basis. Therefore, the exemption being requested meets the special circumstances delineated in 10 CFR 50.12(a)(2)(ii).

Impact on the Environment

There 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 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, the 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 with regard to plant operations. Long range benefits may be gained from this program in terms of improved fuel performance capabilities for extended operating cycles with regard to longer residence times, higher fuel burnups and greater corrosion resistance to RCS operating environment changes.

Delay of the exemption could cause delays in fuel shipment schedules from the vendor due to the need to replace the advanced cladding fuel rods with standard rods.

ATTACHMENT III

BWFC MARK-BW ADVANCED CLADDINGS FUEL ROD EVALUATION

AFFIDAVIT OF JAMES H. TAYLOR

- A. My name is James H. Taylor. I am Manager of Licensing Services for B&W Nuclear Technologies (BWNT). The B&W Fuel Company is administratively responsible to B&W Nuclear Technologies. Therefore, I am authorized to execute this Affidavit.
- B. I am familiar with the criteria applied by BWNT to determine whether certain information of BWNT is proprietary and I am familiar with the procedures established within BWNT to ensure the proper application of these criteria.
- C. In determining whether a BWNT 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 BWNT 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 BWNT. Copies of the document are clearly identified as proprietary. In addition, whenever BWNT 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 BWNT, and an applicable version of the proprietary provision is included in all of B&W's contracts:

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

"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."

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

- (ii) The following criteria are customarily applied by BWNT 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 BWNT research or development plans or programs of present or potential competitive advantage to BWNT.
 - 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 BWNT.
 - 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 BWNT.
 - 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 BWNT procedures with respect to classification and has been found to contain information which falls within one or

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

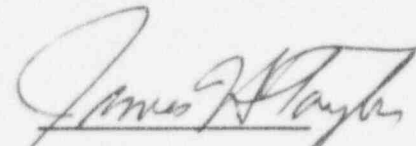
more of the criteria enumerated above. Exhibit "B", which is attached hereto and made a part hereof, specifically identifies the criteria applicable to the document(s) listed in Exhibit "A".

- (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 Nuclear Technologies.
- (v) Specific information with regard to whether public disclosure of the information is likely to cause harm to the competitive position of BWNT, taking into account the value of the information to BWNT; the amount of effort or money expended by BWNT 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 BWNT because it contains information which falls within one or more of the criteria enumerated in Paragraph D, and it is information which is customarily held in confidence and protected as proprietary information by BWNT. This report comprises

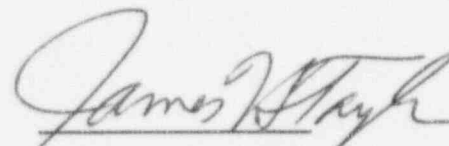
AFFIDAVIT OF JAMES H. TAYLOR (Cont'd.)

information utilized by BWNT in its business which afford BWNT 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 Lynchburg)

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 17th day of April 1995.


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

My Commission Expires July 31, 1995

EXHIBITS A & B

EXHIBIT A

1. B&W Fuel Company Topical Report BAW-2133P, "MARK-BW Advanced Claddings Fuel Rod Evaluation", March 1991.

EXHIBIT B

The above listed document contains information which is considered Proprietary in accordance with Criteria b, c, d, and e of the attached affidavit.