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Our ref: LTR-NRC-05-10

Attn: J. S. Wermiel, Chief
Reactor Systems Branch
Division of Systems Safety and Analysis

March 9, 2005

Subject: Responses to NRC Request for Additional Information on WCAP-15836-P, "Fuel Rod Design Methods for Boiling Water Reactors – Supplement 1" (Proprietary/Non-Proprietary) dated March 2005, TAC No. MB5740

Dear Mr. Wermiel:

Enclosed are five (5) copies of the Proprietary and one (1) copy of the Non-Proprietary version of Responses to NRC Request for Additional Information on WCAP-15836-P, "Fuel Rod Design Methods for Boiling Water Reactors – Supplement 1".

Also enclosed is:

1. One (1) copy of the Application for Withholding, AW-05-1963 (Non-Proprietary) with Proprietary Information Notice.
2. One (1) copy of Affidavit (Non-Proprietary).

This submittal contains proprietary information of Westinghouse Electric Company LLC. In conformance with the requirements of 10 CFR Section 2.390, as amended, of the Commission's regulations, we are enclosing with this submittal an Application for Withholding from Public Disclosure and an affidavit. The affidavit sets forth the basis on which the information identified as proprietary may be withheld from public disclosure by the Commission.

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Correspondence with respect to this affidavit or Application for Withholding should reference AW-05-1963 and should be addressed to J. A. Gresham, Manager, Regulatory Compliance and Plant Licensing, Westinghouse Electric Company LLC, P.O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

Very truly yours,

R. M. Span FOR / J. A. GRESHAM
Rich Span, Acting Manager
Regulatory Compliance and Plant Licensing

Enclosures

cc: F. M. Akstulewicz/NRR
P. Clifford/NRR
W. A. Macon Jr./NRR
L. M. Feizollahi/NRR

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Our ref: AW-05-1963

March 8, 2005

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: Responses to NRC Request for Additional Information on WCAP-15836-P, "Fuel Rod Design Methods for Boiling Water Reactors – Supplement 1" (Proprietary)

Reference: Letter from Rich Span to J. S. Wermiel, LTR-NRC-05-10, dated March 8, 2005

The Application for Withholding is submitted by Westinghouse Electric Company LLC (Westinghouse), pursuant to the provisions of Paragraph (b) (1) of Section 2.390 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 2.390, Affidavit AW-05-1963 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 10 CFR Section 2.390 of the Commission's regulations.

Correspondence with respect to this Application for Withholding or the accompanying affidavit should reference AW-05-1963 and should be addressed to J. A. Gresham, Manager, Regulatory Compliance and Plant Licensing, Westinghouse Electric Company LLC, P.O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

Very truly yours,

R. M. Span for/ J. A. GRESHAM

Rich Span, Acting Manager
Regulatory Compliance and Plant Licensing

Enclosures

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared J. J. McInerney, 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 Company LLC (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:

J. J. McInerney, Director
Systems and Safety Analysis

Sworn to and subscribed
before me this 9th day
of March, 2005

Notary Public

Notarial Seal
Sharon L. Fiori, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires January 29, 2007
Member, Pennsylvania Association Of Notaries

(1) I am Director, Systems and Safety Analysis, in Nuclear Services, Westinghouse Electric Company LLC (Westinghouse), 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 rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 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 Westinghouse 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 2.390 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 that 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 10 CFR Section 2.390, 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 in, Responses to NRC Request for Additional Information on WCAP-15836-P, "Fuel Rod Design Methods for Boiling Water Reactors – Supplement 1," (Proprietary), dated March 2005, for submittal to the Commission, being transmitted by Westinghouse letter (LTR-NRC-05-10) and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse is that associated with Westinghouse's request for NRC approval of WCAP-15836-P, "Fuel Rod Design Methods for Boiling Water Reactors – Supplement 1."

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

(a) Assist proper fuel performance of fuel operating in reactors.

(b) Assist customers to obtain license changes resulting from fuel performance modeling.

Further this information has substantial commercial value as follows:

(a) Westinghouse can use this fuel performance modeling capability to further enhance their licensing position with their competitors.

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 technical evaluation justifications 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.

Further the deponent sayeth not.

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

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Responses to NRC Request for Additional Information on WCAP-15836-P, "Fuel Rod Design Methods for Boiling Water Reactors – Supplement 1"

TAC No. MB5740

March 2005

Westinghouse Electric Company LLC
P.O. Box 355
Pittsburgh, PA 15230-0355

Responses to NRC Request for Additional Information on WCAP-15836-P, "Fuel Rod Design Methods for Boiling Water Reactors – Supplement 1"

Q1. Provide detailed information for an AOO clad strain calculation using STAV7.2. Detailed information should include Fuel Temperature, Relocation, Thermal Expansion, and Clad Strain (corresponding to Figure 4.3.3-2 of WCAP-15942-P) tables as a function of time.

The clad strain is shown in Figure 4.3.3-2 of WCAP-15942-P as a function of burnup for the [

]^{a,c}

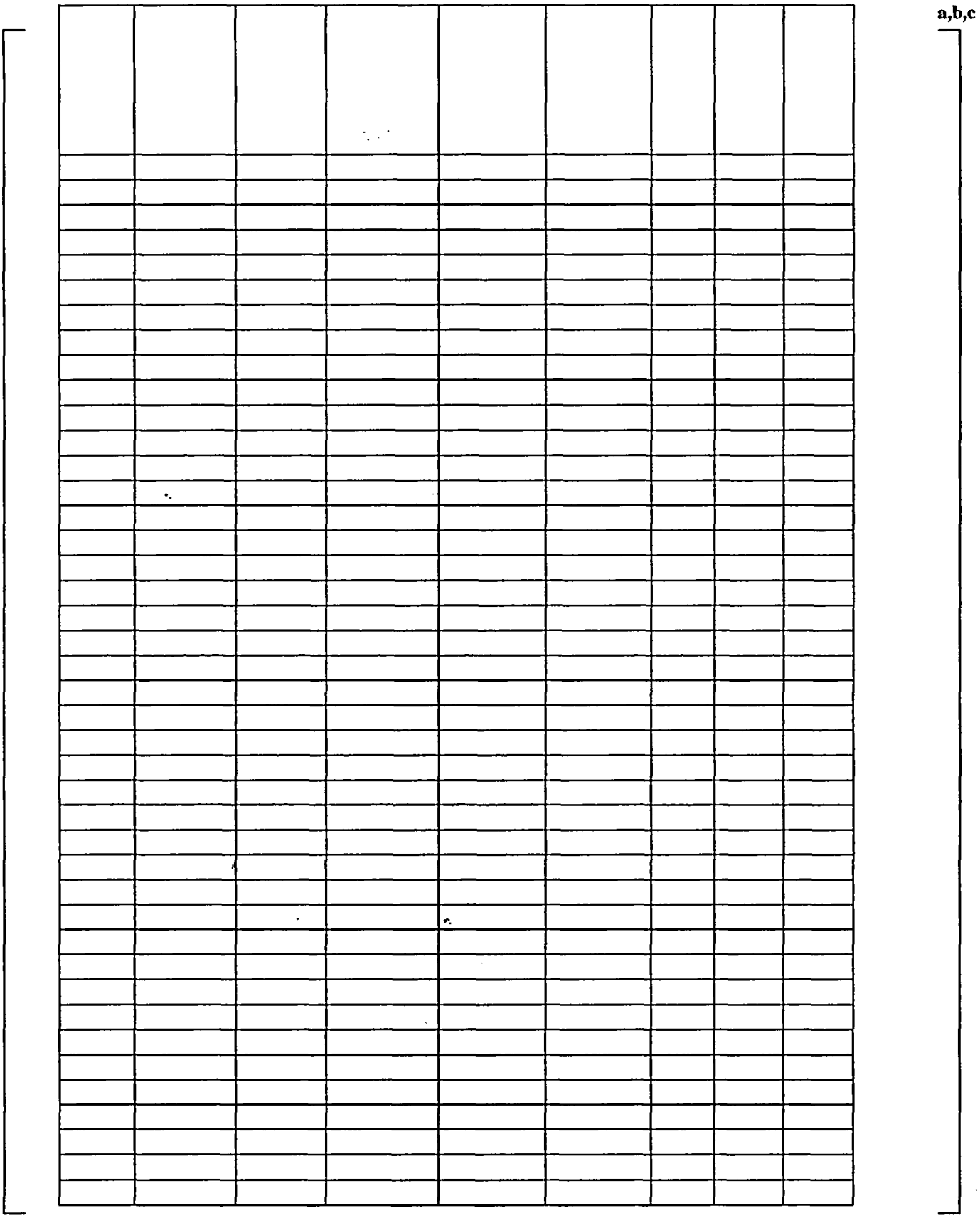
Table 1-1
Clad Strain for BWR Maximum Strain Rod Including AOOs a.b.c

[

]

a,b,c

a,b,c



a,b,c

2. Provide the fission gas release results for a STAV case that ramps the power history in a higher burnup range than the example cases in the topical report to test the transient fission gas release at higher burnup. If the 8% maneuverability factor is found to bound the power ramp, quantify the burnup where this occurs for 24 month cycle

The Westinghouse approach to evaluating the potential impact of transient events on rod internal pressure (RIP) is [

] a,c

[

]^{a,c}

However, these values continue to show substantial margin to the pellet-clad lift-off pressure, and both examples are considered to be conservative.

[

]^{a,c}

Detailed results from a typical case are provided in the following table.

a,b,c

a,b,c

a,b,c

a,b,c

[

]

3. **Regarding the re-crystallized cladding, provide the following:**

   a. **Typical grain size for LK1, 2, 2+ and 3 cladding material**

   [

   ]^{a,c}

   b. **Justification for the applicability of the previous LKn creep model to LK3**

   The creep properties of LK3 have been compared with the creep behavior of LK2 and LK2+. [

   ]^{a,c}

a,b,c

[

]

Figure R3: Hoop creep strain plotted versus time for the three cladding variants LK2, LK2+ and LK3.

c. Clarify how the creep model is justified and applied in the COLLAPSE code for the various alloy types (Table 7-1).

The BWR RXA clad creep model was calibrated as a function of temperature, stress, and fast flux for STAV7.2 as described in Section 2.2.3 of WCAP-15836-P. [

]^{a,c} It can be seen from Figure 7-1 that COLLAPS-3.3D collapse is essentially identical to COLLAPS3.2S.

The impact of the pellet-pellet finite axial gap and the pellet radial support which [

*]^{a,c}

d. Identify the cladding material corresponding to the Studsvik data shown in Table 3.4-2 and Figure 3.4-5

[

]^{a,c}

4. Clarify how the corrosion measurements are made and processed for the rod average and maximum corrosion data provided in the topical report. Provide a typical as-measured corrosion profile on a fuel rod and identify if nodular corrosion is typically present.

Oxide thickness measurements are performed using an oxide thickness measurement instrument, [

]^{a,c}

The probe is [

]^{a,c}

The accuracy of the oxide thickness equipment is ± 3 μm.

In order to obtain a representative maximum oxide thickness value a local average over a length [

]^{a,c}

In the LabVIEW program, the measured data is [

]^{a,c} The evaluated oxide data is then transferred to the Westinghouse database.

Figure R4 presents a typical as measured corrosion profile along with the condensation to measured values in a number of discrete axial positions as well as the average and maximum oxide thickness along the rod.

Nodular corrosion is typically not observed on Westinghouse BWR fuel cladding.

a,b,c

[

]

Figure R4: Oxide layer thickness data from continuous measurements along with the condensation to discrete levels and the finally determined average and maximum oxide layer thicknesses

Oxide thickness values determined by the EC lift-off technique are known to overestimate the real oxide thickness as the standard EC lift-off-measuring technique is obstructed by the ferromagnetic crud that, in some cases, is formed on the cladding surfaces when zinc injection into the reactor water is applied. Westinghouse has, consequently, developed a method to measure the oxide thickness on cladding tubes covered with a magnetic crud layer.

The new method, MAGNACROX, [

]^{a,c} The novel technique has been thoroughly calibrated and tested and was for the first time fully used during the fuel inspection in KKL (KernKraftwerk Leibstadt) in 2000.

MAGNACROX is only used for [

*]^{a,c}

5. **Provide a description of the hydrogen pickup model used by STAV7.2. (Note – this is in anticipation of a future rule change requiring Hydrogen uptake limits.)**

a,c

[

]a,c

Figure 4.3.4-1a - Typical BWR Clad

[a,b,c

]

[

]a,c

6. Provide a description of the heat balance model in STAV7.2 related plenum heatup for the FLR and PLR.

[

]^{a,c}

7. Provide the measured vs predicted data for VIK3 referenced in the RAI responses and comment on flow induced vibration stress for 10x10 fuel.

Measurements of flow induced amplitudes and vibrations of SVEA-96 Optima2 full length and part length rods have been performed in the test facility "BURE" at WSE laboratory for flows [ ]^{a,c}

The results of the amplitude measurements can be compared with the corresponding amplitudes calculated with the [

]^{a,c}

Thus, the measurements demonstrate that the results of the VIK3 model [ ]^{a,c} The results are shown in Figure 1 below.

a,b,c

[

]

Figure 1 - Svea-96 Optima2. Measured (rms) vs calculated flow induced amplitudes.

[

]a,c

8. Provide the basis and justification for the strength coefficient model used in STAV7.2 as a function of the temperatures and fluence ranges for fuel rod design model applications.

[

]a,c

a,b,c

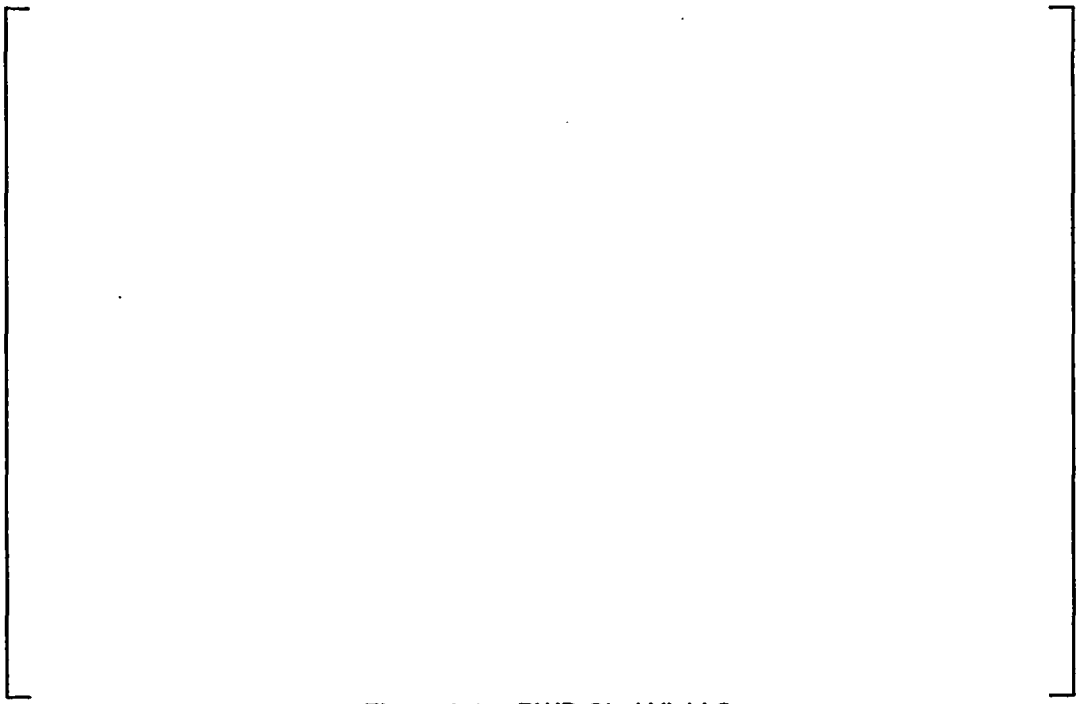


Figure 8-1 - BWR Clad Yield Stress

a,b,c

Figure 8-2 – Predicted versus Measure Yield Stress for BWR Clad

a,b,c

Figure 8-3 – Predicted versus Measured Yield Stress for BWR Clad

a,b,c

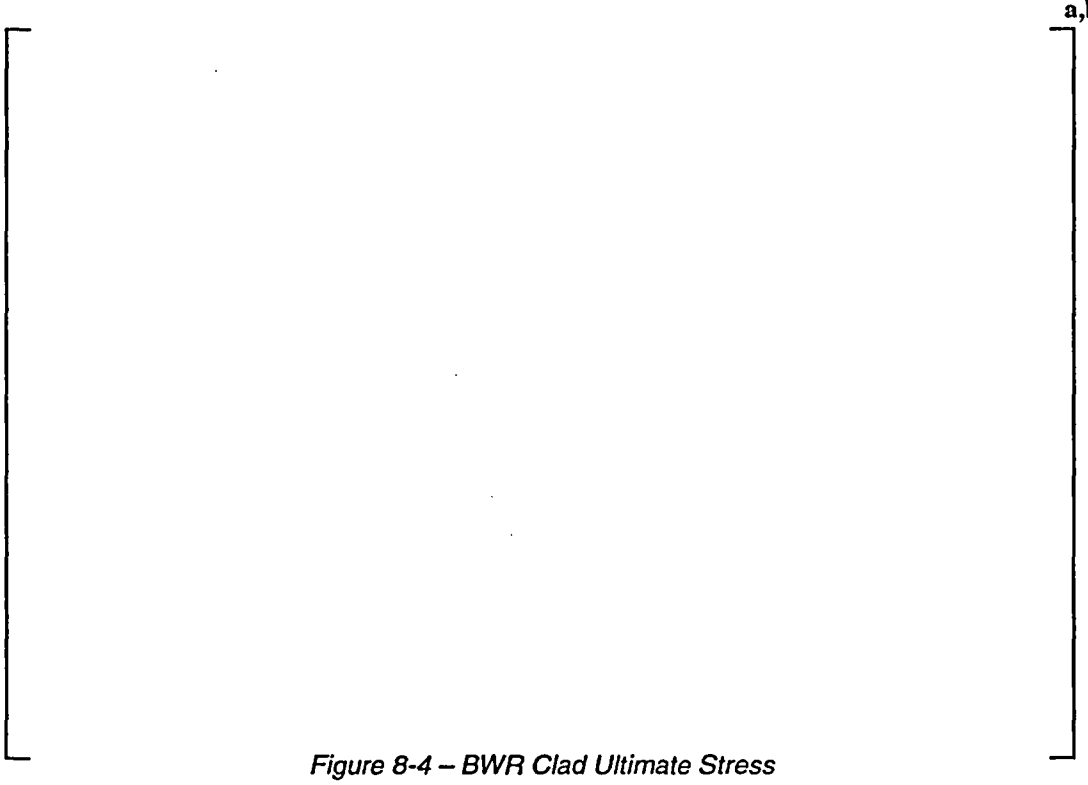
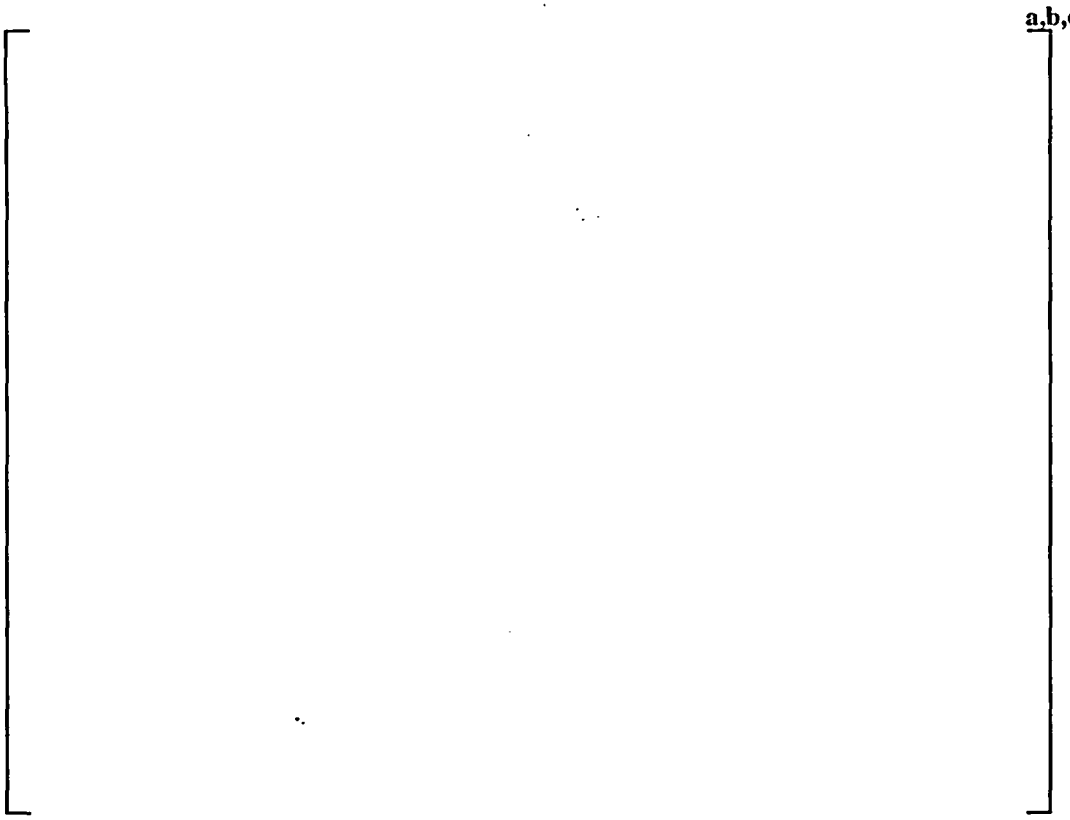


Figure 8-4 – BWR Clad Ultimate Stress

a,b,c

[



]

Figure 8-5 – Predicted versus Measured Ultimate Stress for BWR Clad

[

]a,c

I

]a,c

a,c

Figure 8-7: *Schematic description of the ring tensile testing.*

RESULTS

a.c

a,c

[

]

Table 8-1: Ring tensile testing data.

a,b,c

[

]

a,c

[

]

[ ]a,c

Figure 8-8
STAV7.2 BWR Yield Stress Model vs Temperature

a,b,c

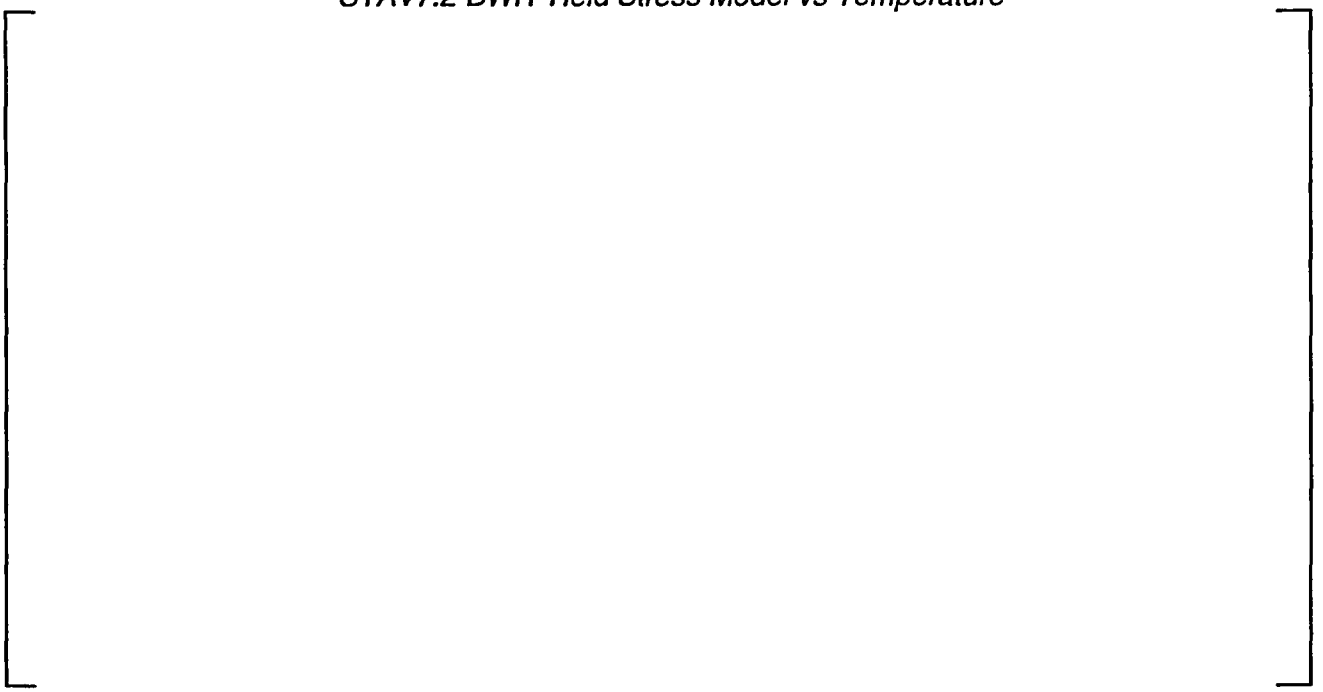


Figure 8-9
STAV7.2 BWR Yield Stress v Fast Neutron Fluence

a,b,c

9. Describe the range of applicability of the fission gas release model for gadolinia fuel?

The gadolinia models in STAV7.2 are applicable for gadolinia fuel w/o up to and including [

]^{a,c}