Westinghouse Electric Company
Nuclear Power Plants
P.O. Box 355
Pittsburgh, Pennsylvania 15230-0355
USA

U.S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, D.C. 20555

Direct tel: 412-374-5290
Direct fax: 412-374-5456
e-mail: corletmm@westinghouse.com

Your ref: Docket No. 52-006
Our ref: DCP/NRC1610

August 7, 2003

SUBJECT: Transmittal of Responses to AP1000 DSER Open Items

This letter transmits the Design Safety Evaluation Report (DSER) Open Items for Westinghouse's application for Design Certification of the AP1000 standard plant. A list of the DSER Open Item responses transmitted with this letter is Attachment 1. The proprietary responses are transmitted as Attachment 2. The non-proprietary responses are provided as Attachment 3 to this letter.

The Westinghouse Electric Company Copyright Notice, Proprietary Information Notice, Application for Withholding, and Affidavit are also enclosed with this submittal letter as Enclosure 1. Attachment 2 contains Westinghouse proprietary information consisting of trade secrets, commercial information or financial information which we consider privileged or confidential pursuant to 10 CFR 2.790. Therefore, it is requested that the Westinghouse proprietary information attached hereto be handled on a confidential basis and be withheld from public disclosures.

This material is for your internal use only and may be used for the purpose for which it is submitted. It should not be otherwise used, disclosed, duplicated, or disseminated, in whole or in part, to any other person or organization outside the Commission, the Office of Nuclear Reactor Regulation, the Office of Nuclear Regulatory Research and the necessary subcontractors that have signed a proprietary non-disclosure agreement with Westinghouse without the express written approval of Westinghouse.

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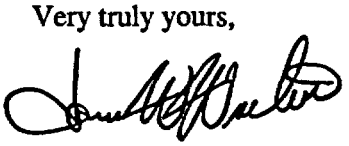
The Westinghouse Electric Company Application for Withholding and Affidavit are also attached to this submittal letter as Enclosure 1. Attachment 2 contains Westinghouse proprietary information consisting of trade secrets, commercial information or financial information which we consider privileged or confidential pursuant to 10 CFR 2.790. Therefore, it is requested that the Westinghouse proprietary information attached hereto be handled on a confidential basis and be withheld from public disclosures. Attachment 3 contains no proprietary information.

This material is for your internal use only and may be used for the purpose for which it is submitted. It should not be otherwise used, disclosed, duplicated, or disseminated, in whole or in part, to any other person or organization outside the Commission, the Office of Nuclear Reactor Regulation, the Office of Nuclear Regulatory Research and the necessary subcontractors that have signed a proprietary non-disclosure agreement with Westinghouse without the express written approval of Westinghouse.

Correspondence with respect to the application for withholding should reference AW-03-1685, and should be addressed to Hank A. Sepp, Manager of Regulatory and Licensing Engineering, Westinghouse Electric Company, P.O. Box 355, Pittsburgh, Pennsylvania, 15230-0355.

Please contact me at 412-374-5355 if you have any questions concerning this submittal.

Very truly yours,



J. W. Winters, Manager
Passive Plant Projects & Development
AP600 & AP1000 Projects

/Enclosure

1. Westinghouse Electric Company Copyright Notice, Proprietary Information Notice, Application for Withholding, and Affidavit AW-03-1685.

/Attachments

1. List of the AP1000 Design Certification Review, Draft Safety Evaluation Report Open Item Responses transmitted with letter DCP/NRC1610
2. Proprietary AP1000 Design Certification Review, Draft Safety Evaluation Report Open Item Responses dated August 7, 2003
3. Non-Proprietary AP1000 Design Certification Review, Draft Safety Evaluation Report Open Item Responses dated August 7, 2003

DCP/NRC1610
Docket No. 52-006

August 7, 2003

Enclosure 1

Westinghouse Electric Company
Application for Withholding and Affidavit

Westinghouse

Westinghouse Electric Company
Nuclear Power Plants
P.O. Box 355
Pittsburgh, Pennsylvania 15230-0355
USA

August 7, 2003

AW-03-1685

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

ATTENTION: Mr. John Segala

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

SUBJECT: Transmittal of Westinghouse Proprietary Class 2 Documents Related to AP1000 Design Certification Review Draft Safety Evaluation Report (DSER) Open Item Response

Dear Mr. Segala:

The application for withholding is submitted by Westinghouse Electric Company, LLC ("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 documents. In conformance with 10 CFR Section 2.790, Affidavit AW-03-1685 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 2.790 of the Commission's regulations.

Correspondence with respect to this application for withholding or the accompanying affidavit should reference AW-03-1685 and should be addressed to the undersigned.

Very truly yours,

J. W. Winters, Manager
Passive Plant Projects & Development
AP600 & AP1000 Projects

/Enclosures

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AW-03-1685

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared James W. Winters, 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.

James W. Winters, Manager
Passive Plant Projects & Development
Nuclear Power Plants Business Unit
Westinghouse Electric Company, LLC

Sworn to and subscribed
before me this 7th day
of July, 2003

Notary Public

KAY E. GONGAWARE
COMMONWEALTH OF PENNSYLVANIA
NOTARY PUBLIC

Notarial Seal
Kay E. Gongaware, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Feb. 7, 2005
Member, Pennsylvania Association of Notaries

(1) I am Manager, Passive Plant Projects & Development, in the Nuclear Power Plants Business Unit, of the 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 rulemaking proceedings, and am authorized to apply for its withholding on behalf of the Westinghouse Electric Company, LLC.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR 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 Electric Company, LLC 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 10 CFR 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 in Attachment 2 as Proprietary Class 2 in the Westinghouse Electric Co., LLC document: (1) "AP1000 Design Certification Review, Draft Safety Evaluation Report Open Item Response."

This information is being transmitted by Westinghouse's letter and Application for Withholding Proprietary Information from Public Disclosure, being transmitted by Westinghouse Electric Company (W letter AW-03-1685) and to the Document Control Desk, Attention: John Segala, DIPM/NRLPO, MS O-4D9A.

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

(a) Provide documentation supporting determination of APP-GW-GL-700, "AP1000 Design Control Document," analysis on a plant specific basis

(b) Provide the applicable engineering evaluation which establishes the Tier 2 requirements as identified in APP-GW-GL-700.

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 AP1000 Design Certification.

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 methodologies 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 performing and analyzing tests.

Further the deponent sayeth not.

DCP/NRC1610
Docket No. 52-006

August 7, 2003

Attachment 3

AP1000 Design Certification Review
Draft Safety Evaluation Report Open Item Non-Proprietary Response

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 21.5-2

Original RAI Number(s): 440.169

Summary of Issue:

The applicant's submittals did not provide sufficient justification that the models and correlations in NOTRUMP or WCOBRIVTRAC have been adequately assessed to cover the ranges expected to occur in the upper plenum of the API 000. While correlations exist to model upper plenum entrainment phenomena, the issue that remains is adequacy of the database. Existing correlations are based on relatively small diameter vessels, low gas flow rates, and for some data, air-water as opposed to steam-water. Because of the small vessel size in these data, conditions were essentially one-dimensional. Flow in the upper plenum of the AP1000 is expected to be non-uniform and three dimensional. Thus, a suitable database for assessing entrainment correlations in the upper plenum has not been established, Given the lack of well scaled experimental data on upper plenum entrainment phenomena and the importance of predicting this process in an advanced plant SBLOCA transient, it is recommended that new experimental data be obtained to support the use of the upper plenum entrainment models in the AP1000. This data was requested by the NRC staff in a letter dated March 18, 2008, from J, Lyons. Therefore, this is DSER Open Item 21.5-2.

Westinghouse Response:

As indicated in Westinghouse letter DCP/NRC1604 dated July 14, 2003, additional testing has been performed in the Oregon State University APEX1000 test facility that is specifically scaled to the AP1000. The test facility description report, the facility scaling report relative to AP1000, and test summary reports for several tests were previously submitted to NRC (Westinghouse letter DCP/NRC1595 dated June 2, 2003) in support of the AP1000 design certification review.

Two APEX1000 tests are discussed here. They are labeled as tests DBA02 and DBA03. Both of these tests simulate an AP1000 double ended direct vessel injection line (DEDVI) break. Test DBA02 simulates an ADS4 failure on the non-pressurizer side of the plant, and DBA03 simulates an ADS4 failure on the pressurizer side of the plant. These tests can be used to examine the effect of the AP1000 power level on system behavior and core and upper plenum inventory in particular.

Figure 1 shows the wide range downcomer pressure for DBA-02 and DBA-03 double-ended DVI break tests. For both tests, the pressure quickly falls due to the size of the break, then the rate of decrease slows as the reactor coolant system becomes saturated near the saturation pressure of the steam generator secondary side. The automatic depressurization system is actuated on the CMT level on the broken side with ADS-1 actuation at about 90 seconds. At this time, the pressure falls more rapidly as ADS-2 and ADS-3 are actuated in sequence. At about 250 seconds, the ASD-4 is actuated and the downcomer pressure falls. Figure 2 shows the narrow range downcomer pressure. The pressure is higher for DBA-02 due to the

interaction between the pressurizer and flow out the ADS-4 valves. The assumed single failure for DBA-02 is on the non-pressurizer side ADS-4. This results in 100% ADS-4 flow area on the pressurizer side, and 50% flow area on the non-pressurizer side. When the larger ADS-4 path is on the pressurizer side, the increased steam flow to that side causes the pressurizer to fill more and then drain more slowly (Figure 3) relative to having the larger ADS-4 path on the opposite hot leg. Figure 4 shows the total ADS-4 liquid flow. The effect of ADS-4 failure location is to reduce the ADS-4 liquid flow for a period of time during DBA-02.

The total DVI injection flow is shown in Figure 5. The flow from the CMTs for both tests stops at 900 seconds when the CMTs are empty. For DBA-03, the IRWST injection occurs before the end of CMT injection, but for DBA-02, an injection gap of about 300 seconds occurs before IRWST injection is established.

A capacitance probe was installed for DBA-02 and DBA-03. This probe measures the two-phase liquid level in the upper plenum. Figure 6 shows the two-phase level for these tests. In both cases, the level falls to the hot leg elevation and remains there until ADS-4 actuation. At that time, the level drops slightly into the upper plenum well above the top of the core, then recovers to the hot leg elevation. For DBA-02, during the injection gap, the mixture level falls slightly below the bottom of the hot leg, but remains significantly higher than the top of the core.

Figures 7 and 8 show the collapsed liquid level and the average void fraction in the core region. The collapsed level drops after ADS-1 is actuated, and the minimum collapsed level occurs after ADS-4 actuation. The average void fraction in the core is nearly 70% at this time. The core inventory recovers steadily as the accumulator and CMT inject. For DBA-02, the gap between the end of CMT injection and the start of IRWST injection results in a reduction in the core inventory, reaching 50% core-average void fraction just before IRWST injection is established.

Figure 9 shows the peak heater rod temperature. The temperature is measured inside the rod which accounts for the temperature elevation above saturation. For both tests, the temperature follows the decay power curve and there is no heatup, indicating the heater rods are adequately cooled.

Figures 10 through 12 show the test results during the long term cooling phase of the tests. Figure 10 shows the capacitance probe two-phase level during the long-term cooling phase of the test (i.e. IRWST-sump injection). In both cases, the level recovers to the top of the hot leg and remains there until the end of the test, and is significantly higher than the top of the core.

Figure 11 shows the collapsed liquid level in the core region for the long term cooling phase. After stable IRWST and sump injection are established, the collapsed level stabilizes near the top of the core. The level falls slightly in DBA-02 due to a mismatch in the levels in the IRWST and sump at the time of sump injection.

Figure 12 shows the peak heater rod temperature. For both tests, the temperature follows the decay power curve and there is no heatup, indicating the heater rods are adequately cooled.

The APEX-1000 DEDVI tests show the following:

1. Two-phase mixture level remains in the upper plenum at all times for both design basis tests.
2. Core-average void fraction reaches a maximum of 70% just after ADS-4 actuation, then decreases to about 30%. For DBA-02, the injection gap before IRWST injection causes an increase in the void fraction to 50%.
3. The AP1000 ADS4 flow capacity as simulated in these tests is sufficient to draw liquid flow through the core and into the upper plenum throughout the transient. This system behavior is the same as seen in integral tests scaled to AP600 and indicates the system behavior is not sensitive to upper plenum entrainment phenomena within the range of AP600 and AP1000 conditions. This is consistent with the insensitivity to upper plenum and hot leg entrainment observed in the sensitivity study discussed in the response to Open Item 21.5-1.
4. The peak heater rod temperature show no temperature excursions which shows that there is effective two-phase heat transfer at the heater rods at all times.

These tests and the other design basis accident tests performed at the APEX-1000 test facility show that the effect of upper plenum entrainment on the passive core cooling system's ability to assure core coolability is not significant. For each test, the two-phase level always remains in the upper plenum, and the core remains covered for all phases of the simulated accident.

Since the APEX-1000 facility is well scaled to AP1000, these tests form the body of data requested in the NRC staff letter dated March 18, 2003 from J. Lyons. This data will be used as the basis for the verification and validation of NOTRUMP and WCOBRA/TRAC will be provided in a separate transmittal and will be included in an update to WCAP-15644, AP1000 Code Applicability Report.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

a, b, c

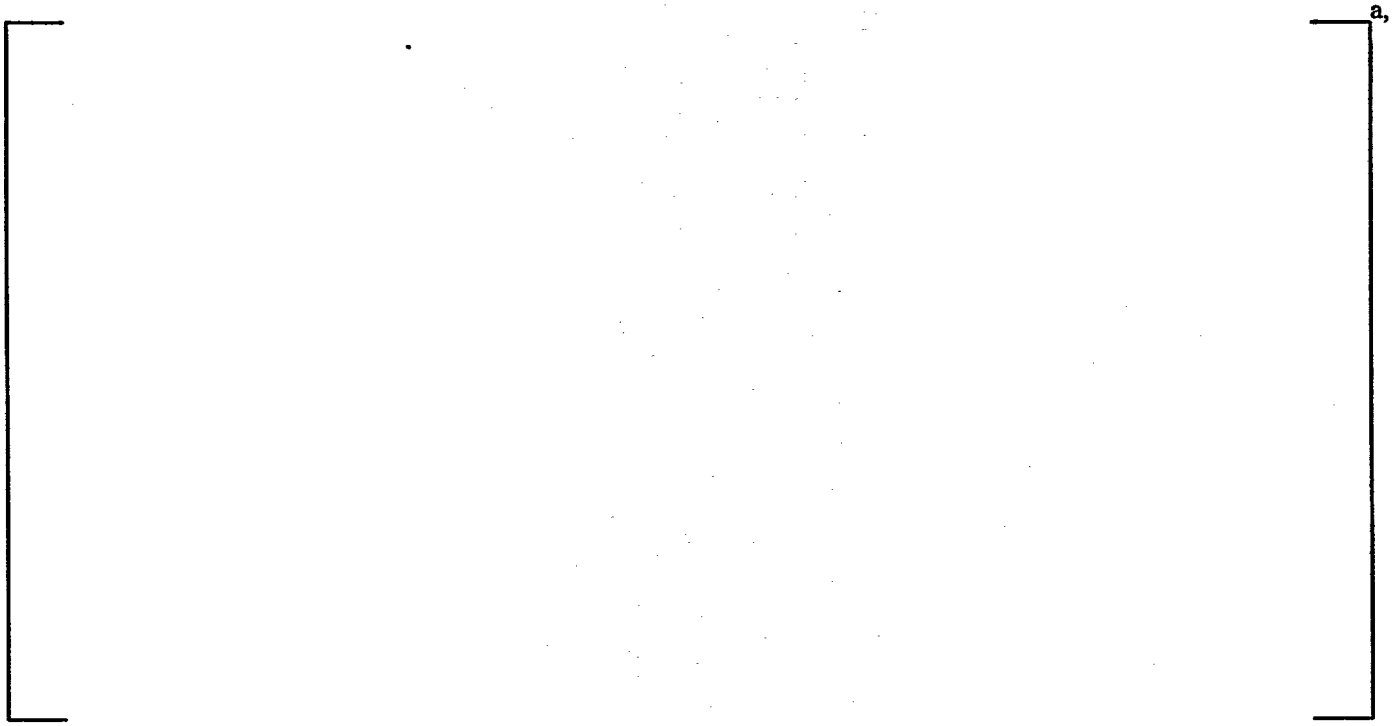

Figure 1: Downcomer Pressure – Wide Range

a, b, c

Figure 2: Downcomer Pressure - Narrow Range

a, b, c

Figure 3: Pressurizer Mass

a, b, c

Figure 4: Integrated ADS-4 Liquid Flow

a, b, c

Figure 5: Total DVI Injection Flow

a, b, c

Figure 6: Two-Phase Mixture Level In Upper Plenum

a, b, c

Figure 7: Core Collapsed Liquid Level

a, b, c

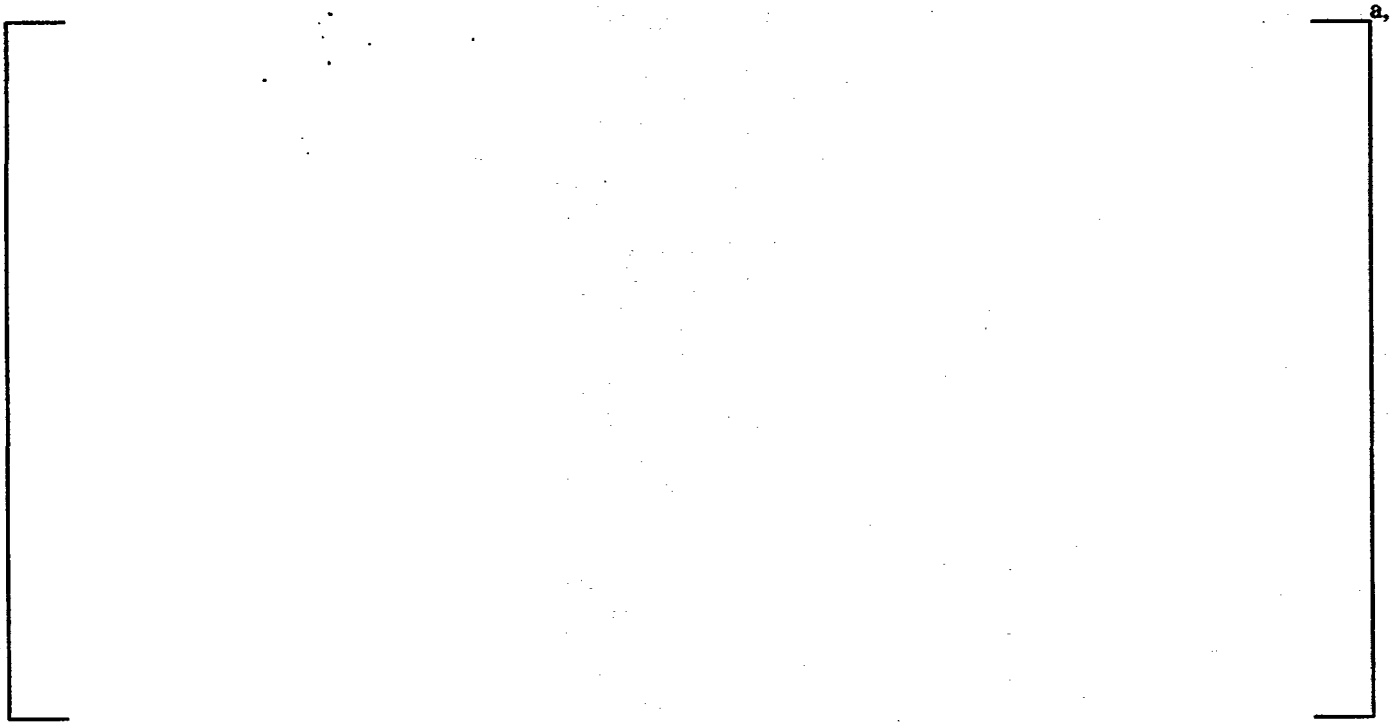

Figure 8: Core Average Void Fraction

a, b, c

Figure 9: Peak Heater Rod Temperature

a, b, c

Figure 10: Two-Phase Mixture Level In Upper Plenum - Long Term Cooling

a, b, c

Figure 11: Core Collapsed Liquid Level – Long Term Cooling

a, b, c

Figure 12: Peak Heater Rod Temperature – Long Term Cooling