Westinghouse
Electric Corporation

Energy Systems

Box 355
Pittsburgh Pennsylvania 15230-0355

AW-95-914

December 21, 1995

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

ATTENTION: MR. T. R. QUAY

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

SUBJECT: Westinghouse Responses to NRC Requests for Additional Information on the AP600

Dear Mr. Quay:

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 10CFR Section 2.790, Affidavit AW-95-914 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-95-914 and should be addressed to the undersigned.

Very truly yours,

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

cc: Kevin Bohrer NRC 12H5

2534A

AW-95-914

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

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COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared Brian A. McIntyre, 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:

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

Sworn to and subscribed
before me this 21st day
of December, 1995

Lorraine M. Piplica
Notary Public

Notarial Seal
Lorraine M. Piplica, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Dec. 14, 1999
Member, Pennsylvania Association of Notaries

(1) I am Manager, Advanced Plant Safety And Licensing, in the Advanced Technology Business Area, 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) Enclosed is Letter NTD-NRC-95-4615, December 21, 1995 being transmitted by Westinghouse Electric Corporation (W) letter and Application for Withholding Proprietary Information from Public Disclosure, B. A. McIntyre (W), to Mr. T. R. Quay, Office of NRR. The proprietary information as submitted for use by Westinghouse Electric Corporation is in response to questions concerning the AP600 plant and the associated design certification application and is expected to be applicable in other licensee submittals in response to certain NRC requirements for justification of licensing advanced nuclear power plant designs.

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

(a) Demonstrate the design and safety of the AP600 Passive Safety Systems.

(b) Establish applicable verification testing methods.

(c) Design Advanced Nuclear Power Plants that meet NRC requirements.

(d) Establish technical and licensing approaches for the AP600 that will ultimately result in a certified design.

(e) Assist customers in obtaining NRC approval for future plants.

I urther 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 advanced plant licenses.

(b) Westinghouse can sell support and defense of the technology 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 advanced nuclear power designs 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 analytical methods and receiving NRC approval for those methods.

Further the deponent sayeth not.

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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 2.790 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) contained within parentheses 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 Section (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR2.790(b)(1).

Enclosure 2 to NTD-NRC-95-4615

(non-proprietary copy of Enclosure 1)

Question 440.312

Re: WCAP-14234 (LOFTRAN CAD)
Page 2-11. Is there any nonlinearity in the opening or closing of ADS valves? Does LOFTRAN assume a linear valve characteristic?

Response:

ADS valve flow area as a function of time is not perfectly linearly. A ten point table of valve opening versus time is available in LOFTRAN to simulate nonlinear opening characteristics of the ADS valves. The transient valve flow area is found by interpolating from this ten point table.

The only analyses performed with LOFTRAN which simulate the ADS valves is the short term RCS depressurization due to inadvertent opening of ADS valves. This analysis is presented in Section 15.6.1 of the SSAR (Reference 440.312-1). In this analysis, the tabular input used for ADS valve simulation is assumed to have a linear opening characteristic.

The assumption of linear opening characteristics has little impact on the minimum DNB ratio for this event. This is demonstrated by comparing the results of the inadvertent opening of two first stage ADS banks to the results of the inadvertent opening of a pressurizer safety valve (also presented in Section 15.6.1 of the SSAR). Sequences of events are presented in Tables 440.312-1 and 440.312-2 for both of these events.

The inadvertent ADS analysis assumes two first stages ADS banks open linearly over 25 seconds. The inadvertent opening of a pressurizer safety valve assumes the valve steps open at time zero. Both events have a minimum DNBR of ~ 2.8. The minimum DNBR during these transient occurs immediately following the time of reactor trip. The principle cause for the reduction in DNBR is due to the reduction in RCS pressure and is terminated by tripping the reactor. At the time of reactor trip, both transients are at the low pressurizer pressure trip setpoint of 1800 psia. The transient RCS pressure characteristics prior to reactor do not influence the minimum DNB ratios reached during the events. Therefore the valve opening characteristics do not significantly impact the minimum DNBR reached.

References:

440.312-1 Westinghouse Letter NTD-NRC-95-4480, "Preliminary Markups of AP600 SSAR Chapter 15 (Accident Analyses)", June 2, 1995

SSAR Revision: NONE

Table 440.312-1. Sequence of Events for Inadvertent Opening of Two First Stage ADS Banks	
Event	Time (seconds)
Two first stage ADS banks begin opening	0.0
Low pressurizer pressure reactor trip setpoint reached (1800 psia)	21.5
RCCA begin to drop into the core	23.5
Minimum DNBR occurs (DNBR = ~2.8)	24.3
ADS valves fully open	25.0

Table 440.312-2. Sequence of Events for Inadvertent Opening of a Pressurizer Safety Valve	
Event	Time (seconds)
Pressurizer safety valve steps open	0.0
Low pressurizer pressure reactor trip setpoint reached (1800 psia)	28.9
RCCA begin to drop into the core	30.9
Minimum DNBR occurs (DNBR = ~2.8)	31.7

Question 440.468

Re: NOTRUMP PVR FOR OSU TESTS, LTCT-GSR-001
Please provide benchmark calculations to transient level swell separate effects tests to demonstrate that the SIMARC methodology, the modified drift-flux correlations, and the changes to the distribution parameter accurately simulate transient two-phase level swell. Compare the NOTRUMP calculated void distribution and two-phase level with the test data. Candidate tests include: GE level swell, Westinghouse 336 rod bundle uncovery tests, and the CSE top and bottom blowdown test data (Please see RAI 440.515 for references). Also, compare the code to counter current flow data to demonstrate that the new methodology properly treats flooding phenomena.

Response:

To demonstrate that the SIMARC methodology, the modified drift-flux correlations, and the changes to the distribution parameter accurately simulate transient two-phse level swell. Westinghouse will perform analyses of the G-2 level swell experiments given in EPRI report EPRI-NP-1692 (see the response to RAI 440.515 for details).

To investigate flooding phenomena, calculations will be performed which will be similar to those performed using WCOBRA/TRAC in Reference 440.468-1. These calculations will demonstrate that the SIMARC methodology, the modified drift-flux correlations, and the changes to the distribution parameter properly treat flooding phenomena. They will basically be computations of vertical CCFL. This work is currently scheduled for completion and transmittal to the NRC by the end of March, 1996.

References

440.468-1 Westinghouse Code Qualification Document for Best Estimate Loss of Coolant Accident Analysis, Volume 3, Hydrodynamics, Components, and Integral Validation, Section 15-1-2 (CCFL in a Vertical Channel), WCAP-12945-P

SSAR Revision: NONE

Question 440.478

Re: NOTRUMP PVR for OSU Tests, LTCT-GSR-001
Please provide a sample calculation showing how the birthing region of Section 4.13 works.

Response:

To demonstrate this logic the AP600 plant cases will be examined and a portion of a run will be identified that shows how a region is "birthed". After the appropriate case and time period is identified, the case will be rerun to capture the necessary detailed information to show the birthing of a region. Included in the NRC transmittal will be a brief description of the case performed and the appropriate figures to show the behavior of the model. This work is currently scheduled for completion and transmittal to the NRC by the end of March, 1996.

In addition, in the interest of clarity and accuracy, it was felt to be desirable to provide a revised description of the region birthing logic. It is in the form of a revision to Section 4.13 of LTCT-GSR-001 and PXS-GSR-002 which will be included in the NOTRUMP Final V&V Report.

4.13 Region Birthing Logic

Birthing logic addresses difficulties associated with the creation and immediate destruction of small regions under certain conditions. Typically these difficulties occurred in a node with point contact flow links at the exact top or bottom of the node. A region would form but would then immediately be swept away through the point contact flow link. This often went on for long periods of time, degrading both the time-step size and the results. One way around this was to eliminate point contact links at the exact top or bottom of nodes in favor of continuous contact links. This, however, in addition to being cumbersome, is not always desirable. Birthing logic is a more direct solution to these difficulties.

The birthing logic is best explained in the way it is done in subroutine BEFORE. BEFORE, as its name implies and as is shown in Figure 2-9 of Reference 440.478-1, is the last subroutine called before the time-step size is selected and the changes in state variables are determined. The object of the birthing logic is to allow the creation (birthing) of new regions only if they are deemed by some criteria to be reasonably capable of surviving (viable). If a nonviable region is allowed to form, it will likely end up with negative mass and/or internal energy at the end of the time step and will have to be combined with the other, more prevalent, region. This can lead to the difficulties described above. The description of the birthing logic in subroutine BEFORE follows.

For a given interior fluid node N, the logic is executed if IBRTHFN(N) is not equal to zero and if node N is not in a stack, i.e., if ISTAKFN(N) is equal to zero. If the current mixture-region mass, TMMFN(N), is nonpositive and the current vapor-region mass, TMVFN(N), is positive, then the mixture region does not exist, but it may be born. If the time rate of change for the mixture-region mass, TMMDTFN(N), is positive, then birthing is possible, though not assured; otherwise the mixture region will be aborted. If birthing is possible, then the logic next checks for a "stillborn" mixture region. To do this, it looks for all point-contact flow links that connect to the exact bottom of node N. It then adds all liquid in-flows and subtracts all liquid out-flows. It also adds TMMDTFN(N) as liquid in-flow since it contains droplet fall from the vapor region and other sources of liquid. It also subtracts an equivalent liquid out-flow for gas out-flow, which is currently out of the prevalent vapor region but will be out of the potential mixture region if it survives. It does this by assuming constant volumetric flow, that is, by phasic density rationing. The resulting sum is the net liquid in-flow to the potential mixture region. The net gas in-flow to the potential mixture region is simply the sum of all gas in-flows for all point contact flow links that connect to the exact bottom of node N. If the sum of the net liquid in-flow and the net gas in-flow is positive, then the region will be born but only if its void fraction is low enough to be a reasonable mixture region. To obtain the void fraction in the potential mixture region, the quality is first calculated as the ratio of the net gas in-flow to the sum of the net liquid in-flow and the net gas in-flow. This quality is then converted to a void fraction at the appropriate pressure. If this void fraction is less than or equal to VFMMAX, then the region will be allowed to proceed to its birth; otherwise, it will be aborted.

At this point, if the mixture region is to be aborted, certain node and link quantities are recalculated so that the mixture region will not be born in this time step. Mixture region masses, internal energies, and their time rates of change are combined into the vapor region and are then zeroed. The derivatives of nodal interregional mass and energy transfer rates are zeroed. Finally, for all links connected to node N, certain mixture region mass and energy convection terms and their derivatives are combined into the vapor region and are then zeroed. This concludes the mixture region birthing logic.

If the current vapor-region mass, TMVFN(N), is nonpositive and the current mixture-region mass, TMMFN(N), is positive, then the vapor region does not exist, but it may be born. If the time rate of change for the vapor-region mass, TMVDTFN(N) is positive, then birthing is possible though not assured; otherwise, the vapor region will be aborted. If birthing is possible, then the logic next checks for a "stillborn" vapor region. To do this, it looks for all point-contact flow links that connect to the exact top of node N. It then adds all gas in-flows and subtracts all gas out-flows. It also adds TMVDTFN(N) as gas in-flow since it contains bubble rise from the mixture region and other sources of gas. It also subtracts an equivalent gas out-flow for liquid out-flow, which is currently out of the prevalent mixture region, but will be out of the potential vapor region if it survives. It does this by assuming constant volumetric flow, that is, by phasic density rationing. The resulting sum is the net gas in-flow to the potential vapor region. The net liquid in-flow to the potential vapor region is simply the sum of all liquid in-flows for all point-contact flow links that connect to the exact top of node N. If the sum of the net liquid in-flow and the net gas in-flow is positive, then the region will be born, but only if its void fraction is high enough to be a reasonable vapor region. To obtain the void fraction in the potential vapor region, the quality is first calculated as the ratio of the net gas in-flow to the sum of the net liquid in-flow and the net gas in-flow. This quality is then converted to a void fraction at the appropriate pressure. If this void fraction is greater than or equal to VFVMIN, then the region will be allowed to proceed to its birth; otherwise it will be aborted.

At this point, if the vapor region is to be aborted, certain node and link quantities are re-calculated so that the vapor region will not be born in this time step. Vapor region masses, internal energies, and their time rates of change are combined into the mixture region and are then zeroed. The derivatives of nodal inter-regional mass and energy transfer rates are zeroed. Finally, for all links connected to node N, certain vapor region mass- and energy-convection terms and their derivatives are combined into the mixture region and are then zeroed. This concludes the vapor region birthing logic.

The NOTRUMP Final Validation Report will contain a list of variable nomenclature. The following nomenclature will be included in the list.

IBRTHFN = fluid node region birthing logic flag. (-) Region birthing logic is invoked in interior fluid node N by setting IBRTHFN(N) to anything but zero. (New input variable in namelist FNODES.)

TMMFN = fluid node mixture region mass, M_M. (lbm) (See page B-7 of Reference 440.478-1.)

TMMDTFN = time rate of change of the fluid node mixture region mass, $\dot{M}_M$. (lbm/sec) (See Equation (2-2) of Reference 440.478-1)

TMVFN = fluid node vapor region mass, M_V. (lbm) (See page B-7 of Reference 440.478-1.)

TMVDTFN = time rate of change of the fluid node vapor region mass, $\dot{M}_M$. (lbm/sec) (Equation (2-4) of Reference 440.478-1)

VFMMAX = maximum void fraction considered to be reasonable for birthing a mixture region. (-) (New input variable in namelist FNODES. Default = 0.15.)

VFVMIN = minimum void fraction considered to be reasonable for birthing a vapor region. (-) (New input variable in namelist FNODES. Default = 0.85.)

References

440.478-1 P.E. Meyer, et.al., "NOTRUMP - A Nodal Transient Small Break and General Network Code," WCAP-10079-P-A (Proprietary), WCAP-10080-A (Non-Proprietary), August, 1985.

SSAR Revision: NONE

Question 440.490

Re: NOTRUMP PVR FOR OSU TESTS, LTCT-GSR-001
NOTRUMP overpredicts the downcomer liquid level during this transient. This will result in an associated over prediction of the two-phase level in the core and upper plenum region, which was not provided for review. Explain why the NOTRUMP code produces a non-conservative downcomer liquid level response and justify the model result for AP600 plant calculations.

Response:

Figure 440.490-1 shows that the downcomer collapsed liquid level in the OSU test and the NOTRUMP prediction are in broad agreement until about 1050 seconds, when NOTRUMP predicts a rising downcomer level as the result of IRWST injection beginning in the NOTRUMP simulation. NOTRUMP overpredicts the test data by at most 6 inches during the period from 450 seconds to 1000 seconds. During the same period the core collapsed liquid level from NOTRUMP is in excellent agreement with the test data, Figure 440.490-2 (see Westinghouse response to RAI 440.487). The drop in downcomer level in the test at 450 seconds corresponds to an increase in the core and upper plenum level as the first stage of ADS valves open. There is a similar increase in the core level in the NOTRUMP simulation for the same event, however, the drop in downcomer level is less than is seen in the test data. It is possible that the level measurement, or LDP, in the downcomer partly attributable to a dynamic effect resulting from accumulator injection at this time. The NOTRUMP simulation of the downcomer level does not produce nonconservative predictions of the core level.

SSAR Revision: NONE

a, b, c

Figure 440.490-1

a,b,c

Figure 440.490-2

Question 440.496

Re: NOTRUMP PVR FOR OSU TESTS, LTCT-GSR-001
NOTRUMP again overpredicts the downcomer liquid level in Fig. 5.3-12 and does not capture the correct trend at the time of minimum level, about 750 seconds into the event. Please explain why the NOTRUMP code overpredicts the liquid inventory in the downcomer and justify that this model deficiency will not lead to non-conservative predictions of the liquid level in the vessel for the AP600 plant calculations.

Response:

Figure 440.496-1 shows that the downcomer collapsed liquid level in the OSU test and the NOTRUMP prediction are in broad agreement until about 500 seconds when the test data indicates a decreasing downcomer level. The decreasing downcomer level in the test is arrested at about 750 seconds when the 4th stage ADS valves open, and as IRWST injection begins the downcomer refills. NOTRUMP overpredicts the test data by at most 1 ft. during the period from 500 to 750 seconds. During the same period the core collapsed liquid level from NOTRUMP is in excellent agreement with the test data Figure 440.496-2 (see response to RAI 440.495). The NOTRUMP simulation does not exhibit the same behavior because of the differing sequence of events, such as delayed ADS initiation. The delay in ADS stage 1 initiation increases the break flow rate. The depressurization rate in NOTRUMP exceeds the test data, resulting in earlier accumulator injection. During the period, from 500 to 750 seconds the loss of mass from the test is greater than the NOTRUMP simulation and explains the difference in downcomer levels. The NOTRUMP simulation of the downcomer level does not produce non-conservative predictions of the core level.

SSAR Revision: NONE

a, b, c

Figure 440.496-1

a, b, c

Figure 440.496-2

Question 440.503

Re: NOTRUMP PVR FOR OSU TESTS, LTCT-GSR-001
Figure 5.4-12 shows that NOTRUMP does not capture the trends nor the magnitude of the downcomer transient liquid level. In particular, the NOTRUMP code overpredicts the downcomer liquid level and does not predict the timing nor magnitude of the minimum downcomer level. Please explain. Fig. 5.4-11 shows that the NOTRUMP code, as in all of the tests, predicts drainage of the upper head while the test data shows fluid in this region. Please explain if the premature drainage of the upper head at about 160 seconds in Fig. 5.4-11 contributes to preventing the loss in downcomer level at 160 seconds in Fig. 5.4-12. Does core uncovery occur during this test at approximately 160 seconds and could the upper head drainage preclude heatup of an exposed core due to the inadvertent cooling? Please explain.

Response:

Figure 440.503-1 shows that the downcomer collapsed liquid level in the OSU test and the NOTRUMP prediction are in broad agreement except that the time of minimum level is displaced, occurring some 250 seconds later in the NOTRUMP simulation relative to the test data. A similar effect is observed in the NOTRUMP core collapsed liquid level, see Figure 440.503-2 (see also response to RAI 440.502). The reason for the apparent difference in behavior between the NOTRUMP simulation and the test data is not related to the initiation times of the ADS, unlike other tests. A review of the flow through ADS stages 1-2-3 reveals that NOTRUMP underpredicts the flow through ADS stage 4 by 200 lbms from about 360 seconds. This could account for the delay in the fall in the core level and similarly the downcomer level. The influence of the upper head draining earlier in NOTRUMP relative to the test data has been addressed in the response to RAI 440.486. In the response to that RAI it was argued that the liquid draining from the upper head is drawn to the pressurizer because of ADS initiation, so the liquid would not produce an overprediction of the core mixture level. There is also no evidence to suggest that the core uncovered at approximately 160 seconds during the test. The lower total flow through ADS stages 1-2-3 and the sustained pressurizer level in the NOTRUMP simulation also indicates that at least some of the upper head liquid may be retained in the primary coolant system, perhaps in the pressurizer.

SSAR Revision: NONE

a, b, c

Figure 440.503-1

a, b, c

Figure 440.503-2

Question 440.508

Re: NOTRUMP PVR FOR OSU TESTS, LTCT-GSR-001, JULY 1995
Fig. 5.5-12 shows that the NOTRUMP code overpredicts the downcomer level and does not capture the trends in the data after the initial 180 seconds of the event. Please explain the reasons for the poor NOTRUMP downcomer liquid level prediction. The ability to predict the location of the two-phase level in the core and upper plenum region is dependent upon the code's ability to correctly simulate and track the downcomer level transient. The inability to predict downcomer level will preclude the code from assessing the effectiveness of the ECC system and the potential for core uncovery for AP600 small break LOCA calculations.

Response:

Figure 440.508-1 shows that the downcomer collapsed liquid level in the OSU test is consistently lower, by an average of 1 ft., than the NOTRUMP prediction after about 200 seconds. During the same period the core collapsed liquid level from NOTRUMP is in good agreement with the test data, Figure 440.508-2 (see response to 440.507). NOTRUMP correctly predicts the system inventory at about 150 seconds, although at this time in the simulation the downcomer level is depressed more than the core level, whereas the levels are similar in the test data. The NOTRUMP simulation does not exhibit identical behavior because of the differing sequence of events. NOTRUMP has more rapid accumulator injection, delayed ADS stage 4 initiation and an underprediction in the flow from ADS stage 1-2-3. The NOTRUMP simulation also stores more water in the pressurizer. The degree of inaccuracy in the NOTRUMP simulation of the downcomer level, from about 200 seconds, does not produce non-conservative predictions of the core level.

SSAR Revision: NONE

a, b, c

Figure 440.508-1

a, b, c

Figure 440.508-2

Question 480.221

Please explain the settings and operation of the "blowout panel" between the reactor cavity and the RCDT room.

Response:

The passage and door between the reactor cavity and the RCDT room have several functional requirements for normal operation and severe accidents. During normal operation the door serves as an HVAC boundary. Air is blown into the bottom of the reactor cavity and flows upward between the walls of the cavity and the reactor vessel insulation, cooling the concrete, the excore detectors and the vessel supports. The normally closed door prevents this air from escaping and bypassing its cooling function.

The door performs no function under LOCA or other design basis accident conditions. During long term post-LOCA core cooling, water from the recirculation sump reaches the core via the PXS piping. Since the passageway from the RCDT room to the reactor cavity plays no role in this scenario, the door does not interfere with core cooling.

In the unlikely event of a severe accident, this passageway is a flow path for flooding the cavity and for recirculation of water from the general containment area to the reactor cavity. This characteristic of the AP600 serves to contain the core debris within the reactor vessel by cooling the external surface of the vessel wall. To support the in-vessel retention function, the door is designed with features to permit gravity flow of water into the cavity from the RCDT room.

In the still more unlikely event that the core should escape from the reactor vessel, it can be effectively cooled if covered with water and distributed over a large floor area. In this scenario, large loads are generated when the molten core contacts the water in the cavity. The door is designed to fail under these loads and allow the core debris to spread out over the floor of the RCDT room as well as the reactor cavity. The term "blowout panel" refers to this scenario.

SSAR Revision: NONE