52-003

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

September 22, 1995

Mr. Nicholas J. Liparulo
Nuclear Safety and Regulatory Activities
Westinghouse Electric Corporation
P.O. Box 355
Pittsburgh, Pennsylvania 15230

SUBJECT: FOLLOWON QUESTIONS CONCERNING AP6000 NOTRUMP PRELIMINARY VALIDATION REPORTS FOR OSU AND SPES-2

Dear Mr. Liparulo:

As a result of its review of the June 1992, application for design certification of the AP600, the staff has determined that it needs additional information in order to complete its review. Enclosed are questions and comments on the NOTRUMP preliminary validation report for OSU Tests (LTCT-GSR-001 dated July 1995) and the NOTRUMP preliminary validation report for SPES-2 Tests (PXS-GSR-002 dated July 1995).

The staff is particularly concerned about RAI's 440.466 through 440.485. Previously, it had been our understanding that the modifications made to the generically approved version of NOTRUMP involved only the addition of AP600 hardware-specific models. Current information suggests that more fundamental changes have been made to friction factors, momentum equations, and critical heat flux correlations. These changes could result in a substantial increase in the level of the review.

You have requested that portions of the information submitted in the June 1992 application for design certification be exempt from mandatory public disclosure. While the staff has not completed its review of your request in accordance with the requirements of 10 CFR 2.790, that portion of the submitted information is being withheld from public disclosure pending the staff's final determination. The staff concludes that these followon questions do not contain those portions of the information for which exemption is sought. However, the staff will withhold this letter from public disclosure for 30 calendar days from the date of this letter to allow Westinghouse the opportunity to verify the staff's conclusions. If, after that time, you do not request that all or portions of the information in the enclosures be withheld from public disclosure in accordance with 10 CFR 2.790, this letter will be placed in the NRC Public Document Room.

These followon questions affect nine or fewer respondents, and therefore is not subject to review by the Office of Management and Budget under P.L. 96 511.

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If you have any questions regarding this matter, you may contact me at (301) 415-1141.

Sincerely,

Original signed by
William C. Huffman, Project Manager
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Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Docket No. 52-003

Enclosure:
As stated

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See next page

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Docket No. 52-003
AP600

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REQUEST FOR ADDITIONAL INFORMATION

NOTRUMP PRELIMINARY VALIDATION REPORT FOR OSU TESTS
LTCT-GSR-001, JULY 1995

440.

463 Fig. 2-1 presents the NOTRUMP nodalization where a single volume represents the secondary system. Please justify the ability of this nodalization to properly model two-phase level swell on the secondary side. Please explain the potential for partial uncovery of the tube bundle following transients and how a single volume will properly model the hydrostatic fluid balance between the downcomer and tube side in addition to the subcooled level at the bottom of the bundle.

464 The core region is modeled as four volumes, yet there is no justification for this choice in nodalization. This simplified nodalization may not produce the correct void distribution in the core and will result in an over prediction of the two-phase level in the vessel core and upper plenum. Thus, the potential for this over-simplified core model to predict the potential for core uncovery is minimized or precluded. Please show that the core nodalization captures the correct void distribution in the core and the resulting two-phase level in the vessel characteristic of small break LOCAs in AP600. Please provide justification that this model/nodalization will properly capture the potential for core uncovery following small breaks. Provide comparisons to transient two-phase level swell and test bundle uncovery data in separate effects tests to justify the model/nodalization (Please see RAI 440.515 below for candidate separate effects tests). The comparisons of NOTRUMP to the four steady-state THTF tests in "Westinghouse Small Break ECCS Evaluation Model Using the NOTRUMP Code," WCAP 10054-P-A, dated August 1984, is not sufficient to demonstrate the ability of the NOTRUMP code to accommodate transient two-phase level swell phenomena. Please describe how the code computes steam release from the two-phase surface in the vessel.

465 Fig. 2-2 shows the wall heat noding. Wall heat effects can represent a major source of heat for small break LOCAs which can subsequently affect depressurization, especially for the slow depressurization transients characterizing AP600 small break LOCA response. Please justify the omission of wall heat transfer from all of the external loop piping and the secondary system components.

NOTRUMP CODE ACCEPTANCE

Section 4.0 describes 20 changes to the models in the NOTRUMP code. Many of these changes are significant code modifications. Changes were made to the following models:

1) Addition of the SIMARC Drift-Flux model
2) Modification to drift-flux correlations
3) Re-casting of momentum equations for net volumetric flow
4) Addition of transient terms to horizontal stratified flow momentum equations
5) Modification to contact coefficients
6) Addition of internally calculated liquid reflux flow links
7) Addition of mixture overshoot logic
8) Addition of implicit treatment of bubble rise
9) Modification to the pump model
10) Implicit treatment of momentum equation gravitational head terms
11) Horizontal flow drift flux levelizing model
12) Addition of region birthing logic
13) Addition of the Shah condensation correlation
14) Addition of the Zuber critical heat flux correlation
17) Changes to the two-phase friction multiplier
18) Addition of Henry-Fauske/HEM critical flow model
19) Improvements to the fluid node stacking logic
20) Modifications to transition boiling correlation solution

In general, the discussion in Section 4.0 does not completely describe the details needed to properly review the various coding and modeling changes. The changes to the above models were described verbally with neither detailed descriptions of the mathematical formulations nor numerical treatments presented. No benchmark to separate effects or integral tests were presented nor referenced for each change to justify or verify that the new models were functioning properly. The following RAIs (440.466-485) relate to the model changes listed above.

466 For the SIMARC drift-flux model, if the flow is concurrent up or down the flow link void fraction is taken from the upstream volume. For countercurrent flow, it is not clear how the flow link void fraction is computed from the discussion in Section 4.2. Please describe how the void fraction is computed for countercurrent flow conditions.

467 Two drift flux models were added to NOTRUMP as discussed in Section 4.2 and 4.3 on page 4-4. Which model is to be used in the NOTRUMP small break LOCA AP600? Under what conditions would each of the models be used? Please explain and provide supporting data for each of the models.

468 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.

469 In expressing the momentum equations from a mass flow to a volumetric flow basis, linearizations of the equations are performed. Provide the volumetric flow based momentum equations and the linearizations that were performed to change the equations to a volumetric flow base. Provide the validations that were performed to verify that the changes were made correctly. Also, provide the code benchmark for this model change.

470 Eq. 4.5-1 describes two terms added to the momentum equation; however, the equation appears to be inconsistent with the volumetric flow based formulation described in Section 4.4 of the report. Please provide the new momentum equation terms in terms of the volumetric formulation. Also describe how the new formulation was validated to justify the modifications. Also clarify if the dW/dt term is to be replaced by the two new terms, and is the plus sign a typographical error in Eq. 4.5-1? Also, show the finite difference form of the new momentum equation and describe how the dA/dt and $d\rho/dt$ terms are to be computed.

471 In Section 4.6, the contact coefficient changes state that the partitioning model places all of the vapor flowing into a node into the region in physical contact with the recipient end of the flow link. In the event the two-phase level is above a flow link end and the upstream volume contains steam, then the steam would enter the downstream two-phase region. Moreover, if the downstream node is large, artificially mixing the steam throughout the two-phase region could result in the placement of large amounts of steam at elevations well below the elevation of the piping inlet connection. This would result in over-swelling the level and produce errors in the two-phase level predictions. Discuss this result in light of the AP600 NOTRUMP modeling and show that this behavior would not adversely affect the AP600 level swell results.

472 In Section 4.7, liquid reflux flow links were added to prevent the nonphysical depressurization of nodes with no mixture regions when subcooled liquid enters. Adding subcooled liquid from the hot legs to a lower core node, for example, could result in artificially cooling the fuel. Please demonstrate that artificially adding the subcooled

liquid to the mixture region below the upper steam regions in the core does not artificially cool the fuel. Also, how does this methodology affect level swell, bubble rise, and steam production in the mixture region to which the subcooled liquid is added? Please explain in detail.

473 In the mixture level overshoot model discussed in Section 4.8, negative mass and energy in an upper node are added to the lower nodes mixture region. Adding the negative mass and energy to another node destroys mass and energy. While rectifying one problem, this approach violates conservation of mass and energy. Please demonstrate that the approach does not introduce errors into the NOTRUMP solution that could change the results or conclusions of an AP600 analysis. Also, identify the cumulative error in this method so that the analyst would see to avoid excessive errors in the calculations due to many level overshoots.

474 Provide the derivations and the expressions for the partial derivatives comprising the implicit bubble rise model formulation of Eq. 4.9-1. Also, show the finite difference form of Eq. 4.9-1 and the terms accompanying the independent variables that would appear on the left hand side of the solution matrix. Please provide a stability and consistency analysis that show both time step size restrictions and that the original set of partial differential equations are recovered in the limit as Δt and Δx approach zero. What level swell calculations were performed to verify this major change to the code? Please provide results of the model calculations verifying the new model (Please see RAI 440.515 below for candidate level swell tests).

475 Please provide a mathematical description of the modified pump model equations and comparisons of the old and new model results with a benchmark calculation.

476 Please describe mathematically the implicit treatment of the gravitational head term in the momentum formulation described in Section 4.11 and the formulation of the momentum equation including all of the independent variables appearing on the left hand side of the solution matrix. Also, provide the results of a stability and consistency analysis for this change. Please provide the results of the verification analyses for these modeling changes.

477 Please provide the new levelizing drift velocity correlation referred to in Section 4.12 and provide benchmark justifying its validity.

478 Please provide a sample calculation showing how the birthing region of Section 4.13 works.

479 Provide a comparison of the NOTRUMP Shah condensation model prediction to condensation test data demonstrating applicability of the model to the range of conditions expected in AP600.

480 Provide a comparison of the results of the as implemented Zuber critical heat flux correlation to test data over the range of conditions expected for AP600 small break LOCAs.

481 Provide comparisons of the new NOTRUMP two-phase friction multiplier to separate effects and/or integral test data below 250 psia to justify the new models extrapolation formulation.

482 Please provide benchmark of the new critical flow model versus critical flow tests to justify and verify the coding changes. Also, please describe the model for unchoked conditions and explain how the model treats the transition from choked to unchoked conditions. Consider selected Marviken critical flow data for verifying the NOTRUMP code's ability to simulate subcooled, saturated two-phase, and single phase steam discharge.

483 Please provide the results of a sample fill and drain calculation to demonstrate the model described in Section 4.18, entitled "Fluid Node Stacking Logic." The detailed verbal description regarding the fluid level tracking model in this section is very difficult to follow. As such, please provide a mathematical description of the logic used to tract mixture level.

484 Please provide a clad temperature calculation to show the effect of the changes to the transition boiling correlation calculation on peak clad temperature for a heatup transient that experiences transition boiling heat transfer.

485 Please describe the Section 4.0 coding and modeling changes that were included in the NOTRUMP simulations for (1) AP600 NOTRUMP Automatic Depressurization System Preliminary Validation Report of RCS-GSR-003, and (2) AP600 NOTRUMP Core Makeup Tank Preliminary Validation Report for 500-Series Natural Circulation Tests of MT01-GSR-011.

The following questions pertain to the two inch cold leg break results of Section 5.1

486 Fig. 5.1-11 shows that the NOTRUMP calculated upper head fluid drains early in the event when the data show that fluid remains trapped in this region. This suggests that the NOTRUMP code incorrectly drains liquid from this region which results in minimizing the potential for uncovery of the core. Please explain why the NOTRUMP code upper head

liquid drains prematurely in this test, and justify that the code will not incorrectly minimize the potential for core uncovery in the AP600 analyses.

487 The OSU test data indicate liquid levels in the upper plenum and core regions. Please provide comparisons of the NOTRUMP liquid levels in the core and upper plenum versus the test data. Also, provide a plot of the void fraction in the core and upper plenum for this test along with identification of the subcooled level. Key parameters for judging small break LOCA response are the liquid and two-phase levels in the vessel (i.e. core and upper plenum regions). The ability of the NOTRUMP code to predict AP600 performance is directly related to the code's ability to predict the liquid inventory and location of the two-phase surface in the inner vessel region. To state that the code captures the phenomena of this transient it must be demonstrated that the code can successfully predict the liquid inventory and location of the two-phase surface in the core or upper plenum regions.

488 Fig. 5.1-23 shows that the NOTRUMP code overpredicts the integrated break flow. Discuss the potential for the source of this error being an inadequate condensation and stratified flow model in the cold legs during accumulator injection. Demonstrate that this model, and result, is conservative with respect to AP600 small break LOCA ECC performance analyses. Also provide an expanded scale, after 400 seconds, for Fig. 5.1-22 so the code comparison can be seen with the break flow data plot.

489 Fig. 5.1-29 shows that the NOTRUMP code overpredicts the PRHR outlet temperature. Please explain why the NOTRUMP code underpredicts the PRHR heat transfer. Justify how this model deficiency results in conservative AP600 small break LOCA ECCS performance predictions.

490 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.

491 Please provide the core inlet and core bypass mass flow rate predictions for the NOTRUMP code.

492 Please provide the core inlet and bypass mass flow rate predictions for the blind two inch cold leg balance line break of Section 5.2. Also, provide the liquid level plots for the upper plenum and core region and the void

distribution in the core region.

The following questions pertain to the double-ended guillotine break of the cold leg balance line of Section 5.3

493 Please explain why the NOTRUMP code depressurizes much faster than the data in Fig. 5.3-1. What break flow discharge coefficients were used for this simulation. Discuss the influence of the steam generator heat transfer model on the pressure transient early in the event. Also, explain why and justify that the faster depressurization will not lead to non-conservative predictions of AP600 plant and ECC performance.

494 The test data for CMT-2 identifies the drain time as 1486 seconds while the report states that the CMT-2 NOTRUMP simulation drain time is >1000 seconds. Fig. 5.3-4 shows that the NOTRUMP code predicts a delayed CMT-2 drainage time and at 1000 seconds is overpredicting the CMT-2 level. Since the test data continues to at least 1486 seconds, please explain why the NOTRUMP simulation was stopped at 1000 seconds. Provide the comparisons out to the CMT-2 drain time. Discuss the impact of the delayed CMT-2 drainage on the core/upper plenum level response and the ability to identify the potential for core uncovery for the AP600 calculations.

495 Please provide the upper plenum and core liquid level plots. Also provide the void distribution plots in the core for this test.

496 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.

497 Please explain the statement that the NOTRUMP code allows a "short spurt of flow at the break" in reference to Fig. 5.3-22.

498 Fig.5.3-25 displays a highly oscillatory behavior in the PRHR inlet flow calculated by the NOTRUMP code which greatly overpredicts the data. Please explain the reasons for this erratic behavior and why NOTRUMP predicts a much higher PRHR flow rate. Also, provide plots to resolve the comparisons of the NOTRUMP code and the data after 400 seconds.

499 What is the effect of the nitrogen from the accumulators on

system response. Can the NOTRUMP code model nitrogen entering the RCS? If not, please justify the omission of nitrogen effects on AP600 response following small break LOCAs.

500 Fig. 5.3-34 displays highly unstable temperature oscillations in CMT-1 computed by the NOTRUMP code. Please explain why the apparently numerical instabilities were not corrected and the simulation rerun. Have these instabilities occurred in the AP600 plant calculations and what is the impact of these numerical problems on AP600 plant response.

501 Please explain what is being done to correct the numerical diffusion problems which result in the premature increase in mixture temperature for CMT-2.

The following questions pertain to the double-ended break of the DVI line in Section 5.4.

502 Please provide the core and upper plenum liquid level plots and the core void fraction plots for this event.

503 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.

504 Please explain the NOTRUMP calculated large negative ADS 1-3 flows shown in Fig. 5.4-17 after 440 seconds.

505 Please explain the source of the oscillations in break flow from about 150 to 240 seconds and 340 to 430 seconds in Fig. 5.4-24. Please explain why the NOTRUMP code does not simulate the data nor trends and underpredicts the break flow from 120 seconds until the end of the transient at 500 seconds.

506 Please discuss the reason for the NOTRUMP overprediction of the PRHR outlet flow rate shown in Fig. 5.4-27. Are the NOTRUMP flow rate oscillations the result of instabilities in the code? Please explain.

The following questions pertain to the Inadvertent ADS Actuation test in Section 5.5.

507 Please provide the liquid level plots in the upper plenum and core regions. Also provide the NOTRUMP plots of the core void distributions for this test.

508 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.

509 Please explain why the NOTRUMP code overpredicts the ADS flow rates in Figs. 5.5-18 and 5.5-19 in view of the fact that system pressure is well predicted during this time period.

510 Please explain why the NOTRUMP code overpredicts the IRWST flow rates for this test shown in Figs. 5.5-20 and 5.5-21.

511 As discussed in Section 5.1.2.1 the secondary steam generator safety valve was reduced from 350 psia to 310 psia to compensate for the underpredicted PRHR heat transfer. Please explain if this approach is to be used in the AP600 plant calculations. Also, please describe the impact of the increased steam generator heat removal on natural circulation and system performance in general. For example, the increased steam generator heat removal could be the source of the excessive depressurization experienced early in the tests for the Double-ended Guillotine Break of the Cold Leg Balance Line and the Inadvertent ADS Actuation transients. Please explain.

512 The secondary pressures, levels, and temperatures were not provided for each of the tests. Please provide comparisons of the secondary pressure, level, and temperature test data responses with the NOTRUMP code predictions.

513 The nodalization of the OSU PRHR shows more spacial detail than that for the SPES-2 tests, yet NOTRUMP was still unable to predict the PRHR heat transfer. Please describe the model that will be used for the AP600 plant calculations.

514 In general, NOTRUMP overpredicted the flow rates from the IRWST. In particular, for the two inch cold leg break,

NOTRUMP predicted a much earlier injection initiation as well as over-predicted the flow rates. Given the non-conservatism associated with the NOTRUMP IRWST injection, the code predictive capability is questionable for assessing the potential for core uncovery during the long term for small break LOCAs in AP600. Please justify that this NOTRUMP code deficiency will not restrict the code from assessing the potential for long term core uncovery.

515 The conclusions state that the NOTRUMP code "captures and accurately represents the key thermal hydraulic phenomena of importance for the AP600 small break LOCA." An important small break LOCA thermal hydraulic phenomenon is two-phase level swell; in particular the two-phase level in the inner vessel region containing the lower plenum, core, upper plenum, and upper head. Because there were no comparisons of the liquid level nor the two-phase level in the inner vessel, there is no assurance that the NOTRUMP code captures this important phenomenon. Based on the over predicted downcomer liquid level transient data and the fact that the upper head also prematurely drained in the NOTRUMP calculations, there is no assurance that the NOTRUMP code can adequately assess the potential for core uncovery for AP600 during small break LOCAs. Major changes have been made to the code bubble rise, drift flux, and level tracking models with no separate effects nor integral test comparisons (the OSU and SPES-2 test comparisons do not provide verification of the code ability to model level swell) provided to verify and validate the capabilities of the code to predict two-phase level swell. Until appropriate benchmark to level swell data can be provided, the NOTRUMP code's ability to accommodate two-phase level swell phenomena is an open issue. Candidate level swell test data for benchmarking NOTRUMP:

(1) THTF bundle uncovery tests[1,2,3,4] includes steady-state and transient bundle uncovery data where the code mixture, liquid level, and void distributions can be used to verify the code level swell and heatup models.

(2) The Containment System Experiments[5,6] provide level swell data from the simple blowdown of a vessel from side and bottom exit nozzles. Test B-10[5] provides pressure and level data for a bottom blowdown while tests B-50 through B-53[6] provide top blowdown level swell data.

(3) The G-2 test facility consists of a test vessel with a simulated core and includes bundle uncovery data[7] for a range of power levels and pressures down to and including atmospheric conditions. Please show the NOTRUMP code mixture levels, void distributions, steam and fuel rod

temperatures for several of these tests covering a range of pressures and power levels. Please also provide the downcomer liquid level response for the tests chosen.

(4) The GE level swell data[8] provide level swell data for the top blowdown of a vessel with and without heat addition, presented in Section B.4.

(5) Additional GE level swell tests[9] were performed which also contains axial void distribution data.

REFERENCES

1. Anklam, T. M., Mills, R. J., White, M. D., "Experimental Investigations of Steady State Bundle Heat Transfer and Two-Phase Mixture Level Swell Under High Pressure Low Heat-Flux Conditions," Oak Ridge National Laboratory, NUREG/CR-2456, March, 1982.

2. "Experimental Investigation of Bundle Boiloff and Reflood Under High-Pressure Low Heat-Flux Conditions," NUREG/CR-2455 ORNL-5846, April, 1982.

3. "Heat Transfer Above the Two-Phase Mixture Level Under Core Uncovery Conditions in a 336-Rod Bundle," Westinghouse Electric Corp., EPRI NP-1692, Vol. 1, January, 1981.

4. Anklam, T. M., "ORNL Small Break LOCA Heat Transfer Test Series I: Rod Bundle Heat Transfer Analysis," Oak Ridge National Laboratory," NUREG/CR-2052, August, 1981.

5. "Experimental High Enthalpy Water Blowdown From a Simple Vessel Through a Bottom Outlet," Battelle Northwest, BNWL-1411, June, 1970.

6. "Coolant Blowdown Studies of a Reactor Simulator Vessel Containing a Perforated Sieve Plate Separator," Battelle Northwest, BNWL-1463, February, 1971.

7. "Heat Transfer Above the Two-phase Mixture Level Under Uncovery Conditions in a 336-rod Bundle," Westinghouse Electric Corporation, EPRI-1692, January 1981.

8. Slifer, B. C., "Loss of Coolant Accident and Emergency Core Cooling Models for General Electric Boiling Water Reactors," NEDO-10329, April 1971.

9. "BWR Refill-Reflood Program - Model Qualification Task Plan," EPRI Report No. EPRI NP-1527, October, 1991.

REQUEST FOR ADDITIONAL INFORMATION

NOTRUMP PRELIMINARY VALIDATION REPORT FOR SPES-2 TESTS
PXS-GSR-002, JULY 1995

The questions pertaining to the OSU test comparison report regarding the modeling improvements of Section 4.0 also apply to the review of the SPES-2 Test report.

440.
516 Was the secondary steam generator relief valve set point reduced for the SPES-2 test comparisons as was done for the OSU modeling? Please explain.

517 Please provide the downcomer liquid level plots for each of these tests with a comparison to the NOTRUMP code predictions.

518 Please provide the liquid level plots and the void distribution plots in the core and upper plenum regions for these tests. Please show a comparison of the core liquid level plots with the NOTRUMP code prediction.

519 Please provide the secondary steam generator pressure, level, and temperature comparisons with the NOTRUMP predictions for each of the tests and explain the reasons for differences, should they exist.

520 For the two inch cold leg break and the double-ended guillotine DVI line break, the NOTRUMP code overpredicted the liquid level above the top of the core. As shown in Fig. 5.1-23, the NOTRUMP code overpredicted the level above the core by as much as six feet and did not capture the trend in the level data throughout the 3000 second two inch cold leg break transient. Although the core remains covered during this test, this very poor comparison to the data demonstrates that the NOTRUMP code is incapable of simulating the trends and the magnitude of the liquid level in the core/upper plenum region following a small break LOCA in the AP600 plant. At 1500 seconds in Fig. 5.1-23, the test data shows the level receding below the two foot elevation while the NOTRUMP code is predicting a rapid increase in level to the eight foot elevation. The ability to predict two-phase level response is essential for assessing small break LOCA ECCS performance. The NOTRUMP prediction of the two inch cold leg break suggests that the code is inadequate for assessing small break LOCA ECCS performance. In view of the poor performance of the NOTRUMP codes ability to predict the level response in the system, please describe what future work is planned to correct this major code deficiency. Please explain the rationale for utilizing the NOTRUMP code for assessing the potential for

core uncovery in the AP600 plant in view of the inability of the code to properly trend and simulate system component liquid level responses for both the OSU and SPES-2 tests.