Docket File

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

June 23, 1997

APPLICANT: Westinghouse Electric Corporation

PROJECT: AP600

SUBJECT: SUMMARY OF AP600 MEETING TO DISCUSS RESOLUTION OF OPEN ITEMS FOR REACTOR SYSTEMS PIRT/SCALING CLOSURE REPORT

The subject meeting was held on April 25, 1997, at the Rockville, Maryland, offices of Nuclear Regulatory Commission (NRC) between representatives of Westinghouse and the NRC staff. The purpose of the meeting was to provide the NRC staff an overview of how Westinghouse intends to closeout open items related to the reactor systems AP600 scaling and PIRT closure report (WCAP-14727).

Highlights from the meeting included:

- Westinghouse has prepared a matrix of all questions, comments, requests for additional information (RAIs), and commitments on the PIRT/Scaling closure report from various sources (NRC, ACRS, EPRI) to ensure that all outstanding issues are addressed in the revised report.

- Westinghouse asserted that the final PIRT/Scaling closure report will be a comprehensive, self-contained, stand-alone document. It will have an appendix that contains all applicable RAIs and related issues. The report will also include an executive summary which provides an overview of the objectives, PIRTs, test facility scaling (both top-down and bottom-up) and a roadmap to appropriate sections of the report where detailed information can be found.

- The report will include multi-loop systems (top-down) and a component (bottom-up) scaling analyses. The bottom-up scaling analyses will be compared with the PIRT and used to define success criteria to confirm tests with adequate scaling.

- Westinghouse stated that the goal of the PIRT/Scaling closure report is to show at least one test facility adequately scales to every high ranked phenomena in the PIRT.

- Westinghouse noted that it was eliminating the NOTRUMP evaluation of pi-groups in Section 3 of the report and deleting Chapter 10 on the integration of test results into the codes. The NRC staff had no objection to these changes.

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Westinghouse and the staff reviewed the PIRT/Scaling issues in the compliance matrix and noted the following actions:

- The matrix will identify the specific ACRS meeting which each attributed ACRS comment originated.

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- Westinghouse will include an explanation on the matrix table of the significance of various formats (such as italics and shading).

- The NRC acceptance column will be deleted.

- Matrix item 15 refers to a request from the staff to validate pi-groups using a mass balance approach. Westinghouse stated that mass balances were previously used to analyze test results in the Quick Look and Final Data Reports. Instead, Westinghouse will provide additional discussion in the report on pi-group validation using bottom-up scaling and will consider recent work done by INEL in this area.

- Westinghouse agreed that the equation discussed in matrix item 29d was incorrect and will be fixed in the revised report.

- Matrix items 44, 58, and 70 will refer to the use of the Griffith screening criteria for water hammers.

- Matrix item 36 should be combined with item 79.

- For matrix item 49, Westinghouse needs to provide a reason why the use of governing equations, per Boure's paper, are not needed.

- Matrix items 55, 67, and 78 refer to oscillations observed during the testing at OSU. The staff felt that the PIRT/Scaling report should address the OSU oscillations to some extent. Westinghouse will re-examine this subject and determine if an appropriate discussion can be included in the report.

- Matrix item 60 is missing the ACRS comment.

- Westinghouse needs to clarify why no action is necessary for matrix item 62.

Westinghouse also discussed schedules for the remaining PIRT/Scaling actions. Westinghouse anticipated that the final report would be issued by the end of May and was hoping to schedule an ACRS meeting in late June. In addition, Westinghouse wanted to meet with the review staff once more after the report was issued to finalize preparation for the ACRS.

Attachment 1 is the list of meeting attendees. Attachment 2 contains the meeting agenda and Westinghouse meeting presentation material.

A draft of this meeting summary was provided to Westinghouse to permit an opportunity to ensure that the representation of comments and discussions was accurate.

original signed by:

William C. Huffman, Project Manager
Standardization Project Directorate
Division of Reactor Program Management
Office Of Nuclear Reactor Regulation

Docket No. 52-003

Attachments: As stated

cc w/atts: See next page

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WESTINGHOUSE - NRC MEETING

ON THE AP600 SCALING AND PIRT CLOSURE REPORT

OPEN ITEM CLOSEOUT

APRIL 25, 1997

MEETING ATTENDEES

NAME	ORGANIZATION
GENE PIPLICA	WESTINGHOUSE
MARK KAUSHANSKY	WESTINGHOUSE
ALAN LEVIN	NRC
PAUL BOEHNERT	NRC
BILL HUFFMAN	NRC

Attachment 1

HANDOUT MATERIAL

FROM APRIL 25, 1997, MEETING ON

AP600 SCALING AND PIRT CLOSURE REPORT

OPEN ITEM CLOSEOUT

Attachment 2

NRC - Westinghouse PIRT/Scaling

Closure Report Meeting

One White Flint, CR 10B13
Friday, April 25, 1997

E. J. Piplica

M. Kaushansky

NRC - Westinghouse PIRT/Scaling Closure Report Meeting Friday, April 25, 1997, One White Flint, CR 10B13

Agenda

8:30 - 9:00 Introduction and Meeting Goals - E. Piplica/W. Huffman

- to present status, comment resolution & to solicit NRC feedback
- to prepare for the ACRS PIRT/Scaling Closure review meeting

9:00 - 9:45 Programmatic Approach to PIRT/Scaling - M. Kaushansky

- schedule for completion
- executive summary as a roadmap
- addressing RAIs, NRC questions, ACRS concerns

9:45 - 11:15 Technical Approach to PIRT/Scaling Closure - E. Piplica

- scope of PIRT/Scaling issues
- single loop evaluations (4 time periods)
- multi-loop evaluations (2 time periods)

NRC - Westinghouse PIRT/Scaling
Closure Report Meeting
Friday, April 25, 1997, One White Flint, CR 10B13

Agenda (continued)

11:15 - 11:45 PIRT/Scaling Closure Results - E. Piplica

- bottom-up and component π groups
- multi-loop equations
- multi-loops π groups for single phase N.C., IRWST, Sump

11:45 - 12:00 Action Items - E. Piplica/W. Huffman

12:00 - 1:00 Lunch

1:00 - 2:30 Proposed Disposition of NRC/ACRS Comments

- compliance matrix
- RAIs
- December 10, 1996 letter from J. Sebrosky to N. Liparulo
- various ACRS THSC requests, questions, comments

2:30 - 3:00 Meeting Summary/Action Items

3:00 Adjourn

NRC - Westinghouse PIRT/Scaling Closure Report Meeting

Background

- Committed to PIRT/Scaling Report Jan. 24, 1996
- Submitted report to NRC
- Received 29 discussion items from NRC Dec. 10, 1996
- Teleconference to review discussion items Dec. 23, 1996
- ACRS review meeting held Dec. 17-18, 1996
- NRC documented Dec. 23 telecon in Jan. 10, 1996

Purpose of meeting

- Present status on discussion items
- To solicit NRC feedback
- To prepare for final ACRS meeting

Programmatic Approach to PIRT/Scaling Closure

General

- Study is intended to demonstrate that the experimental observations from the test programs are representative of AP600 behavior
- Scaling methodology (SASM) is applied to the extent practical throughout the study:
  - top-down scaling technique - application of conservation equations on a system level
  - bottom-up scaling of AP600 system components for specific highly-ranked phenomena and processes

Programmatic Approach to PIRT/Scaling Closure

General

- AP600 scaling study purpose is to confirm:
  - all dominant AP600 phenomena are represented in the experiments (OSU, SPES-2, SETs)
  - no new high-ranked phenomena are introduced by the scaled experiments
  - scaling distortions do not adversely impact the essential phenomena

Programmatic Approach to PIRT/Scaling Closure

Schedule for Completion

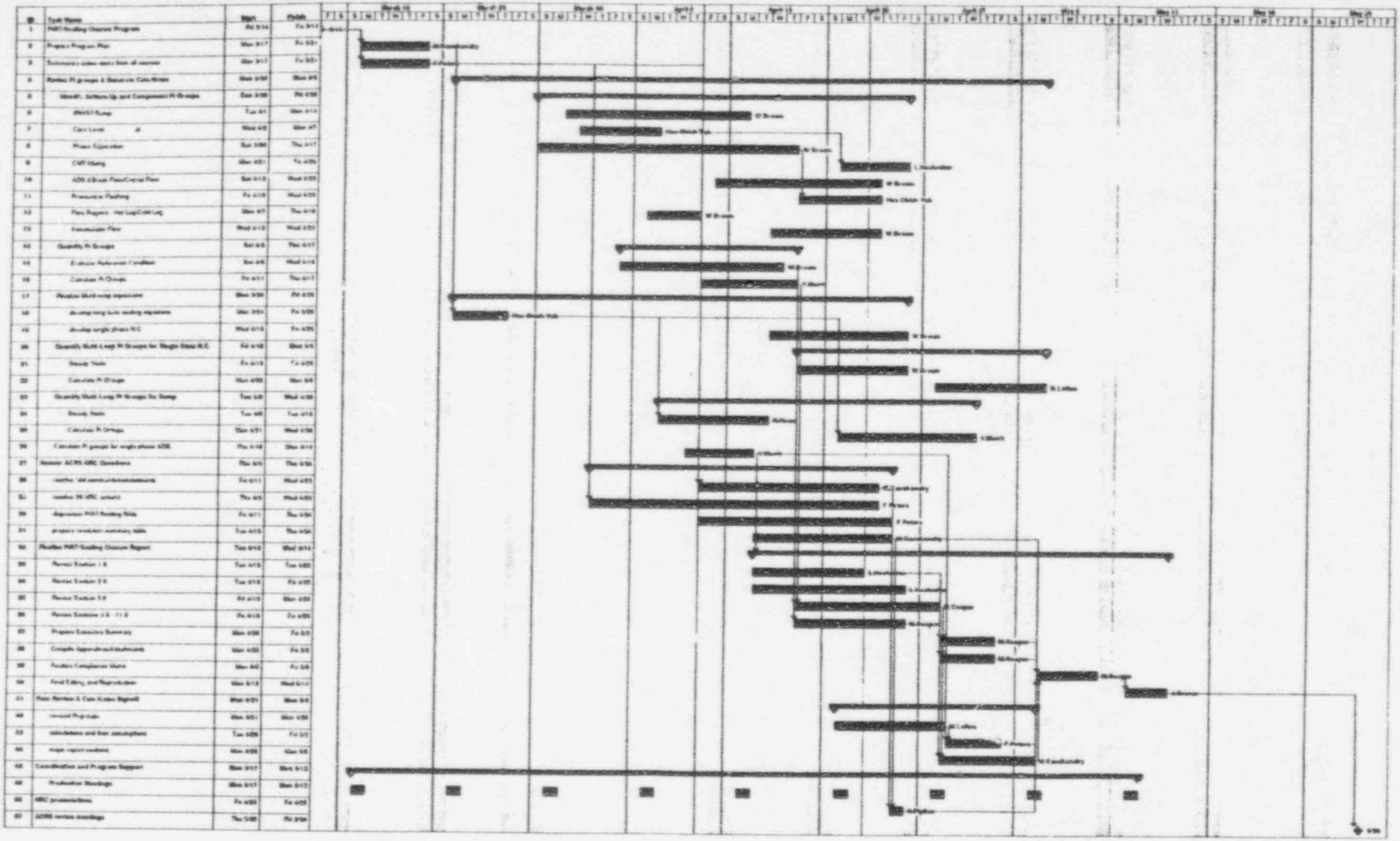
- Continue multi-loop scaling
  - Finalize multi-loop equations
  - Quantify multi-loop π groups for single phase natural circulation, ADS, Sump
- Identify/revise bottom-up scaling for high-ranked phenomena
  - Identify bottom-up and component π groups
  - Quantify π groups

Programmatic Approach to PIRT/Scaling Closure

Schedule for Completion

- Answer NRC/ACRS questions, including:
  - 29 NRC actions
  - disposition of PIRT/Scaling RAIs
  - compliance matrix (summary table)
- Finalize PIRT/Scaling Closure Report
- Peer Review
- NRC Presentation(s)
- ACRS Review Meeting

AP600 PIRT/Scaling Closure Report
Program Plan and Schedule (as of Wed 6/25)



Programmatic Approach to PIRT/Scaling Closure Executive Summary - Roadmap

- Comprehensive Summary of PIRT/Scaling Report
  - Objectives
  - Process for PIRT
  - PIRT for SBLOCA
  - Test Facilities
    - Referenced to PIRT/Scaling document and individual reports
    - Top-Down Scaling
      - Summary of multiple & single loop scaling analyses for SBLOCA
    - Bottom-Up Scaling
      - Summary of scaling for high ranked phenomena/SBLOCA
    - Summary of Facilities Meeting Scaling Criterion
- References to appropriate sections of the report provided for each topic in the Executive Summary - i.e., ROADMAP

Programmatic Approach to PIRT/Scaling Closure Addressing RAI & NRC Questions

Resolution Path

- Address NRC discussion items
- ACRS meeting transcript items
- Items from meeting notes
  - Fernandez
  - Wheeler
  - Westinghouse participants
- PIRT items related to RAIs

Programmatic Approach to PIRT/Scaling Closure NRC Discussion Items

- 29 NRC Discussion Items (representing a total of 36 comments)
  - ref: 12/10/96 letter from NRC (I. Sebrosky) to Westinghouse (N. Liparulo)
- Items were categorized for disposition as follows:
  - 13 - Clarification
  - 14 - Modified Analysis or Additional Analysis
  - 4 - Disagree - justification or clarification provided
    - Validation by mass balance not being pursued (NRC Item #15)
    - High pressure depressurization for SBLOCA is not addressed (NRC Item 19)
    - Eq 3-63 is correct (NRC Item #25)
    - Eq 4-20 is correct. Eq 4-22 provides π group in terms of h (NRC Item 29d)
  - 5 - Not subject for PIRT. Issue closed, agreement reached with NRC per memo dated 1/10/97(NRC/DCP0666).

Programmatic Approach to PIRT/Scaling Closure ACRS Meeting Items

- 50 additional items generated from transcripts and meeting minutes
- Tied into NRC comments wherever appropriate
- Disposition Categorized
  - 16 - Clarification
  - 18 - Modified analysis or additional analysis
  - 6 - Disagree - justification or clarification provided
  - 10 - Not a subject for PIRT

RAIs

- The OITS/RAI system reviewed for possible interface.
- Appendix will be added to PIRT/Scaling report with applicable RAIs and OIs.
- Where appropriate, RAI reference to be included in PIRT.
- Ensure that PIRT addresses the applicable RAIs.

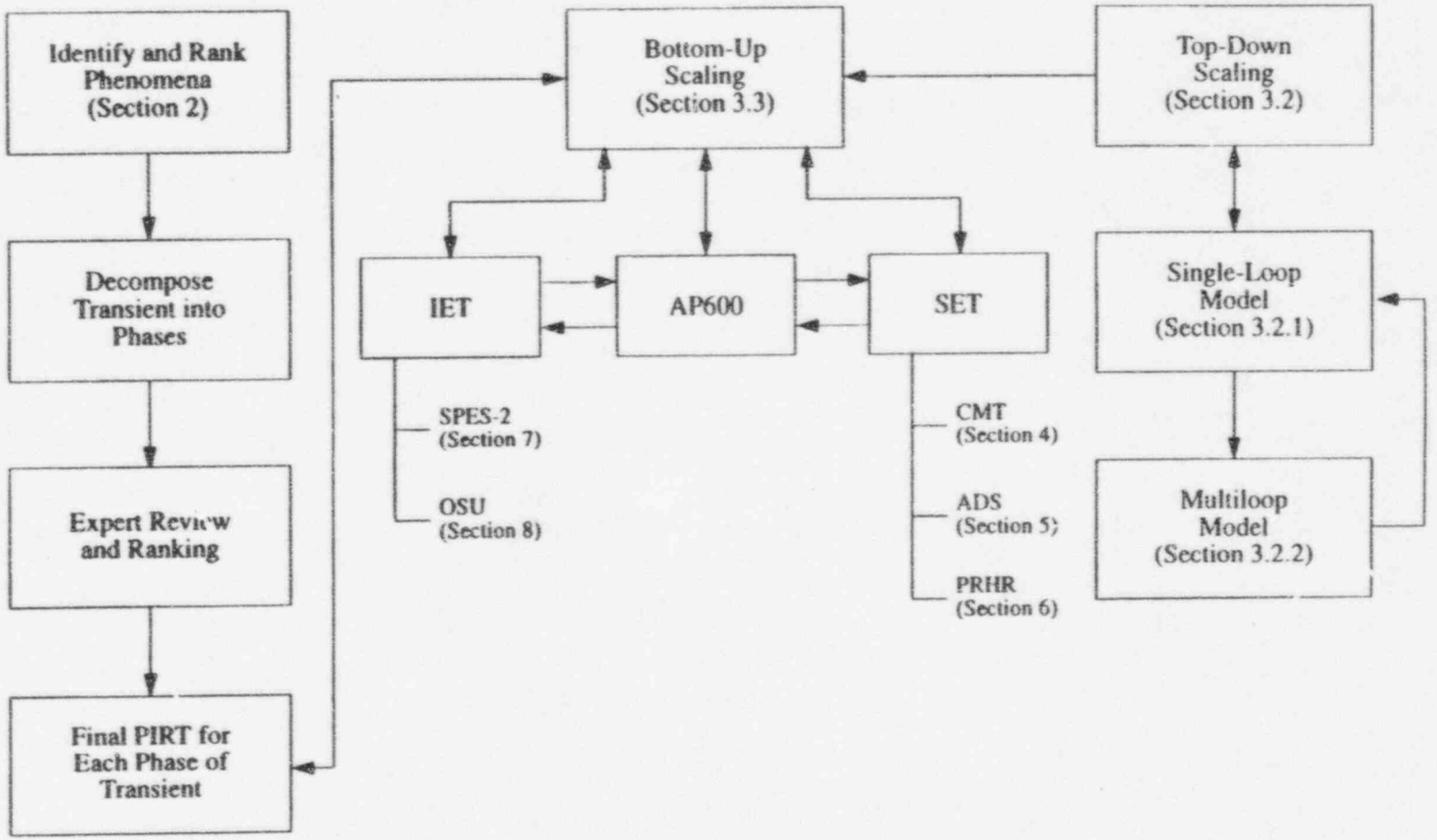
Technical Approach

- Revise initial report to respond to NRC/ACRS/EPRI reviewers comments
  - Add comprehensive, stand-alone Executive Summary
  - Add multi-loop systems analysis
  - Numerically evaluate bottom-up analyses
  - Compare systems analyses and bottom-up analyses with PIRT
  - Identify tests meeting scaling criterion

Technical Approach

- Restructure Section 3, Scaling
  - Include multi-loop and bottom-up scaling
  - Summarize π comparison tables
  - Eliminate NOTRUMP evaluations of π groups
- Provide details in Appendices
  - RAIs (referenced to pertinent text where applicable)
  - Derivations of π groups
  - Calculation of π values (including input parameters)
- Chapter 10 (Integration of Test Results into Analysis Codes) deleted

PIRT/Scaling Process



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Single Loop Scaling (Top Down)

- Single loop model selected to simplify analyses while providing distortions and identifying significant transfer processes
- Energy, mass, and momentum equations derived; non-dimensionalized, and normalized following method of Wulff
- Transient decomposed into 7 phases for analysis
  - Related to state of the RCS
- Normalization identifies significant transfer processes
- Quantified system level distortions

Single Loop Scaling - Methodology

- Seven time periods defined
  - Natural Circulation - Single Phase Steam Generator Flow
  - Natural Circulation - Single Phase PRHR Flow
  - Natural Circulation - Two Phase PRHR Flow
  - ADS1 Blowdown
  - ADS1 and ADS2 Blowdown
  - IRWST Injection
  - Sump Injection

Single Loop Scaling - Methodology

- For each of these time periods:
  - Derive the global conservation equations at the systems level for energy, mass, and momentum transfer for the components within the system
  - Normalize the equations using initial and/or boundary conditions
  - Identify the key driver term in each equation and divide each term by this driver term, resulting in a dimensionless coefficient (π ratio) for each term that is unity or less.

Single Loop Scaling - Methodology

- For each of these time periods:
  - Numerically evaluate the π ratios, as appropriate, for each of the transient periods.
    - Hand calculations used to calculate flows at each transient phase for IETs and AP600 for π evaluations
    - Test data also used to calculate π values

Single Loop Analyses - Conclusions

- Conclusions from the Single Loop Systems Analyses are:
  - Resistance/buoyancy, sensible heat/core power, boiling heat/core power, and convection heat/core power are the significant systems level π ratios.
  - Inertia/buoyancy, phase change momentum flux/buoyancy (boiling and condensation) and single phase compliance/core power are insignificant and may be excluded from further consideration.
  - SPES-2 sensible heat/core power during IRWST injection is distorted. This probably results from the small volume to surface ratio that accentuates the stored energy in the metal walls.

Single Loop Analyses - Conclusions

- Conclusions from the Single Loop Systems Analyses are:
  - Both SPES-2 and OSU Two Phase Compliance/Core Power, One Phase Mechanical Compliance/Core Power, and Two-Phase Mechanical Compliance Core Power appear to be distorted. This may result from neglecting the steam volumes of non-active components.
  - Scaling of both SPES-2 and OSU at the systems level demonstrates that these facilities are accurate simulations of the AP600 and between them, cover the important transfer processes within the distortion criterion.

Multi-Loop Scaling Analyses - Top-Down

- Multi-loop systems analyzed to validate single loop scaling and to identify any interactions between loops.
- Three time phases selected:
  - Single loop natural circulation (initial bound of transient and portion of transient with the most active components/loops)
  - Long Term Cooling (IRWST and Sump Injections) - terminal bound and novel features of AP600 PXS
  - ADS - representative of transient blowdown.

Multi-Loop Scaling Analyses - Top-Down

- Process similar to that for single loop analyses, with the addition of multiple loops
- Status
  - Derivation of π groups complete for Long Term Cooling and ADS Phases
  - Single Phase Natural Circulation analysis to be completed by May 2, 1997.
  - Numerical evaluation of π groups - May 9, 1997

Component Scaling - Bottom-Up

- Bottom-up scaling performed for high ranked phenomena in SBLOCA PIRT for each of the seven transient phases.
- Obtain π groups from component scaling reports where applicable or derive from sub-system analysis
  - Evaluate π groups for AP600 using hand calculations and for IETs and SETs using both hand calculations and test data.
  - Calculate scaling ratios using hand calculations

$$\text{Scaling Ratio} = \frac{\pi_{AP600}}{\pi_{component}}$$

Component Scaling - Bottom-Up

- Status
  - π group formulation 90% complete
  - π group numerical evaluations in progress

Success Criteria

- Scaling ratio between 0.5 and 2.0 of π_{AP600} with $\pi_{component}$ within a factor of $\pm$ two)
- At least one test facility meets the above distortion criterion for each high ranked phenomena in each transient phase.
- Following table illustrates the structure of the summary.
  - One entry per box = success!
  - Multiple entries indicate test overlaps
  - Test with least distortion best for code validation for the given phenomena
- Bottom-up evaluations of π groups for this table are in progress

Conclusions

- We are responding to NRC, ACRS, and EPRI comments
- Comprehensive Executive Summary, including references, is being prepared
- Multiple loop (top down) and component (bottom-up) scaling analyses are in progress
  - Single loop analyses show excellent scaling except for compliance ratios in later phases
  - Expect multiple loop analyses to show improved compliance (steam volumes of non-active components included)
  - On basis of single loop scaling, expect bottom-up scaling to be successful
  - Success criteria defined and numerical evaluations will be provided to confirm scaling

WESTINGHOUSE AP600 PIRT/SCALING CLOSURE REPORT
COMPLIANCE MATRIX

Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
1	Discuss abnormalous [illegible] hardware behavior as in the break flow of the break separator of test SB05	[illegible]	Discussion items, NRC/DCP0639	Not a subject for PIRT	RAI 440.584	Appendix	NRC/DCP0666
2	PIRT rankings appear based on code calculations rather than test results.		Discussion items, NRC/DCP0639 ACRS THSC Mtg. Transcript page 47. Fernandez comment 1.07	A combination of experience, code calculations and test results provide the basis for PIRT rankings.	The PIRT report will further explain the use of code calculations and test results in the formulations of the rankings.	Section 2.2.3	
3	Clarify the applicability of PRHR test results on page 6-41.	Prepare a better defense of PRHR test on IRWST side	Discussion items, NRC/DCP0639. ACRS THSC Mtg. Transcript page 91	The PRHR test report was reissued.	OI-1617, RAI 440.567 address concerns as to the effects of lack of "C" tube data.	Section 6.6	
4	Discuss the fuel rod reactivity or core level phenomena in the LBLOCA PIRT (Section 2.2.2)	Basis for LBLOCA PIRT	Discussion items, NRC/DCP0639 ACRS THSC Mtg. Transcript page 119	Further explanation added to PIRT.		Section 2.2.3	
5	Discuss, cold leg/accumulator flow asymmetries & accumulator discharge phenomena P.2-8. Also, why is DVI a separate item.		Discussion items, NRC/DCP0639	Cold leg/accumulator asymmetries will be discussed. DVI will be deleted from downcomer discussion.		Section 2.2.3	

Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
6	Why is hot leg nozzle bypass path not modeled (Sect.2.2.3, p. 2-14		Discussion items, NRC/DCP0639	Assumption of no hot leg bypass path is conservative and does not need to be modeled		Section 2.2.3	NRC/DCP0666
7	Why does off-site power trip pumps, instead of causing an"S" signal (Table 2.4-8)		Discussion items, NRC/DCP0639	Time of pump trip is consistent with SSAR analysis. Reference to SSAR report analysis will be added to Table 2.4-8.		Section 2.4	
8	Justifications are missing from Table 2.4-11,p.2-62		Discussion items, NRC/DCP0639.	Justifications will be added to Tables 2.4-11.		Section 2.4	
9	Justify that [illegible] limiting T/H conditions selected for initial conditions for LTC		Discussion items, NRC/DCP0639.	Discussion and analysis added to SSAR Chapter 15		NA	NRC/DCP0666
10	Horizontal sections of PRHR may have reduced heat transfer because of vapor trapping.	CHF may reduce heat transfer from PRHR	Discussion items, NRC/DCP0639 Transactions of ACRS THSC Mtg. Pages:. 88, 426-435, 467-475. Fernandez comment: 1.04,1.06, 6.02	PRHR capacity is sufficient without the horizontal sections.	RAI 440.567 and OI-1617	Appendix Section 6.6	

WESTINGHOUSE AP600 PIRT/SCALING CLOSURE REPORT
COMPLIANCE MATRIX

Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
11	Concern about geometric distortions in the test facility ADS piping relative to the AP600 plant. (page 9-4)	Need to compare ADS depressurization. with OSU (valves vs orifices), critical flow concern. Put ADS data into dimensionless form and compare with pressure rate equation derived from scaling. Schrock-defend use of orifices to represent valves.	Discussion items, NRC/DCP0639 ACRS THSC Mtg. Transcript pages: 132-135 Fernandez comment: 4.02	A detailed comparison of the test facility ADS system to the plant ADS will be made to include discussion of valves versus orifices and spool pieces and one sparger versus two. Compare dimensionless depressurization in OSU, SPES and ADS tests.		Section 5.3	
12	[illegible]	[illegible]	Discussion items, NRC/DCP0639	Question is addressed in WCOBRA/TRAC Long Term Cooling Final Validation Report	Section 10 was removed. Reference to WCAP will be added.	NA	NRC/DCP0666
13	Organization not conducive to easy review	no synthesis, road map on key phenomena Fernandez comment: 1.05, 3.08, 3.11	Discussion items, NRC/DCP0639 ACRS THSC Mtg. Transcript pages: 43, 49, 74-77, 78-79,82 Fernandez comment: 10.04, 10.05	The Section 3 of PIRT report is being reorganized and a comprehensive executive summary added to tie the report together.		Executive summary	

Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
14	Inertia and impedance matrices are generated in a multi-loop system analysis and not in single loop analysis. The assumptions in the single loop equivalent are listed without convincing technical justification.	Use Kirkoff's laws for multiloops	Discussion items, NRC/DCP0639 ACRS THSC Mtg. Transcript pages: 179-181	Multi-loop analysis is being added to the PIRT report. Comparisons of the results of the multi-loop analysis with the single loop will demonstrate adequacy of the single loop model.		Sections 3.2.2, 3.2.4, 3.2.5	
15	***Suggest validation of π groups by mass balances.*** Compare test data from different facilities using non-dimensional dp^*/dt^* vs t^* or p^* vs t^*. Use test data to validate π groups.	Need better explanations of comparisons to scaled up test data. Use normalizing method other than core flow. Improve presentation Section 3 6	Discussion items, NRC/DCP0639 ACRS THSC Mtg. Transcript pages: 171-176, 189, 197-295, 208-211, 213, 224-228, 464-466 Fernandez comment: 5.01, 5.05, 5.06, 5.30, 10.01, 10.3	***Formulation is conservative and balance is unnecessary. Would take excessive time and effort to include.*** Section 3 will be expanded to include normalization with respect to time and pressure for the ADS and Sump. Test data π groups will be compared to hand calculations.		Sections 3.2.1.3.3, 3.2.2.2.3, 3.2.1.4, 3.2.3, 3.3.3	

Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
16	π values were not numerically evaluated for PRHR and CMT tests	Clarify LTC more. Compare dimensionless groups with plant.	Discussion items, NRC/DCP0639 ACRS THSC Mtg. Transcript pages: 86, 93, 96, 99, 102-104. Fernandez comment 10.06	Bottoms up scaling being done to generate π values for the PRHR and CMT in the PIRT report.		Section 3.3.3	
17	Concern that codes were used to calculate scaling and code assessment values.	Explain differences between NOTRUMP π groups and hand calculation values (single phase). NOTRUMP referred to as an approved code	Discussion items, NRC/DCP0639 ACRS THSC Mtg. Transcript pages: 385-387, 394-395, 398-399 Fernandez comment: 1.02, 1.08, 5.22	Only test data and hand calculations will be used in evaluation of the π groups. NOTRUMP comparisons will be not be used in PIRT report.		Section 3.2.1.1, 3.2.2.1, 3.3.1	
18	Nomenclature is inconsistent & incomplete	Correct errors	Discussion items, NRC/DCP0639 ACRS THSC Mtg. Transcript pages: 182, 215, 193. Fernandez comment 9.08, 10.0	A comprehensive nomenclature table was generated and will be used throughout the PIRT report.		Table of Contents	

Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
19	***High pressure depressurization for SBLOCA not addressed.***		***Discussion items, NRC/DCP0639***	***An explanation will be added to the PIRT report as to why the high pressure depressurization for SBLOCA was not addressed***		*Section 3.x*	
20	Single loop analysis may not model flow splits and component interaction (see question 14)	Use Kirkoff's laws for multiloops	Discussion items, NRC/DCP0639 Fernandez comment: 1.09	Multi-loop analysis is being added to the PIRT report. Comparisons of the results of the multi-loop analysis with the single loop will demonstrate adequacy of the single loop model.		Section 3.2.4	
21	Problem with Figures 3.3.2 & 3.3.3		Discussion items, NRC/DCP0639	The referenced figures will be fixed.		Figures 3.2-2, 3.2-3	
22	Suggest non-dimensional pressure for each phase of transient. Correct comment on Wulff's recommendation on p. 3-21.	Include pressure equation for other periods and full range of pressure	Discussion items, NRC/DCP0639 ACRS THSC Mtg. Transcript pages: 182	The pressure ranges in the various phases of the transient will be used to evaluate the π groups for the ADS and Sump.		Section 3.2.2.2	
23	Concern that we maintained constant single and two phase volumes, where these volumes change during the transient.		Discussion items, NRC/DCP0639	Volumes are treated as constants for each snapshot but the volumes change between snapshots, i.e. between transient phases.		Section 3.2.2	

Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
24	Vapor or liquid mass balance equation should be included in drift-flux model of 2-phase flow field.		Discussion items, NRC/DCP0639	Vapor and liquid mass balances have been included in the drift flux model for sump injection only.		Section 3.2	
25	***Suggest use of simple critical flow model in place of discussion following equation 3-63.***		***Discussion items, NRC/DCP0639***	***Equation is correct for the homogeneous equilibrium flow model. This is sufficient for comparison of test facilities.***		***Section 3.5***	
26	Scaling analysis(sic) should show that inertia term is negligible in equation 3-72.		Discussion items, NRC/DCP0639	The starting equations will be completely stated and eliminated terms will be explained and justified.		Sections 3.2.2.2.2, 3.2.1.3.4	
27	Concern with scatter of π values and values greater than 1.0	Need experiments to confirm PIRT with dimensionless numbers or π groups to show most important groups. Clarify the normalization approach. Zuber-Section 3 needs to be rewritten. Describe how groups are normalized and how is time selected. Need a consistent approach. Need references for data. Show comparison between. PIRT & scaling, then compare to experiments.	Discussion items, NRC/DCP0639 ACRS THSC Mtg. Transcript pages: 47, 183-189 Fernandez comment: 1.08, 3.09, 5.25, 5.30, 6.03, 10.11	Test data and hand calculations used to evaluate test facility π's. Values are recalculated over steady state periods. Explanations added to text where significant departure from unity exit. Section 3 being reorganized and sections added. Add ref. For data in Table 3.5-x.		Sections 3.3.3, 3.3.4, 3.3.5, Executive Summary	

Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
28	Attached						
29a	Numerical values of π groups were not evaluated for the CMT's; therefore scale distortions could not be assessed.	Explain distortions. Zuber would like to see effects of distortions on π groups of high ranked PIRT items	Discussion items, NRC/DCP0639 ACRS THSC Mtg. Transcript pages: 402-408, 439-445, 461-463 Fernandez comment: 5.27, 6.03	Evaluate and Discuss CMT π's with respect to distortions.		Section 3.5	
29b	Discussion of the CMT cross-sectional area scaling relationships is incomplete.		Discussion items, NRC/DCP0639	Relationship of the CMT cross-sectional area scaling ratios will be expanded.		Section 4.3	
29c	Fig. 4.3.1-4.3.4 are not clearly documented & do not support text at bottom of p 4-17.		Discussion items, NRC/DCP0639	Text and figures will be changed to clarify the discussion.		Section 4.3	
29d	***Equation 4-20 should define heat transfer coefficient., not Nu***		***Discussion items, NRC/DCP0639***	***Equation 4-20 is correct as written. Equation 4-22 states the final relationship required.***		***Section 4.3***	
29e	CMT recirculation π groups need numerical evaluations.	Clearer story on CMT drains and transitions from circulation to draining. SBLOCA PIRT discussion	Discussion items, NRC/DCP0639 ACRS THSC Mtg. Transcript pages: 145-152 Fernandez comment: 4.03	An evaluation of the CMT recirculation π groups will be included. See item 16		Section 3.3.3	

Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
29f	Fig.4.3.7-4.3-11 do not agree with text at top of p. 4-28. Need numerical evaluation of π's.		Discussion items, NRC/DCP0639	Text will be revised; the CMT component level π groups will be presented and evaluated.		Section 4.3	
29g	Test overlaps attaboy!!						

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Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
30		Identify PIRT team names	ACRS THSC Mtg. Transcript pages: 33,127 Fernandez comment: 3.02	Names of experts will be added to PIRT.		Section 2.1 Executive Summary	
31		Document should show that scaling was done after facilities were constructed.	ACRS THSC Mtg. Transcript pages: 37	Initial scaling was updated and improved with time.		Section 3.1	
32		***Should have used the 1994 version of decay heat curve.***	***ACRS THSC Mtg. Transcript pages: 140***	***Heaters were programmed and the tests run prior to revision of the decay heat estimate.***	***The revised decay heat estimate is used in AP600.***	***Section 2.***	
33		Show SG tube rupture analysis for two flow paths and compare with single orifice used in SPES test. Table 2.4-13, SGTR PIRT Address Schrock's question on rupture and critical flow through two ends relative to simulation used in SPES. Address small diameter tube breaks critical flow limited.	ACRS THSC Mtg. Transcript pages: 61,66-69,156-160, 169-171 Fernandez comment: Catton 4.06, 4.09	Present sensitivity studies comparing a single with two break paths.		Section 2.4	

Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
34		Catton- LBLOCA same as 3 & 4 loop plants; was documentation reference in WCAP-14727 cleaned up as promised	Fernandez comment: 1.01	Reference was cleaned up. Resolution presented at 3/28/97 mtg.		Section 2.2.2	
35		Possibility of counter current 2 phase flow ala DiMarzo	ACRS THSC Mtg. Transcript pages: 152 Fernandez comment: 4.04	Not a subject for the PIRT report.		NA	
36		Horizontal stratified flow [illegible]	[illegible]	Analysis shows stratified flow in the hot leg after IRWST injection in the OSU long term cooling tests but not in the plant.		Section 3.3	
37		What is justification for using SPES-2 data for code validation in light of its problems?		Scaling distortions exist in SPES but the data are still acceptable		Executive Summary Section 7.3.5	

Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
38		Zuber-IRWST and sump periods in energy equation but not in momentum equation. Need more consistent selection of volumes. Add time dependent volume to momentum and energy for IRWST and sump periods Develop mixture equation of the IRWST and sump periods. Concern on the change of sump interface influencing flow rates into the system. Clarify sump injection figure. Clarify sump injection energy equation terms. Look at independence of π groups in summary table.	ACRS THSC Mtg. Transcript pages: 323-325, 325-328, 331, 334, 339, 348-350 Fernandez comment: 5. 16, 10.06	The multiloop starting equations for sump and IRWST injection will be completely stated for the two phase mixture. The eliminated terms will be explained and justified. Independence of π groups being verified.		Section 3.2.2.2.2	
39		Zuber- time is inconsistent Basis for time periods	ACRS THSC Mtg. Transcript pages: 354-366	The time periods for each test are based on the transient phase as defined by specific system responses, i.e. valve opening, vessel discharging, etc.			
40		***Bankoff-use average of values during transient phase.***	***ACRS THSC Mtg. Transcript pages: 366*** ***Fernandez comment: 5.21***	***No. Westinghouse is using interval maximum values or the change in variable over the interval.***			

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Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
41		All-explain distortions Basis for Magnitude of Pi groups	ACRS THSC Mtg. Transcript pages: 354-366, 374-376, 402-408 Fernandez comment: 5.27, 6.03			Sections 3.2.1.5, 3.2.3, 3.3.3, Exec. Summary	
42		Data concerning CMT draining can be predicted [illegible]	Fernandez comment: 4.03, 6.04	Not Subject of PIRT, Reference NOTRUMP V & V report		NA	
43		Cross-ref. RAI's or include in Appendix	Fernandez comment: 6.03, 10.0				
44		ACRS [illegible] water hammer [illegible] design issue. Concerned about water hammer from stratified flow in piping.	Fernandez comment: 8.0, 9.03, 10.06	Not Subject of PIRT		NA	
45		Provide outline of Executive Summary to Catton for Feb. ACRS meeting		Outline provided and review comments received.		NA	
46		Scaling groups which indicate distortion in SPES due to excessive stored energy		Distortions are discussed.		Section 7.3	
47		Footnote in Table 2.4-12 is missing.	ACRS THSC Mtg. Transcript pages: 155	Footnote indication was removed.		Table 2.4-12	

Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
48		Question on adequacy of range of sump temperatures for LTC.	ACRS THSC Mtg. Transcript pages: 167-168	Revised PIRT to remove level and temperature since they are boundary conditions and not phenomena.		Section 2.5	
49		***Rewrite governing equations per Boure's paper.***	***ACRS THSC Mtg. Transcript pages: 211, 214,215, 267-271***	***Governing equations are not being rewritten per Boure's paper.***		*NA*	
50		Check independency of Pi groups derived from the energy equation.	ACRS THSC Mtg. Transcript pages: 217-221, 299-306 Fernandez comment: 10.06, 10.11	Independence of equations being checked.		Sections 3.2.1.4, 3.2.3, 3.3.3	
51		Clarify effects of CMT injection during circulation & draining, i.e., constant volume process.	ACRS THSC Mtg. Transcript pages: 263, 420-423 Fernandez comment: 4.03	Bottoms up scaling equations for the balance line voiding are being developed. Clarification of recirculation versus draining.		Section 3.3.2.2	
52		Clarify the energy equation and its normalization for the single phase circulation	ACRS THSC Mtg. Transcript pages: 287 Fernandez comment: 3.09	Multiple loop single phase natural circulation discussion being added to section 3 writeup.		Sections 3.2.2.2.1, 3.2.1.3.1	
53		dp/dt equation needs a work term	ACRS THSC Mtg. Transcript pages: 293-296			Section 3.2.2.2.3	

Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
54		Clarify line resistance for IRWST and sump injection periods low resistance of ADS line	ACRS THSC Mtg. Transcript pages: 311	The line resistance for the IRWST and sump have been clarified and inserted in the equations.		Section 3.2.2.2.2	
55		[illegible]	ACRS THSC Mtg. Transcript pages: 316-319 Fernandez comment: 10.03	Not a subject for the PIRT report.			
56		Zuber "How good is the data for code validation?"	ACRS THSC Mtg. Transcript pages: 384 Fernandez comment: 5.25	At least one test provides nondistorted data for each high ranked phenomena. Reference code V &V.		Section 3.3.5, Exec. Summary	
57		Catton - believes we are using wrong variables for normalization.	ACRS THSC Mtg. Transcript pages: 390 Fernandez comment: 3.09	Normalization process was reviewed.		Sections 3.2.1.3, 3.2.2.2	
58		Schrock - concern on water hammer in GMT balance lines	ACRS THSC Mtg. Transcript pages: 423 Fernandez comment: 6.01	Not a subject for the PIRT report.		Section 4.3	

Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
59		Clairify CMT wall heat transfer and velocities	ACRS THSC Mtg. Transcript pages: 453-456 Fernandez comment: 6.04, 6.05	Reference to Fago's thesis added.		Section 4.3	
60		Ref. Fago thesis to address CMT circulation and thermal stratication	ACRS THSC Mtg. Transcript pages: 459 Fernandez comment: 6.01, 6.05	Reference to Fago's thesis added.		Section 4.3	
61		Why was SG heat transfer high for transients? How was analysis done?	ACRS THSC Mtg. Transcript page: 6 Fernandez comment: Catton 1.03				
62		***OSU scaling at low pressure conditions. dP/d(ρ) vs dP/dT Thermally expandable fluid concept.***	***Fernandez comment: 5.11, 10.12***	***No action is necessary.***			
63		Use (W_o*dh_o/Q_o) for more compact equations, get 2 π groups rather than 3, for the natural circulation phase.	ACRS THSC Mtg. Transcript pages: 216 Fernandez comment: 5.12	Looking at reduction of the number of π groups		Section 3	

Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
64		Check use of Wulff's equation (58)	Fernandez comment: 5.24, 5.30	Use of Wulff's equation (page 3-18) will be examined.		3	
65		Provide ACRS with computer code documentation	Fernandez comment: 10.17			NA	
66		Some tests do not bracket AP600 conditions	Fernandez comment: 3.05 Catton	The overall body of data from the various tests bracket scaled AP600 phenomena to an adequate extent for highly ranked phenomena.		Sections 3.3.4, 3.3.5	
67		OSU Tests: [illegible]	TT-1496-6	Not a subject of PIRT report		Section 8	
68		We need to do the total system scaling and address Novak's bathtub phenomena	From ACRS meeting comments LEHNotes-2	No further action required	Will be included in the PIRT/Scaling Closure Report Section 3.0 (per LEH/WB)	Section 3.2.2	

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Item No.	ACTION ITEMS (Questions, Comments, RAIs, Commitments) NRC	ACRS	Identifier (number, date, meeting, etc.)	Westinghouse Technical Position	Proposed Disposition	Closure Reference	NRC Acceptance
69		[redacted] references [redacted]	JGNotes-1	Send PRHR report, Rev 2 to ACRS			
70		[redacted] with water [redacted]	JGNotes-2	Water hammer concerns were presented to ACRS on December 18-19, 1996	Not a subject for PIRT		
71		**ADS Tests:** Integral test atypicalities - add references to documents (i.e., WCAP-XYZ, Page X) to prior ACRS presentation table.	JGNotes-3	Westinghouse should incorporate in the PIRT/Scaling Closure Report (per LEH)		Sections 4.5, 5.3, 6.3, 7.3, 8.3, 9	
72		[redacted]	[redacted]	Send this report to ACRS to be forwarded to D. [redacted]		NA	
73		Zuber asked if π group 3.4-48 is correct. LEH agreed to check	ENNotes-1B	Being Reviewed by LEH (1 or 2 reports:Test Data/Test Analysis)			
74		Catton never got answers on splitter plate, SGTR, pressurizer, etc. Is it documented in Westinghouse reports?	ENNotes-1C	Not all atypicalities (check splitter plate) are discussed in the PIRT/Scaling Closure Report		Section 7	
75		**OSU tests:** Dhir asked if there was boiling in tubes of PRHR. LEH said he would check.	ENNotes-2	No boiling IN the tubes - only OUTSIDE the tubes per OSU video:			
76		***NOTRUMP:*** ***Dhir wanted explanation of temperature spikes (LEH thought, perhaps, steam). Next meeting will discuss in more detail.***	*ENNotes-5*	***NOTRUMP comparisons will be not be used in PIRT report.***			

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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Section [illegible]	[illegible]
78		***Top down scaling of what caused oscillations. Absolutely eliminate oscillations as a concern (maybe use NOTRUMP).***	*ENNotes-6B*	***Westinghouse disagrees - no need to do this because the phenomena is bound and is not a concern (all per LEH)***			
79	Provide the staff with insights from testing that show the effect of multi-dimentional behavior (e.g., thermal stratification) on system response, and to identify any effects that would not be observed in the tests (e.g., effects on system response due to thermal stratification during a main line break or a steam generator tube rupture)		Summary of November 12 1996 meeting with the NRC - overview of WCAP14727	PXS concern to be resolved in either PIRT/Scaling Closure Report or by a separate letter to the NRC			

PIRT References

Item	OI	Type	Number	Subject	References	Reference Dates	Responsibility	Objective
	38	RAI	952.105	OSU/Scal	NSD-NRC-96-4649	2/16/96, 10/29/96		
	39	RAI	952.106	ROSA	NSD-NRC-96-4696	10/29/96		
	417	MTG/ACRS		CMT		3/15/94		
	428	MTG/ACRS		OSU		9/21/93		
	441	MTG/ACRS		OSU		9/21/93		
	452	MTG/ACRS		OSU		7/22/93		
	1629	DSER	21.5.6-1	SPES-2	21.5.10.1-1			
	2075	RAI	440.259	FDR's	NTD-NRC-95-4573	10/10/95,10/29/96		
	2077	RAI	440.261	CMT/FDR	NTD-NRC-95-4573	10/10/95, 10/29/96		
	2078	RAI	440.262	CMT/TAR	NTD-NRC-95-4573	10/10/95, 10/29/96		
	2087	RAI	480.222	OSU	NTD-NRC-95-4594	11/10/95		
	2096	RAI	480.226	SPES/TAR	NTD-NRC-95-4602	11/30/95		
	2113	RAI	480.235	OSU	NTD-NRC-96-4649	2/16/96		
	2116	RAI	480.251	OSU/FDR	NTD-NRC-95-4598	11/17/95		
	2118	RAI	480.253	OSU/FDR	NTD-NRC-95-4594	11/10/95		
	2127	RAI	480.262	OSU/FDR	NTD-NRC-95-4598	11/17/95		
	2135	RAI	480.270	OSU/FDR	NTD-NRC-95-4598	11/17/95		
	2139	RAI	480.274	OSU/FDR	NTD-NRC-96-4636	1/31/96		
	2140	RAI	480.275	OSU/FDR	NTD-NRC-95-4602, oscillations	11/30/95		
	2316	RAI		SPES/FDR	NTD-NRC-96-4752	6/20/96, 10/29/96		
	2322	RAI		OSU	NTD-NRC-96-4752	6/20/96, 10/29/96		
	2325	RAI		OSU	NTD-NRC-96-4752, oscillations	6/20/96, 10/29/96		
	2326	RAI		OSU	NTD-NRC-96-4752	6/20/96, 10/29/96		
	2329	RAI		OSU	NTD-NRC-96-4752, oscillations	6/20/96, 10/29/96		
	2330	RAI		OSU	NTD-NRC-96-4752	6/20/96, 10/29/96		
	2582	RAI	440.416	SPES/FDR	NTD-NRC-95-4573, CMT's	10/10/95		
	2587	RAI	440.421	SPES/FDR	NTD-NRC-95-4573, S01613	10/10/95		
	2592	RAI	440.426	SPES/FDR	NTD-NRC-95-4573, section 4.2.8	10/10/95		
	2649	MTG		SPES	NTD-NRC-95-4573	10/10/95, 10/29/96		
	2650	MTG		SPES/TAR	NTD-NRC-95-4573	10/10/95, 10/29/96		
	2651	MTG		SPES/TAR	NTD-NRC-95-4573	10/10/95, 10/29/96		
	2654	MTG		SPES/TAR	NTD-NRC-95-4573	10/10/95, 10/29/96		
	2655	MTG		SPES/TAR	NTD-NRC-95-4573, oscillations	10/10/95, 10/29/96		
	2656	MTG		SPES/TAR	NTD-NRC-95-4573	10/10/95, 10/29/96		
	2657	MTG		SPES/TAR	NTD-NRC-95-4573, oscillations	10/10/95, 10/29/96		
	2659	MTG		SPES/TAR	NTD-NRC-95-4573, master plan	10/10/95, 10/29/96		
	2660	MTG		SPES/TAR	NTD-NRC-95-4573	10/10/95, 10/29/96		
	2657	MTG		SPES/TAR	NTD-NRC-95-4573, oscillations	10/10/95, 10/29/96		
	2666	RAI	440.363	OSU/Scal	NTD-NRC-96-4636, roadmap	1/31/96, 10/29/96		
	2667	RAI	440.364	OSU/Scal	NTD-NRC-96-4636	1/31/96, 10/29/96		

Item	OI	Type	Number	Subject	References	Reference Dates	Responsibility	Objective
	2671	RAI	440.368	OSU/Scal	NTD-NRC-96-4636	1/31/96, 10/29/96		
	2672	RAI	440.369	OSU/Scal	NTD-NRC-96-4636	1/31/96, 10/29/96		
	2673	RAI	440.370	OSU/Scal	NTD-NRC-96-4636	1/31/96, 10/29/96		
	2676	RAI	440.373	OSU/Scal	NTD-NRC-96-4765	7/1/96, 10/29/96		
	2677	RAI	440.374	OSU/Scal	NTD-NRC-96-4765	7/1/96, 10/29/96		
	2679	RAI	440.376	OSU/Scal	NSD-NRC-96-4754,page 2-5 repeat	6/21/96, 10/29/96		
	2682	RAI	440.379	OSU/Scal	NSD-NRC-96-4754, section 5.3.1	6/21/96, 10/29/96		
	2687	RAI	440.384	OSU/Scal	NSD-NRC-96-4754, page 5-32	6/21/96, 10/29/96		
	2689	RAI	440.386	OSU/Scal	NSD-NRC-96-4754,page 5-38,-39	6/21/96, 10/29/96		
	2696	RAI	440.393	OSU/Scal	NSD-NRC-96-4754, section 5.7.1	6/21/96, 10/29/96		
	2697	RAI	440.394	OSU/Scal	NSD-NRC-96-4754, section 5.7.2	6/21/96, 10/29/96		
	2700	RAI	440.397	OSU/Scal	NSD-NRC-96-4765, section 7.6.1	7/1/96, 10/29/96		
	2989	RAI	440.523	OSU/FDR	NSD-NRC-95-4602	11/30/95, 10/29/96		
	2995	RAI	440.529	SPES/TAR	NTD-NRC-96-4636	1/31/96, 10/29/96		
	2998	RAI	440.532	SPES/TAR	NTD-NRC-96-4636, PIRT Level of Detail	1/31/96, 10/29/96		
	3001	RAI	480.535	SPES/TAR	NTD-NRC-96-4630	1/26/96, 10/29/96		
	3002	RAI	480.536	SPES/TAR	NTD-NRC-96-4630, uncertainty	1/26/96, 10/29/96		
	3004	RAI	480.538	SPES/TAR	NTD-NRC-96-4636	1/31/96, 10/29/96		
	3005	RAI	480.539	SPES/TAR	NTD-NRC-96-4636	1/31/96, 10/29/96		
	3006	RAI	480.540	SPES/TAR	NTD-NRC-96-4636	1/31/96, 10/29/96		