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

ATTENTION: MR. R. W. BORCHARDT

SUBJECT: DRAFT OUTLINES FOR AP600 TEST AND ANALYSIS REPORTS

Dear Mr. Borchardt:

Westinghouse has prepared draft outlines for a number of AP600 test and analysis reports which are scheduled for completion during the next year. While these outlines are draft and subject to change, they are being provided to the NRC at this time to allow for a better understanding of the content and level of detail to be contained in the reports. Attachment 1 contains the draft outlines for 22 planned test and analysis reports.

Attachment 2 provides a matrix which compares the format and content of the AP600 test and analysis reports with the generic test and analysis format and content outline provided by the NRC (NRC Memorandum, Thadani to Crutchfield, "Revision 2 of the Implementation Plan for the Review of Vendor Testing Programs for the AP600 and SBWR", September 15, 1993).

Due to the tight schedule for completion and subsequent NRC review of the reports we would appreciate NRC feedback on the draft outlines so that there is a better opportunity for incorporation into the test and analysis reports. During a September 24, 1994 phone conference between Westinghouse and NRC staff, the opportunity for a December meeting was discussed. We believe this meeting will provide a good opportunity to discuss the outlines with NRC staff.

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Please contact Brian A. McIntyre on (412) 374-4334 if you have any questions concerning this transmittal.

Nicholas J. Liparulo, Manager
Nuclear Safety Regulatory And Licensing Activities

/nja

Attachments
Enclosure

cc: T. Kenyon, NRC (w/o Attachments)
R. Hasselberg, NRC
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AP600 Test & Analysis Report Draft Outlines
DRAFT - 10/21/94

DRAFT OUTLINES

Final Data Reports

1. SPES-2 Final Data Report
2. OSU Final Data Report
3. CMT Final Data Report
4. ADS Final Data Report

Test Analysis Reports

5. SPES-2 Test Analysis Report
6. OSU Test Analysis Report
7. CMT Test Analysis Report
8. ADS Test Analysis Report

Preliminary Validation Reports

9. NOTRUMP Preliminary Validation Report for SPES-2 Tests
10. NOTRUMP Preliminary Validation Report for OSU Tests
11. NOTRUMP Preliminary Validation Report for CMT Tests
12. NOTRUMP Preliminary Validation Report for ADS Tests
13. LOFTRAN Preliminary Validation Report for SPES-2 Tests
14. LOFTRAN Preliminary Validation Report for CMT Tests
15. W/CT Preliminary Validation Report for SPES-2 Tests
16. W/CT Preliminary Validation Report for OSU Tests
17. W/CT Preliminary Validation Report for OSU/LTC Tests
18. W/CT Preliminary Validation Report for CMT Tests
19. W/CT Preliminary Validation Report for ADS Tests

Final V&V Reports

20. NOTRUMP V&V Report
21. LOFTRAN V&V Report
22. W/CT V&V Report

OUTLINE 1: SPES-2 FINAL DATA REPORT

Summary

1. Introduction
- 1.1 Background
- 1.2 Test Objectives
- 1.3 Test Matrix *(including rationale for test matrix)*

2. Test Facility Description *(summarize from Facility Description Report)*
- 2.1 Introduction
- 2.2 Facility Scaling Summary *(summary from Scaling Report)*
- 2.3 Facility Description
  - 2.3.1 Systems Description
  - 2.3.2 Principle Components Description
- 2.4 Instrumentation *(describe key instrumentation)*
- 2.5 Data Acquisition System *(describe both hardware and software)*
- 2.6 Facility Operation *(including overall procedure for conducting tests)*

3. Data Reduction *(brief description of any data reduction/validation activities)*
- 3.1 Introduction
- 3.2 Test Validation *(description of all data validation criteria)*
- 3.3 Pre-operational Tests
- 3.4 Matrix Tests *(includes identification of all tests - valid and invalid, and brief description of why tests are invalid)*
- 3.5 Error Evaluation

4. Test Results
- 4.1 Pre-operational Test Results
- 4.2 Matrix Test Results *(plots of selected representative data for valid tests)*

5. Test Data Comparison
- 5.1 Comparison of Break Categories
- 5.2 Comparison of Break Sizes
- 5.3 Effects on Non-Safety Systems
- 5.4 Key Test Results

6. Conclusions

7. References

Appendices:

- Appendix A Data Reduction Methods and Validation Process *(description of all data processing, reduction, and validation activities)*
- Appendix B Data Validation Results *(assessment of test validation criteria - specified vs. actual)*
- Appendix C SPES-2 Instrument List
- Appendix D Modified and Failed Instruments by Test
- Appendix E Data Error Analysis

OUTLINE 2: OSU FINAL DATA REPORT

Summary

1. **Introduction**
   - 1.1 Background
   - 1.2 Test Objectives
   - 1.3 Test Matrix *(including rationale for test matrix)*

2. **Test Facility Description** *(summarize from Facility Description Report)*
   - 2.1 Introduction
   - 2.2 Facility Component Description
   - 2.3 Instrumentation
   - 2.4 Data Acquisition System
   - 2.5 Facility Operation *(overall procedure for conducting tests - brief description of procedure for each matrix test)*
   - 2.6 Drawings

3. **Data Reduction** *(brief description of any data reduction/validation activities)*
   - 3.1 Introduction
   - 3.2 Test Acceptance
     - 3.2.1 Critical Instruments
     - 3.2.2 General Acceptance Criteria
     - 3.2.3 Test Specific Acceptance Criteria
     - 3.2.4 Steady State Mass Balance
   - 3.3 Method of Data Reduction

4. **Test Results**
   - 4.1 Introduction
   - 4.2 Pre-operational Test Results
     - 4.2.1 Cold Volume and Pressure Drop Determinations
     - 4.2.2 Hot Pre-operational Tests
   - 4.3 Matrix Test Results

5. **Test Data Comparison**
   - 5.1 Effects of break size
   - 5.2 Effects of break location
   - 5.3 Effects of non-safety systems
   - 5.4 Effects of single failure
   - 5.5 Effect of containment backpressure
   - 5.6 Key test results

6. **Conclusions**

7. **References**

Appendices:

- Appendix A Data Reduction Methods
- Appendix B Data Acceptance Results
- Appendix C Failed Instrument and Changed Instrument List
- Appendix D Data Error Analysis
- Appendix E Instrument Calibration
- Appendix F Channel Calibration Corrections
- Appendix G Mass Balance
- Appendix H Data Plots
- Appendix I Data Files

OUTLINE 3: CMT Final Data Report Outline

Summary

1. Introduction
- 1.1 Background
- 1.2 Test Objectives
  - 1.2.1 Cold Pre-ops
  - 1.2.2 Hot Pre-ops
  - 1.2.3 Steam Condensation of CMT Walls
  - 1.2.4 CMT Heat Transfer During Depressurization
  - 1.2.5 CMT Draindown Tests
  - 1.2.6 Natural Circulation Followed by Draindown
- 1.3 Test Matrix *(including rationale for test matrix)*
- 1.4 Facility Scaling Summary *(summarize from scaling report)*

2. Test Facility Description ***(summarize from Facility Description Report)***
- 2.1 Introduction
- 2.2 Facility Component Description *(CMT, S/WR, Steam Accumulators, Boiler, drain line isolation valve, steam line isolation valve)*
- 2.3 Instrumentation *(describe key instrumentation, including instrumentation list)*
- 2.4 Data Acquisition System *(describe both hardware and software)*
- 2.5 Facility Operation *(including overall procedure for conducting tests)*
- 2.6 Drawings *(P&ID, tank drawings, layout drawings)*

3. Data Reduction ***(brief description of any data reduction/validation activities)***
- 3.1 Introduction
- 3.2 Test Acceptance
  - 3.2.1 Critical Instruments
  - 3.2.2 General Acceptance Criteria
  - 3.2.3 Test Specific Criteria
  - 3.2.4 Mass Balance
- 3.3 Pre-operational Tests
- 3.4 Matrix Tests *(includes identification of all tests - valid and invalid, and brief description of why tests are invalid)*

4. Test Results
- 4.1 Introduction
- 4.2 Pre-operational Test Results *(include summary of those items important to computer code modeling)*
  - 4.2.1 Cold Pre-ops
  - 4.2.2 Hot Pre-ops
  - 4.2.3 Steam Distributor
- 4.3 Matrix Test Results
- 4.4 Test Data Comparisons
- 4.5 Key Test Results (identification of key thermal hydraulic phenomena, e.g. time to steady drain and thermal mixing layer for 300 series tests, wall condensation for 100 series tests, etc.)

5. Conclusions

6. References ***(include references such as Facility Description Report, Scaling report, Quick Look report for Pre-op Tests, etc.)***

Appendices:
- Appendix A Data Reduction Methods *(similar to QLR sections 4.1 and 4.2)*
- Appendix B Data Acceptance Results *(similar to QLR section 4.3)*
- Appendix C Failed Instrument and Changed Instrument List *(identify failed instruments as a function of test)*
- Appendix D Data Error Analysis
- Appendix E Instrument Calibration *(how the raw data on calibration was collected from the facility and summary of raw data)*
- Appendix F Channel Calibration Corrections *(PT reference line heights, TC bias corrections, flow meter calibration corrections)*
- Appendix G Mass Balance
- Appendix H Data Plots
- Appendix I Data Files

OUTLINE 4: ADS Final Data Report Outline

Summary

1. Introduction
- 1.1 Background
- 1.2 Test Objectives
- 1.3 Test Matrix *(including rationale for test matrix)*
- 1.4 Facility Scaling Summary

2. Test Facility Description ***(summarize from Facility Description Report)***
- 2.1 Introduction
- 2.2 Facility Component Description *(include major facility components only)*
- 2.3 Instrumentation *(describe key instrumentation, including instrumentation list)*
- 2.4 Data Acquisition System *(describe both hardware and respective software)*
- 2.5 Facility Operation *(including overall procedure for conducting tests)*
- 2.6 Drawings *(includes key facility P&ID's and photos)*

3. Data Reduction ***(brief description of any data reduction/validation activities)***
- 3.1 Introduction
- 3.2 Test Validation *(description of all data validation criteria)*
- 3.3 Pre-operational Tests
- 3.4 Matrix Tests *(includes identification of all tests - valid and invalid, and brief description of why tests are invalid)*

4. Test Results
- 4.1 Introduction
- 4.2 Pre-operational Test Results *(include summary of those items important to computer code modeling)*
- 4.3 Matrix Test Results *(plots of selected representative data for valid tests)*
- 4.4 Test Data Comparisons *(e.g., identification of any parametric effects, etc.)*
- 4.5 Key Test Results *(identification of any key thermal hydraulic phenomena, etc.)*

5. Conclusions

6. References ***(include references such as Facility Description Report, Scaling report, etc.)***

Appendices:

- Appendix A Data Reduction Methods *(description of all data processing, reduction, and validation activities)*
- Appendix B Data Validation Results *(assessment of test validation criteria - specified vs. actual)*
- Appendix C Data Plots for all Valid Tests *(e.g., 4-6 plots per page for selected data)*
- Appendix D Failed Instrument List *(identify failed instruments as a function of test)*
- Appendix E Component/Event Timing *(identify times for component and/or event actuation)*
- Appendix F Data Error Analysis
- Appendix G Data Files

OUTLINE 5: SPES-2 TEST ANALYSIS REPORT OUTLINE

Summary

1.0 Introduction
- 1.1 Background
- 1.2 Test Objectives *(Summary only)*
- 1.3 Data Reduction Objectives *(Bridge to Code Verification Report)*
- 1.4 Test Matrix, including rationale for test matrix *(Summary only)*

2.0 Test Facility Description *(Summary from facility description report, scaling report)*
- 2.1 Introduction
- 2.2 Facility Scaling Summary
- 2.3 Facility Description
  - 2.3.1 Systems Description
  - 2.3.2 Description of Principle Components
- 2.4 Summary of Instrumentation *(Refer to FDR for details)*
- 2.5 Summary of Data Acquisition System *(Refer to FDR for details)*
- 2.6 Summary of Facility Operation *(Refer to FDR for details)*

3.0 Test Summary
- 3.1 Introduction *(from FDR/FTR)*
- 3.2 Summary of Validation Criteria *(from FDR/FTR)*
- 3.3 Test Matrix and Identification of Valid Tests *(From FDR/FTR)*
- 3.4 Summary of Test Procedures *(from FDR/FTR)*
- 3.5 Summary of Initial Conditions for Tests that are Analyzed

4.0 Data Analysis Methodology
- 4.1 Introduction *(Objectives and Approaches)*
- 4.2 Equations
  - 4.2.1 Mass Balance
  - 4.2.2 Energy Balance

5.0 Analysis of Data
- 5.1 Transient Mass Calculations
  - 5.1.1 Local Void Fraction Calculations and Void Fraction Distributions
  - 5.1.2 Mass Distribution in System
  - 5.1.3 Break Flow
  - 5.1.4 PRHR Flow
  - 5.1.5 ADS Flow
  - 5.1.6 Break Flow
- 5.2 Transient Energy Calculations
  - 5.2.1 Bundle Energy Balance
  - 5.2.2 PRHR Energy Balance
  - 5.2.3 Steam Generator Energy Balance
  - 5.2.4 CMT Energy Balance
  - 5.2.5 ADS Flow Energy

6.0 Discussion of Component Analysis
- 6.1 Power Channel
- 6.2 Core Makeup Tank and Balance Line
- 6.3 Accumulators
- 6.4 Steam Generators, Primary Side
- 6.5 Steam Generators, Secondary Side
- 6.6 Pressurizer and Surge Line
- 6.7 IRWST
- 6.8 PRHR
- 6.9 ADS

7.0 Discussion of System Analysis for SBLOCA, SGTR, and MSLB
- 7.1 Comparison of Overall System Response to Break Sizes
- 7.2 Comparison of Overall System Response to Break Locations
- 7.3 Comparison of Overall System Response to Single Failure Assumptions
- 7.4 Comparison of Overall System Response With and Without Active Systems
- 7.5 SGTR Tests
- 7.6 MSLB Tests

8.0 Conclusions

9.0 References

Appendices
- Appendix A - Development of Mass Balance Equations
- Appendix B - Development of Energy Balance Equations
- Appendix C - Listing of Instrumentation Required for Data Reduction
- Appendix D - Reduced Data Plots *(Supports Sections 5 and 6)*
- Appendix E - Cross Comparison Plots *(Supports Section 7)*

OUTLINE 5: SPES-2 TEST ANALYSIS REPORT OUTLINE

Summary

1.0 Introduction
- 1.1 Background
- 1.2 Test Objectives *(Summary only)*
- 1.3 Data Reduction Objectives *(Bridge to Code Verification Report)*
- 1.4 Test Matrix, including rationale for test matrix *(Summary only)*

2.0 Test Facility Description ***(Summary from facility description report, scaling report)***
- 2.1 Introduction
- 2.2 Facility Scaling Summary
- 2.3 Facility Description
  - 2.3.1 Systems Description
  - 2.3.2 Description of Principle Components
- 2.4 Summary of Instrumentation *(Refer to FDR for details)*
- 2.5 Summary of Data Acquisition System *(Refer to FDR for details)*
- 2.6 Summary of Facility Operation *(Refer to FDR for details)*

3.0 Test Summary
- 3.1 Introduction *(from FDR/FTR)*
- 3.2 Summary of Validation Criteria *(from FDR/FTR)*
- 3.3 Test Matrix and Identification of Valid Tests *(From FDR/FTR)*
- 3.4 Summary of Test Procedures *(from FDR/FTR)*
- 3.5 Summary of Initial Conditions for Tests that are Analyzed

4.0 Data Analysis Methodology
- 4.1 Introduction *(Objectives and Approaches)*
- 4.2 Equations
  - 4.2.1 Mass Balance
  - 4.2.2 Energy Balance

5.0 Analysis of Data
- 5.1 Transient Mass Calculations
  - 5.1.1 Local Void Fraction Calculations and Void Fraction Distributions
  - 5.1.2 Mass Distribution in System
  - 5.1.3 Break Flow
  - 5.1.4 PRHR Flow
  - 5.1.5 ADS Flow
  - 5.1.6 Break Flow
- 5.2 Transient Energy Calculations
  - 5.2.1 Bundle Energy Balance
  - 5.2.2 PRHR Energy Balance
  - 5.2.3 Steam Generator Energy Balance
  - 5.2.4 CMT Energy Balance
  - 5.2.5 ADS Flow Energy

6.0 Discussion of Component Analysis
- 6.1 Power Channel
- 6.2 Core Makeup Tank and Balance Line
- 6.3 Accumulators
- 6.4 Steam Generators, Primary Side
- 6.5 Steam Generators, Secondary Side
- 6.6 Pressurizer and Surge Line
- 6.7 IRWST
- 6.8 PRHR
- 6.9 ADS

7.0 Discussion of System Analysis for SBLOCA, SGTR, and MSLB
- 7.1 Comparison of Overall System Response to Break Sizes
- 7.2 Comparison of Overall System Response to Break Locations
- 7.3 Comparison of Overall System Response to Single Failure Assumptions
- 7.4 Comparison of Overall System Response With and Without Active Systems
- 7.5 SGTR Tests
- 7.6 MSLB Tests

8.0 Conclusions

9.0 References

Appendices
- Appendix A - Development of Mass Balance Equations
- Appendix B - Development of Energy Balance Equations
- Appendix C - Listing of Instrumentation Required for Data Reduction
- Appendix D - Reduced Data Plots *(Supports Sections 5 and 6)*
- Appendix E - Cross Comparison Plots *(Supports Section 7)*

OUTLINE 6: OSU TEST ANALYSIS REPORT OUTLINE

Summary

1.0 Introduction
- 1.1 Background
- 1.2 Test Objectives *(Summary only)*
- 1.3 Data Reduction Objectives *(Bridge to Code Verification Report)*
- 1.4 Test Matrix, including rationale for test matrix *(Summary only)*

2.0 Test Facility Description *(Summary from facility description report, scaling report)*
- 2.1 Introduction
- 2.2 Facility Scaling Summary
- 2.3 Facility Description
  - 2.3.1 Systems Description
  - 2.3.2 Description of Principle Components
- 2.4 Summary of Instrumentation *(Refer to FDR for details)*
- 2.5 Summary of Data Acquisition System *(Refer to FDR for details)*
- 2.6 Summary of Facility Operation *(Refer to FDR for details)*

3.0 Test Summary
- 3.1 Introduction *(from FDR/FTR)*
- 3.2 Summary of Validation Criteria *(from FDR/FTR)*
- 3.3 Test Matrix and Identification of Valid Tests *(From FDR/FTR)*
- 3.4 Summary of Test Procedures *(from FDR/FTR)*
- 3.5 Summary of Initial Conditions for Tests that are Analyzed

4.0 Data Analysis Methodology
- 4.1 Introduction *(Objectives and Approaches)*
- 4.2 Equations
  - 4.2.1 Mass Balance
  - 4.2.2 Energy Balance

5.0 Analysis of Data
- 5.1 Transient Mass Calculations
  - 5.1.1 Local Void Fraction Calculations and Void Fraction Distributions
  - 5.1.2 Mass Distribution in System
  - 5.1.3 Break Flow
  - 5.1.4 PRHR Flow
  - 5.1.5 ADS Flow
  - 5.1.6 Break Flow
- 5.2 Transient Energy Calculations
  - 5.2.1 Bundle Energy Balance
  - 5.2.2 PRHR Energy Balance
  - 5.2.3 Steam Generator Energy Balance
  - 5.2.4 Break Flow Energy
  - 5.2.5 ADS Flow Energy
  - 5.2.6 Overall System Energy Balance

6.0 Discussion of Component Analysis
- 6.1 Power Channel
- 6.2 Core Makeup Tank and Balance Line
- 6.3 Accumulators
- 6.4 Steam Generators, Primary Side
- 6.5 Steam Generators, Secondary Side
- 6.6 Pressurizer and Surge Line
- 6.7 IRWST
- 6.8 PRHR
- 6.9 ADS

7.0 Discussion of System Analysis for SBLOCA and LTC
- 7.1 Comparison of Overall System Response to Break Sizes
- 7.2 Comparison of Overall System Response to Break Locations
- 7.3 Comparison of Overall System Response to Single Failure Assumptions
- 7.4 Comparison of Overall System Response With and Without Active Systems
- 7.5 Simulated Large Break LOCA Transients

8.0 Conclusions

9.0 References

Appendices
- Appendix A - Development of Mass Balance Equations
- Appendix B - Development of Energy Balance Equations
- Appendix C - Listing of Instrumentation Required for Data Reduction
- Appendix D - Reduced Data Plots *(Supports Sections 5 and 6)*
- Appendix E - Cross Comparison Plots *(Supports Section 7)*

OUTLINE 7: CMT TEST ANALYSIS REPORT

Summary

1.0 Introduction
- 1.1 Background
- 1.2 Analysis Objectives
- 1.3 Pre-operational Tests
- 1.4 Matrix Tests

2.0 Analysis Methodology
- 2.1 Analysis Assumptions
- 2.2 Facility Calibrations
- 2.3 Flow Calculations
- 2.4 CMT Level and Mass Balance
- 2.5 CMT Heat Transfer
- 2.6 CMT Energy Balance

3.0 Pre-operational Test Results
- 3.1 Temperature and pressure accuracy/calibration
- 3.2 Flow accuracy/calibration
- 3.3 CMT level accuracy/calibration

4.0 Matrix Test Results *(each test series separately)*
- 4.1 Series xxxx Tests
  - 4.1.1 Overall Results *(temperature, pressure, flow)*
  - 4.1.2 CMT Results *(level, mass balance, HTC, g", etc.)*
- 4.x Test Data Comparisons

5.0 Phenomenological Modeling Results
- 5.1 Wall Heat Transfer
- 5.2 Interfacial Heat Transfer

6.0 Conclusions

7.0 References

OUTLINE 8: ADS TEST ANALYSIS REPORT

Summary

1.0 Introduction
- 1.1 Background
- 1.2 Analysis Objectives
- 1.3 Pre-operational Tests
- 1.4 Matrix Tests

2.0 Analysis Methodology
- 2.1 Analysis Assumptions
- 2.2 ADS Mass Balance
- 2.3 ADS Energy Balance for Flow Quality

3.0 Post Test Orifice Calculation Test Results
- 3.1 Orifice Single Phase Pressure Drop
- 3.2 Flow accuracy/calibration

4.0 Matrix Test Results *(each test series separately)*
- 4.1 Series xxxx Tests
  - 4.1.1 Overall Results *(temperature, pressure, flow, pressure drop, quality)*
  - 4.1.2 ADS Results *(valve pressure drop, sparger pressure drop)*
  - 4.1.3 ADS Valve Two-phase multipliers
- 4.2 Test Data Comparisons
  - 4.2.1 Test to Test Comparisons

5.0 Conclusions

6.0 References

OUTLINE 9: NOTRUMP PRELIMINARY VALIDATION REPORT FOR SPES-2 TESTS

Summary

1.0 Introduction
- Use of NOTRUMP in AP600 safety analyses
- Purpose of the report
- What tests were compared and why

2.0 NOTRUMP SPES-2 Model
- Description of how the SPES-2 is modeled *(noding)*

3.0 NOTRUMP SPES-2 Model Verification Approach
- Noding used, basis for SPES-2 test facility
- Use of test design information
- Use of hot/cold pre-operational data
- Use of test boundary conditions, how

4.0 Model Improvements Added to NOTRUMP
- Discuss specific model changes (if any) that were made to improve the performance of the code using the SSAR and CAD as reference points

5.0 Analysis of the SPES-2 Test Data with NOTRUMP (on test by test basis)
- brief discussion of the tests, how run, results
- comparisons of NOTRUMP to the test data.
- Noding Sensitivity studies

6.0 Assessment of the Verification Results
- Adequacy of NOTRUMP SPES-2 model
- Assessment on the plant calculations

7.0 Conclusions

8.0 References

OUTLINE 10: NOTRUMP PRELIMINARY VALIDATION REPORT FOR OSU TESTS

Summary

1.0 Introduction
- Use of NOTRUMP in AP600 safety analyses
- Purpose of the report
- What tests were compared and why

2.0 NOTRUMP OSU Model
- Description of how the OSU test facility is modeled *(noding)*

3.0 NOTRUMP OSU Model Verification Approach
- Noding used, basis for OSU test facility
- Use of test design information
- Use of hot/cold pre-operational data
- Use of test boundary conditions, how

4.0 Model Improvements Added to NOTRUMP
- Discuss specific model changes (if any) that were made to improve the performance of the code using the SSAR and CAD as reference points

5.0 Analysis of the OSU Test Data with NOTRUMP (on test by test basis)
- brief discussion of the tests, how run, results
- comparisons of NOTRUMP to the test data.
- Noding Sensitivity studies

6.0 Assessment of the Verification Results
- Adequacy of NOTRUMP OSU model
- Assessment on the plant calculations

7.0 Conclusions

8.0 References

OUTLINE 11: NOTRUMP PRELIMINARY VALIDATION REPORT FOR CMT TESTS

Summary

1.0 Introduction

- Use of NOTRUMP in AP600 safety analyses
- Role of CMT in AP600 safety analyses
- Different phases of CMT performance (i.e., drain and recirculation)
- Purpose of the report
- What tests were compared and why

2.0 NOTRUMP CMT Model

- Description of how the CMT is modeled (noding)
- Discussion of the different heat transfer models used by NOTRUMP for the different phases of CMT operation
- Discussion of what specific models are to be verified

3.0 NOTRUMP CMT Model Verification Approach

- Noding used, basis for CMT test facility
- Use of test design information

4.0 Analysis of the CMT Test Data with NOTRUMP

- Assessment of the wall condensation correlation in NOTRUMP
- Assessment of the NOTRUMP interfacial condensation/mixing models for the CMT

5.0 Assessment of the Verification Results to Date

- Adequacy of NOTRUMP wall condensation model
- NOTRUMP ability to model the mixing and draining behavior of the CMT
- Assessment on the plant calculations
- Assessment of convective heat transfer models in NOTRUMP

6.0 Conclusions

7.0 References

OUTLINE 12: NOTRUMP PRELIMINARY VALIDATION REPORT FOR ADS TESTS

Summary

1.0 Introduction

- Use of NOTRUMP in AP600 safety analyses
- Role of ADS in AP600 safety analyses
- Purpose of the report
- What tests were compared and why

2.0 NOTRUMP ADS Model

- Description of how the ADS is modeled *(noding)*
- Discussion of what specific models are to be verified

3.0 NOTRUMP ADS Model Verification Approach

- Noding used, basis for ADS test facility
- Use of test design information
- Use of hot/cold pre-operational data
- Use of calibration tests to obtain flow data
- Use of test boundary conditions, how

4.0 Analysis of the ADS Test Data with NOTRUMP

- comparison of NOTRUMP to tests
- brief discussion of the tests, how run, results
- show plots of calculated quantities, such as flows, pressure, pressure drops
- Noding Sensitivity studies

5.0 Assessment of the Verification Results to Date

- Adequacy of NOTRUMP ADS model
- Assessment on the plant calculations

6.0 Conclusions

7.0 References

OUTLINE 13: LOFTRAN PRELIMINARY VALIDATION REPORT FOR SPES-2 TESTS

SUMMARY

1.0 INTRODUCTION

1.1 Use of LOFTRAN in AP600 Safety Analysis
1.2 Role of SPES-2 in LOFTRAN Validation
1.3 Test Results and Data Used (What and why)

2.0 LOFTRAN SPES-2 MODEL

2.1 Overview
Chapter to introduce the LOFTRAN SPES-2 model.
2.2 Key Phenomena
Introduction of the physical models that need to be verified :
2.3 SPES-2 Model Description

3.0 LOFTRAN SPES-2 MODEL VERIFICATION APPROACH

3.1 Overview
3.2 Description of the SPES-2 LOFTRAN Model
3.3 Analytical Simulations
3.4 Sensitivities Studies

4.0 ANALYSIS OF THE SPES-2 TEST DATA

4.1 Analytical Simulations
4.2 Sensitivities Studies

5.0 ASSESSMENT OF THE VERIFICATION RESULTS

- Adequacy of the LOFTRAN model

6.0 CONCLUSION

7.0 REFERENCES

Appendices

Appendix A : Presentation of LOFTRAN SPES-2 Model
Appendix B : Plots for Analytical Simulations
Appendix C : Plots for Sensitivity Studies

OUTLINE 14: LOFTRAN PRELIMINARY VALIDATION REPORT FOR CMT TESTS

SUMMARY

1.0 INTRODUCTION
- 1.1 Use of LOFTRAN in AP600 Safety Analysis
- 1.2 Role of the CMT in AP600 Safety Analysis
- 1.3 CMT Working Mode (i.e., Recirculation mode only with the actual AP600 design)
- 1.4 Test Results and Data Used (What and why)

2.0 LOFTRAN CMT MODEL
- 2.1 Overview
- 2.2 Key Phenomena
  Introduction of the models that need to be verified:
  - Natural circulation,
  - CMT water temperature evolution (water mixing),
  - CMT wall heat transfer,
  - Boron transport.
- 2.3 CMT Model Description

3.0 LOFTRAN CMT MODEL VERIFICATION APPROACH
- 3.1 Overview
- 3.2 Description of the Stand Alone LOFTRAN CMT Code
- 3.3 CMT Facility Modeling
- 3.4 Analytical Simulations
- 3.5 500 Tests Series
- 3.6 Sensitivities Studies

4.0 ANALYSIS OF THE CMT TEST DATA WITH LOFTRANCMT
- 4.1 Analytical Simulations
- 4.2 500 Test Series
- 4.3 Sensitivities Studies

5.0 ASSESSMENT OF THE VERIFICATION RESULTS TO DATE

6.0 CONCLUSION

7.0 REFERENCES

Appendices

Appendix A	:	Presentation of LOFTRANCMT
Appendix B	:	Plots for Analytical Simulations
Appendix C	:	Plots for 500 Test Series
Appendix D	:	Plots for Sensitivity Studies

OUTLINE 15: WCOBRA/TRAC PRELIMINARY VALIDATION REPORT FOR SPES-2 TESTS

Summary

1.0 Introduction
- Use of WCOBRA/TRAC in AP600 safety analyses
- Purpose of the report
- What tests were compared and why

2.0 WCOBRA/TRAC SPES-2 Model
- Description of how the SPES-2 is modeled (noding)

3.0 WCOBRA/TRAC SPES-2 Model Verification Approach
- Noding used, basis for SPES-2 test facility
- Use of test design information
- Use of hot/cold pre-operational data
- Use of test boundary conditions, how

4.0 Model Improvements Added to WCOBRA/TRAC
- Discuss specific model changes (if any) that were made to improve the performance of the code using the SSAR and CAD as reference points

5.0 Analysis of the SPES-2 Test Data with WCOBRA/TRAC (on a test by test basis)
- brief discussion of the tests, how run, results
- comparisons of WCOBRA/TRAC to the test data.
- Noding Sensitivity studies

6.0 Assessment of the Verification Results

- Adequacy of WCOBRA/TRAC SPES-2 model
- Assessment on the plant calculations

7.0 Conclusions

8.0 References

OUTLINE 16: WCOBRA/TRAC PRELIMINARY VALIDATION REPORT FOR OSU TESTS

Summary

1.0 Introduction
- Use of WCOBRA/TRAC in AP600 safety analyses
- Purpose of the report
- What tests were compared and why

2.0 WCOBRA/TRAC OSU Model
- Description of how the OSU test facility is modeled (noding)

3.0 WCOBRA/TRAC OSU Model Verification Approach
- Noding used, basis for OSU test facility
- Use of test design information
- Use of hot/cold pre-operational data
- Use of test boundary conditions, how

4.0 Model Improvements Added to WCOBRA/TRAC
- Discuss specific model changes (if any) that were made to improve the performance of the code using the SSAR and CAD as reference points

5.0 Analysis of the OSU Test Data with WCOBRA/TRAC (on a test by test basis)
- brief discussion of the tests, how run, results
- comparisons of WCOBRA/TRAC to the test data.
- Noding Sensitivity studies

6.0 Assessment of the Verification Results
- Adequacy of WCOBRA/TRAC OSU model
- Assessment on the plant calculations

7.0 Conclusions

8.0 References

OUTLINE 17: WCOBRA/TRAC PRELIMINARY VALIDATION REPORT FOR OSU/LTC TESTS

Summary

1.0 Introduction

- Use of WCOBRA/TRAC in AP600 safety analyses
- Purpose of the report
- What tests were compared and why

2.0 WCOBRA/TRAC OSU LTC Model

- Description of how the OSU test facility is modeled (noding)

3.0 WCOBRA/TRAC OSU Model Verification Approach

- Noding used, basis for OSU test facility
- Use of test design information
- Use of hot/cold pre-operational data
- Use of test boundary conditions, how

4.0 Model Improvements Added to WCOBRA/TRAC

- Discuss specific model changes (if any) that were made to improve the performance of the code using the SSAR and CAD as reference points

5.0 Analysis of the OSU Test Data with WCOBRA/TRAC (on a test by test basis)

- brief discussion of the tests, how run, results
- comparisons of WCOBRA/TRAC to the test data.
- Noding Sensitivity studies

6.0 Assessment of the Verification Results

- Adequacy of WCOBRA/TRAC LTC model
- Assessment on the plant calculations

7.0 Conclusions

8.0 References

OUTLINE 18: WCOBRA/TRAC PRELIMINARY VALIDATION REPORT FOR CMT TESTS

Summary

1.0 Introduction

- Use of WCOBRA/TRAC in AP600 safety analyses
- Role of CMT in AP600 safety analyses
- Different phases of CMT performance (i.e., drain and recirculation)
- Purpose of the report
- What tests were compared and why

2.0 WCOBRA/TRAC CMT Model

- Description of how the CMT is modeled (noding)
- Discussion of the different heat transfer models used by WCOBRA/TRAC for the different phases of CMT operation
- Discussion of what specific models are to be verified

3.0 WCOBRA/TRAC CMT Model Verification Approach

- Noding used, basis for CMT test facility
- Use of test design information

4.0 Analysis of the CMT Test Data with WCOBRA/TRAC

- Assessment of the wall condensation correlation in WCOBRA/TRAC
- Assessment of the WCOBRA/TRAC interfacial condensation/mixing models for the CMT
- Assessment of the convective heat transfer models

5.0 Assessment of the Verification Results to Date

- Adequacy of WCOBRA/TRAC wall condensation model
- WCOBRA/TRAC ability to model the mixing and draining behavior of the CMT
- Assessment on the plant calculations

6.0 Conclusions

7.0 References

OUTLINE 19: WCOBRA/TRAC PRELIMINARY VALIDATION REPORT FOR ADS TESTS

Summary

1.0 Introduction
- Use of NOTRUMP in AP600 safety analyses
- Role of ADS in AP600 safety analyses
- Purpose of the report
- What tests were compared and why

2.0 NOTRUMP ADS Model
- Description of how the ADS is modeled (noding)
- Discussion of what specific models are to be verified

3.0 NOTRUMP ADS Model Verification Approach
- Noding used, basis for ADS test facility
- Use of test design information
- Use of hot/cold pre-operational data
- Use of calibration tests to obtain flow data
- Use of test boundary conditions, how

4.0 Analysis of the ADS Test Data with NOTRUMP
- comparison of NOTRUMP to tests
- brief discussion of the tests, how run, results
- show plots of calculated quantities such as flows, pressure, pressure drops
- Noding Sensitivity studies

5.0 Assessment of the Verification Results to Date
- Adequacy of NOTRUMP ADS model
- Assessment on the plant calculations

6.0 Conclusions

7.0 References

OUTLINE 20: NOTRUMP VERIFICATION AND VALIDATION REPORT

Summary

1.0 Introduction
- Use of NOTRUMP in AP600 safety analyses
- Purpose of the report
- What tests were compared and why

2.0 Model Improvements made to NOTRUMP
- Document any model improvements made to the code on the basis of the validation performed on the AP600 tests, using the SSAR and CAD as reference points

3.0 NOTRUMP Test Facility Models
- Description of CMT model (noding)
- Description of ADS model (noding)
- Description of SPES-2 model (noding)
- Description of OSU model (noding)

4.0 NOTRUMP Model Verification Approach
- Noding used, basis for test facility models
- Use of test design information
- Use of hot/cold pre-operational data
- Use of calibration tests to obtain flow data
- Use of test boundary conditions, how

5.0 Analysis of the Test Data with NOTRUMP

4.1 CMT Tests
- brief discussion of the tests, how run, results
- comparisons of NOTRUMP to the test data.
- Noding Sensitivity studies

4.2 ADS Tests
- brief discussion of the tests, how run, results
- comparisons of NOTRUMP to the test data.
- Noding Sensitivity studies

4.3 SPES-2 Tests
- brief discussion of the tests, how run, results
- comparisons of NOTRUMP to the test data.
- Noding Sensitivity studies

4.4 OSU Tests
- brief discussion of the tests, how run, results
- comparisons of NOTRUMP to the test data.
- Noding Sensitivity studies

6.0 Blind Test Comparisons

5.1 SPES-2 Blind Tests
- Blind Test Input and Boundary Conditions
- Comparison of Analytical and Test Results
- Conclusions

5.2 OSU Blind Tests
- Blind Test Input and Boundary Conditions
- Comparison of Analytical and Test Results
- Conclusions

7.0 Assessment of the Verification Results
- Adequacy of NOTRUMP model
- Assessment on the plant calculations

8.0 Conclusions

9.0 References

OUTLINE 21: LOFTRAN VERIFICATION AND VALIDATION REPORT

SUMMARY

1.0 INTRODUCTION
- 1.1 Use of LOFTRAN in AP600 Safety Analysis
- 1.2 Role of Test Facilities in LOFTRAN Validation
- 1.3 Test Results and Data Used (What and why)

2.0 Model Improvements made to LOFTRAN
- Document any model improvements made to the code on the basis of the validation performed on the AP600 tests, using the SSAR and CAD as reference points

3.0 LOFTRAN TEST FACILITY MODELS
- 3.1 LOFTRAN CMT Model
  - 3.1.1 Overview
  - 3.1.2 Key Phenomena
  - 3.1.3 CMT Model Description
- 3.2 LOFTRAN SPES-2 Model
  - 3.2.1 Overview
  - 3.2.2 Key Phenomena
  - 3.2.3 CMT Model Description

4.0 LOFTRAN MODEL VERIFICATION APPROACH
- 4.1 LOFTRAN CMT Model Validation
  - 4.1.1 Overview
  - 4.1.2 Description of the LOFTRAN CMT Model
  - 4.1.3 Analytical Simulations
  - 4.1.4 Sensitivities Studies
- 4.2 LOFTRAN SPES-2 Model Validation
  - 4.2.1 Overview
  - 4.2.2 Description of the SPES-2 LOFTRAN Model
  - 4.2.3 Analytical Simulations
  - 4.2.4 Sensitivities Studies

5.0 ANALYSIS OF TEST DATA
- 5.1 CMT Test Analysis
  - 5.1.1 CMT Analytical Simulations
  - 5.1.2 CMT Sensitivities Studies
- 5.2 SPES-2 Test Analysis
  - 5.2.1 SPES-2 Analytical Simulations
  - 5.2.2 SPES-2 Sensitivities Studies

6.0 SPES-2 Blind Test Comparison
- 6.1 Blind Test Input and Boundary Conditions
- 6.2 Comparison of Analytical and Test Results
- 6.3 Conclusions

7.0 ASSESSMENT OF THE VERIFICATION RESULTS
- Adequacy of the LOFTRAN model

8.0 CONCLUSION

9.0 REFERENCES

Appendices

Appendix A : Presentation of LOFTRAN SPES-2 Model
Appendix B : Plots for Analytical Simulations
Appendix C : Plots for Sensitivity Studies

OUTLINE 22: WCOBRA/TRAC VERIFICATION AND VALIDATION REPORT

Summary

1.0 Introduction
- Use of WCOBRA/TRAC in AP600 safety analyses
- Purpose of the report
- What tests were compared and why

2.0 Model Improvements made to WCOBRA/TRAC
- Document any model improvements made to the code on the basis of the validation performed on the AP600 tests, using the SSAR and CAD as reference points

3.0 WCOBRA/TRAC Test Facility Models

3.1 CMT Model
Description of how the CMT Test Facility is modeled (noding)

3.2 ADS Model
Description of how the ADS Test Facility is modeled (noding)

3.3 SPES-2 Model
Description of how the SPES-2 Test Facility is modeled (noding)

3.4 OSU Model
Description of how the OSU Test Facility is modeled (noding)

3.5 OSU LTC Model
Description of how the OSU Test Facility is modeled for Long Term Cooling (noding)

4.0 WCOBRA/TRAC Model Verification Approach

4.1 WCOBRA/TRAC CMT Model Verification Approach
- Noding used, basis for CMT test facility
- Use of test design information
- Use of hot/cold pre-operational data
- Use of calibration tests to obtain flow data
- Use of test boundary conditions, how

4.2 WCOBRA/TRAC ADS Model Verification Approach
- Noding used, basis for ADS test facility
- Use of test design information
- Use of hot/cold pre-operational data
- Use of calibration tests to obtain flow data
- Use of test boundary conditions, how

4.3 WCOBRA/TRAC SPES-2 Model Verification Approach
- Noding used, basis for SPES-2 test facility
- Use of test design information
- Use of hot/cold pre-operational data
- Use of calibration tests to obtain flow data
- Use of test boundary conditions, how

4.4 WCOBRA/TRAC OSU Model Verification Approach
- Noding used, basis for OSU test facility
- Use of test design information
- Use of hot/cold pre-operational data
- Use of calibration tests to obtain flow data
- Use of test boundary conditions, how

4.5 WCOBRA/TRAC Long Term Cooling Model Verification Approach
- Noding used, basis for OSU test facility
- Use of test design information
- Use of hot/cold pre-operational data
- Use of calibration tests to obtain flow data
- Use of test boundary conditions, how

5.0 Analysis of Test Data with WCOBRA/TRAC

5.1 Analysis of CMT Test Data
- brief discussion of the tests, how run, results
- comparisons of WCOBRA/TRAC to the test data.
- Noding Sensitivity studies

5.2 Analysis of ADS Test Data

5.3 Analysis of SPES-2 Test Data

5.4 Analysis of OSU Test Data

6.0 Assessment of the Verification Results
- Adequacy of WCOBRA/TRAC SPES-2 model
- Assessment on the plant calculations

7.0 Conclusions

8.0 References

Comparison of AP600 Test & Analysis Report Contents Against NRC Supplied Outlines
DRAFT - 10/21/94

Key:

FTS	-	Facility Test Specification
FDR	-	Facility Description Report
FSR	-	Facility Scaling Report
CPR	-	Cold Pre-operational Test Report
HPR	-	Hot Pre-operational Test Report
QLR	-	Quick Look Test Report
TDR	-	Test Description Report (Blind Test Initial and Boundary Conditions)
FTR	-	Final Test Report
TAR	-	Test Analysis Report
PVR	-	Preliminary Validation Report
BTR	-	Blind Test Report
FVR	-	Final Validation Report
O	-	OSU Tests (Long Term Cooling Testing at Oregon State University)
S	-	Full Pressure Full Height Testing at SPES-2 Facility
A	-	Automatic Depressurization System Phase B Testing at Vapore Test Facility
C	-	Core Makeup Tank Testing at Waltz Mill CMT Test Facility
N	-	NOTRUMP
W	-	WCOBRA/TRAC
L	-	LOFTRAN

		FTS	FDR	FSR	CPR	HPR	QLR	TDR	FTR	TAR	PVR	BTR	FVR
	FACILITY DESCRIPTION DOCUMENT												
1	**Facility Dimensions** All sketches, drawings, operational procedures, material specifications, geometric information, and other information pertinent to the facility should be included such that an input model can be generated. **(See exception no. 1)**		OS AC										
2	A system schematic drawing should be provided to clearly show how the various components form the overall system.		OS AC										
3	The facility should be described component by component, providing all necessary information to convey the component's function and operation as well as its geometry (areas, volumes, etc.).		OS AC										
4	The drawings should include all dimensions, materials and configurations of each part of the materials and configuration of each part of the facility. All important dimensions of the facility and test section should be given in a table. Pipe sizes and lengths should be included.		OS AC										
5	**Characterization of Active Components** Component operational data should include delay times, rates of change (valve movement), performance curves (pumps) and all other control and performance information necessary to fully describe the experiment.		OS AC		C	C			OS AC				
6	Hydraulic characteristics of valves and pumps should be included.		OS AC		OS C	C			OS AC				

		FTS	FDR	FSR	CPR	HPR	QLR	TDR	FTR	TAR	PVR	BTR	FVR
7	Control systems associated with a component or group of components should be described to the level of detail necessary to convey their function and operation. Sufficient control system data should be included to allow duplication of the modeled control system. Trip points and setpoints should be clearly tabulated for control system functions.		OS C		C	C	OS	OS	OS C				
8	**Facility Characterization** Hydraulic and geometric information necessary to determine loss coefficients and heat transfer coefficients should be included in the data package and referenced.		OS AC		OS C	OS C	C		OS AC				
9	Insulation of components and piping should be clearly identified and, where heaters were used to insulate a component (guard heaters), their control procedure for the experiment should be provided. Insulation material properties and dimensions must be specified.		OS AC										
10	Heat loss due to instrument cooling or uninsulated regions should be identified and quantified if possible.					OS			OS AC				
11	System coolant leakage estimates should be evaluated and included in the facility description package.								OS				
12	Results from any startup and facility characterization tests should be described.				OS C	OS C			OS AC				
13	**Instrumentation Description** Describe types, numbers, and locations of instruments. The location of instruments should be unambiguous..		OS AC						OS AC				

		FTS	FDR	FSR	CPR	HPR	QLR	TDR	FTR	TAR	PVR	BTR	FVR
14	Describe instrument accuracy and calibration procedures to NIST calibration standards. **(See Exception no. 2)**	OS AC							OS AC				
15	Describe signal processing and signal conditioning.		OS AC						OS AC				
16	Describe data acquisition system including recording equipment, response time and sampling time	OS AC	OS AC						OS AC				
17	**Facility Scaling** The objective of the scaling evaluation is to obtain the physical dimensions of the test facility that will preserve the phenomena and processes expected to be present in the full scale plant. Describe the facility scaling approach with the objectives to:			OS C									
18	Obtain the similarity groups which should be preserved between the test facility and the full scale prototype;			OS C									
19	Establish priorities for preserving the similarity groups;			OS C									
20	Provide specifications for test facility design; and	OS AC		OS C									
21	Quantify biases due to scaling distortions.			OS C									

	FTS	FDR	FSR	CPR	HPR	QLR	TDR	FTR	TAR	PVR	BTR	FVR
QUICK LOOK REPORTS												
22 Quick Look Reports (QLR) should be provided for integral experiments if they are part of the vendor's planned reporting although the vendor may also find it useful to prepare them for certain separate effects tests. For integral tests it may be more convenient or appropriate to prepare a QLR to cover a test series e.g. small breaks or SGTRs, rather than each separate test. The objectives of QLRs should be to describe test objectives, how the tests proceeded, the degree to which objectives were met, show the most significant data plots (unqualified data are acceptable at this point) and their agreement with pretest predictions, and list important preliminary conclusions. The WEC letter, reference ET-NRC-93-3946, NSRA-93-005, Docket No. STN-52-003, Subject: General Outline for Quick Look Data Reports on AP600 Tests, signed by N. J. Liparulo, dated August 16, 1993, is consistent with the above description and would be quite acceptable to NRC. **(See Exception no. 3)**						OS C	OS					

Comparison of AP600 Test & Analysis Report Contents Against NRC Supplied Outlines
DRAFT - 10/21/94

	FTS	FDR	FSR	CPR	HPR	QLR	TDR	FTR	TAR	PVR	BTR	FVR
DATA REPORTS												
23 **Qualified Data Tape** All qualified data should be transmitted via either data tape or electronically if feasible.								OS AC				
24 Non-functioning data channels should be identified. If certain channels are erratic, a note should be provided to indicate for which period the channels in question should be ignored.						OS C	OS	OS AC				
25 **Equipment Interaction Log** A listing of the equipment behavior for all hardware that was used in the experiment should be included. Thus, valve opening and closing, pump power downs or programmed changed in speed, core power ramps or power increases, equipment failures and any equipment interactions should be listed.						OS C		OS AC				
26 **Data Microplots** Small figures showing the behavior of all the instrumentation channels should be transmitted. For certain specified parameters such as gamma-densitometer reading, both engineering and raw voltage plots are needed. **(Exception no. 4)**								OS AC				
27 **Data Uncertainty** Uncertainty of all data should be listed. If the only available uncertainties are the manufacturer's published uncertainties not including allowances for the signal processing equipment and recording equipment, then that should be stated. The best possible estimates of uncertainties are required for all key instrumentation.								OS AC				

		FTS	FDR	FSR	CPR	HPR	QLR	TDR	FTR	TAR	PVR	BTR	FVR
28	**Data Log** A log listing interpretations by the Vendor's Data Analysis Team should be included. The Data Log will give the results of the Data Analysis Team's data review. Observations concerning instrumentation zero shifts, noise, superimposed signals, time lags, channel interdependencies, miscalibrations, improper instrumentation hookups, bad channels, and the like from the Data Analysis Team should be entered in the Data Log and transmitted as an attachment to the Data Report.								OS AC				
29	**Instrumentation List** All instrumentation used in the data report should be either referenced to an existing Instrumentation Description Report (containing instrumentation locations, specifications, hookup polarities, and label nomenclature) or described in the subject Instrumentation List such that all changes and modifications to earlier descriptions in the Instrumentation Description Report are clearly stated.		OS AC				OS C	OS	OS AC				
	TEST ANALYSIS REPORTS												
30	An analysis report should be prepared following each test or a group of similar tests. This report should describe what happened, why it happened, and what phenomena of significance occurred.								OS AC	OS AC			
31	In addition, this report should contain comparisons of code calculations with the data.										OS AC		OS AC

Comparison of AP600 Test & Analysis Report Contents Against NRC Supplied Outlines

DRAFT - 10/21/94

		FTS	FDR	FSR	CPR	HPR	QLR	TDR	FTR	TAR	PVR	BTR	FVR
32	The analysis report should include plots of key parameters as a functions of time, describe the behavior of the key parameters, and provide an analysis of major experimental results.								OS AC	OS AC			
33	The Test Analysis Report is designed to: - Provide the exact initial and boundary conditions for each experiment						OS C	OS	OS AC				
34	- Provide figures showing the key parameters and instrumentation that describe the experiment transient behavior;						OS C		OS AC	OS AC			
35	- Provide an interpretation of the important events that occur during the transient including the basis for the interpretation; and								OS AC	OS AC			
36	- Be a referable document.								OS AC	OS AC			
37	**Test Description** A description of the test matrix and objectives for each test including how a test series relates to other test series in the same facility.	OS AC							OS AC	OS AC			
38	For separate effects and component test facilities, the rationale for selection of parametric variations and boundary conditions should be described to show that the testing encompasses the range of conditions expected to occur in the full scale plant.	AC								AC			
39	**Experimental Configuration** A description of special hardware changes, hardware configurations or installations.						OS C	OS	OS AC				

Comparison of AP600 Test & Analysis Report Contents Against NRC Supplied Outlines
DRAFT - 10/21/94

	FTS	FDR	FSR	CPR	HPR	QLR	TDR	FTR	TAR	PVR	BTR	FVR
40 All configurational changes, details on initial conditions and test boundary conditions should be specified.						OS C	OS	OS AC				
41 All the instrumentation used should be either referenced to an existing Instrumentation Description Report (containing instrumentation locations, specifications, hookup polarities, and label nomenclature) or described in the Test Analysis Report such that all changes and modifications to earlier descriptions in the Instrumentation Description Report are clearly stated.						OS C	OS	OS AC	OS AC			
42 **Test Procedure** The way the experiments were conducted should be described. For example, when valves opened, what caused the valves to open, when pumps turned on or off, etc. The test conditions should be described in as much detail as possible.						OS C		OS AC				
43 **Description of Experiments** The transients should be described, transient chronologies should be prepared, major events should be identified, and analysis performed to explain unexpected results.						OS C		OS AC	OS AC			
44 The key instrumentation channels should be described, including their uncertainty.		OS AC				OS C	OS	OS AC	OS AC			
45 **Conclusions and Observations** Identify whether the experiment met the stated objectives, list unexpected results, and present the explanation of all major events.						OS C		OS AC	OS AC			

		FTS	FDR	FSR	CPR	HPR	QLR	TDR	FTR	TAR	PVR	BTR	FVR
	CODE QUALIFICATION REPORT												
46	**Introduction** The introduction should include a detailed discussion of the assessment study background, scope and objectives, and should present the assessment methodology used for the study.										NW L		NW L
47	**Facility and Test Description** A brief discussion should be provided of the experimental facility including its geometric layout, instrumentation, operation procedures, and other information, as required for understanding the code analyses. Reference may be made to the detailed facility description and test results reports.										NW L		NW L
48	The experiments to be calculated should be discussed including important thermal hydraulic information, initial and boundary conditions, and operational information pertinent to the calculations.										NW L		NW L
49	Measurement uncertainty must also be discussed.								OS AC	OS AC			NW L
50	**Code Input Model Description** The code input model should be discussed in detail including nodalization diagram, nodalization rationale, assumptions, boundary and initial conditions and operational conditions for the calculation. The nodalization description should be related to the full scale plant model.										NW L		NW L

		FTS	FDR	FSR	CPR	HPR	QLR	TDR	FTR	TAR	PVR	BTR	FVR
51	Discuss modifications to the input model (nodalization, boundary, initial and/or operational conditions resulting from sensitivity studies (if conducted).										NW L		NW L
52	Provide an input model listing in both hard copy and on data tape. **(See Exception no. 5)**												
53	**Results** Results of the calculations that lead to major conclusions should be clearly presented and discussed.										NW L		NW L
54	Applicable key assessment parameters should be discussed.										NW L		NW L
55	The rationale for performing any sensitivity studies should be discussed along with the methodology used to perform them.										NW L		NW L
56	Modifications to base case conditions and the resulting effect should be fully described and qualified. The discussion should include: - A comparison between the code prediction and the experiments with regard to the important physical phenomena that occurred during the experiments. Identify and explain the causes of discrepancies between the code and data, i.e., discuss the deficiency in the code or the inaccuracy of the experimental measurements. Assess whether the timing of events agrees with the experimental data.										NW L		NW L

	FTS	FDR	FSR	CPR	HPR	QLR	TDR	FTR	TAR	PVR	BTR	FVR
57 - Assess whether the calculated results are self consistent and present a cohesive set of information that is technically rational and acceptable. Explain any unexpected or at first glance strange results calculated by the code, particularly when experimental measurements are not available to give credence to the calculated results. Determine whether calculated results are due to compensating errors. Discuss how important the code deficiency is to the overall results (parameters of interest) or explain why it may no be important for the particular scenario.										NW L		NW L
58 - Provide guidelines for performing similar analyses. **(See Exception no. 6)**												

CODE COMPARISON CALCULATIONS

Background

Assessing the safety of a nuclear installation required the use of a number of highly specialized tools: computer codes, experimental facilities and their instrumentation, special measurement techniques, methods for testing materials and components and so on. A highly effective way of increasing confidence in the validity and accuracy of such tools is provided by code comparison exercises in which calculations produced by a computer code is gauged against agreed standards. For example, predictions of different computer codes for a given physical problem may be compared with each other and with the results of a carefully controlled experimental study which also could be a real plant transient.

These exercises are performed as "open" or as "blind" problems. In an open problem the results of an experiment are available to analysts before it is evaluated. In a blind problem the results of the experiment are not made known to the analysts until after delivery of the calculated results. Depending on the kind of experiment and its objectives, certain boundary and initial conditions of the experiment may be communicated to the analysts before they start the exercise. For all exercises, the analysts are provided with a complete description of the experimental facility as discussed below.

Code Comparison Calculations: Experimental Description Document

		FTS	FDR	FSR	CPR	HPR	QLR	TDR	FTR	TAR	PVR	BTR	FVR
59	A description of the experimental facility, including engineering drawings providing exact facility configurations (no assumptions on what is important). These drawings should include all dimensions, materials, and configurations of each part of the facility. The drawings should be of sufficient detail to allow detailed analytical models to be developed. Unambiguous descriptions of instrumental locations should be provided. All important dimensions of the facility and the test sections should be given in a table.		OS AC						OS AC	OS AC			

		FTS	FDR	FSR	CPR	HPR	QLR	TDR	FTR	TAR	PVR	BTR	FVR
60	Results to be calculated. The points at which parameter values are to be calculated should be specified. If these points include points where experimental data are not available, this should be pointed out and the reason explained. The type of experimental measurements to which calculated results will be compared should be described.										NW L		NW L
61	Experimental data to be available after the experiment is completed, including expected error bands as a function of time. This may help analysts' selection of calculational nodes considering which data will be available for post test analysis. **(See Exception no. 7)**						OS C		OS AC				
62	Initial and boundary conditions. For a blind exercise, initial conditions should be provided after the experiment is performed. The analyst should be able to use preliminary expected initial values to formulate a simulation model and check it out. The analysis would then be performed using the measured initial conditions from the actual experiment with very little change to the previous checked-out simulation model.												NL
63	For an open exercise, all the measured parameters are specified and communicated to the analysts. If specifically recommended boundary conditions are given, a justification for using them should be provided												NW L

		FTS	FDR	FSR	CPR	HPR	QLR	TDR	FTR	TAR	PVR	BTR	FVR
	Code Comparison Calculations: Calculation Comparison Report												
64	Reporting the results of the comparison exercise results requires sufficient information to allow evaluation of the analytical models used, to provide guidance for future code development efforts, and to contribute to better understanding of phenomena. The following should, therefore be included in the comparison report:										NW L		NW L
65	**Facility Description** The experimental facility should be discussed briefly. The description should indicatethe position and error bands of experimental measurements, major components and positions for which calculations have been requested. Calculated results should refer to these descriptions. **(See Exception no. 7)**										NW L		NW L
66	**Computer Codes** Computer codes and versions should be clearly identified. Code descriptions should contain relevant information on the analytical models available, including appropriate equations and assumptions used in the derivation.										NW L		NW L
67	Changes made to the computer code to perform the exercise that are not documented in the referenced code description should be described along with reasons for the changes.												NW L
68	**Simulation Model** A description of the code application model used including nodalization, time step control, empirical program options selected, and other options.										NW L		NW L

		FTS	FDR	FSR	CPR	HPR	QLR	TDR	FTR	TAR	PVR	BTR	FVR
69	Assumptions used in the calculation to simulate the experimental facility (physical properties).										NW L		NW L
70	Specified initial and boundary conditions and assumed initial and boundary conditions used in the calculation.										NW L		NW L
71	**Calculations Performed** Computer used and running time to perform the calculation. **(See Exception no. 8)**										NW L		NW L
72	Results for all points and parameters specified in the problem specification should be plotted and given in tables using metric system units (SI Units). **(See Exception no. 9)**										NW L		NW L
73	Calculated results should be discussed briefly including interesting and unexpected results.										NW L		NW L
74	**Comparison of Calculated Results and Experimental Data** Plots of calculated results and corresponding experimental data with error bands should be shown. It may be necessary to present more than one plot per calculated position because of overlapping results or the need to use an expanded scale in one area. **(See Exception no. 7)**										NW L		NW L
75	Additionally, the comparison report should include information on deviations between planned conditions of the experiment and conditions actually achieved.								OS AC				

		FTS	FDR	FSR	CPR	HPR	QLR	TDR	FTR	TAR	PVR	BTR	FVR
76	**Explanation of Results** The experimental results should be discussed. Any deviations from expected results should be explained if possible. This aids in assessing the difference between computed results and experimental.									OS AC			
77	**Post-exercise Analysis** Post-exercise analysis is important. Analysts should run sensitivity studies to determine which inputs to their codes require closest scrutiny. Various options or models should be tried to see how they affect the results. Nodalization should be scrutinized to see if it was adequate for the problem. Areas which may require additional study include, for example, time step convergence, Nodalization or variation of code options.										NW L		NW L
78	Each analyst should include the results of any post-test analysis as an appendix to the final comparison report, where they add additional pertinent information to previous results. Particular attention should be paid to explaining why substantial deviations occurred between calculated best estimate results and actual data. If a predictive evaluation model calculation is to be reported (in addition to a best estimate calculation), anomalous behavior of the evaluation model compared to the data or to the best estimate calculation should be explained. The differences between best-estimate and evaluation model applications of the codes involved should be tabulated.										NW L		NW L

Exceptions:

1.	(Item no. 1)	Operational procedures are not included in the Test Facility Description Reports. Equivalent information (i.e., equipment interaction information) is provided in the Quick Look Reports and Final Test Reports.
2.	(Item no. 14)	Calibration procedures are not included in Final Test Reports.
3.	(Item no. 22)	Agreements to pre-test predictions were not provided in Quick Look Reports.
4.	(Item no. 26)	Data microplots of selected instrumentation channels will be included in Final Test Report. Raw voltage plots are not provided in the Final Test Report.
5.	(Item no. 52)	The code model input will be discussed in detail (see item 50), however, input model listings will be retained in Westinghouse files and will be available for audit.
6.	(Item no. 58)	Clarification is needed on what this item addresses.
7.	(Item nos. 61,65,74)	Measurement uncertainty from the Final Test Reports (see item no. 27) will be available to assist the analysts in the selection of calculational nodes, however, error bands as a function of time are not provided.
8.	(Item no. 71)	Computer platform will be identified, however, running time will not be identified.
9.	(Item no. 72)	Results are to be plotted in British units (not metric system units).