UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555 - 0001

November 26, 2003

Dr. Jose N. Reyes, Jr., Director
Advanced Thermal Hydraulic Research Laboratory
Oregon State University
130 Radiation Center, A110
Corvallis, OR 98331-5902

SUBJECT: NRC INSPECTION REPORT NO. 99901351/03-01, NOTICE OF VIOLATION AND NOTICE OF NONCONFORMANCE

Dear Dr. Reyes:

This refers to the inspection conducted September 30 through October 2, 2003, at the Advanced Plant Experiment (APEX)-1000 test facility in Corvallis, Oregon. The purpose of the inspection was to review the implementation of the Oregon State University (OSU) Advanced Thermal Hydraulic Research Laboratory (ATHRL) Quality Plan, as it relates to facility scaling and testing activities conducted in support of Westinghouse AP1000 design certification activities at the APEX-1000 test facility. The OSU Quality Plan has been reviewed and accepted by Westinghouse as meeting the requirements of 10 CFR Part 50, Appendix B for the AP1000 project activities. The enclosed report presents the results of this inspection.

During this inspection it was found that certain activities did not meet NRC requirements. The OSU ATHRL did not have a documented process or procedure to address "Notification of Failure to Comply or Existence of a Defect and its Evaluation," as described in 10 CFR Part 21.21 for facility scaling and testing activities performed at the OSU ATHRL. This issue is identified as Violation 99901351/2003-01-01. Also, during this inspection it was found that certain of your activities at the ATHRL APEX-1000 test facility were not conducted in accordance with NRC quality requirements. Specifically, the latest revision of the OSU ATHRL Quality Plan, Revision 3, dated August 4, 2003, failed to establish measures consistent with the requirements of 10 CFR 50, Appendix B, Criterion XVI for Corrective Action and the OSU ATHRL could not produce objective evidence necessary to demonstrate compliance with the Quality Plan and procedures in the areas of drawing configuration control, control of measuring and test equipment, computer software control, and document control for certain APEX-1000 testing activities. Although the inspection team identified several examples of conditions adverse to quality that occurred during the AP1000 Matrix Test program, the inspectors concluded that the identified findings did not significantly affect the integrity or reliability of the facility test data. The findings and references to the pertinent requirements are identified in the enclosures of this letter.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosures will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Sincerely,

/RA/

Theodore R. Quay, Chief
Emergency Preparedness and Plant Support Branch
Division of Inspection Program Management
Office of Nuclear Reactor Regulation

Docket No.: 99901351

Enclosures: Notice of Violation
Notice of Nonconformance
Inspection Report 99901351/03-01

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ADAMS Accession Number: ML033350274

OFFICE	IEPB:DIPM	SC:IEPB:DIPM	BC:IEPB:DIPM	
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NOTICE OF VIOLATION

Oregon State University
Advanced Thermal Hydraulic Research Laboratory
Corvallis, Oregon

Docket No. 99901351
Report No. 03-01

Based on the results of an NRC inspection conducted on September 30 through October 2, 2003, it appears that certain of your activities at the Advanced Plant Experiment (APEX)-1000 test facility were not conducted in accordance with NRC requirements.

A. 10 CFR Part 21.21(a) requires, in part, that each individual, corporation, partnership, dedicating entity, or other entity subject to the regulations in this part shall adopt appropriate procedures to (1) Evaluate deviations and failure to comply to identify defects and failures to comply associated with substantial safety hazards as soon as practicable.....(3) (ii)(b) if the deviation or failure to comply potentially associated with a substantial safety hazard is discovered by a supplier of basic components, or services associated with basic components, and the supplier determines that it does no have the capability to perform the evaluation to determine if a defect exists, the supplier must inform the purchasers or affected licensees within 5 working days of this determination so that the purchasers or affected licensees may evaluate the deviation or failure to comply, pursuant to 21.21 (a).

Contrary to the above, the Oregon State University Advanced Thermal Hydraulic Research Laboratory did not have a documented procedure or process in place to address the “Notification of Failure to Comply or Existence of a Defect and its Evaluation,” as described in Part 21.21, for facility scaling and testing activities. This issue is identified as Violation 99901351/2003-01-01.

This is a Severity Level IV violation (Supplement VII).

Pursuant to the provisions of 10 CFR 2.201, Oregon State University is hereby required to submit a written statement or explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, D.C. 20555-0001, with a copy to the Chief, Emergency Prepardness and Plant Support Branch, Division of Inspection Program Management, Office of Nuclear Reactor Regulation, within 30 days of the date of the letter transmitting this Notice of Violation. This reply should be clearly marked as a "Reply to a Notice of Violation" and should include for each violation: (1) the reason for the violation, or, if contested, the basis for disputing the violation, (2) the corrective steps that have been taken and the results achieved, (3) the corrective steps that will be taken to avoid further violations, and (4) the date when full compliance will be achieved. Your response may reference or include previous docketed correspondence, if the correspondence adequately addresses the required response. Where good cause is shown, consideration will be given to extending the response time.

Dated at Rockville, Maryland
this 26th day of November, 2003

NOTICE OF NONCONFORMANCE

Enclosure 2

Oregon State University
Advanced Thermal Hydraulic Research Laboratory — Docket No. 99901351
Corvallis, Oregon — Report No. 03-01

Based on the results of an NRC inspection conducted on September 30 through October 2, 2003, it appears that certain of your activities at the Advanced Plant Experiment (APEX)-1000 test facility were not conducted in accordance with NRC requirements.

A. Criterion XVI, "Corrective Action," of 10 CFR Part 50, Appendix B, states, in part, that measures be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected.

Criterion XVII, "Quality Assurance Records," of 10 CFR Part 50, Appendix B, states, in part, that sufficient records shall be maintained to furnish evidence of activities affecting quality. The records shall also include closely related data such as qualifications of personnel, procedures, and equipment.....

The Advanced Thermal Hydraulic Research Laboratory (ATHRL) of Oregon State University (OSU), a supplier of safety-related test data to the Westinghouse Electric Company, established measures to assure the quality of test data in the OSU Quality Plan, Revision 3, dated August 4, 2003.

Section 4.3.4, "Procurement Documents," of the Westinghouse Quality Management System (QMS), Revision 5, which has been accepted by the NRC as meeting the requirements of Appendix B to 10 CFR 50, specifies that suppliers for safety-related items and services have a quality program consistent with the applicable portions of 10 CFR 50, Appendix B, as evaluated in accordance with ASME NQA-1-1994.

Contrary to the above, the latest revision of the OSU ATHRL Quality Plan, Revision 3, dated August 4, 2003, failed to establish measures consistent with the requirements of 10 CFR Part 50, Appendix B, for following areas:

i. The inspectors concluded that the Quality Plan failed to establish measures to identify and correct conditions adverse to quality that could affect the integrity and reliability of test data used to support 10 CFR Part 52 certification of the AP1000 design. Consequently, this issue constituted a deficiency in the OSU Quality Plan and is considered a nonconformance with the requirements of 10 CFR Part 50, Appendix B, Criterion XVI.

ii. The inspectors identified that Section 13.0, "Records," of the OSU Quality Plan, Revision 3, failed to include Personnel Training and Qualification Records on the defined list of required quality records for the APEX-1000 test facility. Consequently, this issue constituted a deficiency in OSU Quality Plan and is considered a nonconformance with the requirements of 10 CFR Part 50, Appendix B, Criterion XVII.

These issues are identified as Nonconformance 99901351/2003-01-01.

B. The OSU Quality Plan established quality requirements covering various activities affecting the quality of the scaling analysis and test data submitted to Westinghouse to support AP1000 Design Certification. The Quality Plan included the following

requirements covering the control of drawings, document control, calibration of measuring and test equipment, procedures, and computer software control:

i. Section 7.0, “Drawings,” of the OSU Quality Plan, Revision 3, dated August 4, 2003, states, in part, that piping and instrumentation drawings (P&IDs) and piping as-built drawings shall be used to document the physical configuration of the test facility and any permanent modification to the facility will require these drawings to be revised.

ii. Section 11.0, “Document Control,” of the OSU Quality Plan, Revision 2, dated November 15, 2002, which was effective during the period that Westinghouse AP1000 Matrix Testing was conducted, required control of the preparation, review, approval, and use of documents and that changes to documents be reviewed to the same extent as the originals.

OSU ATHRL Administrative Procedure A-05, Revision 2, dated November 22, 2002, establishes the controls for writing, reviewing, and approving test procedures, change notices, and test results. Section 2.2, “Review and Approval,” requires, in part, the Facility Operating Manager review and the OSU Project Manager approval of original test procedures be documented on a test cover sheet. Section 3.0, “Test Logs and Procedure Change Notices,” specified that errors in procedures that are not typographical errors, incorrect nomenclature, incorrect references, etc., shall be corrected using a Change Notice (CN) form.

iii. Section 12.0, “Calibration,” of the OSU Quality Plan, Revision 2, which was effective during the period that Westinghouse AP-1000 Matrix Testing was conducted, required that test facility instrumentation used for collection of test data, and test equipment used to calibrate this instrumentation shall be calibrated to recognized national standards, or in the cases where a national standard does not exist, the basis of the calibration shall be documented. Calibration shall be performed in accordance with written procedures approved by the Facility Operations Manager. Calibration documents shall be reviewed and maintained as quality records in accordance with the requirements established in Section 14.0, “Records,” of the OSU Quality Plan, Revision 2.

OSU ATHRL “Maintenance Manual,” Revision 3, dated February 20, 2003, establishes the controls for the preparation, performance, and documentation of facility test instrumentation calibration. Section D, “Calibration Records,” requires, in part, that the most recent calibration records be maintained as quality records in a binder designated for those records. The Facility Operations Manager is responsible for ensuring, through periodic review, that those calibration records are accurate and complete.

iv. Section 15.0, “Computer Software Control,” of the OSU Quality Plan, Revision 2, describes the process for controlling computer software used to collect, reduce, or analyze matrix test data. Sections 15.4.4, “Validation Phase,” and 15.4.5, “Matrix Testing Phase,” require that a software Release Authorization be obtained confirming that the software is validated before Matrix Testing begins.

Contrary to the above, ATHRL APEX-1000 test facility personnel failed to adequately implement the above requirements associated with the control of drawings, control of procedures, instrument calibration, and control of computer software. Specifically, the team identified the following examples of failures to adequately implement OSU Quality Plan requirements:

i. During facility walkdowns conducted on October 2, 2003, the inspectors noted three examples of drawings which did not accurately document the physical configuration of the test facility. Specifically, the inspectors identified the following drawing errors: (1) as-built drawing ADS-4, "Automatic Depressurization System," Revision 2, did not accurately reflect the location of instrumentation root valves RV-637 and RV-638, (2) as-built drawing MS, "Main Steam," Revision 2, did not document the field installation of steam generator power operated relief valves, and (3) piping & instrumentation drawing OSU 600002, "Fill/Feed/MS Systems," Revision 11, incorrectly labeled valves MF-003 and RCS-818, failed to document an isolation valve upstream of the RNS pump relief valve RCS-817, and failed to document a vent valve on the chemical and volume and main feed pump suction header. These issues constituted a nonconformance with Section 7.0 of the OSU Quality Plan in that P&IDs and piping as-built drawings failed document the current physical configuration of the test facility.

ii. The procedure change process was not established and implemented consistent with the requirements of Section 11.0 of the OSU Quality Plan. Specifically, Section 3.0 of Administrative Procedure A-05 did not require review and approval of test procedure changes to the same extent as the original procedure, in that OSU Project Manager approval was only required for changes that affected the objectives or acceptance criteria of the test. Additionally, the inspectors identified two examples of failure to adequately implement the procedure change process specified in Section 3.0 of Administrative Procedure A-05. Specifically, the test engineer executed the following test procedure changes without documenting OSU Project Manager approval or completing a change notice form: (1) during Matrix Test OSU-AP1000-01, the reactor power initial condition was changed from 900 kW to 800 kW, and (2) during Matrix Test OSU-AP1000-06, the accumulator pressure initial condition was changed from 191 psig to 232 psig. The inspectors concluded that these revisions were more than minor changes to test initial conditions and should have been reviewed to the same extent as the original procedures and documented on a change notice form. This issue constituted a nonconformance with Section 11.0 of the OSU Quality Plan in that documentation control requirements were not adequately implemented.

iii. The team identified the following two examples of a failure to adequately implement the OSU Quality Plan for the control of measuring and test equipment. (1) During a routine facility walk down conducted on October 1, 2003, the inspectors noted that field device, FMM-905, "Break Separator Loop Seal Flow Indicator," did not have a valid calibration sticker in that the next periodic calibration due date had been omitted. The inspectors subsequently attempted to review the test instrumentation calibration records for the FMM-905 device and discovered that the current record contained erroneous information attributed to a piece of test equipment that had been replaced with the existing flow meter on February 26, 2003. Further evaluation revealed that the calibration paperwork associated with the newly-installed flow meter had been lost and the

instrumentation database and calibration records had not been adequately updated. This issue constituted a nonconformance with Section D, of the ATHRL Maintenance Manual in that the calibration record for the FMM-905 device did not contain accurate and complete information for the as-built configuration of the facility. (2) During the review of the implementation of the calibration of measuring and test equipment, the team noted discrepancies between the documented calibration interval for instrumentation and the actual 18 month calibration intervals currently in effect at the APEX-1000 test facility. (1) control panel power meter indication (Power Meter KW-101, Paladine Model TWMUSEHG) used to monitor power delivered to the reactor core heater elements which was last calibrated in January 1998 and; (2) load cell transmitters (LCT-701, 901, and 902, respectively), used to determine IRWST level and primary and secondary sump level indication which where last calibrated in January 1998. The team considered these items not to be in conformance with the established calibration interval requirements specified in the Maintenance Manual, as well as the established 18 month calibration cycle currently in effect.

iv. ATHRL personnel failed to confirm that the Advanced Plant Experiment (APEX)-1000 test facility data acquisition system (DAS) software was validated prior to beginning Matrix Testing. Specifically, the AP1000 Software Validation Package, Revision 1, which documented the software release authorization for the APEX-1000 DAS, was completed on September 9, 2003. However, five AP1000 Matrix Tests were performed and accepted by Westinghouse prior to completion of the DAS software release authorization. The last accepted AP1000 Matrix Test (OSU-AP1000-06) was conducted on July 9, 2003 and five completed AP1000 Matrix Test procedures and data reports were accepted by Westinghouse on September 3, 2003. This issue constituted a nonconformance with Sections 15.4.4 and 15.4.5 of the OSU Quality Plan in that the DAS software release authorization was not completed prior to beginning Matrix Testing.

These issues are identified as Nonconformance 99901351/2003-01-02.

Please provide a written statement or explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555, with a copy to the Chief, Emergency Preparedness and Plant Support Branch, Division of Inspection Program Management, Office of Nuclear Reactor Regulation, within 30 days of the date of this letter transmitting this Notice of Nonconformance. This reply should be clearly marked as a “Reply to a Notice of

Nonconformance" and should include for each nonconformance: (1) a description of steps that have been or will be taken to correct these items; (2) a description of steps that have been or will be taken to prevent recurrence; and (3) the dates your corrective actions and preventative measures were or will be completed.

Dated at Rockville, Maryland
this 26th day of November, 2003

US NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
DIVISION OF INSPECTION PROGRAM MANAGEMENT
EMERGENCY PREPAREDNESS AND PLANT SUPPORT BRANCH
QUALITY ASSURANCE AND MAINTENANCE SECTION

INSPECTION REPORT

ORGANIZATION:	Oregon State University Advanced Thermal Hydraulic Research Laboratory 130 Radiation center, A110 Corvallis, OR 98331-5902
DOCKET:	99901351
REPORT NO:	99901351/03-01
ORGANIZATIONAL CONTACT:	Dr. Jose N. Reyes, Jr., Director Advanced Thermal Hydraulic Research Laboratory
NUCLEAR ACTIVITY:	Nuclear steam supply system thermal hydraulic testing
INSPECTION LOCATION:	Corvallis, Oregon
INSPECTION DATES:	September 30 - October 2, 2003
INSPECTORS:	Richard P. McIntyre, Team Leader, IEPB Gregory Galletti, Senior Operations Engineer, IEPB Kevin Coyne, Operations Engineer, IEPB Dr. Kent Welter, Office of Nuclear Regulatory Research
APPROVED BY:	***/RA/*** Dale F. Thatcher, Chief Quality and Maintenance Section Emergency Preparedness and Plant Support Division of Inspection and Program Management Office of Nuclear Reactor Regulation

Enclosure 3

1 INSPECTION SUMMARY

The inspection was conducted to review the implementation of selected portions of the Oregon State University (OSU) Advanced Thermal Hydraulic Research Laboratory (ATHRL) Quality Plan, as it relates to facility scaling and testing activities conducted at the Advanced Plant Experiment (APEX)-1000 test facility to support the Westinghouse AP1000 design certification application. The inspection identified one Violation of 10 CFR Part 21 requirements and two Nonconformances for failure to adequately implement the requirements of the 10 CFR Part 50 Appendix B and the OSU ATHRL Quality Plan, in certain areas.

The bases for this inspection were:

> Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to Part 50 of Title 10 of the Code of Federal Regulations (CFR) (Appendix B)
>
> Part 21, "Reporting of Defects and Noncompliance," as defined in Title 10 of the Code of Federal Regulations (CFR)

1.1 Background

The APEX test facility at OSU was originally used to model the AP600 reactor passive safety systems and perform testing to support design certification for the AP600 design.

OSU was awarded as US DOE Nuclear Energy Research Grant (NERI) to modify the model to match the AP1000 reactor design and to perform integral system performance testing of AP1000 safety systems. The data generated by the DOE-sponsored NERI project at OSU is to be referenced by Westinghouse as confirmatory information to supplement the safety analysis performed for AP1000 and submitted to the NRC as part of design certification. The results of the testing programs will be used to address specific questions/issues regarding AP1000 passive safety performance, and address issues related to the effects of liquid entrainment during a small break LOCA.

The APEX-1000 test facility at OSU is a low pressure, scaled model of the Westinghouse AP1000 Advanced Passive Reactor. It consists of the reactor coolant system, passive safety system, 2 steam generators with associated feedwater and main steam systems, chemical and volume control systems, and normal residual heat removal system. The testing at the facility is designed to provide thermal hydraulic data to verify the AP600/AP1000 thermal hydraulic computer codes. The test data will validate the computer code's ability to predict phenomena such as gravity injection, natural convection, and post-accident long-term cooling behavior during various modes of operation.

All scaling and testing activities performed by OSU for AP1000 design certification were conducted using either the OSU ATHRL Quality Plan Revision 2, dated November 15, 2002, or Revision 3, dated August 4, 2003.

In addition, it should be noted that the NRC Office of Nuclear regulatory Research is sponsoring additional confirmatory testing at the OSU APEX-1000 test facility.

1.2 Violation

Violation 99901351/03-01-01 was identified during this inspection and is discussed in Section 3.1 of this report.

1.3 Nonconformance

Nonconformance 99901351/2003-01-01 and 99901351/2003-01-02 were identified during this inspection and are discussed in Sections 3.2, 3.4, 3.5, 3.6, 3.8, and 3.9 of this report.

2. STATUS OF PREVIOUS INSPECTION FINDINGS

No previous inspection findings were reviewed during this inspection.

3 INSPECTION FINDINGS AND OTHER COMMENTS

3.1 10 CFR Part 21

a. Inspection Scope

The team reviewed OSU ATHRL's 10 CFR Part 21 program implementation and conducted discussions with OSU ATHRL staff regarding their 10 CFR Part 21 reporting process.

b. Observations and Findings

The Oregon State TRIGA Reactor (OSTR) does have an Operating Procedure for Part 21 reporting, OSTROP 21, "Procedures for Reporting of Defects and Noncompliance," Revision 5, dated July 2001. The team determined that the OSU Advanced Thermal Hydraulic Research Laboratory does not have a procedure implementing the requirements of 10 CFR Part 21.21. Discussions with OSU ATHRL personnel identified that OSTROP 21 is only applicable to and used by OSU TRIGA reactor personnel. Therefore, the OSU ATHRL does not have in place a procedure and/or process to evaluate and report Defects and Noncompliance at the APEX-1000 test facility.

During discussions with the team on Part 21 implementation, the OSU Project Manager stated that OSU intended to establish and implement a Part 21 procedure/process for the ATHRL facility to address this issue.

c. Conclusions

The failure for the OSU ATHRL to have a procedure implementing the requirements of 10 CFR Part 21.21 is identified as a violation of NRC requirements. (Violation 99901351/2003-201-01)

3.2 Corrective Action Program Implementation

a. Inspection Scope

The team reviewed the process used at the OSU ATHRL APEX-1000 test facility to identify, evaluate, and correct conditions adverse to quality. The team held discussions with OSU personnel and reviewed facility procedures and test logs. The team also reviewed the disposition of failures, malfunctions, and deficiencies encountered during the test program to verify that conditions adverse to quality were promptly identified and corrected.

b. Observations and Findings

10 CFR 50, Appendix B, Criteria XVI, "Corrective Action," requires, in part, that measures be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected. The team reviewed the OSU ATHRL QP in order to assess the corrective action process used at the APEX-1000 facility. Although the OSU QP provided limited guidance for the disposition of test deviations, the team determined that OSU had not established a formal corrective action process meeting the requirements of 10 CFR 50, Appendix B, at the APEX-1000 test facility. Based on a review of test records and discussions with facility personnel, the team determined that several deficiencies had been identified during the AP1000 Matrix Test program. Because the OSU QP did not establish requirements for the identification and resolution of these deficiencies, ATHRL personnel used informal processes to address these issues. These deficiencies included the following:

- An incorrect elevation correction was used in the instrument setup for differential pressure detectors LDP-603 and LDP-604. This issue was documented in an email dated August 1, 2003 and affected the test data for five completed Westinghouse AP1000 Matrix Tests. As discussed in Section 3.5, Test Facility Configuration Control, below, the team also identified a related deficiency in the as-built drawing for the modified automatic depressurization system (ADS)-4 line, which failed to show the correct location and elevation of the low pressure sensing lines for these differential pressure detectors.

- A memo to file dated June 24, 2003, from J. Groome identified that the data acquisition system (DAS) configuration setup for differential pressure transmitter DP-402 used the incorrect engineering units. This issue affected the data for four completed Westinghouse AP1000 Matrix Tests.

- An email from J. Groome to J. Reyes dated February 28, 2003, identified that reactor power could not be raised high enough to achieve the required initial

conditions during test OSU-AP1000-01. Consequently, the test was performed at a lower power than initially specified in the test procedure. In Section 3.6, Document Control, below, the team noted that OSU failed to use an appropriate procedure change process to revise the test initial condition for reactor power.

- An OSU email from J. Groome to R. Wright and R. Vijuk dated March 15, 2003, identified DAS configuration setup errors for differential pressure instruments LDP-127, LDP-202, and LDP-204. These instruments were identified as critical test instruments for test OSU-AP1000-01, which was performed on February 27, 2003.

The team concluded that each of these issues constituted a condition adverse to quality which could have potentially impacted the reliability and integrity of test data supporting AP1000 design certification. Because several of these deficiencies were identified after completion of the affected Matrix Tests, test data that had already been forwarded to Westinghouse required additional evaluation. The OSU program manger stated that Westinghouse was informed of these issues and accepted the Matrix Test data affected by these deficiencies in a letter dated September 3, 2003. Although the team determined that the above examples of conditions adverse to quality did not significantly impact the quality of the AP1000 test data, the team concluded that the OSU ATHRL lacked a formal corrective action process. In particular, the test facility had not established measures that ensured conditions adverse to quality were appropriately identified, evaluated and corrected. The team also noted that the lack of an established corrective action process could limit the ability of OSU to identify potential defects or noncompliances under the provisions of 10 CFR Part 21discussed above in Section3.1.

In a letter dated April 11, 2003, from W. Cummins to J. Lyons, Westinghouse stated that the APEX-1000 test program was conducted in accordance with the OSU QP and the Westinghouse use of the APEX-1000 information to support AP1000 design certification will be treated in accordance with the Westinghouse Quality Plan. Section 4.3.4, "Procurement Documents," of the Westinghouse Quality Management System (QMS), Revision 5, which has been accepted by the NRC as meeting the requirements of Appendix B to 10 CFR 50, specifies that suppliers for safety-related items and services have a quality program consistent with the applicable portions of 10 CFR 50, Appendix B, as evaluated in accordance with ASME NQA-1-1994.

Additionally, Section 17.3, "Quality Assurance During Design, Procurement, Fabrication, Inspection and/or Testing of Nuclear Power Plant Items," of the AP1000 Design Control Document, states that external organizations that developed portions of the design maintained a quality assurance program that meets the NQA-1 criteria that apply to its work scope. The quality requirements contained in ASME NQA-1 includes corrective action requirements that are consistent with the 10 CFR 50, Appendix B, Criterion XVI. Because conditions adverse to quality could affect the integrity and reliability of test data used for safety-related purposes, the team concluded that Criterion XVI, "Corrective Action," was a portion of 10 CFR 50, Appendix B, that was applicable to the APEX-1000 test program. However, OSU QP failed to establish corrective action measures consistent with the requirements of 10 CFR 50, Appendix B, Criterion XVI. Consequently, this issue constituted a deficiency in OSU QP requirements and a

nonconformance with 10 CFR 50, Appendix B. This issue is identified as part of Nonconformance 99901351/2003-01-01.

During discussions with the team, the OSU Project Manager stated that OSU intended to establish and implement a corrective action process for the ATHRL facility to address this issue.

c. Conclusions

A nonconformance was identified for the failure of the OSU QP to establish corrective action measures consistent with the requirements of 10 CFR 50, Appendix B, Criterion XVI requirements. Although the team identified several examples of conditions adverse to quality that occurred during the AP1000 Matrix Test program, the team concluded that these conditions did not significantly affect the integrity or reliability of the facility test data.

3.3 Design Control

a. Inspection Scope

The inspection team reviewed design documents produced at the APEX -1000 test facility to scale components, line resistances, and test conditions (e.g. core power). Discussions were held by the team with facility personal and calculational notebooks were reviewed. The team also made sample hand calculations to verify the values used to scale line resistances in the primary coolant system.

b. Observations and Findings

Scaling

The Scaling Assessment for the design of the OSU APEX-1000 Test Facility Revision 0 (OSU-APEX-03001) is not mentioned in the OSU QP (QP) Revision 2. Although OSU does not have a scaling Subsection in their QP, the team determined that the scaling analysis is a quality design activity and should be addressed in the OSU ATHRL QP. The scaling assessment report describes the basic rationale for modifying the existing APEX/AP600 facility configuration to conform to APEX/AP1000 design specifications. On August 28, 2003 the scaling assessment was accepted by Westinghouse and assigned an AP1000 Document Number of APP-LTCT-T2R-01Z. This report has been previously reviewed in some detail by the NRC staff. Revisions and additions are still being made based on comments received and the final staff review must await receipt of the final report.

The scaling report describes a standard Two-Tiered Scaling (H2TS) methodology which includes discussions on time ratios, process ranking, scaling criteria development and evaluation of scaling distortion. For the APEX-1000 modifications, the maximum core power, core flow area and decay power algorithm were addressed. The IRWST, CMT, sump and pressurizer geometries were modified to preserve AP1000 characteristics. Flow resistances in the ADS4, IRWST, CMT, PRHR and sump recirculation lines were also modified compared to the AP600 configuration of the APEX test facility. Special

consideration was given to the pressurizer surge line scaling in response to analysis conducted by the NRC. A full pressure ADS4 blowdown to IRWST injection scaling analyses was conducted that examined flashing and liquid boil-off rates, IRWST full height liquid head and injection flow rate, core fluid mixture level swell, and initial blowdown test conditions. Finally, upper plenum entrainment was scaled, taking into account draining rates during integral system testing, pool entrainment, lateral de-entrainment, and upper core plate, support plate, and guide tube bundle sizing.

The IWRST direct vessel injection (DVI) Line B was selected by the audit team as a sample to verify scaling parameters. Hand calculations were made by the audit team based on data in Table 7 (page 3-9) of the scaling assessment report to verify minimum and maximum flow resistances (ft/gpm^2). A discussed in Section 3.5 below, the minimum and maximum values in the IWRST DVI Line B calculated by the inspection team matched the values used in the Bench Test conducted to validate the IWRST flow resistances.

c. Conclusions

Scaling Calculation Notebooks Volumes 1 and 2 were reviewed by the team and contained appropriate scoping calculations for modifying the APEX test facility to preserve AP1000 phenomena. All scaling documentation was found to conform to the OSU QP in accordance with the requirements of 10 CFR 50, Appendix B, Criterion III.

3.4 Test Control

a. Inspection Scope

The team reviewed the process used at the APEX-1000 test facility to plan and conduct tests, produce results and process data. The team held discussions with the facility personnel and reviewed test procedures, electronic records, software documentation, and correspondence and meetings between Westinghouse and OSU personnel.

b. Observations and Findings

Test Procedures

Subsection 12.0, “Test Control,” of the OSU QP Revision 2.0, dated November 22, 2002, required that all Matrix Testing shall be conducted within the guidelines of Sections 12.2 through 12.5 of the OSU QP Revision 2. All other testing shall fall within the requirements outlined in Subsection 12.6, “Bench Tests.”

OSU QP Revision 2, states that Matrix Testing shall be performed in accordance with a written Matrix Test Procedure(s) that is in compliance with the latest revision of the Test Specification or contract. For AP1000 testing, no Test Specification was used to develop a Test Matrix and the OSU staff conducted Matrix Testing under the general specifications outlined in the Department of Energy (DOE) contract DE-FG07-01SF22326.

The team reviewed Matrix Test Procedures OSU-AP1000-01, OSU-AP1000-02,OSU-AP1000-03, OSU-AP1000-04, OSU-AP1000-05 and OSU-AP1000-06 to verify that the test procedures used for the conduct of the tests were prepared according to Subsections 12.2 through 12.5 of the OSU QP Revision 2. The team determined that the test objectives, prerequisites, initial conditions, instructions, acceptance criteria and post test activities for the conduct of the tests were included in the test procedures. However, the Matrix Test procedures, in some cases, did not contain appropriate change notices when major deviations from the original test procedure occurred. For example, as discussed in Section 3.6 below, changes were made to the initial conditions of OSU tests without any documentation.

The team noted that Subsections 2.0 and 3.0 of OSU ATHRL Administrative Procedure A-05, Revision 2 duplicates Subsections 12.3, 12.4, and 12.5 of the OSU QP Revision 2.

Test Matrix

The OSU QP Revision 2 does not require a formally approved Test Matrix before Matrix Testing can begin. Matrix Testing is conducted under a "dynamic" test matrix process. This format was agreed upon by the OSU staff and Westinghouse in DOE contract DE-FG07-01SF22326. Under this dynamic matrix testing process, OSU submitted a tentative schedule of tests to Westinghouse for review. A meeting was held at US DOE Headquarters in Germantown, Maryland on March 27, 2003 where OSU and Westinghouse staff produced a report on Testing of Passive Safety System Performance for Higher Power Advanced Reactors (DE-FG0301SF22326). Attachment #2 of this report, "Minutes of Meeting with DOE," contains the parameters for each proposed Matrix Test. Six Matrix Tests, OSU-AP1000-01, OSU-AP1000-02, OSU-AP1000-03, OSU-AP1000-04, OSU-AP1000-05, and OSU-AP1000-06, were conducted between February 18 and July 9, 2003 at OSU. A Preliminary Test Acceptance Report (PTAR) was typically issued to the project sponsor within 1 week of successful completion of the test. In a memo from Westinghouse dated September 3, 2003, "Acceptance of APEX-1000 Tests", five of the six tests were accepted by Westinghouse into the official Test Matrix. Test OSU-AP1000-02 was not accepted by Westinghouse and was not included in the official Test Matrix. This dynamic matrix testing process is used by OSU to expedite Matrix Testing and was determined to be acceptable by the team.

In a memorandum dated September 9, 2003, "Response to Westinghouse Quality Program Audit Report Dated August 12, 2003," OSU proposed the following changes to Subsection 12.2, "Matrix Testing", of the OSU QP:

The project sponsor shall indicate a change in test specification by either of the following means:

1. Reviewing and signing the applicable Matrix Test Procedure to indicate acceptance of the Matrix test as executed.

2. Indicating in writing that the Test Procedure meets the project Sponsor's test criteria.

3. Issuing a revised Test Specification that reflects the Matrix Test Procedure as executed.

The above revision to the OSU QP will provide OSU more flexibility in approving Matrix Test Procedures under a dynamic test matrix process and is acceptable.

Test Results and Data Processing

Section 4.0, "Documentation of Test Results," of Administrative Procedure A-05, Revision 2, provides instructions for producing Preliminary Test Acceptance Reports (PTARs). Six PTARs were reviewed by the audit team, OSU-AP1000-01, OSU-AP1000-02, OSU-AP1000-03, OSU-AP1000-04, OSU-AP1000-05, and OSU-AP1000-06, and were found to contain completed test procedures, instrumentation lists, critical instrument data plots, and test data on optical discs. In some cases, as mentioned in the Test Procedures subsection of Section 3.4 above, changes were not documented when initial test conditions were modified.

The instrumentation system can record data at 2 kHz or higher, but for all testing, was set to record at 1 Hz to balance the fastest desired rate without unnecessarily burdening the CPU and network bandwidth. It was determined that this recording frequency was adequate to capture the faster acting phenomenon. OSU does not perform data analysis and therefore, strong feedback is required by the reviewer (Westinghouse) and the OSU staff to identify an deficiencies in the manner in which data is being acquired. Under the current dynamic matrix testing processes discussed in Test Matrix section of Section 3.4 above, test procedures and results have been approved in large groups.

Data reduction is performed by OSU from the data acquisition system (DAS) and is stored on optical disks. One thousand field instruments are processed by the DAS: 750 analog and 250 discrete. Six hundred and twenty analog instruments are dedicated for historical logging, while the remaining devices provide closed-loop control. The 620 analog instruments interface with National Instruments LabVIEW Data and Supervisory Control (DSC) Module. An in-house application, "AP1000 Engine Manager.VI," provides scaling and exposes the channels to other software application using OLE for Process Control (OPC) protocol and was found to be adequate for processing APEX1000 data.

The remaining analog devices (approximately 130) terminate on Fisher-Porter process controllers (seven total in the system). These controllers provide closed-loop control and calculations to estimate water level, core power and flow rates. Fisher-Porter controllers communicate via RS-485 to an OPC 2.0 compliant server called Micro-DCI communication Services, which in turn transfers data to a Wonderware Human-Machine-Interface (HMI) package called InTouch. InTouch provides visualization, alarming, auditory annunciations and supervisory control and was determined to be acceptable.

Section 15.0, "Computer Software Control," of the OSU QP Revision 2, provides detailed requirements on approval of software, vendor supplied software, software development life cycle, and change control policy. The team verified that all installed software corresponded to the correct version numbers documented in the AP1000 Software

Validation Package Revision 1 (OSU-D-08). Section 15.4, “Software Development Life Cycle,“ of the OSU QP was reviewed in detail by the team. The development life cycle of the DAS was chosen as a representative sample to examine software development. The development life cycle was segmented into 6 phases: charting, planning, development, validation, Matrix Testing and maintenance. The charting phase where high-level goals and functionality were examined was documented in email messages sent between the OSU software developer and project manager. A Functional Requirements/Specifications document (DAS-001 Revision 0), was completed on January 15, 2003, during the planning phase and was found acceptable. Revision 1 of the Functional Requirements/Specification was completed on May 12, 2003, to address several modifications to the software’s functionality. The functional changes were documented according to the Section 15.5, “Change Control Policy,” of the OSU QP Revision 2 and were found to be acceptable.

The team found that the software development and validation phases were being conducted during the Matrix Testing phase. This does not conform to Section 15.4.4 of the OSU QP Revision 2, which requires that a Release Authorization be obtained that confirms that the software is validated before Matrix Testing begins. Specifically, Section 15.0, “Computer Software Control,” of the OSU QP describes the process to validate computer software used to collect, reduce, or analyze matrix test data. Sections 15.4.4, “Validation Phase,” and 15.4.5, “Matrix Testing Phase,” of Revision 2 to the OSU QP, required that a software Release Authorization be obtained confirming that the software is validated before Matrix Testing begins. The AP1000 Software Validation Package Revision 1 was completed on September 9, 2003, *after* the last accepted Matrix Test (OSU-AP1000-06) was conducted. This issue is identified as an example of a failure to adequately implement OSU QP requirements under Nonconformance 99901351/2003-01-02.

e. Conclusions

A nonconformance was identified for the failure of OSU personnel to validate the data acquisition software before beginning testing, which is required by Section 15.0, "Computer Software Control,” of the OSU QP, Revision 2. Although validation of the software was conducted during matrix testing and not before, a software validation package had been completed. The inspection team determined that the failure to validate the software prior to testing did not significantly affect the integrity or reliability of the facility test data.

3.5 Test Facility Configuration Control

a. Inspection Scope

The team assessed the processes used to maintain configuration control over the APEX-1000 test facility. The team performed a facility walkdown and reviewed facility drawings and recent facility modifications. The team also discussed facility configuration control process with the ATHRL staff.

b. Observations and Findings

The NRC staff previously reviewed the design and construction of the APEX test facility during the design certification review for the AP600 design. The results of this review are documented in NRC Inspection Report No. 99900404/94-01, dated January 12, 1995. Therefore, the team reviewed facility modifications that have been implemented subsequent to the AP600 test program to assess the facility configuration control for the AP1000 test program. Major facility modifications necessary to support testing of the AP1000 design included installation of a larger pressurizer and larger core makeup tanks. Additionally, piping frictional head loss factors were adjusted to model the AP1000 plant in accordance with the facility scaling report. The team reviewed the following component test reports to verify that the APEX-1000 facility configuration was consistent with scaling requirements:

- OSU-V-03, "CMT Volume Determination Test for AP1000," Revision 0
- OSU-V-04, "Pressurizer Volume Determination Test for AP1000," Revision 0
- OSU-F-08, "APEX AP1000 Injection Line Flow Test," Revision 0

The team determined that the results from these tests were consistent with scaling report OSU-APEX-0301, "Scaling Assessment for the Design of the OSU APEX-1000 Test Facility," Revision 0.

During facility walkdowns, the team concluded that the test facility material condition and housekeeping were good. The team did not identify evidence of equipment degradation or damage and the facility appeared to be well maintained. Additionally, the team noted that the facility was kept clear of transient material that could impact the ability to obtain reliable test data. Procedure OP A.1, "Operations Administration," Revision 1, required that the facility operator record out of commission equipment and out of calibration instrumentation during facility operation. The team reviewed test logs associated with Westinghouse Matrix Test program and verified that out of commission and out of calibration equipment had been appropriately recorded.

In general, the team concluded that OSU maintained adequate documentation of the test facility configuration with controlled P&IDs and piping as-built drawings. However, during facility walkdowns, the team noted several examples where system drawings did not adequately document facility configuration. These examples included the following:

- As-built drawing ADS-4, "Automatic Depressurization System," Revision 2, had been revised to show the recent replacement of ADS piping but the revision did not document the relocation of instrumentation root valves RV-637 and RV-638 from downstream to upstream of ADS valves RCS-615 and RCS-616, respectively. According to the facility manager, this revision was performed to change the low pressure source to differential pressure transmitters LDP-603 and LDP-604.

- As-built drawing MS, "Main Steam," Revision 2, was not updated to reflect the recent installation of the steam generator power operated relief valves.

- Piping & Instrumentation Drawing OSU 600002, "Fill/Feed/MS Systems," Revision 11, had several minor discrepancies, including: the labeling of pump bypass valves MF-003 and RCS-818 was reversed from the field configuration;

the drawing failed to document an isolation valve installed upstream of relief valve RCS-817; and the drawing did not document a vent valve on the chemical and volume and main feed pump suction header.

Section 7.0, "Drawings," of the OSU QP, stated, in part, that P&IDs and piping as-built drawings shall be used to document the physical configuration of the test facility and permanent modifications to the facility will require these drawings to be revised and approved by the project manager or designee. Additionally, in letter OSU-AP1000-03-09-006, "APEX-1000 Test Facility Configuration," dated September 16, 2003, from OSU to Westinghouse Electric Corporation, OSU stated that the above drawing revisions included all permanent modifications to the facility. Therefore, these drawing errors constituted a nonconformance with Section 7.0 of the OSU QP in that P&IDs and piping as-built drawings failed document the physical configuration of the test facility. This issue is identified as an example of a failure to adequately implement OSU QP requirements under Nonconformance 99901351/2003-01-02.

c. Conclusions

Based on the facility changes reviewed by the team, ATHRL test facility personnel adequately configured the test facility to support the AP1000 Matrix Test Program. The team concluded that the test facility appeared to be well maintained with no evidence of equipment damage or degradation. Although facility drawings were generally adequate to document the facility configuration, the team identified several examples of drawing errors. These drawing errors were identified as an example of a failure to adequately implement OSU QP requirements under Nonconformance 99901351/2003-01-02.

3.6 Document Control

a. Inspection Scope

The team reviewed the quality assurance process used to control administrative, operating, and test procedures. The team also reviewed a sampling of test reports to determine if specified document control measures were effectively implemented.

b. Observations and Findings

10 CFR 50, Appendix B, Criterion VI, "Document Control," states, in part, that measures shall be established to control the issuance of documents, including changes thereto, which prescribe all activities affecting quality. These measures shall assure that documents, including changes, are reviewed for adequacy and approved for release by authorized personnel. The team reviewed QP and administrative requirements for the preparation, review, and approval of test documents. Section 11.0, "Document Control," of the OSU QP, Revision 2 (which was effective during the period that Westinghouse AP1000 Matrix Test program was conducted), stated that the preparation, review, approval, and use of documents shall be controlled. Additionally, the OSU QP specified that changes to documents shall be reviewed to the same extent as the originals.

Administrative Procedure A-05 was written to provide implementation guidance for the documentation control requirements at the ATHRL facility. Section 2.2, "Review and

Approval," of A-05 stated that a test cover sheet was to be utilized to document the review and approval of test procedures. Consistent with QP requirements, the test cover sheet included a sign off for the review and OSU project manager approval of the test procedure. With regard to procedure changes, Section 3.0, "Test Logs and Procedure Change Notices," of A-05, stated that errors in procedures (other than typographical errors, incorrect nomenclature, incorrect references, etc.), were to be corrected using a Change Notice (CN) form.

Although, the OSU QP document control requirements were generally consistent with the requirements contained in 10 CFR 50, Appendix B, Criterion VI, the team determined that the implementing guidance for procedure changes contained in Administrative Procedure A-05 were not consistent with the QP. Specifically, Administrative Procedure A-05 did not require that changes to documents be reviewed to the same extent as the originals in that Section 3.0 of the procedure only required OSU Project Manager approval for test procedure changes that affected the objectives or acceptance criteria of the test. The team noted that changes to other test procedure sections described in A-05, such as pre-requisites, instructions, appendices, and the critical instrumentation list, should have been subject to the same level of approval as the original document. The team concluded that this issue constituted a nonconformance with QP documentation control requirements. This issue is identified as an example of a failure to adequately implement OSU QP requirements under Nonconformance 99901351/2003-01-02.

The team reviewed six completed test procedures conducted to support AP1000 design certification. Although the test procedures were originally prepared, reviewed, and approved in a manner consistent with OSU QP requirements, the team noted two examples where test procedures changes were not adequately controlled:

- In test procedure OSU-AP1000-01, the test engineer made a pen and ink change to step 5.4 in order to change the initial reactor power from 900 kW to 800 kW. This change was executed without documenting OSU program manager approval or the use of a change notice form. An OSU internal e-mail dated February 28, 2003 titles, "OSU-AP-1000-01 DEDVI Test Observations," noted that the operators were unable to achieve the required power level of 900 kW for the test.

- In test procedure OSU-AP1000-06, the test engineer made a pen and ink change to step 5.14 to change the initial accumulator pressure from 191 psig to 232 psig. This change was executed without documenting OSU program manager approval or the use of a change notice. Although the team noted that step 5.11 of the procedure required increasing accumulator pressure to 232 psig, the team determined that it was not obvious from a review of the test procedure alone whether 191 psig or 232 psig was the correct accumulator pressure initial condition.

The team determined that these test procedure changes were more than minor revisions and should have been performed using the change notice process described in Section 3.0 of the Administrative Procedure A-05. Further, the team concluded that the failure to review test procedure changes to the same extent as the original procedure constituted a nonconformance with the OSU QP. This issue is identified as an example of a failure

to adequately implement OSU QP requirements under Nonconformance 99901351/2003-01-02.

The OSU project manager stated that, subsequent to revising these test procedures, all test AP1000 Matrix Test procedures have been reviewed and accepted by Westinghouse. Therefore, the team concluded that the failure to adequately control test procedure changes did not significantly impact the integrity and reliability of the test data.

c. Conclusions

The OSU QP established adequate measures for the control of facility procedures. However, the team identified that the QP procedure change control process had not been adequately implemented. Specifically, administrative procedures did not require review and approval of test procedure changes to the same extent as the original procedures. Furthermore, the team identified two examples where test initial conditions were revised in a manner inconsistent with QP requirements. Because Westinghouse subsequently reviewed and accepted the affected test procedures and associated data, this issue did not significantly impact the integrity or reliability of the test data.

3.7 Record Retention

a. Inspection Scope

The team reviewed OSU QP requirements related to record retention. During the course of the inspection, the team assessed the document retention process to determine if quality records were appropriately stored and maintained.

b. Observations and Findings

10 CFR 50, Appendix B, Criterion XVII, “Quality Assurance Records,” states that sufficient records shall be maintained to furnish evidence of activities affecting quality. Additionally, Criterion XVII states that requirements concerning record retention such as duration, location, and responsibility shall be established.

Section 13.0, “Records,” of the OSU QP identified the types of quality records were retained, record storage locations, access control requirements, and retention duration requirements. During a supplier audit conducted in July 2003, Westinghouse personnel identified several issues associated with quality record control and retention at the APEX test facility. These issues, which were not considered to be formal audit findings by Westinghouse, included the failure to store training and qualification records in accordance with QP requirements; the failure of the QP to address certain aspects of record control such as record classification, responsibility, and retention duration; and the lack of a clear definition of Westinghouse quality record requirements. Following the July 2003 Westinghouse audit, OSU issued Revision 3 to the QP which revised the requirements for training and qualification records, addressed responsibility for record control, and added record retention duration requirements. However, as discussed in Section 3.8 below, the team determined that the revision to training and qualification record requirements was inconsistent with 10 CFR 50, Appendix B, in that these records were no longer considered to be quality records.

The team determined that, for all activities inspected, the test facility maintained sufficient records to furnish objective evidence relating to activities affecting quality. The team noted that records were stored and access controlled in a manner consistent with QP requirements.

c. Conclusions

In general, the ATHRL test facility maintained sufficient records to furnish objective evidence relating to activities affecting quality. The team noted that records were stored and access controlled in a manner consistent with QP requirements. However, the team noted that the Revision 3 of the QP was recently revised and allows maintenance of training and qualification records in a manner inconsistent with 10 CFR 50, Appendix B, and is discussed in detail below in Section 3.8.

3.8 Training Program Implementation

a. Inspection Scope

The inspection team reviewed the applicable programmatic process governing the training requirements for operators of the APEX-1000 test facility, reviewed the ATHRL training records, and discussed the training process with cognizant ATHRL personnel.

b. Observations and Findings

The team reviewed the OSU QPs, Revision 2 and 3, and associated implementation procedures and ATHRL memoranda which documented applicable training activities associated with the AP1000 Matrix Testing. Section 3.0, "Training and Indoctrination," and Section 4.0, "Specialized Training /Qualifications," of the OSU QP requires that all personnel performing or managing activities affecting quality shall be trained in quality requirements applicable to their scope of work. The plan further describes specialized training and qualifications for the Facility Operations Manager, Operators, and Instrumentation and Controls (I&C) technicians. The standards require that both the facility operators and I&C technicians pass written examinations in the disciplines associated with their scope of work. In both instances a written examination may be waived based on previous experience or qualifications and shall be documented with approval from the OSU Program Manager. The standard also requires the facility operators to be certified to perform such activities and that certification documentation include, in part, a description of the activities is qualified to perform, the duration of the qualification, and the basis for the qualification. Section 6.0, "Training Records," of the OSU QP requires individual training records, which include previous personnel work experience, training and qualification records, and Quality Program Indoctrination information to be maintained by the OSU Program Manager.

The team reviewed the training records for the Facility Operations Manager, Facility Operators, and I&C technicians, as well as other individual's associated with the AP-1000 testing program. The team verified that the training records reflected the required information in accordance with the OSU QP, including written examinations for operators and I&C technicians and documentation to support any waivers for such examinations. The training records also provided adequate documentation of the OSU QP indoctrination training, I&C technician calibration training, and AP-1000 design training to support the AP-1000 Matrix testing program.

During the review of Section 13.0, "Records," of Revision 3 of the OSU QP, the team identified that Personnel Training and Qualification Records had been removed from the defined list of "Quality Records for the APEX Test Facility," as previously listed in Revision 2 of the QP. This modification had been made in response to an earlier Westinghouse finding identified during their audit of the AP-1000 testing program, which identified that the training records had not been retained in a manner consistent with the requirements established for quality records. To address this finding, OSU removed personnel training and qualification records from the list of quality records for the APEX Test Facility as listed in Section 14.0, Records," of Revision 2 of the OSU QP. 10 CFR Part 50 Appendix B, Criterion XVII, "Quality Assurance Records," states, in part, that qualifications of personnel are records that shall be maintained to furnish evidence of activities affecting quality. The team concluded that failure to include Personnel Training and Qualification Records on the list of quality records identified in Section 13.0, "Records," of the OSU QP Revision 3, constituted a nonconformance with the requirements of 10 CFR 50, Appendix B, Criterion XVII. This issue is identified as an example of a failure to adequately implement OSU QP requirements under Nonconformance 99901351/2003-01-02.

c. Conclusions

The OSU QP and associated implementing procedures describe the training requirements for individuals associated with the APEX testing facility and provide the necessary detail to ensure training is provided and adequately documented commensurate with the roles and responsibilities of OSU personnel involved in the AP-1000 matrix testing program. However, the team identified a nonconformance where the current revision of the OSU QP, Revision 3, failed to adequately identify quality assurance record requirements regarding qualification and training records consistent with 10 CFR 50, Appendix B, Criterion XVII requirements.

3.9 Calibration of Measuring and Test Equipment

a. Inspection Scope

The inspection team reviewed the applicable programmatic procedures governing the calibration requirements for the test equipment and testing instrumentation of the test facility. The team also reviewed the ATHRL test equipment and testing instrumentation calibration records, and discussed the calibration process with cognizant ATHRL personnel.

b. Observations and Findings

The team reviewed the OSU QPs, Revision 2 and 3, and associated implementation procedures, the ATHRL instrumentation calibration database, and ATHRL memoranda which documented applicable calibration activities associated with the AP-1000 Matrix Testing. Section 9.0, “Instrumentation and Inspection/Test Equipment and Calibration,” and Section 13.0, “Calibration,” of the OSU QP requires, in part, that the procurement of calibration services shall be from a vendor that provides such services to known National Institute of Standards and Technology (NIST) standards, and such calibration activities shall include records which identify pertinent information about such calibration activities. These records shall contain information regarding the NIST standard employed, identify the calibration procedure used, and record both as-found and as-left data for all functions and ranges for the equipment being serviced. Any out of calibration conditions shall also be identified. All calibrations shall be performed in accordance with written procedures and records of the instrument calibration and the instrument calibration procedures shall be maintained as quality records at the APEX facility.

The ATHRL Maintenance Manual, Revision 3, contains the specific implementation guidance for performing testing instrumentation calibration at the facility. The manual establishes and describes the prerequisites, precautions and limitations, calibration periodicity, and calibration record requirements. The manual also provides detailed step-by-step guidance of the calibration activities for the range of test instrumentation at the APEX testing facility. The team reviewed a sample of the instrumentation and test equipment calibration records for a range of instrument types. This included a review of the computerized process used to generate and track calibration work requests. These work requests should verify that the facility instrumentation meets the established calibration standards and verify that the calibration records were maintained as quality records in accordance with the QP and administrative procedures. In general, the team found the calibration records to be complete, conducted in accordance with the QP periodicity requirements, and generally met the criteria established for such records.

However, the team identified the following two examples of a failure to implement adequate control of measuring and test equipment:

1. During a routine facility walk down conducted on October 1, 2003, the team noted that field device, FMM-905, "Break Separator Loop Seal Flow Indicator," did not have a valid calibration sticker in that the next periodic calibration due date had been omitted. The team subsequently attempted to review the test instrumentation calibration records for the FMM-905 device and discovered that the current record contained erroneous information attributed to a piece of test equipment that had been replaced with the existing flow meter on February 26, 2003. Further evaluation revealed that the calibration paperwork associated with the newly installed flow meter had been lost and the instrumentation database and calibration records had not been adequately updated. This was not in accordance with Section D, of the ATHRL Maintenance Manual in that the calibration record for the FMM-905 device did not contain accurate and complete information for the as-built configuration of the facility. As a result of the finding, the OSU staff initiated a Corrective Action Report to document the issue and the remedial actions taken by the facility to correct the deficiency. The facility lead I&C technician verified that all tests that were conducted since the FMM-905 device was put into service correctly showed the desired field range mapping for the unit in the Data Acquisition System (DAS). This assured that the DAS system was accurately configured prior to performance of the AP-1000 matrix testing. Additionally, the facility performed and documented a re-calibration of the unit, on October 1, 2003. The re-calibration verified that the unit had been calibrated at the time of installation and was functioning properly during the period of the AP-1000 matrix testing. The team concluded that the OSU corrective action performed to address the finding to be acceptable.

2. During the review of the calibration implementation, the team noted discrepancies between the documented calibration interval for instrumentation and the actual 18 month calibration intervals currently in effect at the test facility. The team sampled the calibration log records for several power meter and load cell instruments to verify that the instruments were calibrated within the required periodicity. The team identified apparent discrepancies in these calibration records that indicated the instruments had not been calibrated within the 18-month interval. Specific examples included: (1) control panel power meter indication (Power Meter KW-101, Paladine Model TWMUSEHG) used to monitor power delivered to the reactor core heater elements which was last calibrated in January 1998 and; (2) load cell transmitters (LCT-701, 901, and 902, respectively), used to determine IRWST level and primary and secondary sump level indication which where last calibrated in January 1998. The team considered these items not to be in compliance with the established calibration interval requirements specified in the Maintenance Manual, as well as the established 18 month calibration cycle currently in effect.

The team concluded that these two examples constituted a nonconformance with implementation of the OSU QP. Specifically, the OSU ATHRL Maintenance Manual, Revision 3, contains the specific implementation guidance for performing testing instrumentation calibration at the facility. The manual establishes and describes the

prerequisites, precautions and limitations, calibration periodicity, and calibration record requirements. Contrary to these requirements, the team identified examples of the failure to adequately calibrate facility test instrumentation. These issues are identified as an example of a failure to adequately implement OSU QP requirements under Nonconformance 99901351/2003-01-02.

c. Conclusions

The team evaluated the OSU QP and associated implementing procedures, test equipment and testing instrumentation in the AP-1000 matrix testing program calibration logs, and the ATHRL instrumentation calibration database to assure calibration activities were performed in accordance with the administrative requirements set forth in the ATHRL program consistent with the requirements of 10 CFR 50, Appendix B, Criterion XII. While calibration activities were generally performed in accordance with those requirements, the team identified a number of discrepancies that were examples of conditions adverse to quality that occurred during the AP-1000 Matrix testing program. The team concluded that these specific instances of nonconformance did not significantly affect the integrity or reliability of the facility test data.

4 Documents Reviewed

Procedures

A-05	OSU ATHRL Administrative Procedure	Revision 2 November 22, 2002
	OSU ATHRL Maintenance Manual	Revision3 February 20, 2003

Miscellaneous

Quality System	Westinghouse Quality Management System (QMS)	Revision 5
Letter OSU-AP1000-03-09-005	Response to Westinghouse Quality Program Audit Report Dated August 12, 2003	September 16, 2003
Letter OSU-AP1000-03-09-006	APEX-1000 Test Facility Configuration	September 16, 2003
Quality Plan	Oregon State University Advanced Thermal Hydraulic Research Laboratory Quality Plan	Revision 3.0 August 4, 2003
Quality Plan	Oregon State University Advanced Thermal Hydraulic Research Laboratory Quality Plan	Revision 2.0 November 15, 2002
OSU-APEX-03002	OSU APEX-1000 Test Facility Description Report	May 12, 2003
OSU-MISC-003	OSU ATHRL, Power Meter Verification	Revision 0 June 3, 2003

Drawings

P&ID Drawing OSU 600501	CMT 01	Revision 7
As-Built Drawing MS	Main Steam	Revision 2
P&ID Drawing OSU 600301	Steam Generators	Revision 11
As-Built Drawing ADS-4	Automatic Depress. System	Revision 2

P&ID Drawing OSU 600203	RCS System	Revision 12
As-Built Drawing HTL-2	Hot Legs	Revision 2
As-Built Drawing HTL-1	Hot Leg	Revision 2
As-Built Drawing Sump-1	Sump system	Revision 4
As-Built Drawing PRHR	Passive Residual Heat Return	Revision 3
As-Built Drawing CMT-01	Core Makeup Tank	Revision 2
P&ID Drawing OSU 600002	Fill/Feed/MS Systems	Revision 11

Test Reports

OSU-AP1000-01	Double Ended DVI With 3 of 4 ADS 4	Revision 0
OSU-AP1000-02	100 PSIA ADS and Steady-State Entrainment Test	Revision 0
OSU-AP1000-04	AP1000 Double Ended DVI With 3 of 4 ADS 4	Revision 0
OSU-AP1000-05	AP1000 Bottom of CL #4 2" Break	Revision 0
OSU-AP1000-06	AP1000 Full Pressure ADS 4 Blowdown With 3 out of 4 ADS 4	Revision 0
OSU-F-08	APEX AP1000 Injection Line Flow Test	Revision 0
OSU-V-03	CMT Volume Determination Test for AP1000	Revision 0
OSU-V-04	Pressurizer Volume Determination Test for AP1000	Revision 0

Memorandum	APEX Indoctrination Training	November 15, 2002
Memorandum	Calibration Training	November 26, 2002
Memorandum	Corrective Action for missing calibration record for device FMM-905	October 1, 2003

5. PERSONS CONTACTED

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+ * John T. Groome, APEX Test Facility Operating Manager
+ John A. Hopson, ATHRL DAS Coordinator
+ * Teresa Culver, Administrative Project Specialist

Westinghouse Electric Company

+ J.W. Winters, Manager, Passive Plant Projects, AP1000

+ Attended entrance meeting on 9/30/03
* Attended exit meeting on 10/02/03