UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W., SUITE 2900
ATLANTA, GEORGIA 30323-0199

Report Nos.: 50-390/94-25 and 50-391/94-25

Licensee: Tennessee Valley Authority
6N 38A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Docket Nos.: 50-390 and 50-391 License Nos.: CPPR-91 and CPPR-92

Facility Name: Watts Bar 1 and 2

Inspection Conducted: March 21 - April 1, 1994

Inspectors: L R Moore 4/8/94
R. Moore Date Signed

G MacDonald 4/18/94
G. MacDonald Date Signed

Approved By: Candle Julian 4/20/94
C. Julian Date Signed

SUMMARY

Scope:

The purpose of this inspection was to assess the licensee's component testing for Unit 1 and common equipment. The inspectors reviewed electrical and mechanical testing to determine if the equipment functional operability was adequately demonstrated by component tests.

Results:

Overall, the component test results demonstrated adequate verification of the functional operability of tested electrical and mechanical equipment. One exception was pump testing. Several examples were noted in which documentation did not justify acceptance of tests that did not meet the required generic test acceptance criteria. This issue was previously identified by the licensee and all pump test results were to be evaluated by Nuclear Engineering. This item is identified as Inspector Follow-up Item 94-25-01, Justification for Deviations from Pump Generic Test Acceptance Criteria (paragraph 2.3.2).

In the third quarter of 1993, the NRC and the licensee identified administrative and documentation deficiencies in component test activities. Corrective actions which included reorganization of the Startup and Test Organization (SUT), procedure upgrades, and extensive review of completed test results adequately addressed these deficiencies for component testing.

No violations or deviations were identified.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*R. Baron, General Manager, Nuclear Assurance
F. Cobb, Lead Test Engineer, Startup and Test
*D. Daly, Manager, Startup and Test
*W. Elliot, Manager, Engineering and Modifications
P. Hawkins, Lead Instrumentation and Control Test Engineer
D. Kehoe, Quality Assurance Manager, Startup and Test
*D. Koehl, Manager, Technical Support
J. Lund, Principal Mechanical Engineer, Nuclear Engineering
*B. OBrien, Maintenance
*G. Ondriska, Startup Procedures
H. Orozco, Lead Electrical Test Engineer
*P. Pace, Manager, Compliance/Licensing
*T. Porter, Manager, Licensing
S. Poulsen, Test Engineer
*M. Singh, Manager, Modifications
*L. Spears, Site QA Manager
*C. Touchstone, Licensing Engineer
R. Wiggal, Supervisor, Nuclear Engineering

Other licensee employees contacted during this inspection included engineers and administrative personnel.

NRC Personnel

*J. Lara, Resident Inspector

*Attended Exit Interview

Acronyms and abbreviations are listed in paragraph 4.0.

2.0 Pre-operational Test Program Review (IP 70301)

2.1 Background

Component testing activity at Watts Bar began in the first quarter of 1992. The licensee's FSAR section 14.2 stated that the purpose of component testing was to prepare components for pre-operational testing. FSAR section 14.2.12.1, Pre-operational Tests, required that the "functional operability" of individual components be demonstrated as a prerequisite to system level pre-operational testing. The status of component testing at the date of this inspection was that 16,137 tests were completed using approximately 194,000 manhours. There were 9,687 planned tests remaining with a projected manhours of 134,000.

In the third quarter of 1993 the NRC identified program deficiencies in the pre-operational test program which encompassed component test activities. Subsequently the licensee increased the intensity of their qualitative assessments in this area and identified further problems.

Significant Corrective Action Report (SCAR) 930151, which included fourteen Problem Evaluation Reports (PERs) and one Quality Assurance Finding Identification Report (FIR), "... identified a trend of deterioration in the quality of startup testing implementation." The licensee's corrective actions are discussed in paragraph 2.6 of this report. Pre-operational testing was discontinued when the SCAR was initiated; however, component testing continued.

This inspection assessed the adequacy of component testing in demonstrating the functional operability of tested equipment as required by FSAR, Section 14.2. The inspectors selected a sample of electrical and mechanical equipment which had been tested before and after the SCAR 930151 corrective action completion dates. Additionally, the inspectors observed component testing performed during the inspection. The inspectors verified that testing was conducted as described in the Startup Manual (SUM) and in accordance with the Generic Test (GT) procedures. The inspection included review of the training and certification of level II and level III test engineers and the licensee's QA monitoring of test activities.

2.2 Electrical Equipment

Electrical equipment testing reviewed by the inspectors consisted of insulation resistance testing, electrical scheme verification, molded case circuit breakers (MCCBs), and timer relays. The inspectors reviewed completed tests and witnessed testing to determine if the test results verified component operability. Testing was reviewed against the requirements of SUM, Section 6.0, Component Testing, and the appropriate generic test procedures. The inspectors reviewed electrical component tests conducted by vendors, plant maintenance, and the SUT organization. For tests not conducted by SUT, the inspectors verified the test procedures and test results were reviewed and approved by SUT.

2.2.1 Insulation Resistance Testing

Procedure GTE-01, Insulation Resistance, Revision 1 and 3, provided guidance for equipment and cable insulation resistance testing. These tests were conducted by SUT. The following tests were reviewed:

CSI No.	Description
1082A2126 E01000	EDG 1A-A Insulation Resistance
1082A2126 E01001	EDG 1A-A Insulation Resistance Retest
1082A1370 E01000	EDG 1A-A Lube Oil Circulating Pump
1082A1330 E01000	EDG 1A-A Air Compressor
1082A1376 E01000	Auxiliary AC Lube Oil Circulating Pump 2

The documentation indicated that the tests were performed in accordance with the generic test procedure. The test results demonstrated that the test acceptance criteria were met for all tests the inspectors reviewed.

The inspectors concluded that insulation resistance testing was adequate.

2.2.2 Timer Relays

Procedure GTE-14, Timer Relays, Revisions 4 and 5, provided guidance for testing of time delay devices and timer relays. The testing was performed by the SUT organization. The following tests were reviewed:

CSI No.	Description
0082A1904 E14000	EDG 1A-A Time Delay Relay TD3A
0026 0888 E14000	High Pressure Fire Pump Strainer Motor B-B Timer Relay

The inspectors reviewed the documentation for the EDG 1A-A time delay relay and observed test performance of the fire pump strainer relay. The test results for the EDG relay demonstrated that the test was conducted in accordance with the GT procedure and the results met the acceptance criteria. The observed test was conducted in accordance with SUM section 6.0, Component testing, revision 12 and GTE-14, revision 5. The initial test determined that the timer motor required replacement. The timer was replaced, and the GT procedure was performed again to demonstrate that the acceptance criteria were met. The inspectors concluded that the component testing of the timer relays adequately verified the functional operability of these devices.

2.2.3 Electrical Scheme Verification

Procedure GTE-2, Scheme Verification, Revisions 3,4, and 6 provided guidance for this testing. Electrical scheme verification testing was conducted by the SUT organization. The following tests were reviewed by the inspectors:

CSI No.	Description
10670895E02000	RCP 3 Motor Cooler ERCW Supply Valve
10630011E02000	Safety Injection Pump A-A Discharge to RWST
10630020E02000	Safety Injection System Pump Inlet to CVCS Charging Pump
10630464E02000	RHR Return Line Pipe Break Annunciator
10630464E02001	RHR Return Line Pipe Break Annunciator retest
10670258E02000	ERCW Auxiliary Building Supply Header 1B Isolation Valve
1082A2083E02000	EDG 1A-A Electric Governor
1082A2105E02000	EDG 1A-A Air Start Solenoid Valve
1082A2109E02000	EDG 1A-A Remote Emergency Start Circuit

Test results indicated that the electrical circuits matched the requirements of the design drawings identified by the test packages. The testing met the requirements of GTE-2. Test deficiency notices were prepared for circuits which did not match the design drawings.

The inspectors witnessed the performance of the following electrical scheme checks:

CSI No.	Description
10010347E02000	1-FCV-1-107 Steam Dump to Condenser A
10010348E02000	1-FCV-1-108 Steam Dump to Condenser A
10010349E02000	1-FCV-1-109 Steam Dump to Condenser A
10010350E02000	1-FCV-1-110 Steam Dump to Condenser A

The inspectors noted that the testing was performed to the requirements of SUM section 6.0 and Generic Test GTE-2 revision 7. The circuit schemes were verified to match the design drawing, 1-45N600-1-2, revision 8, which was referenced for acceptance criteria in the test packages. The inspectors concluded that the observed scheme verification testing was adequate.

2.2.4 Molded Case Circuit Breakers

Testing of MCCBs was performed by plant electrical maintenance and vendors. Plant procedure MI 57.27, Initial Testing Of Molded Case Circuit Breakers, Revision 11, provided guidance for MCCB testing by electrical maintenance. The procedure was approved by SUT as meeting the component test requirements on a SUM, Section 6.0, Appendix C evaluation form dated March 5, 1994. SUT generic test GTE-15, Molded Case Circuit Breakers, Revision 2, was approved on February 10, 1994. Electrical maintenance MCCB testing was documented on plant work orders.

On August 19, 1992, the licensee initiated SCAR No. WBSCA920069, revision 0, due to a high failure rate of the existing MCCBs during MCCB testing. The root cause for failure was evaluated through destructive examination. The examination identified concrete dust and debris contamination on breaker contacts, internal mechanisms, and breaker lubricant. Licensee management implemented a breaker changeout program to replace existing MCCBs with vendor tested breakers. The SCAR was still open with a closure date of September 30, 1994. The MCCBs were installed in accordance with system schedules; the last system was scheduled for August 31, 1994. At the time of the inspection, 2328 MCCBs had been replaced and 542 MCCBs still required replacement. The SCAR root cause determination and corrective action was adequate.

Farwell and Hendricks, Southern Testing Services, and United Controls Inc. were approved to provide tested MCCBs and testing services. The vendors developed procedures based on MCCB Test Procedure MI 57.27, Revision 11, which had been approved by SUT. United Controls MCCB testing was controlled by Procedure NQTP-1816.1.1, Revision 3, Nuclear Qualification Test Plan Molded Case Circuit Breakers, which was approved by licensee engineering on January 26, 1993. Farwell and Hendricks MCCB testing was performed to Procedure TVA-1, Revision 0, Functional Test Procedure For Molded Case Circuit Breakers For Tennessee Valley Authority In Compliance With TVA Procedure MI 57.27, which was approved by licensee engineering on December 18, 1992. Southern Testing Services

MCCB testing was performed on individual procedures prepared for specific make/models of MCCBs. The instructions used by Southern Testing Services were generic and were based on Procedure MI 57.27. The vendor MCCB test procedures were approved by SUT on SUM, Section 6.0, Appendix C forms dated March 16, 1993, and March 5, 1994.

Vendor tested MCCBs and test documentation was reviewed by licensee Procurement Engineering for acceptance. Existing MCCBs were replaced using the work order process. The work order process controlled the removal of the existing MCCBs, cleanliness, configuration control, and connector tightness. No additional MCCB testing was to be performed by SUT or electrical maintenance personnel following installation of the vendor tested MCCBs. SUT reviewed the MCCB test results data sheets in the work orders. The following tests were reviewed:

CSI No.	Description
10630006E15000	Breaker WBN-1-BKR-063-0001B-A
10630024E15000	Breaker WBN-1-BKR-063-0008-A
00670022E15000	Breaker WBN-1-BKR-067-0360A
10670161E15000	Breaker WBN-1-BKR-067-0009A-A
10670162E15000	Breaker WBN-1-BKR-067-0009B-A
1082A2066E15000	Breaker WBN-1-BKR-082-0181-A
10630003E15000	Breaker WBN-1-BKR-063-0001A-A

The test sample selected for review included testing performed by electrical maintenance and all three vendors. The test results met the acceptance criteria of the approved vendor test procedure or MI 57.27 as appropriate to the performing organization. Acceptance criteria for the trip testing were based on vendor trip curves and data. M&TE was verified to be within calibration and the inspectors noted that SUT had reviewed the results. The inspectors concluded that the testing implemented the requirements of the SUM and verified the functional operability of the MCCBs as required by FSAR 14.2.

2.3 Mechanical Equipment

Mechanical equipment reviewed by the inspectors included relief valves, pumps, manual valves with operator extensions and fire dampers. The focus of the review was to determine if the test results adequately demonstrated the functional operability of the equipment as required by FSAR 14.2. Additionally, the inspectors reviewed component test activity to determine if administrative controls were consistent with the SUM requirements and test conduct was consistent with GT procedure requirements.

2.3.1 Relief Valves

Relief valve testing was performed by the plant maintenance organization. Plant Procedure MI 0.11, Safety/Relief Valves, Revision 12, provided guidance for this testing. This procedure was evaluated by the SUT organization and verified to implement the

component test requirements. The evaluation was documented on an SUM Appendix C evaluation form dated September 16, 1992. The generic test procedure, GTM-07, Safety/Relief Valves, Revision 1, was approved on February 8, 1994. The tests were documented on plant work orders (WOs). The following tests were reviewed by the inspectors:

WO No.:	Description
93-02716-00	Safety Injection (SIS) Pump Discharge Relief
93-02714-00	Residual Heat Removal (RHR) Heat Exchanger Relief
93-02719-00	Accumulator 2 Relief
93-02675-00	SIS Pump Suction Relief
93-00388-64	Essential Raw Cooling Water (ERCW) Reactor Building Return Header 1C Relief
93-00388-27	Component Cooling System (CCS) and Auxiliary Feedwater System (AFW) SP Cooler 1A Relief
93-03550-00	Air Tank Relief
93-03556-00	Air Tank Relief
93-00388-02	ERCW EDG 1B-B Heat Exchanger 1B2 Relief

The documentation for the above relief valve tests demonstrated that the equipment was tested in accordance with the GT procedure requirements. Appropriate calibrated measuring and test equipment (M&TE) was used to verify valve set pressures. The inspectors concluded that relief valve testing implemented the requirements of the SUM and verified the functional operability of the valves as required by FSAR 14.2.

2.3.2 Pumps

Generic Test Procedure GTM-02, Pump Functional Test, Revision 1, provided the guidance for test conduct and established the acceptance criteria for pump testing. The acceptance criteria required the verification of motor nameplate parameters, vibration testing, and a three point verification of the manufacturer's pump curve. The following tests were conducted by the SUT organization and test results documentation was reviewed by the inspectors.

CSI No.	Description
0067 -0133-M02000	ERCW Pump D-A
1082A-1393-M02000	EDG 1A-A AC Lube Oil Circ Pump 1
1082A-1397-M02000	EDG 1A-A Aux. AC Lube Oil Circ Pump A
1082A-1399-M02000	EDG 1A-A Aux. AC lube Oil Circ Pump B
1062A-0356-M02000	Centrifugal Charging Pump 1B-B
1062A-0360-M02000	Centrifugal Charging Pump 1A-A
1063 -0384-M02000	SI Pump 1A-A
1063 -0385-M02000	SI Pump 1B-B
1074 -0080-M02000	RHR Pump 1B-B
1074 -0079-M02000	RHR Pump 1A-A
2067 -0680-M02000	ERCW Screen Wash Pump 2A-A

The inspectors noted examples of accepted pump tests in which the GT acceptance criteria for the three point pump curve verification were not met (for example, skid mounted EDG lube oil auxiliary pumps and the ERCW screen wash pump). For the EDG lube oil pumps, there were no curves provided by the vendor; however, no alternate acceptance criteria for flow verification was provided. Two points rather than three points were determined for the screen wash pump and the component cooling pumps. No justification was documented for the acceptance of these tests with results deviating from the GT acceptance criteria. The licensee had previously identified this issue and initiated FIR 930128, which was not yet resolved. These tests had been performed before the SCAR 930151 corrective action implementation. The corrective action for this FIR required an evaluation by Nuclear Engineering of 65 completed pump test results. The inspectors concluded that the test documentation with unjustified acceptance criteria deviations did not provide verification of the functional operability of pumps. This item was identified as inspector followup item (IFI) 50-390/94-25-01, Justification for Deviations from Pump Generic Test Acceptance Criteria.

Other pumps tests which did not meet the pump curve verification requirement were the ERCW pumps, SI pumps and RHR pumps. In the case of the ERCW pumps, engineering calculated a new pump minimum flow requirement based on Unit 1 operations only and determined that adequate flow margin was available. The SIS and RHR pump tests results did not vary substantially from the pump curve; however, they were not accepted as successful tests by the licensee. It was noted by the inspectors that these tests were performed after completion of corrective actions for SCAR 930151. Flow verification for these pumps would be accomplished by the system level pre-operational tests. The engineering evaluations resolving the test deficiency notices (TDNs) for these tests stated that the system level testing would accomplish more accurate pump flow determinations. The inspectors concluded that the SIS and RHR pump component tests were adequate to support system level pre-operational testing.

2.3.3 Manual Valves and Fire Dampers

Procedure guidance for manual valve testing and Fire dampers were provided by GTM-01, Manual Valve Test, Revision 3, and GTM-03, HVAC Gravity Dampers, Fire Dampers, and Fire Doors, Revision 3. Manual valve testing was performed for valves with operator extension linkages. The following component tests were reviewed. These tests were performed by the SUT organization.

CSI No.	Description
1062A-0642-M01000	HT Recirc Pump Suction
1062A-0638-M01000	CVCS Seal Water Heat Exchanger Bypass
0031R-0068-M03000	Battery Room Exhaust Isolation
0031R-0070-M03000	Battery Room Exhaust Isolation
0031Q-0036-M03000	No. 1 250 V Battery Board Room
0031P-0002-M03000	Control Room AHU A Backdraft Damper

The documentation demonstrated that the tests were conducted in accordance with SUM 6.0, and the acceptance criteria of the applicable GT procedure were met. The inspectors concluded that the tests adequately verified the functional operability of the tested equipment.

2.4 Training and Certification of Test Engineers

The inspectors reviewed the licensee's training requirements for test engineers implementing the component test program. Section 14.2.2.7 of the FSAR stated the education and experience requirements for level II and level III test engineers with the responsibility for preparing procedures, conducting testing, and reviewing test results. The FSAR requirements were implemented in the SUM procedure 5.0, Indoctrination, Training, and Certification of SUT Personnel, revision 3.

The inspectors reviewed the list of certified Level II and Level III test engineers. Documentation was reviewed to verify that training and certification requirements were met for a selected a sample of test engineers. Component tests reviewed by the inspectors received the appropriate Level II and Level III test engineer reviews by certified individuals. In PER 930284, the licensee identified examples of component tests which were not reviewed by appropriate certified test engineers. The corrective action required the review of approximately 9000 test results by SUT to verify the adequacy of the performed tests. The review identified that 44 components required retest. The inspectors verified the retests were entered into the component test matrices.

2.5 Component Test Matrix

Section 14.2 of the FSAR stated that safety related and selected non-safety related equipment will be included in the component test program. The Watts Bar Nuclear Plant Component Test Matrix CSI Report identified specific equipment to be tested. The inspectors selected a sample of equipment from SIS and RHR system drawings to verify inclusion on the component test matrix. The following equipment was selected for this verification:

Drawing 1-47W810-1, RHR System Flow Diagram, revision 9

FCV 74-9	FCV 63-185
FCV 74-1	RCV 74-505
FCV 74-35	FCV 74-32
FCV 74-24	FCV 74-26
FCV 74-12	FE 74-12
RHR PUMP 1A-A	FCV 74-3

Drawing 1-47W811-1, SI System Flow Diagram, revision 11

FE 63-159	FCV 63-164
RCV 63-604	FCV 63-166
FCV 63-97	FCV 63-79

FCV 63-11	RCV 63-535
RCV 63-637	FCV 63-5
SIS Pump 1B-B	

The above components were included on the Component Test Matrix CSI Report dated March 23, 1994. The inspectors concluded the licensee's identification of safety related equipment to be included in the component test program was adequate.

2.6 Previously Identified Component Test Program Deficiencies

The following PERs and FIRs from SCAR 930151 specifically addressed component test activity deficiencies. As indicated by the descriptions, these issues were primarily administrative and documentation deficiencies. The items were identified in the third quarter of 1993 and corrective action implementation was completed in January, 1994.

PER 930309	Test Approval Processing for Special Performance Tests Inadequate
PER 930284	SUT Test Engineers Did Not Review Plant Performed Component Test Results as Required By SUM
PER 930325	M&TE Out of Tolerance Notices Not Evaluated in Required Time Period
PER 930761	Non-Safety Related Pumps Did Not Meet GTM-02 Acceptance Criteria
FIR 930128	Safety Related Pump Tests Did Not Meet GTM-02 Acceptance Criteria
PER 930239	Test Procedure Steps Not Performed or Not Performed in Sequence
PER 930209	SUT Review and Approval of Plant Test Procedures for Acceptance Not Accomplished/Documented
PER 930202	Inadequate M&TE Accuracy for Testing of Equipment

Corrective actions for SCAR 930151 addressed the program or process deficiencies which contributed to these issues. These corrective actions included reorganization of the SUT organization with management experienced in startup activities, review and revision of procedures, and retraining of personnel. Procedure compliance was emphasized. Additionally, a comprehensive review of component test results was performed by the licensee's test engineers to verify the adequacy of testing. The SUM was revised to include a section specifically addressing component testing separate from pre-operational system level testing. The GT procedures were revised to clarify acceptance criteria

and administrative requirements. The inspectors concluded that the corrective actions adequately addressed the identified component test related deficiencies.

The inspectors reviewed documentation for tests before and after the SCAR initiation to verify that the equipment function was adequately demonstrated by component testing. These tests were discussed in paragraphs 2.3 and 2.4 of this report. The majority of component tests reviewed by the inspectors were performed prior to the August, 1993 initiation date of SCAR 930151. Although the inspectors noted examples of the documentation and administrative deficiencies previously identified, the test results indicated that adequate verification of equipment function was accomplished. The inspectors noted no examples of these deficiencies in tests of electrical and mechanical equipment tested after August, 1993.

2.7 Quality Assurance (QA) Monitoring

The inspectors reviewed QA monitoring of component test activities. At the date of this inspection, there was a QA manager and five QA evaluators specifically assigned to the SUT organization. QA staff coverage was provided on two shifts, days and swings. The inspectors reviewed a sample of QA audit reports which monitored various aspects of component testing performance. These included conduct of testing, test procedure review and approval, test results review and approval, identification and resolution of TDNs, impact of temporary modifications on testing, and evaluation of Level II and Level III test engineer activities.

Several reports demonstrated the licensee's quality assurance organizations monitoring of component test activity. Audit Report NA-WB-94-0019 reviewed approved component test packages for electrical and mechanical equipment. PER 940060 was issued to identify motor winding resistance testing which did not incorporate a resistance correction factor. Corrective action required retest of the equipment. Audit Report NA-WB-94-0009 was a detailed assessment of pre-operational and component testing of the SIS and RHR equipment. Sixty component tests were reviewed to verify that tests performed prior to the SCAR 930151 initiation adequately demonstrated equipment function. Audit Reports NA-WB-93-0125 and QWB-R-93-0034 evaluated test conduct. Findings from these audits resulted in upgrading of GT procedures

The inspectors reviewed the December 1993, and January, 1994 TDN Trend Reports which provided a trend of causes for test deficiencies. For example, in the month of January, wiring errors contributed to 84 percent of 101 TDNs. The inspectors concluded that QA monitoring of component test activities was adequate.

3.0 Exit Interview

The inspection scope and findings were summarized on April 1, 1994 with those person indicated in paragraph 1. The lead inspector described the areas inspected and discussed in detail the inspection results below. Dissenting comments were not received from the licensee. Proprietary information is not contained in this report.

(Open) Inspector Followup Item 50-390/94-25-01, Justification for Deviations from Pump Generic Test Acceptance Criteria.

4.0 Acronyms and abbreviations

AHU	Air Handling Unit
CCS	Component Cooling System
CVCS	Chemical and Volume Control System
EDG	Emergency Diesel Generator
ERCW	Essential Raw Cooling Water
FCV	Flow Control Valve
FE	Flow Element
FIR	Finding Identification Report (QA audit)
FSAR	Final Safety Analysis Report
GT	Generic Test
GTE	Generic Test Electrical
GTM	Generic Test Mechanical
IP	Inspection Procedure
MCCB	Molded Case Circuit Breaker
M&TE	Measuring and Test Equipment
PER	Problem Evaluation Report
QA	Quality Assurance
RCP	Reactor Coolant Pump
RCV	Relief Valve
RHR	Residual Heat Removal (system)
RWST	Refueling Water Storage Tank
SI	Safety Injection
SIS	Safety Injection System
SUT	Startup and Test (organization)
TDN	Test Deficiency Notice
WO	Work Order