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ENCLOSURE

SAFETY EVALUATION REPORT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PRESTART TEST CORRECTIVE ACTION PROGRAM

TENNESSEE VALLEY AUTHORITY

WATTS BAR NUCLEAR PLANT, UNIT 1

DOCKET NO. 50-390

1.0 INTRODUCTION

The Nuclear Regulatory Commission (NRC) requires licensees to demonstrate that their nuclear facility plant equipment is capable of performing its designed safety functions prior to plant fuel loading. The Tennessee Valley Authority (TVA), as required by 10 CFR 50, Appendix B, Section XI, conducted a Preoperational Test Program to accomplish this objective for the Watts Bar Nuclear Plant Unit 1 (WBN). The Preoperational Test Program for WBN is described in detail in Chapter 14.0 of the WBN Final Safety Analysis Report (FSAR). FSAR, Chapter 14.0, states that the WBN Preoperational Test Program shall be conducted in full compliance with NRC Regulatory Guide (RG) 1.68, "Preoperational and Initial Start-up Test Programs For Water-Cooled Power Reactors", November 1973 (RG 1.68). For purposes of system preoperational and initial start-up testing, this commitment remains in place for plant licensing including fuel loading and subsequent power operation. TVA has stated that the Preoperational Test Program for WBN Unit 1 is essentially complete.

A lengthy delay has occurred between the completion of many WBN Unit 1 preoperational tests previously conducted, and future plant operation. This delay resulted from TVA's management breakdown and the extended shutdown of all of TVA's nuclear facilities. TVA implemented a management reorganization and a redirection of resources to recover their already licensed facilities as well as the licensing of WBN. To address TVA's concerns, as well as NRC staff concerns, regarding the current capability of the WBN safety systems to perform their intended safety functions, TVA has proposed to conduct a Prestart Test Corrective Action Program (CAP). By submittal dated December 30, 1988, subsequently revised by submittal dated June 26, 1989, and by separate submittal dated May 22, 1989, TVA has provided a WBN Prestart Test CAP Plan.

TVA has stated in the Prestart Test CAP that the unique condition at the WBN facility, in terms of the lengthy delay between construction, preoperational testing and future plant operations, has raised specific concerns regarding; plant equipment degradation, the effect on the operating organizations' knowledge about the plant and its procedures, and equipment modifications performed without adequate post-modification testing.

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The stated objective of the Prestart Test CAP Plan is, to the extent required for fuel loading at WBN, to demonstrate the operational capability of the safety systems as well as other frequently used systems for safe power operation. The WBN safety systems and their attendant safety functions have been provided in the WBN Prestart Test CAP. TVA has used and will continue to use the generated output from TVA's Nuclear Engineering Design Baseline Verification Program as the source for system and component functional testing requirements. A discussion of TVA's proposed exceptions to the RG-1.68 testing requirements is provided in Section 2.3.5 below. Major testing planned at WBN includes: integrated engineered safety features actuation testing, standby power supply (diesel generator) testing, containment integrated leak rate testing, and non-nuclear heatup testing.

TVA has proposed this program as a supplement to the essentially completed WBN Preoperational Test Program and as a CAP in the recovery of the WBN facility. TVA has stated this program will identify, document, investigate, and correct problems at WBN related to its safety systems and components in preparation for fuel loading. The satisfactory results of this program combined with other TVA programs will be used by TVA to support initial fuel loading, start-up, and subsequent power operation.

2.0 EVALUATION

2.1 Overall Scope and Objective of the Prestart Test Program (PTP)

The principle objective of the PTP is to engender confidence that certain pre-operational tests conducted, which previously demonstrated the operational capability of WBN, remain valid, and, for those safety systems and components which have become suspect by mere fact of the lengthy delay between the pre-operational tests and future plant operation, a retest shall be conducted. System functional testing shall also be conducted in instances where post-modification testing was or is believed to have been inadequate.

The PTP, as proposed by TVA, will fulfill the requirements of RG 1.68 for the pre-fuel loading part of the system functional test program with certain defined exclusions. A list of the systems to be tested is provided in Table 1 of the PTP submittal. The systems and tests excluded from the program and the basis for the exclusions are provided in Exhibit A of the same.

TVA has designed the PTP to provide for extensive pretest and post-test engineering reviews. Each engineering review will be formally documented thereby ensuring the adequacy and availability of the test performance and the test results.

2.2 Prestart Test Program Organization and Information Flow

Attachment 2 of TVA's June 26, 1989 submittal illustrates a flow chart of the PTP process and the groups responsible for the process steps. A Joint Test Group (JTG) is responsible for reviewing PTP documentation. As discussed

above, the PTP input acceptance criteria primarily originates from the output of TVA's WBN Design Baseline and Verification Program for each system/component. The Systems Engineering Section, Technical Support prepares and reviews the Functional Analysis Reports (FARs), the Test Analysis Reports (TARs) and Test Analysis Packages (TAPs). These documents are discussed below. Systems Engineering also prepares and implements the PTP Test Instructions where necessary.

The JTG organization, referred to above, performs upper level overall reviews of the PTP documentation. The charter for the JTG is documented in Site Director Procedure AI-6.13, "JTG Charter". These reviews include addressing the potential impact of other WBN programs on PTP testing, Test Instruction development, test result reviews, and the review of the pretest FARs, and the post-test TAR's.

The PTP individual system test results, are compiled into a TAP, and are presented to the JTG and Plant Operating Review Committee (PORC) for approval. Subsequent to the PORC's review and approval, the Plant Manager's approval of the TAP is required. The approved TAP is kept as a permanent Quality Assurance record.

The staff has reviewed the membership and information flow of the PTP and concludes that an adequate representation of technical expertise and an adequate level of managerial responsible charge exists within the PTP process to achieve the PTP objectives.

2.3 Prestart Test Program Methodology

The Prestart Test Program (PTP) will be conducted and audited by TVA using appropriate plant procedures. Specifically, WBN Site Instruction AI-6.12, Prestart Test Program, Site Director Procedure AI-6.13, JTG Charter, Site Director Procedure AI-6.14, Conduct of Test, and Site Director Procedure AI-6.15, System Completion Verification, are some of the procedures which will be used to implement the PTP.

2.3.1 Systems and Component Functions Identification

The systems and component level functions to be tested as part of the WBN PTP are defined in the pretest review process. The WBN Design Baseline Verification Program, which is being conducted by TVA's Nuclear Engineering organization, includes the generation of revised preoperational test scoping documents. These documents are or will be prepared for all of the systems listed in Table 1 of TVA's PTP submittal dated June 26, 1989. These documents will also be reviewed by the WBN PTP Test Engineers for consistency with the FSAR, Design Criteria, Technical Specifications, and Configuration Control Drawings.

The system functions, as defined by the WBN PTP, include those functions that involve more than one component, system response for accident as well as normal

operation, automatic actuations and interlocks, and response time performance. System functional verification is required by the PTP as well as those functional requirements associated with an individual component within a given system.

Functions which are addressed by the WBN PTP include all primary safety functions, including those needed to protect the integrity of the reactor coolant pressure boundary, those needed to achieve and maintain safe shutdown, and those needed to prevent or mitigate the consequences of accidents. TVA has also included as part of the PTP, WBN fire detection and suppression functions as well as other balance of plant equipment, whose failure could prevent or cause a reactor trip or engineered safety features actuation.

2.3.2 Function Test Matrices (FTM) and Functional Analysis Reports (FAR's)

The pretest reviews, referred to above, result in the preparation of certain PTP documents called FTM's and FAR's for each system to be tested. The system and component functions are compiled into a matrix (FTM) which will identify the test or tests required to demonstrate system and component functional acceptability. The FTM's are an attachment to the FAR. The FAR lists a system's major functions, including components, flow requirements, vibration criteria and interfacing functions, such as interlocks and signals. The FAR's also list the references used, the Test Instructions used to test the system functions, applicable as-constructed drawings, applicable as-designed drawings, applicable Surveillance Instructions for functional validation, and a general system description. The system description is taken from the WBN FSAR and WBN SER. The FAR also provides a checklist for the Prestart Test Engineer, and PTP Test Request Forms which list equipment and the type of testing to be performed. The staff has reviewed the FAR and FTM documents for the Component Cooling System, as a sample of such documents, and finds them to be satisfactory in terms of providing system and functional information including cross-references to Test Instructions for use by the Prestart Test Engineer.

In addition to the above PTP documents, TVA has implemented Site Director Procedure AI-6.15, System Completion Verification which provides a process to ensure all identified open work items affecting a system's return to service be completed or dispositioned prior to prestart testing. This procedure is discussed in more detail in Section 2.3.7 of this evaluation. As discussed above, the JTG must review and approve each FAR prior to commencement of each specific PTP test.

2.3.3 Test Instructions and Test Conduct

TVA has chosen to utilize, where possible, the existing plant procedures and instructions (e.g., Surveillance Instructions), to implement the WBN PTP. In cases where the existing plant instructions would not adequately verify the required system or component functions, new test instructions will be prepared or changes to existing instructions will be made to address the PTP requirements. All new PTP Test Instructions as well as those existing

instructions which are changed to accommodate PTP requirements must be reviewed and approved by the JTG prior to their implementation.

PTP test performance activities will be conducted in accordance with the requirements of each specific FAR. Test conduct will be in accordance with Site Director Procedure AI-6.14, Conduct of Test, which will ensure that PTP personnel have the guidance, the requirements, and the responsibility in the performance of test activities. Using a procedure for such a situation will ensure that the performance of all testing activities are uniformly controlled while performed. AI-6.14 specifically lists the Test Director qualifications and his responsibilities, including what to do for identified test deficiencies or procedural deviations. The staff has reviewed AI-6.14 and finds the procedure satisfactory in content for the purposes of supporting PTP testing implementation.

2.3.4 Test Analysis Packages (TAPS)

Following completion of a system's testing a TAP will be prepared for that system. TVA has stated that each TAP will include the successfully completed Test Instructions, reviews conducted of the tests and the completed FTM. JTG review and concurrence of each TAP is required prior to PORC review and Quality Assurance retention. The staff finds this PTP process acceptable as it will ensure that documented evidence of the completed tests including disposition of any test deficiencies and omissions are available for TVA and NRC staff review.

2.3.5 PTP System Exceptions

The PTP must test the systems necessary to support WBN fuel loading and safe shutdown following an accident. Exhibit A of TVA's submittal dated June 26, 1989, provides a discussion of those systems which are excluded from the PTP and the basis for each exclusion. System exclusions are primarily based on the successful completion of the WBN Preoperational Test Program or on the fact that the system will be tested, subsequent to the PTP, as part of the Preoperational Test Program (e.g. start up testing). Some systems are excluded from testing because the loading of nuclear fuel prior to testing is the required or the preferred way to test the system (e.g., Extraction Steam System, Incore Flux Detection System).

Most "Balance of Plant" systems have been excluded from the PTP because these systems are already in service, were adequately tested by the Preoperational Test Program, or are currently under operations control and do not present a challenge to safe shutdown or accident mitigation. Some systems in this category of exclusions include; Auxiliary Boiler, Water Treatment, Building Heating, 6.9 Kilovolt Unit Power System, Yard Lighting, and the Plant Process Computer. The complete list of exclusions is included in Exhibit A of the PTP submittal.

The staff has reviewed the proposed list of system exclusions and finds the system exclusions to be acceptable. TVA has not excluded any system from the PTP which is required for fuel loading, safe shutdown or accident mitigation.

Furthermore, the staff has reviewed Table 1 of the PTP submittal and finds that the systems which are required for fuel loading, safe shutdown and accident mitigation are specifically listed as being included in the WBN PTP. Therefore, the staff finds this list to be acceptable.

2.3.6 PTP Programmatic Exceptions (Appendix A)

TVA has proposed to exclude certain specific programmatic requirements of Appendix A to RG-1.68. TVA has stated that those items not specifically listed as exclusions in the PTP, will be conducted as part of the PTP.

Part A of Appendix A to RG-1.68, Preoperational Testing requires, in general, system flushing and cleaning of piping and vessels. TVA's PTP will not include flushing and cleaning activities or verification of such because the applicable systems are either already in service, are controlled under the WBN Layup Program (which controls cleanliness for its systems), or are currently being or will be modified. Systems being modified are under the cognizance of Quality Assurance/Quality Control, whose processes independently ensure adequate cleaning and flushing. TVA has also stated that those portions of systems directly interacting with the reactor coolant system will be flushed under the chemistry program controls prior to hot functional testing. The staff has reviewed these programmatic exclusions and finds them to be acceptable because TVA has adequately addressed the RG-1.68 requirements for flushing and cleaning of systems using other TVA WBN programs and controls. Appendix A to RG-1.68 also requires hydrostatic testing of all piping, vessels, and systems designed to contain pressurized or radioactive fluids. The WBN PTP as proposed will not include system hydrostatic tests or verification of hydrostatic tests since hydrostatic testing was controlled by either the construction controls process prior to responsibility transfer of the system to operations or the construction controls of modifications since the transfer of the system to operations. The staff finds this exclusion acceptable since neither TVA nor the NRC staff have previously found hydrostatic testing related deficiencies in the Preoperational Test Program and prior construction efforts at WBN.

The WBN PTP excludes all hydrostatic tests as discussed above, including those for the reactor coolant system pressure boundary. However, TVA has elected to perform, as part of the WBN PTP, a cold hydrostatic test of the reactor coolant system due to modifications performed since the initial construction test. The staff finds this acceptable.

Appendix A of RG 1.68, Part 1.c requires licensees to conduct vibration monitoring of the reactor internals in accordance with RG 1.20 (Safety Guide 20), "Vibration Measurements on Reactor Internals," and vibration monitoring of other components such as piping systems, heat exchangers, and rotating machinery. The WBN PTP does include vibration measurements as defined

above with the exception of the reactor internals. TVA has stated that the reactor internal vibration measurements were a one time test which was satisfactorily conducted in Preoperational Test W-1.10. TVA has stated there have been no changes or modifications to this system which would warrant a retest. The staff agrees with TVA and finds this exclusion acceptable.

The following list of systems are excluded from the WBN PTP because the systems are not applicable to the WBN design; Standby Liquid Control System, Emergency Condenser, Reactor Core Isolation Cooling System, Shielding Cooling System, and Automatic Depressurization System. The staff agrees with TVA in that the above listed systems are not part of the WBN design and, therefore, their exclusion is appropriate and acceptable.

The following list of systems are excluded from the WBN PTP because the systems are either part of the post fuel load Preoperational Test Program, yet to be conducted, or outside the scope of the WBN PTP and, therefore, covered by other WBN programs; Automatic Reactor Power Control System, Incore Monitor System, Control Rod System, Auxiliary Start-up Instrumentation System, and Heater Vents and Drains Systems. The staff has reviewed these WBN PTP system exclusions and has found the exclusions to be acceptable since these systems will be tested by other WBN programs and are not needed for fuel loading or can not be practically tested prior to fuel load.

The power conversion Makeup Water and Chemical Treatment Systems, as delineated in RG 1.68 Appendix A, Section A.4.h, and the turbine portion of the Ventilation System, Section A.5.j, are proposed to be excluded from the WBN PTP because these systems were either previously adequately tested during the Preoperational Test Program and/or they are not relied upon for safe shutdown and accident mitigation. The staff has reviewed these exclusions and has found them to be acceptable.

TVA has proposed to exclude Communications System Tests from the WBN PTP for the Plant Telephone System which are required by Section A.6.d of Appendix A to RG 1.68. The justification provided for this exclusion is that the Plant Telephone System is currently being operated and maintained under operational control. The staff agrees with TVA in that the Plant Telephone System testing is served by the daily use and maintenance by Operations and that repairs required to the system would result from the necessity of the system for routine daily operational conduct. Therefore, the staff concludes that the exclusion of the Plant Telephone System from the WBN PTP is acceptable.

Section A.7.a, "Containment Systems" of Appendix A to RG-1.68 requires, among other things, an overpressure test of the primary containment. The overpressure test is a one time test to verify proper design and construction of the containment vessel. TVA has previously satisfactorily completed this test for WBN. Therefore, the staff finds this exclusion acceptable. The staff notes that TVA has included as part of the PTP, an Integrated Leak Rate (Type A) Test (ILRT) to ensure the containment integrity of WBN has been maintained during the extended licensing period. A visual inspection of the containment

liner should be included as part of the ILRT so as to identify any damage which may have occurred from modifications performed since the initial construction of WBN.

Section A.10 of Appendix A to RG 1.68, "Fuel Storage and Handling Systems," Part a, requires that the licensee conduct spent fuel pit cooling system tests. TVA has excluded from the WBN PTP those portions of this requirement which introduce water into the spent fuel pit. TVA would have to remove new fuel currently being stored in the spent fuel pit to perform this test. The staff agrees with TVA that it would be impractical to relocate the new fuel for this test. Furthermore, TVA has stated the excluded portion of this test was acceptably tested by the Preoperational Test Program and no modifications have been made which would warrant a retest. Therefore, the staff finds this exclusion to be acceptable.

Section A.10 of Appendix A to RG 1.68, Part c, requires the licensee to perform "Operability and Leak Tests of Sectionalizing Devices in the Fuel Storage Pool and Refueling Canal". For the reasons stated above, the staff also finds this exclusion acceptable.

Section A.12 of Appendix A to RG 1.68, parts b and c, require personnel monitor, survey instrument, and laboratory equipment tests to be conducted. TVA stated that tests for this equipment are included in a program administered by WBN Radiological Control and are, therefore, excluded from the WBN PTP. Since these tests are being conducted by other WBN programs, the staff finds their exclusion from the PTP to be acceptable.

Sections B, C, and D of Appendix A to RG 1.68 requires that Precritical Tests (Post-Fuel Load), Low Power Tests, and Power Ascension Tests be conducted. TVA has limited the scope of the WBN PTP to include only those tests required to support fuel loading. The tests required by Sections B, C, and D of Appendix A to RG-1.68 are, therefore, by definition, excluded from the WBN PTP. These tests will be conducted by other WBN Programs subsequent to the successful completion of the WBN PTP. Therefore, the staff finds these exclusions to be acceptable.

2.3.7 PTP Programmatic Exceptions (Appendix C)

Appendix C to RG 1.68 provides guidance regarding the preparation and content of procedures for preoperational tests, fuel loading, start-up to critical and the initial ascension to rated power. Since TVA has programmatically limited the scope of the WBN PTP to include only those systems and tests required to support fuel loading, the start-up and power ascensions portions of RG 1.68, Appendix C are not applicable to the WBN PTP. The requirements listed in the remaining Sections of Appendix C, procedures for preoperational tests and fuel loading, are applicable and have been incorporated into the WBN PTP with the exception of the following items discussed below.

Section A.1 of Appendix C to RG-1.68 provides the procedural prerequisites which apply to the WBN PTP. TVA has stated that all systems included in the WBN PTP will undergo a Systems Completion Verification (SCV). As previously referenced, WBN Site Director Procedure AI-6.15, Systems Completion Verification, provides for a process to ensure all identified open work items affecting a system's return to service are completed or dispositioned before WBN prestart testing. The staff has reviewed WBN AI-6.15 and finds that, if properly implemented, all construction open items and existing deficiencies will be identified and tracked toward closure or dispositioned as to not affecting the system's return to service, in support of WBN system alignment and prestart testing.

However, during an NRC staff inspection conducted May 22 through June 16, 1989, the staff identified that, contrary to the original TVA WBN position, several construction completion activities were currently scheduled to be worked on in parallel with prestart testing for the same system. As documented in staff Inspection Report 50-390/89-07, dated July 11, 1989, the staff recognizes that a small amount of outstanding work at the time of system testing is likely. However, the SCV procedure must be used to properly control and evaluate open items for possible impact on PTP system test results. The NRC Inspector felt that although adequate tracking of significant open items for evaluation was occurring, their disposition was not adequate with respect to item closure before commencement of prestart testing. The staff considers the WBN PTP to be a verification of integrated "whole" system performance for the WBN safe shutdown and accident mitigation systems. Piece-meal type component testing or partial system testing for the PTP systems may invalidate the test results. As such, the staff recommends TVA consider a requirement for JTG review of the SCV punchlist items for potential impact on test results prior to testing. The amount of work outstanding at the time of testing should be minimal. This item is an Inspector Follow-up Item 50-390/89-07-02.

Section A.1.a of Appendix C to RG-1.68 requires, among other things, a check of wiring continuity and electrical protection devices. TVA has stated that these checks were previously performed and there are programs and instructions in place to perform the checks in the event of a fault or during routine maintenance or calibration. The staff has reviewed these exclusions and finds that TVA's previous satisfactory performance of these checks remains valid, and if electrical continuity for certain plant equipment does not currently exist, the prestart test of the systems would identify such cases. Repairs subsequent to problem identification would be required to be performed prior to PTP test acceptance.

Section A.1.a of Appendix C to RG-1.68 also requires adjustments of settings on torque-limiting devices, temperature controllers, and limit switches. TVA has included these adjustments, as required, in the WBN PTP for the components affecting the required plant safety functions identified by TVA Nuclear Engineering (NE). The staff agrees with TVA that only equipment affecting the functions identified by NE is required to be adjusted because the functions identified by NE include all those functions required for safe shutdown and/or

accident mitigation. Plant devices, controllers, and switches not required for safe shutdown and/or accident mitigation should be readjusted, as required, during hot functional and subsequent plant system testing. Therefore, the staff finds the PTP exclusion of the above equipment to be acceptable.

Section A.1.c of Appendix C to RG-1.68 requires tests of individual components or subsystems to demonstrate that they meet their functional requirements. TVA has proposed to exclude from the PTP valve operability against pressure tests, testing for pump rotational direction, motor loading, motor rotational direction, Megger or hipot tests, and several checks related to piping and vessels.

Valve operability against pressure tests have been proposed to be replaced with tests conducted under the Motor-Operated Valve Testing and Surveillance (MOVATS) program. The staff issued, by letter dated June 28, 1989, Generic Letter (GL) 89-10: Safety-Related Motor-Operated Valve Testing and Surveillance to all licensees and holders of construction permits for nuclear power plants, which includes WBN. The new guidance expands the scope and total overall effort required for MOVATS programs. The latest GL 89-10 implementation schedule for WBN is June 28, 1994. However, TVA has stated that all MOV's identified by NE as having a function of operability against pressure will be included in the existing MOVATS program prior to fuel loading. Although the current WBN MOVATS program is not as thorough a program as GL 89-10 recommends, the staff concludes that the current updated program will provide reasonable assurance that WBN safety-related MOV's will develop sufficient torque to operate as required against pressure during and following a design basis accident.

TVA has stated that the WBN PTP testing as currently proposed will provide adequate verification of; safety related pump rotational direction, motor loading, motor rotational direction, megger tests, leak tightness, and proper gasketing. The staff agrees with TVA and finds these exclusions to be acceptable. The staff also accepts TVA's position that WBN construction controls were, in conjunction with current program controls, adequate to ensure that safe systems are clean, flushed, and are, as appropriate, properly layed-up and that system components, circuit breakers, and piping have been properly bolt torqued, tested, and insulated. The staff notes that TVA will correct any malfunctions of circuit breakers under the TVA WBN maintenance program and that the circuit breakers are currently tested and will continue to be tested in accordance with the plant periodic maintenance program. The staff finds these exclusions and commitments to be acceptable.

RG 1.68, Appendix C, Sections B, C, and D provide guidance for Fuel Loading, Start-up-to-Critical, and Power-Ascension. By definition the WBN PTP has excluded these events as the program only provides all prefuel loading testing. Therefore, the staff finds these exclusions to be acceptable.

3.0 CONCLUSION

Based on the reviews discussed above, the staff has concluded that the WBN Prestart Test Corrective Action Program Plan, as presently proposed, is acceptable, and, if properly implemented, the program will ensure proper verification of the functional integrity of the safety systems at WBN to the extent required for fuel loading.

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