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ENCLOSURE 2

SAFETY EVALUATION REPORT BY THE OFFICE OF SPECIAL PROJECTS

RESTART TEST PROGRAM

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR POWER PLANT, UNIT 2

DOCKET NO. 50-260

1.0 INTRODUCTION

The operability of Browns Ferry Nuclear Plant (BFN), Unit 2 safety systems and their capability to perform their safety functions were put under scrutiny by the Tennessee Valley Authority (TVA) due to employee generated concerns, a prolonged plant shutdown, and extensive plant modifications. A major re-review of the BFN, Unit 2 initial design, construction, and operating practices was conducted and a Restart Test Program (RTP) was instituted to ascertain the functional integrity of the accident mitigation and safe shutdown systems. The proposed program is described in TVA letters dated October 7, 1986 and July 13, 1987, and in Volume III, Section 8.0 of the Nuclear Performance Plan (NPP).

The NRC has conducted several inspections in the implementation of the RTP as documented in Inspection Reports (IRs) 50-260/87-12, 87-27, 87-30, 87-33, 87-37, 87-42, 87-46, 88-02, 88-04, 88-05, 88-10 and 88-16. IRs 88-18 and 88-21, yet to be issued, contain RTP related information.

2.0 EVALUATION

2.1 OVERALL SCOPE AND OBJECTIVE OF THE RTP

The principal objective of the RTP is to engender confidence that certain preoperational tests conducted during initial plant licensing and surveillance inspections, routinely conducted following plant licensing, were valid tests that can ensure the current functional integrity of safety systems and components. Where changes in system configuration or inadequate validation of existing pre-operational test results dictate a retest, the RTP provides for testing. This testing is developed by a TVA approved organization with established controls and procedures. The RTP considered BFN's prolonged outage and the extensive plant modifications performed. This dictated consideration that all plant systems required for shutdown and cooldown of the reactor under transient and accident conditions be reviewed in terms of the documentation of adequate testing and verification that the required safety systems will perform their intended safety function.

The scope of testing in the RTP is governed by TVA BFN Site Director's Standard Practice (SDSP) - 12.1, "Restart Test Program", Revision 3, dated February 24, 1988 and SDSP - 12.2, "Development of System Test Specifications", Revision 4, dated February 24, 1988. The scope of SDSP-12.1 specifically addresses the commitments made in Volume III, Section 8 of the NPP for the RTP. The scope of SDSP-12.2 stipulates the test requirements for the systems selected to be tested as part of the RTP. The scope of the RTP includes individual system testing, as well as integrated system tests, such as a simulated Loss of Coolant Accident (LOCA) concurrent with a Loss of Offsite Power (LOP), (LOP/LOCA test), and a Backup Control Test, which tests the controls required for shutdown from outside the control room. These integrated tests will provide for additional verification of procedures and equipment, and further operator training.

2.2 RTP ORGANIZATION

As illustrated by Figure 1 of TVA's July 13, 1987 submittal, the BFN Site Director is responsible for the overall implementation of RTP and for providing the necessary interface with other TVA organizations. A Joint Test Group (JTG) is responsible for reviewing the scope and technical adequacy of the RTP and for making recommendations to the Plant Manager. The Plant Manager is responsible to the Site Director. The RTP organization also includes a RTP manager and certified test engineers responsible for ensuring the restart tests are satisfactorily completed. All of the RTP test result packages are reviewed by the JTG.

The JTG membership includes the Unit 2 Superintendent (now titled the Operations Superintendent) as the Chairman and representatives, as appropriate, from the Division of Nuclear Engineering (DNE), Maintenance, Modifications, Operations, Quality Assurance, Restart Test, Technical Support Services, and General Electric (NSSS Vendor Representative). The staff finds the JTG membership diverse enough to provide the technical expertise required to conduct the RTP review functions and to evaluate test results, and is, therefore, an acceptable organization to function as a subcommittee to the PORC.

The staff has reviewed the membership of the RTP Organization and concludes that an adequate representation of technical expertise exists to achieve the RTP objectives.

2.3 RTP METHODOLOGY

The responsibility of DNE, as part of the Design Baseline and Verification Program (DBVP), includes the verification and/or generation of the design criteria necessary to document system design functions utilized in satisfying the Safe Shutdown Analysis. The DBVP generated Test Requirement Documents (TRD), produced from the System Requirement calculations, are a fundamental input to the RTP. Project Instruction BFEP PI 86-26 governs the generation of the TRD.

The TRDs are compiled and documented by the Restart Test Engineer in System Test Specifications (STS). The STS is a document which specifies the minimum testing to be performed on selected systems for the RTP. From this document, an RTP Test Instruction is written to implement the test requirements. Many test requirements have resulted directly from the DBVP, as indicated above. However, test requirements may also result from the RTP system review discussed below.

The designated RTP Test Engineer performs a system review to determine test requirements necessary for reliable system operation. This system review addresses items such as past maintenance and operational history documentation, vendor recommended testing, the extent of modifications performed during the current Unit 2 cycle 5 outage, and licensing commitments. As a result of the DBVP and these system reviews, TVA has determined that some systems will require extensive testing while others will have no specific or special testing required. A system check list (SCL) is utilized on those systems with no testing requirements to determine their operational status. Items such as system procedures, hold orders, temporary alterations, Engineering Change Notices, and a system walkdown is included in the SCL.

RTP Test Instructions allow for the utilization of existing site test procedures, where appropriate, to satisfy testing requirements. Specific test requirements not covered by existing plant instructions requires that step-by-step test instructions be written. The RTP, including the STS generation, test instruction development, test conduct, and test results review, is administratively controlled by SDSP-12.1 and 12.2.

2.4 SELECTION OF SYSTEMS FOR TESTING

2.4.1 RTP PROGRAMMATIC EXCEPTIONS

The RTP must address the systems necessary to support Unit 2 safe shutdown following an accident. During a meeting between NRC staff and TVA, on April 26, 1988, (see Meeting Summary letter dated May 24, 1988), the staff requested additional information regarding the differences between industry typical pre-operational test programs, as described in USNRC Regulatory Guide (RG) 1.68, "Initial Test Programs For Water-Cooled Nuclear Power Plants, Revision 2, August 1978," and the BFN RTP. TVA provided the requested information during a meeting on June 21, 1988 (see Meeting Summary letter dated July 27, 1988).

Section C.1 of RG 1.68 provides industry guidance regarding the criteria used for the selection of plant systems to be preoperationally tested. Sections C.1.b, d, and e of this criterion identifies the equipment necessary to support safe shutdown and cooldown of the reactor under transient and postulated accident conditions, the equipment classified as engineered safety features, and the equipment assumed to function or for which credit is taken in the accident analysis of the facility, as described in the Final Safety Analysis Report (FSAR). Since the BFN DBVP evaluations have identified the equipment necessary to support safe shutdown for the FSAR Chapter 14 Design Basis Events, the required equipment testing identified for pre-operational testing in RG 1.68, Criteria C.1.b, d, and e, would be satisfied if included in the BFN RTP. The BFN RTP approach developed by TVA is, in fact, consistent with RG 1.68 since the DBVP provides the majority of the input to the RTP. Therefore, the staff finds the scope of the accident mitigation and safe shutdown systems, which are to be tested prior to BFN restart, acceptable. Deviations or exceptions which occur during testing of this equipment are required to be evaluated and dispositioned by TVA per SDSP-12.1, Section 6.6, "Test Exceptions", and must be available for NRC staff audit.

RG 1.68, Criteria C.1.a, c, and f are excluded in part from the BFN RTP. These criteria identify those plant structures, systems, and components which are used for shutdown and cooldown of the reactor under normal plant conditions, which are tested under Technical Specifications, and which are used to process, store, control, or limit the release of radioactive materials.

Equipment associated with normal plant cooldown is excluded from the RTP. TVA has identified and evaluated all of the mechanical, and electrical system interfaces which exist with the systems required for safe shutdown from transients, accidents, and special events, and has ensured that a failure of normal plant cooldown equipment would not prevent BFN from achieving safe shutdown. Therefore, since safe shutdown remains assured, the staff finds this RTP exclusion acceptable.

The BFN Technical Specifications (TS) must be complied with as they are an Appendix to the Operating License for the facility. The tests required by the TS are performed regardless of the scope of the RTP. Therefore, since there is no intention to supersede the BFN TS Surveillance Requirements, the exclusion of these tests from the RTP is appropriate and acceptable.

RG 1.68, Criterion C.1.f identifies those plant structures, systems, and components that would be used to process, store, control, or limit the release of radioactive materials. The BFN RTP includes those systems required to support accident mitigation and safe shutdown as described above. Systems and equipment other than those required to perform the above functions, were evaluated for adverse interfacial impact on the required systems as described above. Those structures, systems, and components having no potential adverse impact were excluded from the RTP. The staff has evaluated this exclusion and has found it to be acceptable since all of the systems required to mitigate the radiological consequences of an accident are included in the RTP.

2.4.2 SELECTED SYSTEMS

By submittal dated July 13, 1987 (referenced in Section 1.0 above) TVA provided, as Attachment 1, an RTP system test list. This list provides the system title and associated system number as well as the RTP group assignments, discussed in Section 2.5 below, for all of the systems to be tested as part of the RTP.

NRC Inspection Report 50-260/87-36 documents the staff's review of the information contained in TVA's BFN DBVP. The inspection effort included a review of the BFN Safe Shutdown Analysis (SSA). The SSA includes a list of systems required for BFN to achieve and maintain safe shutdown during design basis events. The list of systems to be tested under the RTP agrees with the SSA list. The staff concluded during the inspection that TVA had adequately addressed the areas of mechanical and electrical systems in the DBVP including the SSA. Since the RTP system test list was taken from the SSA, the staff has concluded that this system list is complete and is therefore, acceptable.

2.4.3 RTP TESTING TYPE EXCEPTIONS

Section 1.0 of Appendix A to RG 1.68 provides guidance regarding the type of testing performed during preoperational test programs. These tests may

include manual and automatic operation, and verification of operation following loss of normal power supplies. The scope of testing provided in the BFN RTP includes consideration for these type tests with the exception of testing in the degraded mode. This exception is based on TVA calculations which ensure the systems or portions of systems necessary to provide for safe shutdown can perform their required safety functions during the design basis worst case conditions. Section 1 of Appendix A also specifies that tests must include, as appropriate, proper function of instrumentation and controls, permissive and prohibit interlocks, equipment protective devices whose malfunction or premature actuation may shut down or defeat system or equipment operation, and system vibration, expansion, and restraint testing. The BFN RTP scope includes consideration of these test types with the exception of vibration, expansion, and restraint testing.

During the June 21, 1988 meeting between NRC and TVA, the above exceptions with particular concern for the exclusion of vibration measurements of systems during testing. Piping vibration has been a problem at BFN in the past, however, corrective actions in each instance were implemented. TVA has stated that vibration testing was not required based on the results of testing performed during the BFN original pre operational testing program, the plant's operational history since that time, and the corrective actions taken for instances where excessive vibrations was observed. TVA has also indicated that periodic TS Surveillance Instructions (SI) require verification of major pump vibrations in accordance with ASME Section XI. Since TVA has performed corrective action in instances where excessive vibration was identified during BFN's previous operational history and since the majority of BFN's required systems with significant flow velocities (e.g., Core Spray, RCIC Service Water, and Emergency Equipment Cooling Water) have not historically experienced vibration problems during operation, the staff finds the programmatic exclusion of vibration measurements acceptable. The staff, however, recognizes that in accordance with TS requirements, TVA will continue to conduct required periodic Surveillance Instructions to verify acceptable critical pump vibration in accordance with ASME Section XI. The staff also expects the RTP Test Engineers to use engineering judgment in the reporting of any detectable excessive vibration during individual or integrated restart tests.

The staff has evaluated the exceptions discussed above and has concluded that they are acceptable in that the calculations performed must support the elimination of degraded mode testing the excepted testing types would provide little or no additional data for system operability assessment (e.g., performing expansion measurements with no significant increase in system temperature), or the type tests will be conducted by the TVA BFN Post Modification Test Section (e.g., restraint testing subsequent to modifications). Piping expansion and restraint testing should be performed subsequent to system modification and/or be incorporated in the power ascension test program, as appropriate.

In summary, various system specific test exceptions have been taken for the specific reasons provided by TVA. The staff has evaluated these exceptions and has found them to be acceptable.

2.5 RTP IMPLEMENTATION

2.5.1 INDIVIDUAL SYSTEM TESTING

TVA implementation of the BFN RTP has resulted in the categorization of systems to be tested and the degree of testing prior to BFN, Unit 2 restart. The systems have been categorized for convenience and clarification into one of three groups. TVA has defined these three groupings as follows:

Group 1: Systems which are determined to be critical to safe shutdown of the plant. Testing requirements are determined primarily by the DBVP. An STS will be prepared and an RTP Test Instruction written and conducted. A test results package will be compiled for each system so as to auditably document the test results and system readiness status.

Group 2: Systems which have few test requirements specified by the DBVP but provide direct support to plant operation. The majority of the system is addressed by the RTP review to determine test requirements. An STS will be prepared and a RTP Test Instruction written and conducted. A test results package will be compiled for each system so as to auditably document the test results and system readiness status.

Group 3: Systems not directly supporting plant operation nor important to safety will, in general, require no testing. No system test requirements are provided from the DBVP. This group will not have an STS nor a RTP Test Instruction prepared, but will be addressed by the requirements of the SCL.

These groupings provide a prioritization methodology for conducting the RTP system tests. The primary difference between Groups 1 and 2 is the scope of the DBVP test requirements for the particular system. A Group 2 classification for a system may have a few DBVP test requirements, however, the majority of these system tests are the result of the RTP Organization's System review. The staff has evaluated the grouping of systems in the RTP and has found that Groups 1 and 2 receive the same level of technical review, administrative control, and approval, and are therefore, acceptable. Systems placed in Group 3 are not important to safety, therefore, the use of only an SCL to determine system operability status, as described in Section 2.3 above, is also acceptable.

2.5.2 INTEGRATED SYSTEM TESTING

In addition to individual system testing, the RTP includes integrated system tests. These tests which are outlined below, are being performed to provide added confidence in integrated system performance, to provide additional verification of plant procedures and equipment, and to further operator training.

o LOP/LOCA Test

Plant response to a loss of all offsite power concurrent with a simulated loss of coolant accident will be demonstrated.

o Backup Control Test

A test of the controls required for shutdown from outside the control room, (Safe Alternate Shutdown) by verifying proper operation of local control transfer switches and the functions of the Remote Shutdown Panels.

o Integrated Cold Functional Testing

Systems will be operated per operating instructions in an integrated manner, as much as possible, before fuel loading or restart. For example, operators would pull condenser vacuum and operate the circulating water, condensate, and feedwater systems together.

2.5.3 PROGRAMMATIC IMPLEMENTATION

In order for the staff to acquire additional confidence in the programmatic implementation of the BFN RTP, the staff selected two safety systems for evaluation in terms of the adequacy of the use of DBVP Baseline Test Requirements Document, System Test Specifications (STS), and associated Test Instructions. These systems are the Standby Gas Treatment and Standby Diesel Generator Systems. The results of these evaluations are provided below.

2.5.3.1 RTP IMPLEMENTATION FOR THE STANDBY GAS TREATMENT SYSTEM

To establish that the programmatic aspects of the RTP are correctly implemented, the staff and its consultant reviewed the Restart Test Results Package for the Standby Gas Treatment System (SGTS) (2-BFN-RTP-065). The package was chosen as a representative sample of the ongoing RTP effort. The test results package contained the following documents:

- o Test Summary
- o System Check List (SCL)
- o System Test Specification (STS)
- o System Test Instruction (STI)
- o System Punch List (SPL)

As such, the test results package content followed the guidelines SDSP-12.1.

The staff and its consultant reviewed the completeness and consistency of the following three documents:

- o Test Requirements
- o System Test Specification

- o System Test Instructions

The staff and its consultant confirmed that the Test Requirement Document followed the procedure BFEP PI 86-26.

The STS was developed by the Restart Test Group (RTG) via combining the DNE test requirements as well as the review of the following:

- o Engineering Change Notices
- o Nuclear Plant Reliability Data System (NPRDS) and Maintenance Request (MR) History
- o Employee Concerns, Licensing Commitments, and Condition Adverse to Quality (CAQ) Program
- ° Vendor Recommendation

The staff and its consultant verified that the STS were written in accordance with SDSP-12.2 and SIL-007.

The STI is a comprehensive document which provides the system acceptance criteria, thereby dictating the steps to be followed during the test. The STI also documents test exceptions and lists SIs used to satisfy test steps. The staff and its consultant verified that the STIs accurately reflect the tests identified in the STS. The STIs were written in accordance with SIL-003.

Test Exceptions (TEs) were included in Appendix B of the STIs. TEs are written when an RTP Test Instruction step cannot be completed or the validity of data is questionable. Within the area of dispositioning RTP TEs, the staff has some concerns which are being monitored in order to ascertain the effectiveness of the RTP. Although the staff is concerned about the absolute number of TEs, of more importance is the evaluation, resolution, and impact on the restart test acceptability. The following concerns have been noted by the NRC Resident Inspectors and will be documented in further detail in NRC Inspection Report 50-260/88-21.

The RTP is not a stand alone activity. There has been on the part of the licensee a reluctance to issue and process a Condition Adverse to Quality Report (CAQR) for TEs that clearly should require one under TVA's CAQ Program. The tendency has been to conduct troubleshooting, investigation, analysis, evaluation, and sometimes, resolution of problems identified in the RTP, solely under the TE activity. This action is not consistent with the CAQ Program that should umbrella all plant activities affecting quality. These concerns have been discussed with TVA BFN management. TVA has stated that they will provide CAQRs in parallel with TEs where conditions warrant them. The NRC inspectors will continue to monitor this activity.

Under the BFN RTP, it is possible to satisfactorily closeout a test as acceptable without closing all TEs against that test. Those TEs should be classified as to their significance and tracked on the SPLs. However, the overall program to provide for the appropriate identification, tracking, resolution, and closure of the significant TEs identified in the RTP should be the CAQR.

About 21 TEs were generated by the RTG for the SGTS. The open TEs are listed in the Test Summary as required by SDSP-12.1. Changes to the RTP tests were handled through the RTP change sheet described in SDSP-12.1. Fifteen change notices were reviewed. Finally, the SCL and SPL were reviewed. The SCL was used to identify open items related to the operational readiness of the system and to establish a punch list of open items with priorities. The SCL followed the procedures SDSP-12.1 and SIL-006. The SPL is used to track and expedite work associated with open items affecting the RTP. The administration and control of the SPL is governed by SIL-005. Therefore, based on the above, the staff finds the RTP programmatic implementation for the SGTS to be acceptable.

2.5.3.2 RTP IMPLEMENTATION FOR THE STANDBY DIESEL GENERATOR SYSTEM

The TVA DBVP and the RTP Organization's review has resulted in the identification of the functional test requirements for the Standby Diesel Generator (DG) System which, in summary, is to demonstrate that this system will perform all required safe shutdown functions. The integrated plant response to an accident will be verified by a series of special tests consisting of:

a) A Loss of Offsite Power Test

b) A Unit 2 Simulated Loss of Coolant Accident Test

c) A Unit 2 Simulated Loss of Coolant Accident combined with a Loss of Offsite Power with Diesel Generator "D" disabled

d) A Unit 2 Simulated Loss of Coolant Accident combined with a Loss of Offsite Power with battery number 2 disconnected.

These tests will demonstrate that the DGs will start on Automatic and Manual initiation signals, provide power to the 4 KV distribution system, and provide verification of proper operation of the equipment necessary to effect the safe shutdown of the plant. In addition to these tests, TVA has also proposed special tests to determine and verify the capability of DGs A, B, C and D, to accept their emergency loads in accordance with the DG loading requirements. TVA has proposed to test DG A & B close to their full load requirement and will verify by computer model the actual test results and predict the DG response during full load. All other DGs will be partially loaded and their test results and full load response verified by the computer model.

The staff has had several interactions with TVA to discuss the applicable Baseline Test Requirements, STS, and procedures. Based on our review as supplemented by these discussions, the staff has determined that the planned testing of the DGs, in accordance with the above RTP generated documents, will identify any problems with the DG's. After satisfactory resolution of any identified problems, TVA will have demonstrated the functional integrity of the BFN Standby DG systems. Any test exceptions or deficiencies and their resolutions will be available for a staff audit. Therefore, based on the above, the staff finds the RTP programmatic implementation for the Standby Diesel Generator System to be acceptable.

Although some weakness has been observed regarding the programmatic dispositioning of TE's, the RTP procedures reviewed constitute an acceptable program for dispositioning TEs. The staff will continue to monitor TVA's activity in this area.

2.6 RTP ADMINISTRATIVE CONTROLS AND IMPLEMENTING PROCEDURES

Section 8.0 of Volume III, of the BFN NPP states that the RTP will be conducted to ensure that plant systems are capable of meeting their safe shutdown requirements. Also stated is that coordination and development of the RTP is the responsibility of the Restart Test Manager and that an element of the RTP will be the establishment of a program to control test performance and document and evaluate test results.

As discussed in Section 2.3, Project Instruction BFEP PI 86-26 governs the generation of the Test Requirements Document (TRD) by DNE. SDSP 12.1, "Restart Test Program", and SDSP 12.2, "Development of System Test Specifications", were developed to administratively control the RTP processes and the documentation and use of the generated implementing procedures. These procedures govern the RTP in terms of the use of the DBVP generated Baseline Test Requirements through and including the generation and use of the System Test Specifications, procedure implementation reviews, and approval of the completed restart test procedures.

To assist in the implementation of the BFN RTP, eight additional procedures have been written. These are called Section Instruction Letters (SIL) and are numbered 001 to 008. A brief description of these procedures follows:

- SIL-001, "Preparation and use of Division of Nuclear Engineering DNE Need Sheets, prescribes the manner for the preparation and use of "DNE Need Sheets". The "DNE Need Sheets" are used by the Restart Test Engineer to list items requiring DNE action.

- SIL-002, "Training and Qualification of Restart Test Program Personnel", establishes the training and qualification for RTP personnel and specifies work activities allowed for certified personnel.

- SIL-003, "RTP Instruction Example Formats", provides example forms and pages for use in developing RTP Test Instruction appendices and signature logs.

- SIL-004, "File Indexes," provides guidelines for the filing and indexing of RTP correspondence to ensure adequate record accountability and retrievability.

- SIL-005, "System Punch List Program," provides a program for the administration and control of a system punch list. This punch list assists tracking and expediting work associated with open items affecting the RTP.

- o SIL-006, "System Check List Preparation", specifies the process by which a System Check List (SCL) is completed for systems, as required by SDSP-12.1. The steps involved in performing the SCL will identify open items related to the operational readiness of a system and its documentation, and establish a punch list of open items with priorities.

- o SIL-007, "Review Documentation Reports", outlines a process for the documentation and updating of the review process used to generate the System Test Specifications.

- o SIL-008, "Restart Test Program Procedure Review Group", establishes a Procedure Review Group whose basic purpose is to review documents generated by the RTP to ensure they are technically accurate, administratively correct, and adequate in scope to support their intent per SDSP-12.1/SDSP-12.2 prior to being submitted to the Joint Test Group.

The staff and its consultant have reviewed all of the above procedures and found them to contain adequate content and detail such that proper implementation of these procedures would result in an effective RTP. Therefore, the staff and its consultant finds these documents acceptable.

3.0 CONCLUSION

Based on the reviews discussed above, the staff and its consultant have concluded that continued implementation of the BFN RTP, as presently constructed, will ensure proper verification of the functional integrity of the safety systems at BFN Unit 2.

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Dated: August 12, 1988

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