

Docket No. 50-412

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MEMORANDUM FOR: Thomas M. Novak, Assistant Director
for Licensing

FROM: William T. Russell, Deputy Director
Division of Human Factors Safety

SUBJECT: SAFETY EVALUATION REPORT INPUT
BEAVER VALLEY POWER STATION UNIT 2
CHAPTER 14 - INITIAL TEST PROGRAM

Duquesne Light Company's description of its initial test program and response to TMI Action Plan Item I.G.1 for the Beaver Valley Power Station Unit 2 initial test program has been reviewed through Amendment 8 to the FSAR. Our Chapter 14 Safety Evaluation Report input is enclosed. At the suggestion of the PM, the enclosed SER is a mark-up of the DSER, which is in the CRESS word processing system. Although some of the items noted in the DSER have been closed, there still remains a number of items which require additional information from the applicant.

The review of the Beaver Valley Power Station Unit 2 Initial test program is being performed with assistance from Battelle Pacific Northwest Laboratories' personnel.

No SALP input is included because there has been no interaction with the applicant since the DSER SALP evaluation.

Richard Becker, Senior Nuclear Systems Engineer (X29689), is the PSRB reviewer for the Beaver Valley Power Station Unit 2 initial test program. Questions regarding this evaluation should be directed to him. The reviewer is not aware of any "Differing Professional Opinions" for the initial test program.

Original Signed By
WILLIAM T. RUSSELL

William T. Russell, Deputy Director
Division of Human Factors Safety

Enclosure:
SER Input

cc w/enclosure: G. Knighton
B. K. Singh
R. Gruel, PNL

DW/RAB2/BEAVER VALLEY SER

OFFICE	DHFS:PSRB	DHFS:PSRB	DHFS:PSRB	D/DIR:DHFS			
SURNAME	RA Becker:tjc	GR Mazetis	DL Ziemann	W Russell			
DATE	11/21/84	11/21/84	11/21/84	11/21/84			

14 INITIAL TEST PROGRAM

The Beaver Valley Unit 2 startup and test program is established to administratively and technically control all testing activities, from completion of construction and to power level escalation testing. The startup and test program provides documented assurance that the plant's structures, systems, and components will operate in compliance with their design criteria in a manner that does not endanger the health and safety of the public, plant personnel, or plant equipment.

To the extent practicable, plant operating and emergency procedures are tested and evaluated during the execution of this program. The startup and test program also assists in the training of plant operating and maintenance personnel by providing them with hands on experience in the operation and maintenance of plant equipment, utilizing plant procedures.

To facilitate a systematic approach in conducting the startup and test program, the program has been divided into three major phases: (1) construction proof test, (2) preoperational test, and (3) initial startup test.

The construction proof test phase includes pre-installation and post-installation testing of individual structures, systems, and components under the jurisdiction of a construction startup group. The prime objective of this phase is to verify that construction activities associated with the respective structures, systems, or components have been completed and documented. Another function is to verify that the components within the system can be put into operation safely. The testing requirements associated with this phase verify installation integrity and component and system functional characteristics, and ensure that the structures, systems, and components are ready for pre-operational testing. These tests, in general, include instrument calibration, electrical continuity and insulation resistance measurements, pump and motor rotation and vibration checks, and hydrostatic testing, cleaning, and flushing.

The pre-operational test phase normally begins after construction proof testing on individual components and systems or subsystems is completed and jurisdictional control has been turned over to the operations startup group. This phase includes the tests required to demonstrate that structures, systems, and components perform satisfactorily and that they are ready to support fuel loading and the initial startup testing. During the pre-operational test phase, two types of tests are performed: pre-operational tests and system operability verification (SOV) tests. The pre-operational tests are performed on safety-related structures, systems, or components in accordance with Section XI of Appendix B of 10 CFR 50. The SOV tests are performed on structures, systems, or components that are not classified as safety related. Although these two types of tests are similar in scope, the administrative processing of the tests and results may be different. Where practicable, testing during the preoperational testing phase will be performed under system design conditions. Tests for which system design conditions are not practicable or cannot be simulated will be performed as close to design conditions as possible and the test acceptance criteria will be adjusted accordingly.

The initial startup phase begins with the preparation for fuel load and extends through operation at rated power and warranty demonstrations. The initial startup test phase is divided into three areas: fuel loading testing, post-loading testing, and criticality testing. Testing is performed during this phase of the program to

- (1) ensure that fuel loading is accomplished in a safe manner
- (2) confirm the reactor nuclear design basis
- (3) demonstrate that the plant responds to transients as designed
- (4) ensure that the plant can be safely brought to sustained rated power operations

The staff's review of FSAR Chapter 14 concentrated on the administration of the test program and the completeness of the preoperational and startup test

abstracts. The review included the SER-CP; the FSAR; licensee event report summaries for operating reactors of similar design to identify potentially serious event and chronic or generic problems, Standard Technical Specifications, NUREGs-0660, -0694, and -0737; and startup test reports for other similar type plants. The review followed SRP 14.2.

The staff's review included verification of the following features of the initial test program:

- (1) The applicant will develop test procedures using input from the NSSS vendor, the architect-engineer, its engineering staff, and equipment suppliers and contractors. Operating experiences at similar plants will be factored into the development of the test procedures.
- (2) The applicant will conduct tests using approved test procedures. Administrative controls will cover (a) the completion of test prerequisites, (b) the completion of necessary data sheets and other documentation, and (c) the review and approval of modifications to test procedures. The applicant has stated that administrative procedures will also cover implementation of modification or repair requirements identified as being required by the tests and any necessary retesting.
- (3) The applicant will review the results of each test for technical adequacy and completeness by review groups including the NSSS vendor and architect-engineer as appropriate. Preoperational test results will be reviewed before fuel loading and the startup test results from each test condition or power level will be reviewed before proceeding to the next test condition or power level.
- (4) The applicant will use normal plant operating and emergency operating procedures in performing the initial test program, thereby verifying the correctness of the procedures to the extent practicable.
- (5) The schedule for conducting the initial test program allows adequate time to conduct all preoperational and startup tests. Preoperational test

Insert

The applicant has made a number of changes to the initial test program as a result of our questions. Examples of these changes follow:

- (1) expanded FSAR Figure 14.2-3 to provide an index of system operability verification, preoperational, and startup tests;
- (2) increased the testing for the instrument air preoperation test to provide for testing of both a sudden and gradual loss of pressure on each individual valve;
- (3) expanded testing to include simultaneously closing all MSIV's at 100% power;
- (4) expanded testing to demonstrate that the air flow paths of quench and recirculation spray nozzles overlap water flow test paths for pumps;
- (5) included a verification that a manual trip will remove power from the reactor trip breaker undervoltage coil and energize the shunt trip coil;
- (6) modified station blackout test to assure loss of power is maintained long enough for plant conditions to stabilize.

procedures will be available for NRC regional personnel review at least 60 days before scheduled implementation. Startup test procedures will be available for review not less than 60 days before the scheduled fuel loading date.

- (6) An abstract of each test is presented in FSAR Chapter 14. The staff verified that there are test abstracts for those structures, systems, components, and design features that: (a) will be used for shutdown and cooldown of the reactor under normal, transient, and accident conditions and for maintaining the reactor in a safe shutdown condition for an extended period of time; (b) will be used for establishing conformance with safety limits or limiting conditions for operation that will be included in the facility technical specifications; (c) are classified as engineered safety features or will be relied on to support or ensure the operations of engineered safety features within design limits; (d) are assumed to function or for which credit is taken in the accident analysis of the facility, as described in the FSAR; or (e) will be used to process, store, control, or limit the release of radioactive materials.
- (7) The test objectives, prerequisites, test methods, and acceptance criteria for each test abstract are in sufficient detail to establish that the functional adequacy of the structures, systems, components, and design features will be demonstrated.
- (8) Exceptions to RG 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants," Revision 2, are identified and adequately justified.

The staff was unable to verify all of the above and therefore additional information was requested from the applicant (letter from G. W. Knighton to E. J. Woolever dated October 20, 1983). A meeting with the applicant was held on January 12, 1984 to discuss the issues; ~~however, the applicant has not yet formally responded to this request.~~ *and additional information was submitted in Amendments 5 through 8. The items still requiring resolution are tabulated in Table 14-1.* Insert

On the basis of its review, ~~the staff concluded that~~ *remaining items* ~~upon satisfactory resolution of the items identified in the aforementioned letter,~~ *Table 14-1* the initial test program described in the FSAR (as amended through Amendment ~~8~~) will meet SRP 14.2 and

10 CFR 50.34(b)(6)(iii), which requires inclusion of plans for preoperational testing and initial operations in the FSAR; 10 CFR 50, Appendix B, Section XI, which requires a test program to ensure that all testing required to demonstrate that structures, systems, and components will perform satisfactorily in service is identified and performed in accordance with written test procedures that incorporate the requirements and acceptance limits contained in applicable design documents; and NUREG-0737, Item I.G.1, which requires additional testing and training during the initial test program.

This review and evaluation was performed with the assistance of Battelle Pacific Northwest Laboratories' personnel.

07/20/84

TABLE 14-1
OPEN ITEMS - INITIAL TEST PROGRAM

RAI* QUESTION NUMBER	STATUS
640.9	FSAR Subsection 14.2.12.6.4, Shutdown from Outside the Control Room and Verification of the Potential for Cold Shutdown, should include test initiation with the turbine generator in operation.
640.14	FSAR Subsection 14.2.12 test abstracts should include specific sources of acceptance criteria.
640.16	FSAR Table 1.10-1 should be revised to provide specific reference to where the testing and training requirements of NUREG-0737, Item I.G.1, are addressed.
640.18	FSAR Subsection 14.2.12 test abstracts should be modified to demonstrate that capacities of pressurizer PORVs and main steam line atmospheric dump valves are consistent with the accident analysis assumptions for both minimum and maximum valve capacities.
640.19	Discrepancies exist between the classification of certain test abstracts in FSAR Subsection 14.2.12 and FSAR Figure 14.2-3.
640.20	FSAR Subsection 14.2.12 test abstracts should be modified to ensure that the accumulator isolation valves can open under maximum differential pressure conditions.
640.23	FSAR Subsection 14.2.12.6.5, Verification of Plant Performance Following Turbine Trip Coincident with Loss-of Offsite Power at load, should be modified to secure appropriate sections of the Safeguards Area Ventilation which are ac powered.
640.25	Provide assurance that adequate drainage for the fire protection system is provided to preclude flooding and that adequate testing is included for nozzles serving indoor facilities.
640.26	(1) demonstrate proper operation of the isolated phase duct cooling system under fully loaded conditions; (2) demonstrate that Class 1E dc loads necessary for safe shutdown are operable at minimum dc voltages and (3) demonstrate full load testing of vital bus inverters.

- 640.27 FSAR Subsection 14.2.12.55.1, Emergency Diesel Generator System Test, should be modified to demonstrate proper operation during complete loss of load.
- 640.30 Justify the apparent exceptions to Regulatory Guide 1.68, Appendix A, of the following: (1) Reactor Vessel Internal Inspection (1.a.3, 4.s, 5.p); (2) leak detection systems outside of containment (1.j.7); (3) monitoring of atmospheric parameters in containment leakage monitoring system (1.j.22); (4) testing of containment humidity monitors in containment vacuum system (1.j.22); (5) testing of condenser hotwell level control system at power (5.s); and (6) testing of gaseous and liquid radwaste systems at power (5.c.c).
- 640.31 Clarify the use of System Operability Verification (SOV) tests during both the Preoperational and Startup test phases.

*Request for Additional Information

10/9/84

BEAVER VALLEY - UNIT 2

TER INPUT THROUGH AMENDMENT 8 (9/84)

The following items are the TER input for the Beaver Valley-2 Initial Plant Test Program through FSAR Amendment 8 (9/84).

- | Item | Description |
|--------|---|
| 640.9 | FSAR Subsection 14.2.12.6.4 (Shutdown from Outside the Control Room and Verification of the Potential for Cold Shutdown) should include test initiation with the turbine generator in operation, or further technical justification should be provided for not performing this test in accordance with RG 1.68.2, Initial Startup Test Program to Demonstrate Remote Shutdown Capability for Water Cooled Nuclear Power Plants. |
| 640.14 | FSAR Subsection 14.2.12 test abstracts should include specific sources of acceptance criteria. |
| 640.16 | FSAR Table 1.10-1 should be revised to provide specific reference to where the testing and training requirements of NUREG-0737, Item I.G.1, are addressed. |
| 640.18 | FSAR Subsection 14.2.12 test abstracts should be modified to demonstrate that capacities of pressurizer PORVs and main steam line atmospheric dump valves are consistent with the accident analysis assumptions for both minimum and maximum valve capacities. |
| 640.19 | Discrepancies exist between the classification of certain test abstracts in FSAR Subsection 14.2.12 and FSAR Figure 14.2-3. The following test abstracts should be classified as stated. |

Test Section Number	Description
Type	
14.2.12.16.2 Core Load IST	Reactor Coolant System Sampling for
14.2.12.17.1 SOV	Turbine Plant Sampling System
14.2.12.31.2 Heater IST	Plant Operation Following Loss of FW
14.2.12.54.1 SOV	Normal AC Power Distribution System
14.2.12.63.1 HVAC IST	Engineered Safety Features Equip.

14.2.12.68.1 Aux. & Waste Handling Bldg. HVAC
 SOV
 14.2.12.69.2 Misc. Sec. Plant HVAC Systems
 SOV
 14.2.12.70.1 Condensate Polishing Bldg. HVAC
 Systems
 SOV

- 640.20 FSAR Subsection 14.2.12 test abstracts should be modified to ensure that the accumulator isolation valves can open under the maximum differential pressure conditions of zero RCS pressure and maximum expected accumulator precharge pressure, or technical justification to RG 1.79, Preoperational Testing of Emergency Core Cooling Systems for Pressurized Water Reactors, should be provided in FSAR Table 1.8-1.
- 640.23 FSAR Subsection 14.2.12.6.5 (Verification of Plant Performance Following Turbine Trip Coincident with Loss-of-Offsite Power at Load) should be modified to secure appropriate sections of the Safeguards Area Ventilation System which are ac powered to simulate loss of ac conditions during the 2-hour turbine-driven auxiliary feedwater pump test. Also, acceptance criteria (2) should be rewritten as it currently is unclear.
- 640.25 (1) FSAR Question 410.24 does not necessarily address flooding caused by automatic and/or manual fire protection (water) systems. Provide assurance that adequate drainage is provided to preclude flooding.
- (2) FSAR Subsection 14.2.12.50.2 (Wet Pipe and Deluge Sprinkler System Test) should be modified to verify that nozzles serving indoor facilities are air-flow tested and that these tests overlap the water flow tests.
- 640.26 (1) FSAR Subsection 14.2.12.53.1 (Main Generator and Transformer Auxiliaries Test) or other test abstracts should be modified to demonstrate proper operation of the isolated phase bus duct cooling system under fully loaded conditions.
- (2) FSAR Question 430.11 deals with the Class 1E ac system. Demonstrate that Class 1E dc loads necessary for safe shutdown are operable at minimum dc voltage.
- (3) FSAR Subsection 14.2.12 has yet to be modified to add full load testing of vital bus inverters.
- 640.27 FSAR Subsection 14.2.12.55.1 (Emergency Diesel Generator System Test) should be modified to demonstrate proper operation during complete loss of load or technical justification should be provided for exception to RG 1.108, Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants.

640.30 The following items regarding conformance with Regulation Guide 1.68, Initial Test Programs for Water-Cooled Nuclear Power Plants, Appendix A, should be addressed:

- (1) Provide technical justification as to why FSAR Subsection 14.2.12.8.11 (Reactor Vessel Internals Inspection) has been deleted. This test is used to provide conformance with Regulatory Guide 1.20, Comprehensive Vibration Assessment Program, as stated in FSAR Table 1.8-1 and FSAR Subsection 3.9N.2.4 (1.a.3, 4.s, 5.p).
- (2) FSAR Subsection 14.2.12 test abstracts should be modified to address leak detection systems located outside of containment (1.j.7).
- (3) FSAR Subsection 14.2.12.14.1 (Containment Leakage Monitoring System) should specify which atmospheric parameters are monitored (1.j.22).
- (4) FSAR Subsection 14.2.12.13.1 (Containment Vacuum System Test) or other appropriate test abstract should include testing of containment humidity monitors (1.j.22).
- (5) FSAR Subsection 14.2.12 test abstracts should include testing of condenser hotwell level control system at power or technical justification should be taken to RG 1.68 (5.s).
- (6) FSAR Figure 14.2-3 should be modified to identify testing of gaseous and liquid radwaste systems at power (5.c.c).

640.31 FSAR Subsection 14.2.1.2 states that System Operability Verification (SOV) tests are performed as part of the Preoperational Test Phase. However, the following SOV tests are to be accomplished partially or completely during the Initial Startup Test Phase. These tests should either be designated as Initial Startup Tests, or FSAR Subsections 14.2.1.2 and 14.2.1.3 should be rewritten to clarify the use of SOV tests during both the Preoperational and Initial Startup Test phases.

Section Number	Description
14.2.12.7.3	Verification of Performance Calculation
14.2.12.17.1	Turbine Plant Sampling System
14.2.12.28.2	Condensate Polishing System Capability
14.2.12.30.1	Feedwater Heater Drain System Test
14.2.12.33.1	Automatic S.G. Level Control Test
14.2.12.36.2	Turbine Overspeed Trip Test
14.2.12.38.1	Moisture Separ. & Reheat Control System
14.2.12.39.1	Turbine Stretch Test
14.2.12.44.2	Cooling Tower Performance Test

14.2.12.57.1	Plant Communications Test
14.2.12.63.2	Fuel, Decont. Bldg. & Pipe Tunnel HVAC
14.2.12.71.1	Loose Parts Monitoring System Test

9/14/84

BEAVER VALLEY - UNIT 2

Status of Responses to NRC Questions Through Amendment 7 (7/84)

Item	Description
640.9	FSAR Subsection 14.2.12.6.4 (Shutdown from Outside the Control Room and Verification of the Potential for Cold Shutdown) should include test initiation with the turbine generator in operation, or further technical justification should be provided for not performing this test in accordance with RG 1.68.2, Initial Startup Test Program to Demonstrate Remote Shutdown Capability for Water Cooled Nuclear Power Plants. Also, part of test method (2) regarding staffing levels and test duration, appears to have been inadvertently deleted. It should be reinstated.
640.14	FSAR Subsection 14.2.12 test abstracts should include specific sources of acceptance criteria.
640.16	FSAR Table 1.10-1 should be revised to provide specific reference to where the testing and training requirements of NUREG-0737, Item 1.6.1, are addressed.
640.18	FSAR Subsection 14.2.12 test abstracts should be modified to demonstrate that capacities of pressurizer PORVs and main steam line atmospheric dump valves are consistent with the accident analysis assumptions for both minimum and maximum valve capacities.
640.19	Discrepancies exist between the classification of certain test abstracts in FSAR Subsection 14.2.12 and FSAR Figure 14.2-3. The following test abstracts should be classified as stated.

Section Number	Description	Test Type
14.2.12.16.2	Reactor Coolant System Sampling for Core Load	IST
14.2.12.17.1	Turbine Plant Sampling System	SOV
14.2.12.31.2	Plant Operation Following Loss of FW Heater	IST
14.2.12.54.1	Normal AC Power Distribution System	SOV
14.2.12.63.1	Engineered Safety Features Equip. HVAC	IST
14.2.12.68.1	Aux. & Waste Handling Bldg. HVAC	SOV
14.2.12.69.2	Misc. Sec. Plant HVAC Systems	SOV
14.2.12.70.1	Condensate Polishing Bldg. HVAC Systems	SOV

640.20 FSAR Subsection 14.2.12 test abstracts should be modified to ensure that the accumulator isolation valves can open under the maximum differential pressure conditions of zero RCS pressure and maximum expected accumulator precharge pressure, or technical justification to RG 1.79, Preoperational Testing of Emergency Core Cooling Systems for Pressurized Water Reactors, should be provided in FSAR Table 1.8-1.

640.23 FSAR Subsection 14.2.12.6.5 (Verification of Plant Performance Following Turbine Trip Coincident with Loss-of-Offsite Power at Load) should be modified to secure appropriate sections of the Safeguards Area Ventilation System which are ac powered to simulate loss of ac conditions during the 2-hour turbine-driven auxiliary feedwater pump test. Also, acceptance criteria (2) should be rewritten as it currently is unclear.

640.25 (1) FSAR Question 410.24 does not necessarily address flooding caused by automatic and/or manual fire protection (water) systems. Provide assurance that adequate drainage is provided to preclude flooding.

(2) FSAR Subsection 14.2.12.50.2 (Wet Pipe and Deluge Sprinkler System Test) should be modified to verify that nozzles serving indoor facilities are air-flow tested and that these tests overlap the water flow tests.

640.26 (1) FSAR Subsection 14.2.12.53.1 (Main Generator and Transformer Auxiliaries Test) or other test abstracts should be modified to demonstrate proper operation of the isolated phase bus duct cooling system under fully loaded conditions.

(2) FSAR Question 430.11 deals with the Class 1E ac system. Demonstrate that Class 1E dc loads necessary for safe shutdown are operable at minimum dc voltage.

(3) FSAR Subsection 14.2.12 has yet to be modified to add full load testing of vital bus inverters.

640.27 FSAR Subsection 14.2.12.55.1 (Emergency Diesel Generator System Test) should be modified to demonstrate proper operation during complete loss of load or technical justification should be provided for exception to RG 1.108, Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants.

640.30 The following items regarding conformance with Regulation Guide 1.6B, Initial Test Programs for Water-Cooled Nuclear Power Plants, Appendix A, should be addressed:

(1) Provide technical justification as to why FSAR Subsection 14.2.12.8.11 (Reactor Vessel Internals Inspection) has been deleted. This test is used to provide conformance with Regulatory Guide 1.20, Core Inspection, Vibration, and

Program, as stated in FSAR Table 1.8-1 and FSAR Subsection 3.9N.2.4 (1.a.3, 4.s. 5.p).

- (2) FSAR Subsection 14.2.12 test abstracts should be modified to address leak detection systems located outside of containment (1.j.7).
- (3) FSAR Subsection 14.2.12.14.1 (Containment Leakage Monitoring System) should specify which atmospheric parameters are monitored (1.j.22).
- (4) FSAR Subsection 14.2.12.13.1 (Containment Vacuum System Test) or other appropriate test abstract should include testing of containment humidity monitors (1.j.22).
- (5) FSAR Subsection 14.2.12 test abstracts should include testing of condenser hotwell level control system at power or technical justification should be taken to RG 1.68 (5.s).
- (6) FSAR Figure 14.2-3 should be modified to identify testing of gaseous and liquid radwaste systems at power (5.c.c).

640.31 FSAR Subsection 14.2.1.2 states that System Operability Verification (SOV) tests are performed as part of the Preoperational Test Phase. However, the following SOV tests are to be accomplished partially or completely during the Initial Startup Test Phase. These tests should either be designated as Initial Startup Tests, or FSAR Subsections 14.2.1.2 and 14.2.1.3 should be rewritten to clarify the use of SOV tests during both the Preoperational and Initial Startup Test phases.

Section Number	Description
14.2.12.7.3	Verification of Performance Calculation
14.2.12.17.1	Turbine Plant Sampling System
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14.2.12.36.2	Turbine Overspeed Trip Test
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14.2.12.44.2	Cooling Tower Performance Test
14.2.12.57.1	Plant Communications Test
14.2.12.63.2	Fuel, Decont. Bldg. & Pipe Tunnel HVAC
14.2.12.71.1	Loose Parts Monitoring System Test