



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION**  
REGION II  
245 PEACHTREE CENTER AVENUE N.E., SUITE 1200  
ATLANTA, GEORGIA 30303-1200

June 19, 2020

Mr. James Barstow  
Vice President,  
Nuclear Regulatory Affairs and Support Services  
Tennessee Valley Authority (TVA)  
1101 Market Street, LP 4A-C  
Chattanooga, TN 37402-2801

SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3 – TRIENNIAL  
INSPECTION OF EVALUATION OF CHANGES, TESTS AND EXPERIMENTS  
BASELINE INSPECTION REPORT 05000259/2020010 AND 05000260/2020010  
AND 05000296/2020010

Dear Mr. Barstow:

On May 8, 2020, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at Browns Ferry Nuclear Plant, Units 1, 2, and 3. On June 18, 2020, the NRC inspectors discussed the results of this inspection with Mr. Steven M. Bono and other members of your staff. The results of this inspection are documented in the enclosed report.

No findings or violations of more than minor significance were identified during this inspection.

This letter, its enclosure, and your response (if any) will be made available for public inspection and copying at <http://www.nrc.gov/reading-rm/adams.html> and at the NRC Public Document Room in accordance with Title 10 of the *Code of Federal Regulations* 2.390, "Public Inspections, Exemptions, Requests for Withholding."

Sincerely,

**/RA/**

James B. Baptist, Chief  
Engineering Branch 1  
Division of Reactor Safety

Docket Nos. 05000259 and 05000260 and 05000296  
License Nos. DPR-33 and DPR-52 and DPR-68

Enclosure:  
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INSPECTION OF EVALUATION OF CHANGES, TESTS AND EXPERIMENTS  
BASELINE INSPECTION REPORT 05000259/2020010 AND 05000260/2020010  
AND 05000296/2020010 dated June 19, 2020

**DISTRIBUTION:**

G. Ottenberg, RII  
M. Riley, RII  
T. Su, RII  
J. Baptist, RII

ADAMS ACCESSION NUMBER: **ML20174A300**

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OFFICE	RII DRS	RII DRS	RII DRS	R II DRS	
NAME	G. Ottenberg	M. Riley	T. Su	J. Baptist	
DATE	06/19/2020	06/19/2020	06/19/2020	06/20/2020	

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**U.S. NUCLEAR REGULATORY COMMISSION**  
**Inspection Report**

Docket Numbers: 05000259, 05000260 and 05000296

License Numbers: DPR-33, DPR-52 and DPR-68

Report Numbers: 05000259/2020010, 05000260/2020010 and 05000296/2020010

Enterprise Identifier: I-2020-010-0040

Licensee: Tennessee Valley Authority (TVA)

Facility: Browns Ferry Nuclear Plant, Units 1, 2, and 3

Location: Athens, AL 35611

Inspection Dates: May 04, 2020 to May 08, 2020

Inspectors: G. Ottenberg, Senior Reactor Inspector  
M. Riley, Reactor Inspector  
T. Su, Reactor Inspector

Approved By: James B. Baptist, Chief  
Engineering Branch 1  
Division of Reactor Safety

Enclosure

## SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) continued monitoring the licensee's performance by conducting a triennial inspection of evaluation of changes, tests and experiments baseline inspection at Browns Ferry Nuclear Plant, Units 1, 2, and 3, in accordance with the Reactor Oversight Process. The Reactor Oversight Process is the NRC's program for overseeing the safe operation of commercial nuclear power reactors. Refer to <https://www.nrc.gov/reactors/operating/oversight.html> for more information.

## List of Findings and Violations

No findings or violations of more than minor significance were identified.

## Additional Tracking Items

Type	Issue Number	Title	Report Section	Status
URI	05000260/2020010-01	Water Hammer Analysis for Unit 2 HPCI Turbine Exhaust Piping	71111.17T	Open

## INSPECTION SCOPES

Inspections were conducted using the appropriate portions of the inspection procedures (IPs) in effect at the beginning of the inspection unless otherwise noted. Currently approved IPs with their attached revision histories are located on the public website at <http://www.nrc.gov/reading-rm/doc-collections/insp-manual/inspection-procedure/index.html>. Samples were declared complete when the IP requirements most appropriate to the inspection activity were met consistent with Inspection Manual Chapter (IMC) 2515, "Light-Water Reactor Inspection Program - Operations Phase." The inspectors reviewed selected procedures and records, observed activities, and interviewed personnel to assess licensee performance and compliance with Commission rules and regulations, license conditions, site procedures, and standards.

## REACTOR SAFETY

### 71111.17T - Evaluations of Changes, Tests, and Experiments

#### Sample Selection (IP Section 02.01) (21 Samples)

The inspectors reviewed the following evaluations, screenings, and/or applicability determinations for 10 CFR 50.59 from May 4, 2020, to May 8, 2020.

- (1) Evaluation DCN 70515, Replace Traveling Water Screens for Unit 1, 2, and 3, Rev. C, Revision 4
- (2) Evaluation DCP 72175, Unit 1- Main Steam Alternate Leakage Treatment (ALT) Pathway Modification, Rev. 0, Revision 0
- (3) Evaluation DCN 71987, Replace Unit 1 HPCI Vacuum Breaker Valves, Rev. A, Revision 0
- (4) Evaluation DCN 71988, Replace Unit 2 HPCI Vacuum Breaker Valves, Rev. A, Revision 1
- (5) Evaluation DCN 71865, Replace U3 HPCI Vacuum Breaker Valves and Modify Existing Piping, Rev. B, Revision 2
- (6) Screen DEC 72833, MS Alternate Leakage Treatment Pathway Valve Vibration Tie-Back Support, Revision 3
- (7) Screen SCN 72378, Increase Relief Valve Setpoints to Limit Undesired Actuations, Revision A
- (8) Evaluation DCN 71212, Unit 2 Replace Existing Obsolete 50KV SOLA Type I&C Bus Voltage Regulators, Rev. A, Revision 0
- (9) Screen DCN 71802, Create ECP to Install SLC Pump Suction Accumulator, Revision A
- (10) Screen DCN 72238, Install Viscoelastic Dampers on Main Steam Lines, Revision A
- (11) Screen DCN 70510, Replace Unit 2 DIV I and II HDR Inverters with Suitable Replacements, Revision A
- (12) Screen DCN 70819, Isolation fuses for EDG Protective Relaying Circuits, Rev. A, Revision 0
- (13) Screen DCN 72675, Torque Switch TS-17 Will be Eliminated from the Valve Closing Circuit Logic, Revision 0
- (14) Screen BFN-18-216-01, BFN Unit 2 Steam Leak Detection Upgrade, Revision 0
- (15) Evaluation DCN 71507 Upgrade BFN U3 Foxboro System, Rev. 3, Revision. 0
- (16) Evaluation FE 1342280, Compensatory Measure for FE 1342280, Revision. 3
- (17) Evaluation DCN 69532, Replace Unit 1/2 & Unit 3 Emergency Diesel Generator Governors, Rev. A, Revision. 3

- (18) Screen DCN 69626, Replace Obsolete SOR Pressure Switch in Various Systems, Rev. A, Revision. 0
- (19) Screen DCN 69710, Replace Obsolete MCR Recorder with Westronics Paperless Recorders, Rev. A, Revision 1
- (20) Screen DCN 71265, Reconfigure Valve Control to Prevent Spurious Operation, Rev. A, Revision 1
- (21) Screen 2-AOI-47-3, Rev 22, Revised reactor power level from 30% to 26R RTP to support EPU, Revision 0

## INSPECTION RESULTS

Unresolved Item (Open)	Water Hammer Analysis for Unit 2 HPCI Turbine Exhaust Piping URI 05000260/2020010-01	71111.17T
<p><u>Description:</u> Engineering Change (EC) 71988 implemented a modification to the Unit 2 high pressure coolant injection (HPCI) turbine exhaust line and HPCI vacuum breaker subsystem to minimize backflow from the suppression pool to the HPCI exhaust line following a HPCI turbine trip. Updated final safety analyses (UFSAR) Section 6.4.1 states that the function of the vacuum breakers is to prevent intermittent negative pressure in the exhaust piping from pulling water out of the torus and causing a water hammer problem. The UFSAR also states that the HPCI system piping material is composed of carbon steel and is designed to USA Standard (USAS) B31.1.0-1967, "Power Piping," which required in section 101.5, Dynamic Effects, that impact forces caused by all external and internal conditions (e.g., water hammer) be considered in the piping design.</p> <p>The purpose of calculation MDQ0020732016000535, "Analysis of Browns Ferry Nuclear Unit 2 HPCI Turbine Exhaust Steam Line Transient Loads Following HPCI Turbine Exhaust System Plant Modifications," Revision 1, was to enable analysis of water hammer induced piping loads in the exhaust lines following the plant modifications to ensure the exhaust lines could handle the stresses upon restarting. Section 5.3 of the calculation determined HPCI could be restarted automatically and reach full speed as soon as 20 seconds following a HPCI turbine trip. This is due to a potential single failure of the HPCI turbine overspeed trip device. UFSAR Section 6.4.1 states that the HPCI system is automatically shutdown on turbine overspeed and is capable of automatically restarting if an injection signal is received and the shutdown signal no longer exists.</p> <p>During the review of the EC package, the team identified that MPR Report 0048-0052-RPT-001, "Independent Technical Review on Browns Ferry Unit 2 HPCI Turbine Exhaust Piping Proposed Modification," Revision 1, stated that the calculation used a non-conservative assumption of 2% water volume in the exhaust piping as an input into the water hammer analysis and recommended that a transient analysis be performed to determine the actual amount of water in the exhaust line at the time of HPCI turbine restart. This transient analysis was documented in calculation 0048-0053-CALC-001, "HPCI Turbine Exhaust Siphoning Transient," Revision 0, and determined that a water volume of up to approximately 43.8% would exist in the exhaust piping at the time of restart. The team identified that this was a discrepancy from the 2% water volume used in calculation MDQ0020732016000535, which is used as an input into the piping stress analysis, CDQ0020732016000533, "Browns Ferry Nuclear Plant Summary of Piping Analysis N1-273-01R," Revision 4, that is used to conform to the requirements of USAS B31.1.0.</p> <p>This unresolved item is being opened to determine if a violation of 10 CFR 50.59 exists. In</p>		

order to make this determination, the team will need to determine whether the change would have resulted in exceeding code allowances or other applicable stress or deformation limits set in USAS B31.1.0 for the HPCI exhaust piping.

Planned Closure Actions: The licensee plans to provide an analysis detailing how the piping stresses resulting from the original 2% water volume in calculation MDQ0020732016000535 bounds the piping stresses resulting from the water volume used in Calculation 0048-0053-CALC-001, due to the differences in assumptions used in both calculations. The team will need to review the analysis to verify that the stresses caused by a HPCI restart on the turbine exhaust piping would not result in exceeding code allowances or other applicable stress limits set in USAS B31.1.0.

Licensee Actions: The licensee determined there was reasonable assurance that the HPCI system could perform its intended function until the analysis can be completed.

Corrective Action References: Condition Report 1606616

## **EXIT MEETINGS AND DEBRIEFS**

The inspectors verified no proprietary information was retained or documented in this report.

- On June 18, 2020, the inspectors presented the triennial inspection of evaluation of changes, tests and experiments baseline inspection results to Mr. Steven M. Bono and other members of the licensee staff.
- On May 8, 2020, the inspectors presented the Initial Inspection Results Debrief inspection results to Steven M. Bono and other members of the licensee staff.

## DOCUMENTS REVIEWED

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
71111.17T	Calculations	0048-0053-CALC-001	HPCI Turbine Exhaust Siphoning Transient	Rev. 0
		CDQ0020732016000533	Browns Ferry Nuclear Plant Summary of Piping Analysis N1-273-01R	Rev. 4
		ED-Q-0254-880142	FUSE PROGRAM - 125Vdc Boards A, B, C, D, 3A, 3B, 3C, 3D	Rev. 7
		ED-Q2000-870048	125Vdc System Short Circuit Calculations	Rev. 9
		MDQ002073201600535	Analysis of Browns Ferry Nuclear Unit 2 HPCI Turbine Exhaust Steam Line Transient Loads Following HPCI Turbine Exhaust System Plant Modifications	Rev. 1
		MDQ0068930029	MINIMUM PIPE WALL THICKNESS AND CORROSION ALLOWANCE FOR REACTOR WATER RECIRCULATION (RWR) SYSTEM	Rev. 5
		MDQ2073910103	MOV 2-FCV-73-44 Operator Requirements and Capabilities Calculation	Rev. 12
		NDQ099920010019	Ex-Containment Removal Coefficients for Alternative Source Term Analyses	Rev. 6
		W81930916002	1/3-PS-71-1A, 1B, 1C and 1D Setpoint and Scaling Calculation	Rev. 4
	Corrective Action Documents	CR 1341458, PER 200863, CR 1038747, CR 1415269		
	Corrective Action Documents Resulting from Inspection	CR 1606544	Detail in FSAR for ALT Leak Path	05/07/2020
		CR 1606578	Evaluate BFN-18-216 50.59 Screening for NEI 01-01	05/07/2020
		CR 1606604	During NRC 50.59 Inspection the need to review SCN 72738 screening criteria was identified.	05/07/2020
		CR 1606616	Revise MDQ0020732016000535 to Clarify Methodology	05/07/2020
		CR 1606630	Revise 50.59 screen and Evaluation to incorporate screen wash strainers	05/07/2020
		CR 1606686	DCN 69710 Replace MCR Recorders. The Dry-well effluent recorder was an analog to digital replacement and the 50.59 was not screened in.	05/07/2020



Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		CR 1606688	Revise the 10 CFR 50.59 Review for DCN 68532 to incorporate a discussion of the failure mode for the surge suppressor and capacitors	05/07/2020
	Drawings	0-47W490-2	Mechanical Service Water, Air, Fire Protection	Rev. 8
		0-47W491-7	Mechanical Service Water, Air, & Fire Protection	Rev. 14
		0-47W491-9	Mechanical Service Water, Air, & Fire Protection	Rev. 3
		1-47BD400-43	DC 72175, Sheets 1 and 2	Rev. 0
		1-47E225-100	Harsh Environmental Data Drawing Series Index, Notes and References	Rev. 8
		1-47E225-110	Harsh Environment Data EL 565.0	Rev. 5
		1-47E831-1	Flow Diagram Condenser Circulating Water	Rev. 41
		1-47E850-1	Flow Diagram Fire Protection & Raw Service Water	Rev. 27
		1-47E850-2	Flow Diagram Fire Protection & Raw Service Water	Rev. 31
		2-45E714-1	Wiring Diagram 250 DC Reactor MOV BDS Schematic Diagram	Rev. 16
		2-45E714-4	Wiring Diagram 250V DC Reactor MOV BD 2B Schematic Diagram	Rev. 36
		2-47E610-73-1	Mechanical Control Diagram - HPCI System	Rev. 56
		3-47E812-1	Flow Diagram High Pressure Coolant Injection System	Rev. 73
		3-47E820-2	Flow Diagram Control Rod Drive Hydraulic System	Revs. 19 and 21
		3-47E820-2-APPJ	Appendix J Testing Boundary for Control Rod Drive Hydraulic System	Rev. 4
		3-47E820-2-ISI	ASME Section XI Control Rod Drive Hydraulic System Code Class Boundaries	Rev. 14
		961111MA	Relief Valve Drawing	Rev. 0
	Engineering Changes	DCN 51607	Respan of Tech Spec Instruments for EPU	Rev. A
		PIC 70629A	Revise Proposed Diesel Generator Governor Logic for Emergency Fast Start	Rev. A
	Engineering Evaluations	BFN0EQ-IPS-003	Static-O-Ring Pressure Switches	Rev. 3
		EWR18PROG064241	Review and Approval SOR Test Report 9058-102 Rev. 3	11/15/2018
	Miscellaneous		Safety Evaluation of GE Topical Report NEDC-31858P, Revision 2, "BWROG Report for Increasing	03/03/1999

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
			MSIV Leakage Limits and Elimination of Leakage Control Systems," September 1993	
			BROWN FERRY NUCLEAR PLANT, UNITS 2 AND 3 - ISSUANCE OF AMENDMENTS REGARDING LIMITS ON MAIN STEAM ISOLATION VALVE LEAKAGE (TAC NOS. MA6405 AND MA6406)	03/14/2000
			BROWNS FERRY NUCLEAR PLANT (BFN) -UNITS 1, 2, AND 3 -LICENSE AMENDMENT -ALTERNATIVE SOURCE TERM	07/31/2002
			Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Proposed Technical Specification Change To Revise The Leakage Rate Through MSIVs - TS-485	11/22/2013
		8001206-EMI-1	EMI/RFI Qualification Report for Engine Governor Control System Upgrade	Rev. 0
		EWR17PROJ073080	HPCI Restart Transient	Rev. 2
		MPR Report 0048-0052-RPT-001	Independent Technical Review on Browns Ferry Unit 2 HPCI Turbine Exhaust Piping Proposed Modification	Rev. 1
		SR-473	2-FCV-73-44 Weak Link Analysis	Rev. 2
		SS-E18.15.01	Requirements for Digital Systems(Real-Time Data Acquisition and Control Computer Systems)	Rev. 9
		TVA-BFN-TS-405	BROWNS FERRY NUCLEAR PLANT (BFN) - UNITS 1, 2, AND 3- SUPPLEMENTAL INFORMATION ASSOCIATED WITH RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI) RELATED TO TECHNICAL SPECIFICATIONS (TS) CHANGE NO. TS-405 - ALTERNATIVE SOURCE TERM (AST) (TAC NOS. MB5733, MB5734, MB5735).	08/24/2004
		TVA-BFN-TS-436	BROWNS FERRY NUCLEAR PLANT (BFN) UNIT 1 - TECHNICAL SPECIFICATION (TS) 436 - INCREASED MAIN STEAM ISOLATION VALVE (MSIV) LEAKAGE RATE LIMITS AND EXEMPTION FROM 10 CFR 50, APPENDIX J	07/09/2004
		US14525-EMIR/RFIR-ONS-0001	TVA Browns Ferry Unit 2 and 3 Digital Controls Upgrade Electromagnetic and Radio Frequency	Rev. A

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
			Interference Report	
	Procedures	1-AOI-100-1	Reactor Scram	Rev. 24
		1-OI-68	Reactor Recirculation System	Rev. 40
		2-AOI-100-1	Reactor Scram	Rev. 113
		2-OI-68	Reactor Recirculation System	Rev. 158
		3-AOI-100-1	Reactor Scram	Rev. 71
		3-OI-68	Reactor Recirculation System	Rev. 99
		NPG-SPP-09.3	Plant Modifications and Engineering Change Control	Revs. 24, 32, and 33
		NPG-SPP-09.3 IP-ENG-001	Standard Design Process	Rev. 1
	Work Orders	119872578, 113122016, 118008166, 118299683, 113122016, 114128873, 120136104, 118031889, 118035236, 119538467, 119873861, 118491608		
		PM 126676 Evaluation	Disassembly, inspection, cleaning and refurbishment of actuator	
		PM126675 Evaluation	Disassembly, inspection, cleaning and refurbishment of actuator	