



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
REGION II**

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ATLANTA, GEORGIA 30303-1257

February 8, 2017

Mr. Joseph W. Shea  
Vice President, Nuclear Licensing  
Tennessee Valley Authority  
1101 Market Street, LP 3D-C  
Chattanooga, TN 37402-2801

**SUBJECT: BROWNS FERRY NUCLEAR PLANT - NRC INTEGRATED INSPECTION  
REPORT 05000259/2016004, 05000260/2016004, AND 05000296/2016004**

Dear Mr. Shea:

On December 31, 2016, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at your Browns Ferry Nuclear Plant, Units 1, 2, and 3. On January 20, 2017, the NRC inspectors discussed the results of this inspection with Mr. S. Bono and other members of your staff. The results of this inspection are documented in the enclosed report.

NRC inspectors documented two findings of very low safety significance (Green) in this report. Both of these findings involved a violation of NRC requirements. The NRC is treating these violations as non-cited violations (NCVs) consistent with Section 2.3.2.a of the Enforcement Policy.

If you contest the violations or significance of these NCVs, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington DC 20555-0001; with copies to the Regional Administrator, Region II; the Director, Office of Enforcement; and the NRC resident inspector at Browns Ferry Nuclear Plant.

If you disagree with a cross-cutting aspect assignment in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your disagreement, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001; with copies to the Regional Administrator, RII, and the NRC resident inspector at Browns Ferry Nuclear Plant.

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 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding."

Sincerely,

**/RA/**

Alan Blamey, Chief  
Reactor Projects Branch 6  
Division of Reactor Projects

Docket Nos.: 50-259, 50-260, 50-296  
License Nos.: DPR-33, DPR-52, DPR-68

Enclosure: NRC Integrated Inspection Report 05000259/2016004,  
05000260/2016004 and 05000296/2016004

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BROWNS FERRY NUCLEAR PLANT - NRC INTEGRATED INSPECTION REPORT  
05000259/2016004, 05000260/2016004, AND 05000296/2016004 FEBRUARY 8, 2017

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ADAMS ACCESSION NUMBER: ML17039A855

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Letter to Joseph W. Shea from Alan Blamey dated February 8, 2017.

SUBJECT: BROWNS FERRY NUCLEAR PLANT - NRC INTEGRATED INSPECTION  
REPORT 05000259/2016004, 05000260/2016004, AND 05000296/2016004

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**U.S. NUCLEAR REGULATORY COMMISSION**

**REGION II**

Docket Nos.: 50-259, 50-260, 50-296

License Nos.: DPR-33, DPR-52, DPR-68

Report No.: 05000259/2016004, 05000260/2016004, 05000296/2016004

Licensee: Tennessee Valley Authority (TVA)

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

Location: Corner of Shaw and Nuclear Plant Road  
Athens, AL 35611

Dates: October 1, 2016, through December 31, 2016

Inspectors: D. Dumbacher, Senior Resident Inspector  
T. Stephen, Resident Inspector  
A. Ruh, Resident Inspector  
R. Baldwin, Senior Operations Engineer  
R. Williams, Senior Reactor Inspector  
G. Ottenberg, Senior Reactor Inspector  
D. Terry-Ward, Construction Inspector  
J. Seat, Project Engineer

Approved by: Alan Blamey, Chief  
Reactor Projects Branch 6  
Division of Reactor Projects

Enclosure

## SUMMARY

05000259/2016004, 05000260/2016004, 05000296/2016004; 10/01/2016–12/31/2016; Browns Ferry Nuclear Plant, Units 1, 2, and 3; (Operability Determinations and Functionality Assessments, Problem Identification and Resolution)

The report covered a three-month period of inspection by resident and regional inspectors. Two violations were identified. The significance of inspection findings is indicated by their color (Green, White, Yellow, Red) using Inspection Manual Chapter (IMC) 0609, "Significance Determination Process" (SDP) dated April 29, 2015. Cross-cutting aspects are determined using IMC 0310, "Aspects Within the Cross Cutting Areas" dated December 4, 2014. All violations of NRC requirements are dispositioned in accordance with the NRC's Enforcement Policy dated November 1, 2016. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 6.

### A. NRC-Identified and Self-Revealing Findings and Violations

#### Cornerstone: Mitigating Systems

- Green. A self-revealing non-cited violation (NCV) of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings" was identified for the licensee's failure to provide sufficient detail, in this case, appropriate to the work activity in procedure, MCI-0-000-ACT004, Maintenance of SMB-0 through SMB-4T Limitorque Actuators, which impacted the design features of HPCI valve 1-FCV-73-2. As an immediate corrective action, the valve was repaired and corrective actions initiated to address the quality and details of motor operated valve procedures. The licensee entered the violation into their corrective action program as Condition Reports (CRs) 1228056 and 1229289.

The performance deficiency was more than minor because it was associated with the Equipment Performance attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences (i.e. core damage). Specifically, the reliability of the valve was reduced due to the impending worm gear teeth failure. While the valve was full open, the High Pressure Coolant Injection (HPCI) pump was able to fulfill its safety function of injecting water into the reactor. Since the valve was able to close upon entering outage U1R11, the HPCI system was able to isolate the HPCI steam supply line in the event of a HPCI steam line break. This finding was evaluated in accordance with NRC IMC 0609, Appendix A, Mitigating Systems Screening Questions. The inspectors determined the finding screened to Green as HPCI was not unavailable longer than its TS allowed outage time and the finding did not involve the loss or degradation of equipment designed to mitigate a seismic, flooding, or severe weather initiating event. The inspectors determined that the finding had a cross-cutting aspect of Procedure Adherence in the Human Performance area [H.8], because individual staff members did not review procedures and instructions prior to work to validate they were appropriate for the scope of work. (Section 1R15)

- Green. An NRC identified NCV of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings" was identified for the licensee's failure to accomplish the Prompt Determination of Operability (PDO) for CR 1039036 in accordance with the requirements of NEDP-22, "Operability Determinations and Functional Evaluations," Sections 3.2.2.E, 3.2.2.G, and Attachment 2.

As an immediate corrective action, the licensee revised the PDO to include an evaluation that supported a reasonable expectation of operability. The licensee entered the violation into the corrective action program as CR 1219620.

The performance deficiency was more-than-minor because it was associated with the Human Performance attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences (i.e. core damage). Specifically, after considering the inadequacies of the PDO, additional and significant evaluation was required to maintain reasonable assurance of the HPCI system operability. The doubt stemmed from uncertainty about the actual water level in the turbine, the expected transient severity, and the unanalyzed effects of the piping configuration. This finding was evaluated in accordance with NRC IMC 0609, Appendix A, Exhibit 2 "Mitigating Systems Screening Questions," dated June 19, 2012. The inspectors determined the finding was Green because it was a deficiency affecting the qualification of HPCI, but it maintained its operability. The inspectors determined that the finding had a cross-cutting aspect of Evaluation in the Problem Identification and Resolution area [P.2], because the organization did not thoroughly investigate this issue commensurate with its potential safety significance. (Section 4OA2.3)

## REPORT DETAILS

### Summary of Plant Status:

Unit 1 began a scheduled refueling outage on October 1, 2016 and was restarted on October 29, 2016. During the restart activities, the High Pressure Coolant Injection (HPCI) inboard drywell isolation valve (1-FCV-73-2) failed to open and the unit was subsequently shut down. 1-FCV-73-2 was repaired and the unit was restarted on November 3, 2016. The unit reached 100 percent rated thermal power (RTP) on November 6, 2016 and maintained at, or near, 100 percent RTP for the rest of the inspection period.

Unit 2 operated at, or near, 100 percent RTP for the entire inspection period except for two unplanned and four planned downpowers until it began coastdown on December 21, 2016 for an upcoming outage. The unplanned downpowers were a November 13, 2016, reduction to 93 percent for feedwater heater string isolation and a November 23, 2016, reduction to 78% for a lowering condenser vacuum caused by small fish entering the intake. The planned downpowers occurred on October 21, November 4, November 18, November 28, and December 10, 2016 for normal maintenance activities.

Unit 3 operated at, or near, 100 percent RTP for the entire inspection period except for two unplanned and one planned downpowers. The unplanned downpower on October 25, 2016, to 91 percent was due to a feedwater heater level control valve failure. The unplanned downpower on December 21, 2016 was to perform repairs to the 3B2 moisture separator level control valve. The planned downpower on December 28, 2016 was for maintenance.

## **1. REACTOR SAFETY**

Cornerstones: Initiating Events, Mitigating Systems, and Barrier Integrity

### 1R04 Equipment Alignment (71111.04)

#### .1 Partial System Walkdown

##### a. Inspection Scope

The inspectors performed partial walkdowns of the following systems to verify the operability of redundant or diverse trains and components when safety equipment was inoperable. The inspectors focused on identification of discrepancies that could impact the function of the system and, therefore, potentially increase risk. The inspectors reviewed applicable operating procedures, walked down control system components, and determined whether selected breakers, valves, and support equipment were in the correct position to support system operation. The inspectors also verified that the licensee had properly identified and resolved equipment alignment problems that could cause initiating events or impact the capability of mitigating systems or barriers and entered them into the corrective action program (CAP). Documents reviewed are listed in the Attachment. The inspectors completed three Equipment Alignment Partial Walkdown samples.

- Unit 1 Loop II Shutdown Cooling System during the beginning of the refueling outage with Loop I Shutdown Cooling out of service for testing



- Unit 1 4kV electrical power components with the Unit Station Service Transformers (USST) out of service
- Unit 1 inspection internal to the suppression chamber (torus) and review of the Coatings Report associated with the drywell and torus

b. Findings

No findings were identified.

.2 Complete Walkdown

a. Inspection Scope

The inspectors completed a detailed alignment verification of the Alternate Decay Heat Removal System. This included review of the relevant operating instruction and mechanical drawings to verify equipment availability and operability. The inspectors reviewed relevant portions of the Updated Final Safety Analysis Report (UFSAR) and Technical Specifications (TS). This detailed walkdown also verified electrical power alignment, the condition of applicable system instrumentation and controls, component labeling, pipe hangers and support installation, and associated support systems status. The inspectors examined applicable System Health Reports, open Work Orders (WOs), and any previous Condition Reports (CRs) that could affect system alignment and operability. Documents reviewed are listed in the Attachment. This activity constituted one Equipment Alignment Complete Walkdown inspection sample, as defined in Inspection Procedure 71111.04.

b. Findings

No findings were identified.

1R05 Fire Protection (71111.05)

.1 Fire Protection Tours

a. Inspection Scope

The inspectors reviewed licensee procedures for transient combustibles and fire protection impairments, and conducted a walkdown of the fire areas (FA) and fire zones (FZ) listed below. Selected FAs/FZs were examined in order to verify licensee control of transient combustibles and ignition sources; the material condition of fire protection equipment and fire barriers; and operational lineup and operational condition of fire protection features or measures. The inspectors verified that selected fire protection impairments were identified and controlled in accordance with procedures. The inspectors reviewed applicable portions of the Fire Protection Requirements Manual (FPRM) including the applicable Pre-Fire Plan drawings, to verify that the necessary firefighting equipment, such as fire extinguishers, hose stations, ladders, and communications equipment, was in place. Documents reviewed are listed in the Attachment. This activity constituted six Fire Protection Walkdown inspection samples, as defined in Inspection Procedure 71111.05.

- Unit 1 Drywell, verification of no transient combustibles during closeout

- Unit 1 Reactor Building, EL 621', Fire Area 06, 480v Shutdown Board Room 1A
- Unit 1 Reactor Building, EL 621', Fire Area 07, 480v Shutdown Board Room 1B
- Unit 3 Reactor Building, EL 593', Fire Area 12, 480v RMOV Board Room 3B
- Intake Building, Fire Area 25-1 including review of Table S-3 NFPA 0805 Implementation requirements per 10CFR 50.48(c)
- Unit 2 Reactor Building, Fire Area 2-1, EL 519'-565', From R8 to R11

b. Findings

No findings were identified.

1R08 Inservice Inspection Activities (71111.08)

a. Inspection Scope

Non-Destructive Examination Activities and Welding Activities

From October 10, 2016, through October 14, 2016, the inspectors conducted an onsite review of the implementation of the licensee's inservice inspection (ISI) program for Unit 1. The ISI program is designed to monitor degradation of pressure retaining components in vital system boundaries. The scope of this program includes components within the reactor coolant system boundary, risk-significant piping boundaries, and containment system boundaries.

The inspectors directly observed the following non-destructive examination (NDE) activities. These activities were mandated by the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code of Record: 2007 Edition with 2008 Addenda). The inspectors evaluated the NDE activities for compliance with the requirements in Section XI and Section V of the ASME Code. The inspectors also evaluated if any identified indications or defects were dispositioned in accordance with either the ASME Code or an NRC-approved alternative requirement. Additionally, the inspectors reviewed the qualifications of the NDE technicians performing the examinations to determine if they were in compliance with ASME Code requirements.

- Ultrasonic Examination (UT) of RCH-1-2C, RPV vessel head weld, ASME Class 1
- Visual Examination (VT-1) of 1-47B403-1, Snubber, ASME Class 1
- VT-1 of 1-47B403-8, Snubber, ASME Class 1

The inspectors directly observed the following welding activity. The inspectors evaluated this activity for compliance with site procedures and the requirements in Section IX and Section XI of the ASME Code. Specifically, the inspectors reviewed the work orders (WO), repair or replacement plans, weld data sheets, welding procedures, procedure qualification records, welder performance qualification records, and NDE reports.

- WO 117235018, Replace Unit 1C RHRSW Heat Exchanger Demineralized Water Branch Line downstream of BFN-1-SHV-023-0552

The inspectors reviewed the listing of non-destructive surface and volumetric examinations performed since the previous refueling outage. The inspectors verified that the licensee did not identify any relevant indications that were analytically evaluated and accepted for continued service.

## Identification and Resolution of Problems

The inspectors reviewed a sample of ISI-related issues entered into the corrective action program. The inspectors determined if the licensee had appropriately described the scope of the problem and had initiated corrective actions. The review also included the licensee's consideration and assessment of operating experience events applicable to the plant. The inspectors performed this review to ensure compliance with 10 Code of Federal Regulations (CFR) Part 50, Appendix B, Criterion XVI, "Corrective Action," requirements.

These activities constituted one sample of IP 71111.08.

### b. Findings

No findings were identified.

## 1R11 Licensed Operator Regualification Program and Licensed Operator Performance (71111.11)

### .1 Licensed Operator Regualification Program

#### a. Inspection Scope

On October 19, 2016, the inspectors observed a licensed operator training session for an operating crew on the Unit 2 Simulator involving just-in-time training for the upcoming Unit 1 refueling outage startup with equipment failures.

The inspectors specifically evaluated the following attributes related to the operating crew's performance:

- Clarity and formality of communication
- Ability to take timely action to safely control the unit
- Prioritization, interpretation, and verification of alarms
- Correct use and implementation of procedures including Abnormal Operating Instructions (AOIs)
- Timely control board operation and manipulation, including high-risk operator actions
- Timely oversight and direction provided by the shift supervisor, including ability to identify and implement appropriate technical specifications actions such as reporting and emergency plan actions and notifications
- Group dynamics involved in crew performance

The inspectors assessed the licensee's ability to assess the performance of their licensed operators. The inspectors reviewed the post-examination critique performed by the licensee evaluators, and verified that licensee-identified issues were comparable to issues identified by the inspector. The inspectors reviewed simulator physical fidelity (i.e., the degree of similarity between the simulator and the reference plant control room, such as physical location of panels, equipment, instruments, controls, labels, and related form and function). Documents reviewed are listed in the Attachment. This activity constituted one Observation of Regualification Activity inspection sample.

b. Findings

No findings were identified.

.2 Control Room Observations

a. Inspection Scope

Inspectors observed and assessed licensed operator performance in the plant and main control room, particularly during periods of heightened activity or risk and where the activities could affect plant safety. Inspectors reviewed various licensee policies and procedures covering Conduct of Operations, Plant Operations, and Power Maneuvering.

Inspectors utilized activities such as post maintenance testing, surveillance testing, and other activities to focus on the following conduct of operations as appropriate;

- Operator compliance and use of procedures
- Control board manipulations
- Communication between crew members
- Use and interpretation of plant instruments, indications, and alarms
- Use of human error prevention techniques
- Documentation of activities, including initials and sign-offs in procedures
- Supervision of activities, including risk and reactivity management
- Pre-job briefs

This activity constituted one Control Room Observation inspection sample.

b. Findings

No findings were identified.

.3 Annual Review of Licensee Regualification Examination Results

a. Inspection Scope

On September 22, 2016, the licensee completed the comprehensive biennial requalification written examinations and the annual requalification operating examinations required to be administered to all licensed operators in accordance with Title 10 of the Code of Federal Regulations 55.59(a)(2), "Requalification Requirements," of the NRC's "Operator's Licenses." The inspectors performed an in-office review of the overall pass/fail results of the individual operating examinations, written examinations, and the crew simulator operating examinations in accordance with Inspection Procedure (IP) 71111.11, "Licensed Operator Requalification Program." These results were compared to the thresholds established in Section 3.02, "Requalification Examination Results," of IP 71111.11. This activity constitutes one sample of annual review of licensee requalification examination results.

b. Findings

No findings were identified.

## 1R12 Maintenance Effectiveness (71111.12)

### a. Inspection Scope

The inspectors reviewed the specific structures, systems, and components (SSC) within the scope of the Maintenance Rule (MR) (10CFR50.65) with regard to some or all of the following attributes, as applicable: (1) Appropriate work practices; (2) Identifying and addressing common cause failures; (3) Scoping in accordance with 10 CFR 50.65(b) of the MR; (4) Characterizing reliability issues for performance monitoring; (5) Tracking unavailability for performance monitoring; (6) Balancing reliability and unavailability; (7) Trending key parameters for condition monitoring; (8) System classification and reclassification in accordance with 10 CFR 50.65(a)(1) or (a)(2); (9) Appropriateness of performance criteria in accordance with 10 CFR 50.65(a)(2); and (10) Appropriateness and adequacy of 10 CFR 50.65 (a) (1) goals, monitoring and corrective actions. The inspectors compared the licensee's performance against site procedures. The inspectors reviewed, as applicable, work orders, surveillance records, CR's, system health reports, engineering evaluations, and MR expert panel minutes; and attended MR expert panel meetings to verify that regulatory and procedural requirements were met. Documents reviewed are listed in the Attachment. This activity constituted one Maintenance Effectiveness inspection sample.

- Unit 3 HPCI erratic startup and maintenance practices associated with HPCI turbine stop valve mechanical trip

### b. Findings

No findings were identified.

## 1R13 Maintenance Risk Assessments and Emergent Work Control (71111.13)

### a. Inspection Scope

For planned online work and/or emergent work that affected the combinations of risk significant systems listed below, the inspectors examined on-line maintenance risk assessments, and actions taken to plan and/or control work activities to effectively manage and minimize risk. The inspectors verified that risk assessments and applicable risk management actions (RMA) were conducted as required by 10 CFR 50.65(a)(4) applicable plant procedures. As applicable, the inspectors verified the actual in-plant configurations to ensure accuracy of the licensee's risk assessments and adequacy of RMA implementations. Documents reviewed are listed in the Attachment. This activity constituted six Maintenance Risk Assessment inspection samples.

- Unit 1 refueling outage, Day 2, high decay heat and an abnormal offsite power lineup
- Unit 1 reactor head lift evolution with short time to boil
- Unit 1 reactor coolant system drain down following a shutdown cooling train swap
- Unit 1 reactor vessel head tensioning
- Unit 1 Yellow risk due to concurrent D emergency diesel generator (EDG) and D 4kv shutdown board maintenance
- Unit 2 Yellow risk due to Division 1 Analog Trip Unit Panel 9-81 fan repair

b. Findings

No findings were identified.

1R15 Operability Determinations and Functionality Assessments (71111.15)

.1 Routine

a. Inspection Scope

The inspectors reviewed the operability/functional evaluations listed below to verify technical adequacy and ensure that the licensee had adequately assessed TS operability. The inspectors reviewed applicable sections of the UFSAR to verify that the system or component remained available to perform its intended function. In addition, where appropriate, the inspectors reviewed licensee procedures to ensure that the licensee's evaluation met procedure requirements. Where applicable, inspectors examined the implementation of compensatory measures to verify that they achieved the intended purpose and that the measures were adequately controlled. The inspectors reviewed CRs on a daily basis to verify that the licensee was identifying and correcting any deficiencies associated with operability evaluations. Documents reviewed are listed in the Attachment. This activity constituted five Operability Evaluation inspection samples.

- EDG C jacket water leak (CR 1219043)
- Unit 2 HPCI discharge pipe elevated temperatures during the monthly venting surveillance
- Unit 1 past operability review for Valve 1-FCV-73-2 actuator failure
- Reduced cooling water flows to 3A, 3B, 3C EDGs (CRs 1234848, 1234849, 1234852)
- Unit 1 HPCI system briefly exceeded system design pressure during cold-quick start surveillance

b. Findings

Introduction: NRC inspectors reviewed the details of a self-revealing NCV of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings" for the licensee's failure to provide sufficient detail in procedure, MCI-0-000-ACT004, Maintenance of SMB-0 through SMB-4T Limitorque Actuators.

Description: On July 20, 2016 the Unit 1 HPCI steam line inboard isolation valve, 1-73-2, was declared inoperable because of a catastrophic valve stem failure (See NCV 05000259/2016003-04, Inadequate Prompt Determination of Operability for HPCI Steam Line Inboard Isolation Valve). Maintenance repaired and tested the valve on July 31<sup>st</sup>. This maintenance also replaced the motor actuator. The licensee successfully tested the HPCI pump, achieving full rated flow and pressure on August 8<sup>th</sup>. Refueling outage U1R11 started on October 1<sup>st</sup>. The reactor was taken critical early on October 29<sup>th</sup>. The attempt to open 1-73-2 following the startup resulted in the valve not opening with its breaker tripping on thermal overload.

Maintenance replacement procedure MCI-0-000-ACT004, step 7.4[5], stated to "Install drive sleeve assembly into housing." The actuator drawing in Attachment 2 of MCI-0-

000-ACT004 showed a required worm gear spacer as item #28. This spacer was not installed with the drive sleeve assembly just prior to the July 31, 2016 plant re-start. The valve did open one time on July 31<sup>st</sup> and close one time on October 1<sup>st</sup>. As a result of the missing spacer the attempted opening of valve 1-73-2 on October 29, 2016, caused worm gear and bull gear interaction that broke off four of the worm gear teeth, making the valve incapable of opening fully. The licensee returned Unit 1 to cold shutdown to perform the actuator repair because the inboard HPCI steam isolation valve is unisolable from the reactor. After repairs, on November 3, 2016, the licensee restarted the Unit 1 reactor and successfully opened the HPCI inboard steam isolation valve 1-73-2 and then tested the HPCI pump. Condition report 1229289 was written to confirm procedure MCI-0-000-ACT004 was not sufficiently detailed for this particular actuator installation.

Analysis: The inspectors determined that the failure to have sufficient detailed guidance appropriate to the maintenance work activity affecting quality on the HPCI inboard steam isolation valve was a performance deficiency. Specifically, the actuator reassembly procedure lacked sufficient detail to ensure all the parts essential to the safety function of the valve were installed. The performance deficiency is more than minor because it was associated with the Equipment Performance attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences (i.e. core damage). Specifically, the reliability of the valve was reduced due to the impending worm gear teeth failure. While the valve was full open, the HPCI pump was able to fulfill its safety function of injecting water into the reactor. Since the valve was able to close upon entering outage U1R11 the HPCI system was able to isolate the HPCI steam supply line in the event of a HPCI steam line break. A redundant downstream valve could also have fulfilled this automatic isolation function. This finding was evaluated in accordance with NRC IMC 0609, Appendix A, Mitigating Systems Screening Questions. The inspectors determined the finding screened to green as HPCI was not unavailable longer than its TS allowed outage time and the finding did not involve the loss or degradation of equipment designed to mitigate a seismic, flooding, or severe weather initiating event. The inspectors determined that the finding had a cross-cutting aspect of Procedure Adherence in the Human Performance area [H.8], because individual staff members did not review procedures and instructions prior to work to validate they were appropriate for the scope of work.

Enforcement: 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings" states, in part, "Activities affecting quality shall be prescribed by documented instructions, procedures, or drawings of a type appropriate to the circumstances ...." Contrary to the above, since July 31, 2016, the valve actuator for 1-73-2 was missing a spacer on the drive sleeve assembly due to a procedure that was not appropriate to the circumstances because it lacked specific details. As an immediate corrective action, the valve was repaired and corrective actions initiated to address the quality and details of motor operated valve procedures. The licensee entered the violation into their corrective action program as CRs 1228056 and 1229289. This violation is being treated as an NCV consistent with Section 2.3.2 of the Enforcement Policy. (NCV 05000259/2016004-01, Inadequate Reassembly Procedure for HPCI Steam Line Inboard Isolation Valve Actuator)

#### 1R19 Post Maintenance Testing (71111.19)

##### a. Inspection Scope

The inspectors witnessed and reviewed post-maintenance tests (PMTs) listed below to verify that procedures and test activities confirmed SSC operability and functional capability following the described maintenance. The inspectors reviewed the licensee's completed test procedures to ensure any of the SSC safety function(s) that may have been affected were adequately tested, that the acceptance criteria were consistent with information in the applicable licensing basis and/or design basis documents. The inspectors witnessed and/or reviewed the test data, to verify that test results adequately demonstrated restoration of the affected safety function(s). The inspectors verified that problems associated with PMTs were identified and entered into the Corrective Action Program (CAP). Documents reviewed are listed in the Attachment. This activity constituted four Post Maintenance Test inspection samples.

- Post maintenance test (MOVATs) of Unit 1 RHR LPCI Loop 1, inboard isolation valve 1-FCV-74-53, WO 117169691
- Post maintenance test of Unit 1 Reactor Core Isolation Cooling (RCIC) following installation of a design change, WO 117194723
- Post maintenance test of Unit 1 Standby Liquid Control system (SLC) following modification to add a pump suction accumulator, WO 117067777
- Post maintenance test of Unit 1 drywell airlock following replacement of the door seals, WO 116734404

b. Findings

No findings were identified.

1R20 Refueling and Other Outage Activities (71111.20)

.1 Unit 1 Refueling Outage 11

a. Inspection Scope

From October 1, through November 3, 2016, the inspectors examined the refueling outage activities to verify that they were conducted in accordance with Technical Specifications, applicable plant procedures, and the licensee's outage risk assessment and management plans. The inspectors monitored critical plant parameters and observed operator control of plant conditions through Cold Shutdown (Mode 4), Refueling (Mode 5), Plant restart and power ascension through Startup (Mode 2) and Run (Mode 1). Some of the significant outage activities specifically reviewed and/or witnessed by the inspectors were as follows:

Outage Risk Assessment

Prior to the beginning of the refueling outage, the inspectors attended outage risk assessment team meetings and reviewed the Outage Risk Assessment Report. The inspectors reviewed the daily Refueling Outage Reports, including the Outage Risk Assessment Management (ORAM) Safety Function Status, and regularly attended the daily outage status meetings. The inspectors frequently discussed risk conditions and protected equipment with operations and outage management personnel to assess licensee awareness of actual risk conditions and mitigation strategies.



### Shutdown and Cooldown Process

The inspectors witnessed the shutdown and cooldown of Unit 1 in accordance with applicable licensee procedures.

### Decay Heat Removal

The inspectors reviewed licensee procedures for normal and alternate decay heat removal and conducted main control room panel and in-plant walkdowns of systems and components to verify correct system alignment. During planned evolutions that resulted in increased outage risk conditions for shutdown cooling, inspectors verified that the plant conditions and systems identified in the risk mitigation strategy were available. In addition, the inspectors reviewed controls implemented to ensure that outage work was not impacting the ability of operators to operate spent fuel pool cooling, Residual Heat Removal system (RHR) shutdown cooling, and/or the Alternate Decay Heat Removal system.

### Critical Outage Activities

The inspectors examined outage activities to verify that they were conducted in accordance with Technical Specifications, licensee procedures, and the licensee's outage risk control plan. Some of the more significant inspection activities accomplished by the inspectors were as follows:

- Walked down selected safety-related equipment clearances associated with tagout numbers:
  - 1) 1-TO-2016-0003, Clearance 1-077-0002D for Drywell equipment drain sump outboard isolation valve
  - 2) 1-TO-2016-0005, Clearance 1-074-0010 for Loop II of RHR condensate flush and fill prior to startup
  - 3) 1-TO-2016-0004; Clearance 1-071-0003 for RCIC steam line trap drain valve
- Verified Reactor Coolant System (RCS) inventory controls, specifically, the makeup methods used during operations with the potential to drain the reactor vessel (OPDRV's)
- Verified electrical systems availability and alignment
- Observed the RCS hydro / leak test and simultaneous SCRAM time testing
- Monitored important control room plant parameters (e.g., RCS pressure, level, flow, and temperature) and Technical Specification compliance during the various shutdown modes of operation and mode transitions
- Evaluated implementation of reactivity controls
- Reviewed control of containment penetrations and overall integrity
- Examined foreign material exclusion controls particularly in proximity to and around the reactor cavity, equipment pit, and spent fuel pool
- Performed routine tours of the control room, reactor building, refueling floor and drywell
- Verified the licensee was managing fatigue by performing a sample review of fatigue assessments, schedules and work hours of online and outage personnel

### Reactor Vessel Disassembly and Refueling Activities

The inspectors witnessed selected activities associated with reactor vessel disassembly, and reactor cavity flood-up and drain down. The inspectors witnessed

in-vessel and spent fuel pool fuel handling operations during the reactor core fuel shuffles performed in accordance with Technical Specifications and applicable operating procedures.

#### Drywell Closeout

The inspectors reviewed the licensee's conduct of Drywell Closeout, and performed an independent, detailed closeout inspection.

#### Restart Activities

The inspectors specifically observed the following:

- Unit 1 approach to criticality and power ascension on October 29, 2016 and November 3, 2016
- Reactor Coolant Heatup/Pressurization to Rated Temperature and Pressure on October 29, 2016 and November 3, 2016.

#### Corrective Action Program

The inspectors reviewed Condition Reports generated during the refueling outage and attended management review committee meetings to verify that initiation thresholds, priorities, mode holds, operability concerns and significance levels were adequately addressed. Resolution and implementation of corrective actions were also reviewed for completeness.

This activity constituted one Refueling and Other Outage Activities sample, as defined in Inspection Procedure 71111.20. Documents reviewed are listed in the Attachment.

#### b. Findings

No findings were identified

### 1R22 Surveillance Testing (71111.22)

#### a. Inspection Scope

The inspectors witnessed portions of, and/or reviewed completed test data for the following surveillance tests of risk-significant and/or safety-related systems to verify that the tests met Technical Specifications surveillance requirements, UFSAR commitments, and inservice testing and licensee procedure requirements. The inspectors' review confirmed whether the testing effectively demonstrated that the SSCs were operationally capable of performing their intended safety functions and fulfilled the intent of the associated surveillance requirements. Documents reviewed are listed in the Attachment. This activity constituted seven Surveillance Testing inspection samples: four routine test, two containment isolation valve test, and one reactor coolant system leakage test.

#### Routine Surveillance Tests:

- 1-SI-4.7.A.2.G, As found Local Leak Rate Tests for Unit 1 RCIC and HPCI exhaust line check valves
- 0-SR-3.8.1.9 (c), Emergency Diesel Generator C, Load Acceptance Test
- 1-SI-3.3.1.A, ASME Section XI System Leakage Test of the Reactor Pressure Vessel and Associated Piping (ASME Section III, Class 1 and 2), Revision 19

- 2-SR-3.5.1.1(HPCI) - Maintenance of Filled HPCI Discharge Piping

Containment Isolation Valve Tests:

- 1-SR-3.6.1.10(A) and 1-SR-3.6.1.10(B) Local Leak Rate Testing (LLRT) of Outboard Main Steam Isolation Valves (MSIV) A and B
- U1R11 Local Leak Rate / Appendix J and MSIV testing results cumulative review

Reactor Coolant System Leak Detection Tests:

- 2-SR-3.4.4.1 – Manual Calculation of Unidentified, Identified and Total Leakage

b. Findings

No findings were identified.

#### 4. **OTHER ACTIVITIES**

##### 4OA1 Performance Indicator Verification (71151)

###### .1 Cornerstone: Initiating Events

###### a. Inspection Scope

The inspectors reviewed the licensee's procedures and methods for compiling and reporting the following Performance Indicators (PIs). The inspectors examined the licensee's PI data for the specific PIs listed below for the fourth quarter of 2015 through the third quarter of 2016. The inspectors reviewed the licensee's data and graphical representations as reported to the NRC to verify that the data was correctly reported. The inspectors validated this data against relevant licensee records (e.g., CRs, Daily Operator Logs, Plan of the Day, Licensee Event Reports, etc.), and assessed any reported problems regarding implementation of the PI program. The inspectors verified that the PI data was appropriately captured, calculated correctly, and discrepancies resolved. The inspectors used the Nuclear Energy Institute (NEI) 99-02, Regulatory Assessment Performance Indicator Guideline, to ensure that industry reporting guidelines were appropriately applied. Documents reviewed are listed in the Attachment. This activity constituted nine PI inspection samples, as defined in Inspection Procedure 71151.

- Unit 1, 2, and 3 Unplanned Scrams
- Unit 1, 2, and 3 Unplanned Scrams with complications
- Unit 1, 2, and 3 Unplanned Power Changes.

###### b. Findings

No findings were identified.

##### 4OA2 Problem Identification and Resolution (71152)

###### .1 Review of items entered into the Corrective Action Program:

###### a. Inspection Scope

As required by Inspection Procedure 71152, "Identification and Resolution of Problems," and in order to help identify repetitive equipment failures or specific human performance issues for follow-up, the inspectors performed a daily screening of items entered into the licensee's CAP. This review was accomplished by reviewing daily CR reports, and periodically attending Management Review Committee (MRC) and Plant Screening Committee (PSC) meetings.

b. Findings

No findings were identified.

.2 Semi-annual Trend Review:

a. Inspection Scope

As required by Inspection Procedure 71152, the inspectors performed a review of the licensee's CAP and other associated programs and documents to identify trends that could indicate the existence of a more significant safety issue. The inspectors' review was focused on repetitive equipment issues, but also included licensee trending efforts and licensee human performance results. The inspectors' review nominally considered the six-month period of July through December 2016. The inspectors reviewed licensee trend reports and the Integrated Trend Reports from February 2016 to November 2016, in order to determine the existence of any adverse trends that the licensee may not have previously identified. This inspection constituted one Semi-annual Trend Review inspection sample as defined in IP 71152. Documents reviewed are listed in the Attachment.

b. Observations and Findings

The licensee had identified trends and appropriately addressed them in their CAP. The inspectors observed that the licensee had performed a detailed review. The licensee routinely reviewed cause codes, involved organizations, established key words and system links to identify potential trends in their data. The inspectors compared the licensee process results with the results of the inspectors' daily screening. Trends that have been identified by the inspectors and reported to the licensee were appropriately entered into the licensee's trending program.

Noteworthy Licensee identified trends included:

- All three Units' Reactor Water Cleanup System pump mechanical seals have had a lower than expected seal life (CR 1241674)
- Temporary equipment has not been adequately tracked in accordance with the licensee's procedures (CR 1228954)

Noteworthy NRC identified adverse trends included:

- Several operability determinations have not been consistently meeting the licensee's required standards for completeness and accuracy (CRs 1173067, 1193991, 1213614, 1216071, 1219620)
- Fire Protection requirements are not being consistently implemented (CRs 1219614, 1218609, 1223302, 1221908, 1221912, 1193142)

- Over half of all operability determinations requested (in 2016) by the operations staff were cancelled before they were completed

No violations were identified.

.3 Annual Follow-up of Selected Issues - (Closed) Unresolved Item (URI)  
05000296/2015002-01 HPCI Turbine Exhaust Drain High Level:

a. Inspection Scope

Inspectors previously identified a URI associated with repeat observations of HPCI Turbine Exhaust Drain Pot High Level alarms upon shutdown of the Unit 3 HPCI turbine. As previously documented in NRC Inspection Report 05000296/2015002, the inspectors questioned the licensee on the potential of having a large volume of water in the HPCI turbine prior to turbine startup and whether the HPCI turbine exhaust piping would be subjected to water hammer forces that could render the equipment inoperable. With support from the system vendor, the licensee determined that potential water hammer forces would not be excessive, that system piping integrity would be maintained, that the turbine would not be damaged and that the turbine exhaust rupture discs would not be adversely affected. Based on these evaluations, the licensee concluded that, although degraded/non-conforming, the HPCI system maintained operability. Inspectors opened URI 05000296/2015002-01 (HPCI Turbine Exhaust Drain High Level) to allow the NRC to review the operability determination, licensee actions, and system design to determine if a more than minor performance deficiency exists. The inspectors reviewed corrective actions, design documents, vendor documentation, and operability determination. Documents reviewed are listed in the Attachment.

This activity constituted one annual follow-up of selected issues sample as defined in IP 71152.

b. Findings

Introduction: An NRC identified non-cited violation (NCV) of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings" was identified for the licensee's failure to properly implement the Prompt Determination of Operability (PDO) for CR 1039036 in accordance with NEDP-22, "Operability Determinations and Functional Evaluations."

Description: As part of the inspection performed for URI 296/2015002-01, the NRC identified several examples of deficiencies with the PDO that evaluated the operability of the HPCI system with a large volume of water in the Unit 3 HPCI turbine casing following turbine trips. The PDO deficiencies were the result of not properly executing various sections of TVA procedure NEDP-22, "Operability Determinations and Functional Evaluations." Below are examples of inadequate monitoring actions and unsupported assumptions associated with the degraded condition.

Example 1: Monitoring the Maximum Water Level in the Turbine.

NEDP-22, Section 3.2.2.G, required engineers to identify, evaluate, and document any monitoring actions needed to ensure that the condition did not continue to degrade to a point that challenged the basis for operability. The PDO established actions to measure, record, and, as a compensatory measure, to drain the water level in the HPCI turbine

exhaust piping following each flow rate surveillance test. The PDO established a maximum operability water level as the centerline of the turbine rotor.

The PDO method for monitoring the HPCI turbine water level resulted in non-conservative values. The measurement method did not account for differential pressure effects between atmospheric pressure and the slightly negative turbine exhaust pressure present when measurements were obtained. The slight negative pressure was confirmed on the plant computer and a differential pressure as small as 0.5 psid would have created a non-conservative error of 14 inches, removing all the assumed margin in the PDO.

In addition to recording the water level, engineering was trending drain times as another way to monitor for continued operability. Independent inspector reviews of data obtained since May 2015 identified that drain times and water level readings had no apparent correlation and were, in some cases, contradictory.

#### **Example 2: Normal vs. Transient Assumptions Affecting Impact Loads.**

NEDP-22, Attachment 2, states that assumptions should be conservative and be backed by objective evidence. The inspectors identified the following examples where unsupported assumptions were made:

Based on a vendor analysis of a similar condition at a different facility, the licensee concluded that the analyzed water hammer impact loads were acceptable. By engineering judgement, the PDO also concluded that the vendor's transient analysis was very conservative when compared to observed system data during routine testing. As a result, the PDO concluded that a substantial amount of additional margin existed. The basis for the additional margin was that actual turbine exhaust pressure peaks were much smaller and slower during routine testing than assumed in the vendor's transient analysis. The inspectors determined that the comparison of routine test data directly to the vendor's transient analysis parameters was not valid because the vendor's input clearly indicated that higher and faster pressure peaks in the turbine casing were to be expected when the turbine's exhaust path was obstructed with water. The inspectors determined that the PDO made an assumption about the relationship between the normal and transient conditions that was non-conservative and not backed by objective evidence. As a result, TVA made inappropriate conclusions about the available margin.

#### **Example 3: HPCI Turbine Allowable Stress.**

NEDP-22, Section 3.2.2.E, states that inputs to the basis for operability should be validated with field data and that input from equipment vendors can be used after considering its technical accuracy. However, TVA did not identify a significant discrepancy between field conditions (as-built configuration) and the vendor analysis. The PDO failed to consider the effect of differences in the as-built plant configuration and the vendor's analysis as well as the TVA dynamic piping model. Specifically, the inspectors identified that a pressure balanced expansion joint existed, in a "tee" configuration, between the turbine and the first piping anchor for the turbine exhaust piping. The inspectors determined that the as-built "tee" configuration, which was not considered in the analysis, would result in higher HPCI turbine stresses because the dynamic water hammer forces would not be transmitted to the piping supports but rather to the turbine casing. The inspectors reviewed the allowable loading on the HPCI turbine in the UFSAR Appendix C, "Structural Qualification of Subsystems and

Components," Table C.4-2, and determined that the maximum slug speed predicted in the original vendor analysis would impose a force on the turbine that would exceed the allowed loading by a factor of two.

A subsequent TVA inquiry confirmed that the vendor had not considered the effects of a teed expansion joint because the facility previously analyzed did not have one. The licensee subsequently requested additional analysis specific to the Browns Ferry facility. The revised analysis removed some of the conservatisms in the original analysis and found that the maximum slug speed and resulting forces would be less than the allowed loads in the UFSAR. The inspectors determined that the failure to consider the as-built configuration resulted in an inadequate PDO which required additional and significant evaluation to maintain reasonable assurance of the HPCI system operability.

Analysis: The inspectors determined that the failure to accomplish the PDO for CR 1039036 was a performance deficiency. Specifically: 1) prescribed actions were not accurately monitoring the degraded condition to ensure that the PDO remained valid, 2) the PDO made unsupported assumptions and 3) vendor input was used without validating it against field data. The performance deficiency was more-than-minor because it was associated with the Human Performance attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences (i.e. core damage). Specifically, after considering the inadequacies of the PDO, additional and significant evaluation was required to maintain reasonable assurance of the HPCI system operability. The doubt stemmed from uncertainty about the actual water level in the turbine, the expected transient severity and the unanalyzed effects of the piping configuration. This finding was evaluated in accordance with NRC IMC 0609, Appendix A, Exhibit 2 "Mitigating Systems Screening Questions," dated June 19, 2012. The inspectors determined the finding was Green because it was a deficiency affecting the qualification of HPCI, but it maintained its operability. The inspectors determined that the finding had a cross-cutting aspect of Evaluation in the Problem Identification and Resolution area [P.2], because the organization did not thoroughly investigate this issue commensurate with its potential safety significance.

Enforcement: 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings" states, in part, "activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances, and shall be accomplished in accordance with these instructions, procedures or drawings." TVA procedure NEDP-22, "Operability Determinations and Functional Evaluations," Sections 3.2.2.E, 3.2.2.G, and Attachment 2, established requirements concerning the implementation of monitoring actions, use of assumptions, and use of inputs that form the basis of operability. Contrary to the above, from June 20, 2015, to October 17, 2016, the PDO for CR 1039036 was not accomplished in accordance with the requirements of NEDP-22 Sections 3.2.2.E, 3.2.2.G, and Attachment 2. As an immediate corrective action, the licensee revised the PDO to include an evaluation of the actual Browns Ferry configuration that supported a reasonable expectation of operability. The licensee entered the violation into the corrective action program as CR 1219620. This violation is being treated as an NCV consistent with Section 2.3.2 of the Enforcement Policy. URI 05000296/2015002-01 is closed to NCV 05000296/2016004-02, Inadequate Prompt Determination of Operability for the HPCI System.

#### 4OA3 Follow-up of Events and Notices of Enforcement Discretion (71153)

##### (Closed) Licensee Event Report (LER) 05000296/2016-006-00, High Pressure Coolant Injection System Found to be Inoperable During Testing

###### a. Inspection Scope

On June 8, 2016, the high pressure coolant injection turbine stop valve mechanical trip valve behaved erratically upon turbine start. Troubleshooting and maintenance on the valve led to discovery of a condition that could have resulted in the HPCI system being unable to perform its required safety function in a Mode where HPCI operability was required. The inoperability was caused by the HPCI turbine stop valve mechanical trip valve's reset spring, which was deformed and weakened from years of continuous compression. The spring was replaced and the system was returned to service on June 10, 2016. The event was considered a safety system functional failure. The inspectors reviewed the licensee event report associated with this event and determined that the report adequately documented the summary of the event including the cause of the event and potential safety consequences. Document reviewed are listed in the Attachment.

This activity constituted one licensee event report closeout sample as defined in IP 71153.

###### b. Findings

No findings were identified. This LER is closed.

#### 4OA5 Other Activities

##### .1 Periodic Resident Inspector Review of INPO Evaluations

###### a. Inspection Scope

The inspectors reviewed the Institute of Nuclear Power Operations (INPO) Interim Evaluation of Browns Ferry Nuclear Plant on November 3, 2016. The report was reviewed to ensure that issues identified were consistent with the NRC perspectives of licensee performance and to verify if any significant safety issues were identified that required further NRC follow-up. The report review was discussed with licensee management.

###### b. Findings

No findings were identified.



.2 Operation of an Independent Spent Fuel Storage Installation (ISFSI) at Operating Plants (IP 60855.1)

a. Inspection Scope

The inspectors reviewed changes made to the ISFSI programs and procedures, including those associated with 10 CFR 72.48, "Changes, Tests, and Experiments," screens and evaluations to verify that changes made were consistent with the license and/or certificate of compliance. The inspectors reviewed records to verify that the licensee recorded and maintained the location of each fuel assembly placed in the ISFSI. Documents reviewed are listed in the Attachment. This activity constituted one semi-annual Operation of an ISFSI inspection sample, as defined in IP 60855.1.

b. Findings

No findings were identified.

.3 (Closed) Apparent Violation 05000296/2016013-02: Failure to Maintain Complete and Accurate Fire Watch Records

a. Inspection Scope

On March 11, 2016, the Nuclear Regulatory Commission's (NRC) Office of Investigations (OI) completed an investigation at Browns Ferry Nuclear Plant (BFN). The purpose of the investigation was to determine whether Day & Zimmermann (DZ) contract fire watch employees deliberately failed to conduct roving fire watches at BFN Units 1, 2, and 3. Based on the results of the investigation, one apparent violation of 10 CFR 50.48 and one apparent violation of 10 CFR 50.9 were identified, as documented in NRC Inspection Report 05000296/2016013 and Investigation Report No. 2-2015-037 (ADMAS Accession No. ML16211A006), dated July 27, 2016. The apparent violation of 10 CFR 50.48 was considered for escalated enforcement and dispositioned under the NRC Enforcement Policy as documented in NRC Inspection Report 05000296/2016015 and Investigation Report No. 2-2015-037 (ADMAS Accession No. ML16333A437) dated November 28, 2016. The apparent violation of 10 CFR 50.9 was not considered for escalated enforcement. After further review, inspectors determined that the additional violation of 10CFR 50.9 was not of more than minor significance.

b. Findings

No findings were identified. Apparent Violation 05000296/2016013-02, Failure to Maintain Complete and Accurate Fire Watch Records, is closed.

.4 (Closed) Unresolved Item (URI) 05000259, 260, 296/2015007-03: Procurement of Electrical Equipment for Ungrounded Electrical Systems (ML16033A462)

a. Inspection Scope

During the 2015 Browns Ferry component design bases (teams) pilot inspection, the team identified a URI regarding the licensee's procurement of components for Browns Ferry's ungrounded auxiliary power system. The inspectors reviewed the facts of the subject URI as well as the licensee's evaluation which included a statement of the URI, a

description of the measures taken by BFN to address this item, and an evaluation of the effectiveness of these measures with regard to the resolution of this URI. The licensee's evaluation determined that the station's design bases and vendor specifications were met. The inspectors reviewed the licensee's evaluation and determined it was adequate.

The inspectors reviewed Electrical Engineering, General Engineering Specifications DS-E9.4.1, Selection and Specifications, Revision 1, and SS E9.2.01, Alternating-Current Induction Motors (Squirrel-Cage Type), Revision 7, and determined that both specifications appropriately referenced ANSI/NEMA MG 1, Motors and Generators. Specification SS E9.2.01 also stated that "Unless otherwise specified herein, all electrical equipment shall conform to the latest applicable published standards of ANSI, IEEE, and NEMA in effect on the date of the invitation to bid, as to all features of material, workmanship, design, and tests, including but not limited to ANSI/NEMA MG 1, Motors and Generators.

The inspectors reviewed procurement documents to verify the components listed below met the requirements of ANSI/NEMA MG 1 which was in effect at the time of the invitation to bid or purchase.

- Motor operated valve 3-FCV-73-2
- Motor operated valve 2-FCV-68-3
- Components fed from 480VAC Diesel Aux. Boards A (MCC): Chilled Water Pump (PMP-31-2101), compartment: 2E2 (30HP), Diesel Gen. Bldg. Fuel Oil Transfer Pump (PMP-18-35B), compartment: 2D (7.5HP), Vacuum Priming Pump B, compartment: 12A (40HP)
- Component fed from 480VAC Diesel Aux. Boards B (MCC): Diesel Gen. Bldg. sump Pump B, compartment: 12A (5HP)

Finally, the inspectors reviewed documentation to determine the frequency at which the 480VAC, 3 phase, ungrounded safety-related auxiliary power system electrical boards are checked for grounds to demonstrate compliance with, Final Safety Analysis Report (FSAR) Section 8.4, BFN-50-7200D, Section 3.5, table 3.5-1. The team verified that equipment operating on the ungrounded auxiliary power system was operating within the BFN licensing basis. Documents reviewed are listed in the Attachment.

#### b. Findings

No findings were identified, and the URI is now closed.

#### 4OA6 Meetings, Including Exit

##### Exit Meeting Summary

On January 20, 2017, the resident inspectors presented the quarterly inspection results to Mr. Steve Bono, Senior Site Vice President, and other members of the licensee's staff, who acknowledged the findings. The inspectors confirmed that proprietary information was controlled to protect from public disclosure.

ATTACHMENT: SUPPLEMENTAL INFORMATION

## **SUPPLEMENTAL INFORMATION**

### **KEY POINTS OF CONTACT**

#### **Licensee**

S. Bono, Site Vice President  
L. Hughes, General Plant Manager  
J. Paul, Nuclear Site Licensing Manager  
M. McAndrew, Manager of Operations  
L. Slizewski, Superintendent of Operations  
M. Kirschenheiter, Assistant Director for Site Engineering  
R. Coons, Licensing Engineer  
D. Drummonds, Program Engineer  
M. Lawson, Radiation Protection Manager  
J. Smith, System Engineer  
T. Stafford, NFPA-805 Program Manager  
H. Smith, Fire Marshal  
J. Steele, Fire Operations Supervisor  
J. Story, ISI Program  
D. Coffey, Reactor Engineering Manager  
T. Anderson, Performance Improvement Manager

**LIST OF ITEMS OPENED, CLOSED AND DISCUSSED**

Opened and Closed

|                     |     |                                                                                                     |
|---------------------|-----|-----------------------------------------------------------------------------------------------------|
| 05000259/2016004-01 | NCV | Inadequate Reassembly Procedure for HPCI Steam Line Inboard Isolation Valve Actuator (Section 1R15) |
| 05000296/2016004-02 | NCV | Inadequate Prompt Determination of Operability for the HPCI System (Section 4OA2.3)                 |

Closed

|                              |     |                                                                                             |
|------------------------------|-----|---------------------------------------------------------------------------------------------|
| 05000296/2015-002-01         | URI | HPCI Turbine Exhaust Drain High Level (Section 4OA2.3)                                      |
| 05000259,260,296/2015-007-03 | URI | Procurement of Electrical Equipment for Ungrounded Electrical Systems (Section 4OA5.4)      |
| 05000296/2016-006-00         | LER | High Pressure Coolant Injection System Found to be Inoperable During Testing (Section 4OA3) |
| 05000296/2016013-02          | AV  | Failure to Maintain Complete and Accurate Fire Watch Records (Section 4OA5.3)               |

## LIST OF DOCUMENTS REVIEWED

### **Section 1R04: Equipment Alignment**

#### Drawings:

0-47E610-72-1, – Aux Decay Heat Removal System, Sheet 1 R006  
 0-47E610-72-2, – Aux Decay Heat Removal System, Sheet 2 R006  
 0-47E873-1, Aux Decay Heat Removal System, Sheet 1, R008  
 0-47E873-2, Aux Decay Heat Removal System, Sheet 2, R008  
 PIP 02-03, Electrical Distribution, Rev. March, 2010

#### Other Documents:

Operator Logs dated October 1, 2016 through October 5, 2016  
 Protective Coatings program for Unit 1; 0-TI-417, Rev 23

### **Section 1R05: Fire Protection**

#### Procedures:

NPG-SPP 18.4.7, Control of Transient Combustibles, Rev 9

#### Other Documents:

CR 1241595  
 CR 1242398  
 CR 1242827  
 Fire Protection Report Volume 2, Rev. 55  
 NFPA 805 Fire Protection Report Volume 1, Rev. 0

### **Section 1R08: Inservice Inspection Activities**

#### Procedures:

MSI-0-001-VSL001, Reactor Vessel Disassembly and Reassembly, Rev. 118  
 N-MT-6, Magnetic Particle Examination for ASME and ANSI Code Components and Welds, Rev. 36  
 N-PT-9, Liquid Penetrant Examination of ASME and ANSI Code Components and Welds, Rev. 39  
 N-UT-78, PDI Generic Procedure for the Manual Ultrasonic Examination of Reactor Pressure Vessel Welds PDI-UT-6, Rev. 9  
 N-VT-1, Visual Examination Procedure for ASME Section XI Preservice and Inservice, Rev. 47  
 N-VT-3, Visual Examination of Weld Ends Fit-ups and Dimensional Examination of Weld Joints, Rev. 31

#### Drawings:

1-CHM-2102-A, Closure Head Assembly Weld Locations, Rev. 0  
 1-ISI-0414-C, Browns Ferry Nuclear Plant Unit 1 Reactor Vessel Supports, Rev. 0  
 1-ISI-PLE-002, NI-173-5R-Isometric Torus Analysis of ECCS & Ring Header PEN X-204, Rev. 3

#### Work Orders/Work Requests:

WO 117235018, Replace Unit 1C RHRSW Heat Exchanger Demineralized Water Branch Line downstream of BFN-1-SHV-023-0552

#### Condition Reports:

CR 1115734, A leak was found on the 2C3 FW Heater immediately following the Dec 2015 outage  
 CR 1150627, Calibration Blocks are not in conformance with ASME Section XI code

CR 1218637, Vessel flange inspection results  
 CR 946763, ASME Section XI Work Order bypassed Initial Review

Miscellaneous Documents:

BFN-MNT-SSA-15-008, Maintenance Weld Program Self-Assessment  
 Certificate of Certification for Magnaflux Ultragel II Couplant Batch# 14G106  
 Certificate of Compliance for General Angle Beam Calibration and Verification Block SN 791719  
 Certificate of Conformance for Transducer: 01-887, 01-888  
 Notice of Indication form: VT-14-074  
 Report of Calibration for Digital Thermometer SN T-12463  
 Report of Calibration for Ultrasonic Flaw Detector USN60 SN 0132M6  
 UT Calibration/Examination Report No.: R-064  
 Visual Examination Record Report No.: R-051, R-052  
 Welder/Welding Operator Performance Qualification Record for EID: FMOSV5G1A,  
 7TCBW2LCM, M0P7R2U2Y

**Section 1R11: Licensed Operator Regualification**

1-GOI-100-1A Startup from Cold Shutdown  
 October 19, 2016 Just in Time training session to support the U1R11 startup

**Section 1R12: Maintenance Effectiveness**

Procedures:

MCI-0-073-TRB001 HPCI Turbine-Terry Turbine CCS-Disassembly, Inspection, Rework and Reassembly, Rev. 31

Drawings:

2-47E812-2 Flow Diagram HPCI Oil System, Rev. 15

Other Documents:

CR 1179483  
 CR 1193989  
 Equipment Apparent Cause Evaluation Report for CR 1179483  
 Function 073-B and 073-C, HPCI (a)(1) Evaluation  
 GE Service Information Letter 392, Rev. 1  
 WO 116593729  
 WO 116798508

**Section 1R13: Maintenance Risk Assessments and Emergent Work Control**

Procedures:

NPG-SPP-09.11.1 Equipment Out of Service Management, Rev. 15

Drawings:

2-45E670-13 Wiring Diagram ECCS DIV I Analog Trip Units Schematic Diagram, Rev. 23

Other Documents:

Browns Ferry Equipment Out Of Service Reports dated October 2, October 3, October 21, and October 24, 2016  
 CR 1231344  
 Equipment Tagout 2-TO-2016-0001/2-071-0001  
 eSOMS Narrative Logs dated October 1, 2016 to December 31, 2016

Protected Equipment List 0-PE-2016/2-256-0001  
WO 1189297277

### **Section 1R15: Operability Evaluations**

#### Procedures:

3-SI-3.2.4(DG D) EECW Check Valve Test on Diesel Generator D, Rev. 12  
0-SR-3.8.1.9 (c), Diesel Generator C Emergency Unit 1 Load Acceptance Test, Rev 11

#### Other Documents:

CR 1234848  
CR 1234849  
CR 1234852  
CR 1219043 EDG C Jacket Water Leak observed during U1R11 Load Acceptance Test  
MDQ0000672013000125 Evaluation of EECW Component Flow Rates with the Most Limiting Pump Configuration, Rev. 1

### **Section 1R19: Post Maintenance Testing**

#### Procedures:

1-SR-3.1.7.7 – SLC System Functional Test – Pump, Revision 20

#### Other Documents:

WO 116734404, Retest of Unit 1 drywell airlock following replacement of the door seals  
WO 117067777, Retest of Unit 1 Standby Liquid control system following modification to add a pump suction accumulator  
WO 117194723, Retest of Unit 1 Reactor Core Isolation Cooling (RCIC) following installation of a design change

### **Section 1R20: Refueling and other outage activities**

#### Procedures

1-GOI-200-2B, Primary Containment Closeout, Revision 1 (Drywell and Torus closeouts)  
1-SR-3.4.9.1(1) Reactor Heatup and Cooldown Rate Monitoring, Revision 0014  
1-SR-3.5.1.8, HPCI Main and Booster Pump Set Developed Head and Flow Rate Test at 150 psig Reactor Pressure. Revision 14  
MSI-0-000-LFT001: Lifting Instructions for the Control of Heavy Loads, Revision 0071

#### Condition Reports

1218609 Fire watch requirements not met upon entering mode 5  
1218637 Unit 1 Reactor Vessel flange indications and scratch

#### Other Documents

Work schedules during the Unit 1 Refueling outage for 4 members of the fire brigade, 4 reactor operators, 4 senior reactor operators, and 4 maintenance workers

### **Section 1R22: Surveillance Testing**

#### Drawings

2-47E812-1 Flow Diagram High Pressure Coolant Injection System

#### Procedures:

0-SI-4.7.A.2.G As found LLRT for Unit 1 RCIC and HPCI exhaust line check valves

0-SR-3.8.1.9 (c), Diesel Generator C Emergency Unit 1 Load Acceptance Test, Revision 11  
 1-SI-3.3.1.A, ASME Section XI System Leakage Test of the Reactor Pressure Vessel and  
 Associated Piping (ASME Section III, Class 1 and 2), Revision 19  
 2-SR-3.5.1.1 (HPCI) Maintenance of Filled HPCI Discharge Piping

Other Documents:

WO 116734239 Penetration 212 LLRT  
 WO 116734245 Penetration 214 LLRT  
 WO 116734336 1-SR-3.6.1.3.10(A) – (As Found) Main Steam Line A: Penetration X-7A LLRT  
 WO 116734346 1-SR-3.6.1.3.10(B) – (As Found) Main Steam Line B: Penetration X-7B LLRT  
 WO 118298410 2-SR-3.4.4.1 – Manual Calculation of Unidentified, Identified & Total Leakage

Condition Reports

1218408 Valve 1-71-14 failed the LLRT  
 1218531 B ADHR Secondary pump tripped and required AOI-78 entry  
 1232052 2-FR-77-6 Flow Recorder Readings Erratic

**Section 40A1: Performance Indicator Verification**

Procedures:

FAQ for NEI 99-02 Regulatory Assessment Performance Indicators as of October 26, 2016  
 NEI 99-02 Regulatory Assessment Performance Indicator Guideline, Rev 7

Other Documents:

Operator Narrative Logs from October 1, 2015 to September 30, 2016

**Section 40A2: Identification and Resolution of Problems**

Procedures:

NPG SPP 22.300, Corrective Action Program, Rev. 7

Other Documents:

Browns Ferry Quarterly Integrated Inspection Reports

259/260/296/2015-004 (ML 16043A248)

259/260/296/2016-001 (ML 16134A224)

259/260/296/2016-002 (ML 16225A208)

259/260/296/2016-003 (ML 16315A108)

CR 1061051

CR 1161330

CR 1169591

CR 1173067

CR 1193991

CR 1213614

CR 1216071

CR 1218609

CR 1219614

CR 1219620

CR 1221908

CR 1221912

CR 1223302

CR 1227659



CR 1228954

CR 1241674

CRs 999196, 1018316, 1038747, 1039036, 1042146, 1042150, 1153504, 1153513, 1153543, 1153549, 1193991

Justification for Deferral of Degraded or Nonconforming Condition for CR 1038747

PDO for CR 1039036

Trimester Trend Report from February 2016 until May 2016

Trimester Trend Report from June 2016 until September 2016

Trimester Trend Report from October 2015 until January 2016

### **Section 4OA3: Event Follow-up**

#### **Other Documents:**

Equipment Apparent Cause Evaluation Report for CR 1179483

LER 05000296/2016-006-00

Past Operability Evaluation for CR 1179483

### **Section 4OA5: Other Activities**

#### **Drawings**

0-45E732-1, Wiring Diagram 480V Diesel Auxiliary Bd A Single Line, Rev. 46

0-45E732-2, Wiring Diagram 480V Diesel Auxiliary Bd A Single Line, Rev. 26

0-45E732-3, Wiring Diagram 480V Diesel Auxiliary Bd B Single Line, Rev. 41

0-45E732-4, Wiring Diagram 480V Diesel Auxiliary Bd B Single Line, Rev. 21

Elementary Diagram 0-177B2245, Sheet 1, 480V Diesel Auxiliary Board B (Item 20B), dated 2/17/70

Elementary Diagram 0-177B2245, Sheet 7, 480V Diesel Aux Bd B, dated 2/13/14

Elementary Diagram 0-177B2245, Sheet 8, Trip Circuits- 2 Breaker, dated 2/13/14

Elementary Diagram 0-177B2245-10, Sheet 10, 480 V Diesel Aux Board B, dated 2/13/14

Elementary Diagram 177B2245, Sheet 0, Standard Nomenclature & Symbol List, dated 12/29/69

Elementary Diagram 177B2245, Sheet 4, 480V Diesel Auxiliary Board B Item 20B, dated 2/17/70

Elementary Diagram 177B2245, Sheet 6, 2 Breaker Throwover Fixed Preference- Normal Source- Power Diagram, dated 2/17/70

Elementary Diagram 177B2245, Sheet 9, 480V Diesel Aux Bd B, dated 2/17/70

#### **Miscellaneous Documents**

BFN-VTD-G080-1440, Instructions Installation and Maintenance of 7700 Line Motor Control Centers, Rev. 1

BFN-VTD-G080-3355, 7700-Line, General Electric, Motor Control Center Renewal Parts Bulletin, G080-3355, Rev. 0

Contract 69C33-91128, Reliance Electric Company, Diesel Generator Oil Transfer Pump, dated 1/15/70

Contract 70C30-92266, Crane Company, Diesel Building Sump Pump, dated 8/1/74

Contract 90744, GE PO H0813, BFN-3-FCV-068-0003, dated 6/17/66

Contract 91750, GE PO H0597, BFN-3-FCV-073-0002, dated 2/24/70

EQV 71407, Replace MOV Magnesium Rotor Motor with Aluminum Rotor Motor, Rev. A

EQV 71446, Replace MOV Magnesium Rotor Motor with Aluminum Rotor Motor, Rev. A

Procurement Engineering Group (PEG) package (PKG) CFK570P – PO 836093

PEG PKG NO. CRP205J - PO 733602 (2-FCV-68-3)

PEG PKG NO. 200000081119, dated 8/28/00

PEG PKG NO. CRP205J, Rev. 2

Purchase Order 68C3000091054, Nash Engineering Company, Vacuum Priming Pump, dated 8/1/1974  
 Purchase Order P-98NAM-218021, Nuclear Logistics Inc., Chilled Water Pump, dated 5/11/98  
 TVA contract # 6031-90744, 75789 for Equipment Package for One – or-two unit nuclear plants for the Browns Ferry Site near Alabama, dated 6/17/66  
 TVA FSAR section 8.4  
 TVA project # 600367A, Qualification Type Test Report, Limitorque Valve Actuators for BWR Service, dated 7/13/76  
 TVA report 80058, Limitorque Valve Actuator Qualification for Nuclear Power Station Service, dated 1/11/80  
 TVA Specification 6162, Class 1E Motorized Valve Operators for TVA Nuclear Plants, Rev. 2  
 TVA Specification, B44 880512 002, Revision to Specification 6162 for contract 86XMQ-838100, dated 5/12/88  
 TVA-NQA-PLN89-A, Nuclear Quality Assurance Plan (NQAP) (Quality Assurance Program Description), Rev. 32

#### Procedures

0-GOI-300-1/ATT-11, General Operating Instruction, Attachment 11, Control Bay Operator Round Log, Rev. 223  
 0-GOI-300-1/ATT-5, General Operating Instruction, Attachment 5, Unit 1 Reactor Building Operator Round Logs, Rev. 254  
 0-GOI-300-1/ATT-9, General Operating Instruction, Attachment 9, Unit 3 Reactor Building Operator Round Logs, Rev. 250  
 0-GOI-300-2, General Operating Instruction, Electrical, Rev. 132  
 BFN-50-7200D, 480V AC Auxiliary Power System, Rev. 11  
 BFN-60-768, Power, Control, and Signal Cables for Use in Class 1 Structures, Rev. 19  
 DS-E12.6.3, Electrical Design Standard, Auxiliary and Control Power Cable Sizing, up to 15,000 Volts, Rev. 10  
 DS-E9.4.1, Electrical Engineering, General Engineering Specifications, Selection and Specifications, Rev. 1  
 NEMA MG 1 “Motors and Generators” 1967, 1978 and 2011 editions  
 NPG-SPP-09.3, Plant Modifications and Engineering Change Control, Rev. 21  
 NPG-SPP-31.2, Records Management, Rev. 5  
 SS E9.2.01, Alternating-Current Induction Motors (Squirrel-Cage Type), Rev. 7

#### Corrective Action Program Documents generated as a result of the inspection

CR 1127990, CDBI-2015 0-GOI-300-1, Attachment 5...verifications for checking for 480V grounds  
 CR 1131464, Drawing 0-45E732-1 Rev.046 incorrectly shows that 480V Diesel Aux A has a ground test switch  
 CR 1131466, Drawing 0-45E732-3 Rev.041 incorrectly shows that 480V Diesel Aux B has a ground test switch

#### Other Documents:

Browns Ferry 10 CFR 72.212 Report of the Evaluations for the HI-STORM FW System, Rev. 2  
 Browns Ferry FSAR for the HI-STORM FW MPC Storage System, Rev. 2.1a

## LIST OF ACRONYMS

|       |                                                           |
|-------|-----------------------------------------------------------|
| ADAMS | Agencywide Document Access and Management System          |
| AOI   | Abnormal Operating Instruction                            |
| ASME  | American Society of Mechanical Engineers                  |
| BFN   | Browns Ferry Nuclear                                      |
| CAP   | corrective action program                                 |
| CFR   | Code of Federal Regulations                               |
| CR    | condition report                                          |
| DZ    | Day & Zimmermann                                          |
| EDG   | emergency diesel generator                                |
| FA    | fire areas                                                |
| FPRM  | Fire Protection Requirements Manual                       |
| FSAR  | Final Safety Analysis Report                              |
| FZ    | fire zones                                                |
| HPCI  | high pressure coolant injection                           |
| IP    | Inspection Procedure                                      |
| ISFSI | Independent Spent Fuel Storage Installation               |
| ISI   | inservice inspection                                      |
| IMC   | Inspection Manual Chapter                                 |
| INPO  | Institute of Nuclear Power Operators                      |
| LER   | Licensee Event Report                                     |
| LLRT  | local leak rate test                                      |
| MR    | Maintenance Rule                                          |
| MRC   | Management Review Committee                               |
| MSIV  | main steam isolation valve                                |
| NCV   | non-cited violation                                       |
| NEI   | Nuclear Energy Institute                                  |
| NDE   | non-destructive examination                               |
| NRC   | U.S. Nuclear Regulatory Commission                        |
| OPDRV | operations with the potential to drain the reactor vessel |
| ORAM  | outage risk assessment management                         |
| PDO   | prompt determination of operability                       |
| PMT   | post-maintenance test                                     |
| PSC   | Plant Screening Committee                                 |
| RCIC  | reactor core isolation cooling                            |
| RCS   | reactor coolant system                                    |
| RHR   | residual heat removal                                     |
| RMA   | risk management actions                                   |
| RTP   | rated thermal power                                       |
| SDP   | significance determination process                        |
| SLC   | standby liquid control                                    |
| SSC   | structures, systems, and components                       |
| TS    | Technical Specification(s)                                |
| TVA   | Tennessee Valley Authority                                |
| UFSAR | Updated Final Safety Analysis Report                      |
| URI   | Unresolved Item                                           |
| WO    | work order                                                |