TENNESSEE VALLEY AUTHORITY

Post Office Box 2000, Decatur, Alabama 35609-2000

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ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Browns Ferry Nuclear Plant, Unit 3
Renewed Facility Operating License No. DPR-68
NRC Docket No. 50-296

Subject: **Unit 3 Replacement Steam Dryer Visual Inspection Results (U3R20)**

Enclosed is a summary of the results of the visual inspections of the Unit 3 Replacement Steam Dryer that were performed during the recent refueling outage (U3R20). The inspections are required to be performed in accordance with Operating License Condition 2.C(14)(e) during the first two scheduled refueling outages after reaching full Extended Power Uprate conditions which requires that the results of the inspection be submitted in a report within 90 days following startup. This second report for Unit 3 is being submitted pursuant to Operating License Condition 2.C(14)(f) which requires that the results of the inspection be submitted in a report within 90 days following startup.

There are no new regulatory commitments contained in this letter. Should you have any questions concerning this submittal, please contact Christopher L. Vaughn, Nuclear Site Licensing Manager, at (256) 729-2636.

Respectfully,

Matthew Rasmussen
Site Vice President

Enclosure: Browns Ferry Unit 3 Replacement Steam Dryer (RSD) Inspection Results from the Second Refueling Outage (U3R20) Following Installation of RSD and Implementation of Extended Power Uprate

cc (w/ Enclosure):

NRC Regional Administrator - Region II
NRC Senior Resident Inspector - Browns Ferry Nuclear Plant

**ENCLOSURE**

**Browns Ferry Nuclear Plant**
**Unit 3**

**Browns Ferry Unit 3 Replacement Steam Dryer (RSD) Inspection Results from the Second Refueling Outage (U3R20) Following Installation of RSD and Implementation of Extended Power Uprate**

See Enclosed

# Browns Ferry Unit 3 Replacement Steam Dryer (RSD) Inspection Results from the Second Refueling Outage (U3R20) Following Installation of RSD and Implementation of Extended Power Uprate

## Purpose

This report provides the results of visual inspections of the Replacement Steam Dryer (RSD) as required by the Browns Ferry Unit 3 Renewed Facility Operating License No. DPR-68, License Condition 2.C.(14).(f). This license condition requires that the results of the visual inspections of the RSD be submitted to the NRC within 90 days following startup from each of the first two respective refueling outages.

## Summary

The Unit 3 RSD was inspected from February 28 through March 12, 2022, during the Spring 2022 refueling outage (Unit 3 Refueling Outage 20: U3R20). This was the second refueling outage following installation of the RSD in March 2018 during Unit 3 Refueling Outage 18 (U3R18) and operation at Extended Power Uprate (EPU) conditions since July 13, 2018. The inspections were performed in accordance with GE Hitachi Nuclear Energy Report No. 003N5663, Revision 2 ("Tennessee Valley Authority (TVA) Browns Ferry Nuclear Station (BFNS): Recommendations for Future Inspections - Replacement Steam Dryer"). The RSD design and the materials and fabrication processes utilized are expected to result in significantly improved resistance to stress corrosion cracking. Therefore, the inspection recommendations in the GEH report focus primarily on the locations that may be susceptible to fatigue from flow-induced vibration. The locations identified are those indicated to have relatively significant cyclic loading during the dryer's operation, as determined by detailed stress analyses.

Tables 1 ("Frequency of Recommended Locations Based on Analysis" and 2 ("Description of Recommended Inspections Locations") of the GEH Report list locations that are considered the most susceptible for fatigue cracking based on BWR dryer experience and stress analysis. All accessible weld and weld heat-affected zone (HAZ) base metal surfaces of the RSD were visually inspected during U3R20, with a total scope of 647 points. The summary results of the inspections can be found in the table starting on the next page.

**The following explanations apply to the table:**

**NRI: No Relevant Indication**

**RI: Relevant Indication**

**The parentheses after each Inspection Location refer to the number of points inspected for each.**

## Browns Ferry Unit 3 Replacement Steam Dryer (RSD) Inspection Results from the Second Refueling Outage (U3R20) Following Installation of RSD and Implementation of Extended Power Uprate

| Inspection Location | Method | Inspection Result | Condition Report (if RI) | Disposition |
|---|---|---|---|---|
| **STEAM DRYER ID** | | | | |
| | | | | |
| Divider Plate Welds & HAZs (32) | VT-1-89 | NRI | | |
| Trough Side Plate to Base Plate Weld & HAZs (6) | VT-1-89 | NRI | | |
| Hood Vertical / Horizontal Welds & HAZs (12) | VT-1-89 | NRI | | |
| Perforated Plate to Trough Side Plate Weld & HAZs (22) | VT-1-89 | NRI | | |
| Trough Spacer Pin Weld & HAZs (6) | VT-1-89 | NRI | | |
| Skirt to Support Beam Weld & HAZs (8) | VT-1-89 | NRI | | |
| Guide Channel to Tee Weld & HAZs (4) | VT-1-89 | NRI | | |
| Skirt to Tee Weld & HAZs (12) | VT-1-89 | NRI | | |
| Drain Pipe to Trough Base Plate Weld & HAZs (12) | VT-1-89 | NRI | | |
| Drain Pipe to Elbow Weld & HAZs (21) | VT-1-89 | NRI | | |
| Drain Elbow to Pipe Weld & HAZs (11) | VT-1-89 | NRI | | |
| Drain Elbow to Skirt Weld & HAZs (12) | VT-1-89 | NRI | | |
| Collar to Skirt Weld & HAZs (12) | VT-1-89 | NRI | | |
| Cover Plate to Hood Weld & HAZs (2) | VT-1-89 | NRI | | |
| Trough Base Plate to Hood Weld & HAZs (4) | VT-1-89 | NRI | | |
| Hood Support Stiffener Assembly, Stiffener to Hood Support Tee Weld & HAZs, 360 degree weld (16) | VT-1-89 | NRI | | |
| Hood Support Stiffener Assembly, Stiffener to Trough Weld & HAZs, 360 degree weld (16) | VT-1-89 | NRI | | |
| Skirt to Lower Support Ring Weld plus 2 Splice Bars & HAZs (2) | VT-1-89 | NRI | | |
| Skirt to Lower Support Ring Weld & HAZs (6) | VT-1-89 | NRI | | |
| Splice Bar Attachment Weld and HAZs (4) | VT-1-89 | NRI | | |
| Trans Brace to Upper Support Ring Weld & HAZs (2) | VT-1-89 | NRI | | |
| Trans Brace Coupler Weld & HAZs (1) | VT-1-89 | NRI | | |
| Trans Brace Plate Welds & HAZs (8) | VT-1-89 | NRI | | |
| Trans Brace Support Welds & HAZs (12) | VT-1-89 | NRI | | |
| Base Plate to Upper Support Ring Weld & HAZs (4) | VT-1-89 | NRI | | |
| Base Plate to Upper Support Ring/Latch Assembly Welds & HAZs (2) | VT-1-89 | NRI | | |
| Base Plate to Upper Support Ring/Lifting Assembly Welds & HAZs (2) | VT-1-89 | NRI | | |
| Cover Plate to Upper Support Ring Weld & HAZs (2) | VT-1-89 | NRI | | |
| Splice Bar to Upper Support Ring and Trough Welds & HAZs (2) | VT-1-89 | NRI | | |
| USR Segment Weld & HAZs (4) | VT-1-89 | NRI | | |

## Browns Ferry Unit 3 Replacement Steam Dryer (RSD) Inspection Results from the Second Refueling Outage (U3R20) Following Installation of RSD and Implementation of Extended Power Uprate

| Inspection Location | Method | Inspection Result | Condition Report (if RI) | Disposition |
|---|---|---|---|---|
| Skirt to Upper Support Ring Weld & HAZs (6) | VT-1-89 | NRI | | |
| | | | | |
| **STEAM DRYER OD** | | | | |
| | | | | |
| 000 Degree Pad Welds & HAZs (1) | VT-1-89 | NRI | | |
| Steam Dryer Outer Banks Access Panel Welds & HAZs 000 Side (6) | VT-1-89 | NRI | | |
| Steam Dryer Outer Banks Access Panel Welds & HAZs 180 Side (6) | VT-1-89 | NRI | | |
| Both Sides of the Bank to Divider Plate Weld & HAZs (16) | VT-1-89 | NRI | | |
| Both Sides of the Bank to Exhaust Plenum Plate Vertical Weld & HAZs (20) | VT-1-89 | NRI | | |
| Hood to Cover Plate Horizontal Weld & HAZs (2) | VT-1-89 | NRI | | |
| Hood to Top Cap Horizontal Weld & HAZs (6) | VT-1-89 | NRI | | |
| Perforated Plate to Bank Top Cap Weld & HAZs (6) | VT-1-89 | NRI | | |
| Perforated Plate to Trough Side Plate Weld & HAZs (6) | VT-1-89 | NRI | | |
| Trough Side Plate to Base Plate Weld & HAZs (6) | VT-1-89 | NRI | | |
| Both Sides of the Hood Support to Trough Weld & HAZs (16) | VT-1-89 | NRI | | |
| Perforated Plate to End Plate Weld & HAZs (4) | VT-1-89 | NRI | | |
| Perforated Plate to Perforated Plate Weld & HAZs (16) | VT-1-89 | NRI | | |
| Perforated Plate to End Plate Weld & HAZs from Trough Base Plate to Hood Cap (8) | VT-1-89 | NRI | | |
| Trough Spacer Pin Weld & HAZs (6) | VT-1-89 | NRI | | |
| Bank Tie Rod Bolting Welds & HAZs for all 6 locations on the 000 Deg Side (6) | VT-1-89 | NRI | | |
| Bank Tie Rod Bolting Welds & HAZs for all 6 locations on the 180 Deg Side (6) | VT-1-89 | NRI | | |
| Hood to Trough Base Plate Horizontal Weld & HAZs (4) | VT-1-89 | NRI | | |
| Both Sides of the Divider Plate to Inner Plate Welds & HAZs (6) | VT-1-89 | NRI | | |
| Drain Channel to Upper Support Ring Horizontal Weld & HAZs (4) | VT-1-89 | NRI | | |
| Drain Channel to Support Beam Weld & HAZs (8) | VT-1-89 | NRI | | |
| Drain Channel to Support Ring Tab Welds & HAZs (20) | VT-1-89 | NRI | | |
| Guide Channel to Drain Channel Tee Vertical Weld & HAZs (4) | VT-1-89 | NRI | | |

## Browns Ferry Unit 3 Replacement Steam Dryer (RSD) Inspection Results from the Second Refueling Outage (U3R20) Following Installation of RSD and Implementation of Extended Power Uprate

| Inspection Location | Method | Inspection Result | Condition Report (if RI) | Disposition |
|---|---|---|---|---|
| Drain Channel to Drain Channel Tee Vertical Weld & HAZs (8) | VT-1-89 | NRI | | |
| Skirt to Drain Channel Tee Vertical Weld & HAZs (4) | VT-1-89 | NRI | | |
| Doubler Plate to Upper Support Ring & HAZs (8) | VT-1-89 | NRI | | |
| General Overview of the Side Surfaces (4) | VT-1-89 | NRI | | |
| General Overview of the Top Surfaces (1) | VT-1-89 | NRI | | |
| Hood to Inlet End Plate Vertical Weld & HAZs (18) | VT-1-89 | NRI | | |
| Both Hood to Hood Tee Vertical Welds & HAZs (4) | VT-1-89 | NRI | | |
| Hood to Hood Tee Vertical Weld & HAZs (18) | VT-1-89 | NRI | | |
| Both Sides of the Hold Down Assembly to Exhaust Plenum Plate Vertical Weld & HAZs (4) | VT-1-89 | NRI | | |
| Hold Down Assembly to Trough Base Plate Horizontal Weld & HAZs (2) | VT-1-89 | NRI | | |
| 4 Instrument Tower Pads (1) | VT-1-89 | RI | 1761661 | Accepted as-is |
| Lifting Assembly - Support Ring Anchor Weld & HAZs (4) | VT-1-89 | NRI | | |
| Lifting Assembly - Bolting (4) | VT-1-89 | NRI | | |
| Lifting Assembly - Lower Bracket and Welds Plus HAZs (4) | VT-1-89 | NRI | | |
| Lifting Assembly - Middle Bracket and Welds Plus HAZs (4) | VT-1-89 | NRI | | |
| Lifting Assembly - Rod to Anchor Weld & HAZs (4) | VT-1-89 | NRI | | |
| Lifting Assembly - Upper Bracket and Welds Plus HAZs (4) | VT-1-89 | NRI | | |
| Latch Box General Condition for Evidence of Handling Damage (2) | VT-1-89 | NRI | | |
| Lower Guide Channel General Condition for Evidence of Handling Damage (2) | VT-1-89 | NRI | | |
| Lower Support Ring to Guide Channel Horizontal Weld & HAZs (2) | VT-1-89 | NRI | | |
| Lower Support Ring to Skirt Horizontal Weld & HAZs (6) | VT-1-89 | NRI | | |
| Lower Support Ring Splice Bar General Condition for Evidence of Handling Damage (2) | VT-1-89 | NRI | | |
| Splice Bar Attachment Weld & HAZs (8) | VT-1-89 | NRI | | |
| Seismic Lug General Condition for Evidence of Handling Damage, also Associated Bolting, Welds & HAZs (2) | VT-1-89 | RI | 1762156 | Accepted as-is |
| Bank Tie Bar Welds & HAZs (34) | VT-1-89 | NRI | | |
| Trough Base Plate Center Horizontal Weld & HAZs (1) | VT-1-89 | NRI | | |

**Browns Ferry Unit 3 Replacement Steam Dryer (RSD) Inspection Results from the Second Refueling Outage (U3R20) Following Installation of RSD and Implementation of Extended Power Uprate**

| Inspection Location | Method | Inspection Result | Condition Report (if RI) | Disposition |
|---|---|---|---|---|
| Top Flange to C-Channel to Hood Cover Weld & HAZs (2) | VT-1-89 | NRI | | |
| Upper Support Ring Horizontal Weld & HAZs (26) | VT-1-89 | NRI | | |
| Upper Support Ring Tapered Pin Seal Weld & HAZs (8) | VT-1-89 | NRI | | |
| Upper Support Ring to Splice Bar Vertical Weld & HAZs (4) | VT-1-89 | NRI | | |
| Upper Support Ring to Guide Channel Horizontal Weld & HAZs (2) | VT-1-89 | NRI | | |
| Upper Support Ring to Skirt Horizontal Weld & HAZs (2) | VT-1-89 | NRI | | |

Inspection Results

Two relevant indications were noted during inspections performed during U3R20. They are described as follows:

(1) BFN3-SD OD Instrument Tower Pads: Steam Dryer Instrument Tower Pads 1, 2, and 3 had twisted crimp collar shafts that were unchanged from their previous inspection during Unit 3 Refueling Outage 19 (U3R19).

(2) BFN3-SD OD Seismic Lug 005 and BFN-3 SD OD Seismic Lug 185: A relevant indication of wear was observed at the contact point of the Steam Dryer Support Lug for the Steam Dryer Seismic Blocks at 5 degrees and 185 degrees. This wear was the result of mechanical damage incurred by removal and reinstallation of the RSD, and was unchanged from the previous inspection during U3R19.

Disposition of Indications

Condition Reports (CRs) were initiated for both relevant indications, and an Engineering Evaluation was prepared as part of the corrective action plan for each CR to disposition the indications. Each disposition is as follows:

(1) BFN3-SD OD Instrument Tower Pads (CR 1761661): Because instrumentation (pressure sensors, strain gages, and accelerometers) was required during the Unit 3 Cycle 19 Fuel Cycle to access in-situ dryer conditions during operation, an instrumentation package was installed. A means was required for the instrumentation leads to exit the vessel via a penetration in the reactor head, so an instrument mast/tower was installed on top of the RSD that was held in place by pads that were welded to the RSD and whose sole function was to hold the mast/tower in place. Inspections performed during U3R19 showed that Steam Dryer Instrument Tower Pads 1, 2, and 3 had twisted crimp collar shafts. Since the instrument package was only required to provide monitoring for the first cycle of EPU operation, the instrument package, as well as the mast/tower, were removed during U3R19. Therefore, the Instrument Tower Pads no longer have a function with the mast/tower removed, and any observed indications were

accepted as-is. During U3R20, inspections were again performed on the Steam Dryer Instrument Tower Pads, and the indications were unchanged from when they were first observed during U3R19. Therefore, the indications were again acceptable as-is.

(2) BFN3-SD OD Seismic Lug 005 and BFN-3 SD OD Seismic Lug 185 (CR 1762156): The main purpose of the Steam Dryer Seismic Blocks is to transfer the lateral load from the RSD to the RPV support brackets. The indications that were observed during U3R19 and U3R20 on the Steam Dryer Seismic Blocks at 5 degrees and 185 degrees were the result of mechanical damage incurred by the removal and reinstallation of the RSD, and are not expected in any way to interfere with the ability of the seismic blocks to perform their required function to transfer the lateral load from the RSD to the RPV support brackets. Therefore, these indications have no bearing on the structural integrity of the seismic blocks and are acceptable as-is with no repair required.

Conclusion

A completed second baseline inspection of the Browns Ferry Unit 3 Replacement Steam Dryer (RSD) was performed during the Spring 2022 Refueling Outage 20. This baseline inspection included successful visual inspection of all inspection locations required by the Facility Operating License Condition 2.C.(14).(f) for inspection of the RSD. All observations were acceptable for the locations inspected. There were two relevant indications that were adequately dispositioned. Since two baseline inspections of the RSD have now been completed, future inspections will be performed in accordance with the guidelines specified in GE Hitachi Nuclear Energy Report No. 003N5663, Revision 2.