



Post Office Box 2000, Decatur, Alabama 35609-2000

July 20, 2021

10 CFR 50.4

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

Browns Ferry Nuclear Plant, Unit 2
Renewed Facility Operating License No. DPR-52
NRC Docket No. 50-260

Subject: **Unit 2 Replacement Steam Dryer Visual Inspection Results (U2R21)**

Enclosed is a summary of the results of the visual inspections of the Unit 2 Replacement Steam Dryer that were performed during the recent refueling outage (U2R21). The inspections are required to be performed in accordance with Operating License Condition 2.C(18)(g) during the first two scheduled refueling outages after reaching full Extended Power Uprate conditions. This first report for Unit 2 is being submitted pursuant to Operating License Condition 2.C(18)(h) which requires that the results of the inspection be submitted in a report within 90 days following startup.

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

Respectfully,

A handwritten signature in black ink, appearing to read 'M. Rasmussen', with a stylized flourish at the end.

Matthew Rasmussen
Site Vice President

U.S. Nuclear Regulatory Commission

Page 2

July 20, 2021

Enclosure: Browns Ferry Unit 2 Replacement Steam Dryer (RSD) Inspection Results from the First Refueling Outage (U2R21) 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 2**

Browns Ferry Unit 2 Replacement Steam Dryer (RSD) Inspection Results from the First Refueling Outage (U2R21) Following Installation of RSD and Implementation of Extended Power Uprate

See attached

Browns Ferry Unit 2 Replacement Steam Dryer (RSD) Inspection Results from the First Refueling Outage (U2R21) 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 2 Renewed Facility Operating License No. DPR-52, License Condition 2.C.(18).(h). 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 2 RSD was inspected from March 1 through 14, 2021, during the Spring 2021 refueling outage (Unit 2 Refueling Outage 21: U2R21). This was the first refueling outage following installation of the RSD in March 2019 during Unit 2 Refueling Outage 20 (U2R20) and operation at Extended Power Uprate (EPU) conditions since June 2019. 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 U2R21, with a total scope of 646 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 2 Replacement Steam Dryer (RSD) Inspection Results from the First Refueling Outage (U2R21) 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 2 Replacement Steam Dryer (RSD) Inspection Results from the First Refueling Outage (U2R21) 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 2 Replacement Steam Dryer (RSD) Inspection Results from the First Refueling Outage (U2R21) 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		
Lifting Assembly - Support Ring Anchor Weld & HAZs (4)	VT-1-89	NRI		
Lifting Assembly - Bolting (4)	VT-1-89	RI	1676166	Repaired
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	NRI		
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 2 Replacement Steam Dryer (RSD) Inspection Results from the First Refueling Outage (U2R21) 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

Relevant indications were noted at only one inspection location during inspections performed during U2R21. They are described as follows:

(1) BFN2-SD OD LA 220 Eye - Bolting and BFN2-SD OD LA 320 Eye - Bolting: The Steam Dryer Lifting Assembly Bolts at 220° and 320° were observed to have sheared at the shaft and the nut was no longer present. Both bolts were retrieved and a failure analysis was performed. The analysis concluded that it appeared that the presence of small cyclic loads on the bolts combined with a mildly aggressive local environment containing chlorides led to the corrosion-assisted fatigue failure of the bolts (a possible source of the cyclic load is a vibration of the dryer unit locking pin assembly).

Disposition of Indications

Condition Report (CR) 1676166 was initiated to disposition both relevant indications. The disposition is as follows:

(1) BFN2-SD OD LA 220 Eye - Bolting and BFN2-SD OD LA 320 Eye - Bolting: The sole function of the Steam Dryer Lifting Assembly Bolts at 220° and 320° is to prevent rotation of the lifting lug. Therefore, a repair was decided upon to tack weld the remaining bolt assembly as this would prevent rotation of the lifting lug and restore functionality. (NOTE: Per the recommendation of the inspection vendor, the repair was performed not only for the bolts that were sheared but also was performed preemptively for the intact bolts at 40° and 140° to eliminate any future concerns about loose parts in the reactor vessel.)

Browns Ferry Unit 2 Replacement Steam Dryer (RSD) Inspection Results from the First Refueling Outage (U2R21) Following Installation of RSD and Implementation of Extended Power Uprate

Conclusion

A completed baseline inspection of the Browns Ferry Unit 2 Replacement Steam Dryer (RSD) was performed during the Spring 2021 Refueling Outage 21. This baseline inspection included successful visual inspection of all inspection locations required by the Facility Operating License Condition 2.C.(18).(h) for inspection of the RSD. All observations were acceptable for the locations inspected. There were two relevant indications that were adequately dispositioned. The subsequent inspection scope of the RSD will be performed during Unit 2 Refueling Outage 22 (U2R22) in Spring 2023, and the results will be provided at that time consistent with the Browns Ferry Operating License.