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U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Browns Ferry Nuclear Plant, Units 1, 2, and 3
Renewed Facility Operating License Nos. DPR-33, DPR-52, and DPR-68
NRC Docket Nos. 50-259, 50-260, and 50-296

Subject: Long Term Steam Dryer Inspection Plan

Reference: Letter from TVA to NRC, "Unit 3 Long Term Steam Dryer Inspection Plan," dated October 3, 2022

Enclosed is the long term inspection plan for the Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3 Replacement Steam Dryers. The inspection plan is being submitted pursuant to Unit 1 Operating License Condition 2.C(18)(i), Unit 2 Operating License Condition 2.C(18)(i), and Unit 3 Operating License Condition 2.C(14)(g) which require that a long term steam dryer inspection plan be submitted based on industry operating experience along with the baseline inspection results.

The enclosed inspection plan supersedes in its entirety the Unit 3 Long Term Inspection Plan submitted by the referenced letter and removes the need to provide a non-proprietary version of the Unit 3 inspection plan as discussed in that letter.

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,

A handwritten signature in black ink, appearing to read 'Manu Sivaraman', is written over a light blue horizontal line.

Manu Sivaraman
BFN Site Vice President

U.S. Nuclear Regulatory Commission
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January 20, 2023

Enclosure: GE Hitachi Nuclear Energy 007N4785 Revision 0, Tennessee Valley Authority (TVA) Browns Ferry Nuclear Station (BFNS), Recommendations for Future Inspections – Replacement Steam Dryer

cc (w/ Enclosure):

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

ENCLOSURE

**Browns Ferry Nuclear Plant
Units 1, 2, and 3**

**GE Hitachi Nuclear Energy 007N4785 Revision 0, Tennessee Valley Authority (TVA)
Browns Ferry Nuclear Station (BFNS), Recommendations for Future Inspections –
Replacement Steam Dryer**

See Enclosed



HITACHI

GE Hitachi Nuclear Energy

007N4785

Revision 0

November 2022

Tennessee Valley Authority (TVA) Browns Ferry Nuclear Station (BFNS)

Recommendations for Future Inspections – Replacement Steam Dryer

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

The design, engineering, and other information contained in this document is furnished for the purposes of providing recommendations for future inspections on the replacement steam dryer at the Browns Ferry Nuclear Station (BFNS) in proceedings before the U.S. Nuclear Regulatory Commission (USNRC). The only undertakings of GEH, with respect to information in this document, are contained within the contracts held between GEH, its customers, or participating utilities and nothing contained within this document shall be construed as changing any existing contractual items. The use of this information by anyone for any purpose other than for which it is intended, is not authorized; and with respect to any unauthorized use, GEH makes no representation or warranty, and assumes no liability as to the completeness, accuracy, or usefulness of the information contained within this document.

REVISION SUMMARY

Rev #	Section Modified	Revision Summary
0	All	Initial Release

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1.0 INTRODUCTION

This document provides recommendations for future inspections of BFNS Unit-1, Unit-2, and Unit-3 replacement steam dryer.

The replacement steam dryer design and the materials and fabrication processes utilized are expected to result in significantly improved resistance to stress corrosion cracking. Therefore, these inspection recommendations 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 the detailed stress analyses.

In addition, this document provides recommendations for future inspections of the remnants of the flow-induced vibration (FIV) instrumentation at the BFNS Unit-3 steam dryer. The FIV instrumentation was removed during the first outage after the dryer was put into service and the remnant locations have been provided to BFNS by GEH.

2.0 INSPECTION RECOMMENDATIONS

2.1 Prior To The First Operating Cycle

All fabrication records and the pre-service baseline video record should be inventoried, reviewed, and archived. The records shall be sufficient to comprehensively define the condition of all structural components and their attachment welds, so that they provide a basis for comparison of all critical areas for future inspections. The records shall include those pertaining to any deviations or structural alterations that may occur during shipment from the fabricator, final assembly, and installation.

2.2 After One Operating Cycle

2.2.1 General Area Examination

The Inspection personnel planning or evaluating the steam dryer inspections should review the dryer configuration and become familiar with the weld locations. It is recommended that the replacement steam dryers be visually examined during each scheduled refueling outage until at least two full operating cycles at full Extended Power Uprate (EPU) conditions have been achieved. A general area visual examination (VT-3) should be performed over all areas that are accessible from the exterior of the steam dryer to confirm that the replacement steam dryer has no obvious cracking, significant deformation, or missing parts.

In order to be consistent with previous inspections, the examination resolution requirements shall be per References 2 and 3. This utilizes the 1/32 inch black line on an 18% neutral gray card for VT-1. Because there are not specific VT-3 resolution requirements per Reference 3, the resolution requirements of the VT-3 examinations shall be the same as those for VT-1.

2.2.2 Locations Potentially Subject to Fatigue

Table 1 lists the locations that are considered the most susceptible for fatigue cracking based on BWR dryer experience and the stress analysis. Accessible weld and weld heat affected zone (HAZ) base metal surfaces of the replacement steam dryer should be visually inspected during each scheduled refueling outage until at least two full operating cycles at full EPU conditions have been achieved. The resolution standard for these visual examinations should be "best effort VT-1" in accordance with Section 5.2 of BWRVIP-139-A (Reference 3).

2.2.3 Vessel Support Lugs

In consideration of the weight increase of the replacement steam dryer, all four of the vessel steam dryer support lugs should be visually (VT-1) examined. This examination should include the entire lug attachment weld to the vessel, and at least ½ -inch of adjacent lug weld heat affected zone material. In addition, the top surface of the lug at the inboard end where the dryer weight is supported (bearing area) and at least one inch of the vertical lug surface adjacent to the dryer bearing area should be examined. The top surface of the 184 and 274 degree vessel support lugs should also be inspected for damage from contact with the dryer leveling screw.

2.2.4 Locations Prone to Handling Damage

There are a number of locations thought to be prone to handling damage, e.g., local deformation, and gouges, rolled metal and torn welds. These locations are the lower and middle part of the dryer where the guide rod would pass and bearing areas where the support brackets would land. These locations should be examined at each outage when the steam dryer is removed. A VT-3 resolution is sufficient for these examinations.

2.2.5 Remnant of Removed FIV Instrumentation

This examination is applicable to the Unit 3 steam dryer only. The remnants of the removed FIV instrumentation should be visually inspected for loose parts and weld cracks. This equipment does not provide any structural support or pressure retention for the Replacement Steam Dryer, except for the two plugs installed during instrumentation removal. Therefore, a VT-3 resolution is sufficient for these examinations, except for the plug welds, which should be visually (VT-1) examined. Inspectors should review the FIV instrumentation configuration to become familiar with the instrumentation locations.

Note, the cables running between the conduit and instruments were restrained by clips, made from stainless steel shim stock. Each clip was attached using resistance spot welds (RSW) to the steam dryer surface. The clips were removed during the instrumentation removal; however, some resistance spot weld nuggets may remain. It is recommended that inspection of any remaining nuggets be included as part of the general area VT-3 examination of the dryer.

2.3 Scope Expansion

Should a relevant indication be found in any of the weld locations during the recommended inspections in Section 2.2.2, similar locations (welds) should be examined during the same outage. Scope expansion should include at a minimum the mirror symmetric dryer locations that correspond to the component with the relevant indication. If one or more of the mirror

symmetric dryer locations also shows a relevant indication, all dryer locations that contain this type of component should be inspected. Should a relevant indication be found during the general area examination in a location not specifically identified, the scope of the inspection should be expanded to include all similar weld locations, e.g., mirror symmetric dryer locations. The resolution standard for these visual examinations should be "best effort VT-1" in accordance with Section 5.2 of BWRVIP-139-A (Reference 3)

2.4 Subsequent Re-Inspections

2.4.1 Fatigue Locations

The "best effort VT-1" inspections described in Section 2.2.2 should be repeated during subsequent refueling outages as indicated in Table 1. Inspection of additional regions will only be required by the scope expansion requirement of Section 2.3. The basis of these recommendations is engineering judgement considering prior EPU experience. If relevant indications are reported in any inspection, the inspection interval noted for that location in Table 1 shall be increased to each subsequent refueling outage until the indication is determined to have stabilized.

2.4.2 All Other Areas

The inspections recommended in Sections 2.2.1 (VT-3 of dryer exterior), 2.2.3 and 2.2.4 are recommended at each refueling outage. Inspection recommendations for instrumentation remnants, Section 2.2.5, should follow the frequency recommendations found in Table 1.

2.4.3 Bases Of Inspection Recommendations

The bases for these inspection recommendations are as follows:

1. Typical BWR practice, engineering judgement, experience with original equipment steam dryers, and industry recommendations (BWRVIP-139, Reference 3)
2. Fatigue cracking experience with BWR steam dryers (SIL-664, Reference 1)
3. The replacement dryer is heavier than the original dryer, which suggests additional attention to potential damage in the region of the steam dryer support lugs
4. Removal locations of FIV instrumentation and plug installations (Unit 3 dryer only)

3.0 REFERENCES

1. **GE Hitachi Nuclear Energy Service Information Letter 644**, *BWR Steam Dryer Integrity*. August 2006. SIL No. 644, Rev 2
2. **ASME Boiler & Pressure Vessel Code**, *Rules for Inservice Inspection of Nuclear Power Plant Components*. Section XI, 1989 Edition
3. **BWRVIP-139-A: BWR Vessel and Internals Project, Steam Dryer Inspection and Flaw Evaluation Guidelines**. EPRI, Palo Alto, CA: 2009. 1018794

Table 1: Frequency of Recommended Inspection Locations Based on Analysis

Component Description	Frequent	Less Frequent	Infrequent
Lower Skirt Ring Splices	F		
Skirt Tees	F		
Seismic Blocks	F		
Dryer Base Plate	F		
Trough Thin Section	F		
Trough Thick Section	F		
Bank End Plates - Inner	F		
Bank End Plates - Outer			IN
Outlet End Plates - Inner	F		
Outlet End Plates - Outer	F		
Hoods - Inner	F		
Hoods - Outer		LF	
Inlet End Plates - Inner			IN
Inlet End Plates - Outer			IN
Drain Pipes			IN
Drain Channel		LF	
Cover Plate		LF	
Support Ring			IN
Tie Bars – Bank to Bank		LF	
Tie Bars - Center		LF	
Trans Brace – Base Plate			IN
Trans Brace Brackets			IN
Divider Plate – Inner Banks	F		
Divider Plate – Outer Banks			IN
Hood Support – Inner Banks	F		
Hood Support – Outer Banks			IN
Mast Pad ¹			IN
Pressure Sensor Plugs ¹		LF	
Pressure Sensor Pads ¹			IN
Sensor Mounting Pads ¹			IN
Conduit Clamp Pads ¹			IN

Component Description	Frequent	Less Frequent	Infrequent
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Pads ¹			IN
Cable Clips ^{1,2}			IN
C-Channel			IN
Top Flange			IN
Hood Support Stiffener- Outer	F		
Hood Support Stiffener - Center	F		
Drain Channel Support Beam	F		
Drain Channel Tabs	F		

Notes:

F = Each refueling outage until at least two full operating cycles at full EPU operating conditions have been achieved. Inspection areas that show no relevant indications during EPU inspections should be re-inspected at a frequency not to exceed five refueling cycles.

LF = Each refueling outage until at least two full operating cycles at full EPU operating conditions have been achieved. Inspection areas that show no relevant indications during EPU inspections should be re-inspected at a frequency not to exceed five refueling cycles. Fifty percent of components should be inspected in each subsequent re-inspection outage.

IN = Each refueling outage until at least two full operating cycles at full EPU operating conditions have been achieved. Inspection areas that show no relevant indications during EPU inspections should be re-inspected at a frequency not to exceed five refueling cycles. Twenty-five percent of components should be inspected in each subsequent re-inspection outage.

Note 1: Unit 3 Steam Dryer Only.

Note 2: The cable that ran between the end of the conduit and the instrument was restrained by approximately 1,300 strips of stainless-steel shim stock that was resistance spot welded to the steam dryer. These strips were scraped off the dryer when the instruments were removed. However, some of the resistance spot weld nuggets may remain on the dryer surface. It is recommended that any remaining resistance spot weld nuggets be included as part of the general VT-3 inspection of the steam dryer.