



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION**  
WASHINGTON, D.C. 20555-0001

December 11, 2018

Vice President, Operations  
Entergy Operations, Inc.  
Grand Gulf Nuclear Station  
P.O. Box 756  
Port Gibson, MS 39150

**SUBJECT: GRAND GULF NUCLEAR STATION, UNIT 1 – REVIEW OF THE STEAM  
DRYER'S LONG-TERM INSPECTION PLAN AND BASELINE RESULTS  
(EPID L-2018-LRO-0015)**

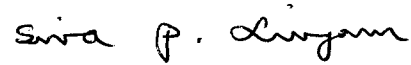
Dear Sir or Madam:

By letter dated March 27, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18088A044), Entergy Operations, Inc. (the licensee) requested U.S. Nuclear Regulatory Commission (NRC) approval for the Grand Gulf Nuclear Station, Unit 1 (GGNS) long-term steam dryer inspection plan along with the baseline inspection results to satisfy License Condition 2.C(46)(g), which states, "At the end of the second refueling outage, following the implementation of the EPU [extended power uprate], the licensee shall submit a long-term steam dryer inspection plan based on industry operating experience along with the baseline inspection results for NRC review and approval." The licensee replaced the steam dryer as part of the EPU modifications.

The licensee submitted the results of the steam dryer visual inspection for the first two scheduled refueling outages on June 30, 2017 (ADAMS Accession No. ML17186A023), after NRC approved the EPU for GGNS on July 18, 2012 (ADAMS Accession No. ML121210020). Further, the licensee provided recommendations for future inspections of the GGNS replacement steam dryer on October 17, 2017 (ADAMS Accession No. ML17290B137). The NRC staff has completed its review of these results and recommendations, and concludes that the licensee has adequately performed steam dryer baseline inspections and prepared an acceptable long-term steam dryer inspection plan in accordance with Boiling Water Reactor (BWR) Vessel and Internals Project (BWRVIP)-139-A, "BWR Vessel and Internals Project, Steam Dryer Inspection and Flaw Evaluation Guidelines" (ADAMS Accession No. ML111662165), including General Electric Service Information Letter 644, "BWR Steam Dryer Integrity," to satisfy the GGNS License Condition 2.C(46)(g). The technical report BWRVIP-139-A provides guidelines for inspecting critical locations in the steam dryer based on configurations and relative stresses due to operating fluctuating loads to minimize the risk of loose parts. The NRC staff's detailed review of these documents is enclosed.

If you have any questions, please contact me at (301) 415-1564 or via e-mail at [Siva.Lingam@nrc.gov](mailto:Siva.Lingam@nrc.gov).

Sincerely,



Siva P. Lingam, Project Manager  
Plant Licensing Branch IV  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-416

Enclosure:  
Review of the Steam Dryer's  
Long-Term Inspection Plan

cc: Listserv

## REVIEW SUMMARY

### STEAM DRYER LONG TERM INSPECTION PLAN AND BASELINE INSPECTION RESULTS

#### ENERGY OPERATIONS, INC.

#### GRAND GULF NUCLEAR STATION, UNIT 1

#### DOCKET NO. 50-416

### 1.0 INTRODUCTION

By letter dated March 27, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18088A044), Entergy Operations, Inc. (the licensee) requested U.S. Nuclear Regulatory Commission (NRC) approval for the Grand Gulf Nuclear Station, Unit 1 (GGNS) long-term steam dryer inspection plan along with the baseline inspection results to satisfy License Condition 2.C(46)(g), which states, "At the end of the second refueling outage, following the implementation of the EPU [extended power uprate], the licensee shall submit a long-term steam dryer inspection plan based on Industry operating experience along with the baseline inspection results for NRC review and approval." The licensee replaced the steam dryer as part of the EPU modifications.

The licensee submitted the results of the steam dryer visual inspection for the first two scheduled refueling outages (RFOs) on June 30, 2017 (ADAMS Accession No. ML17186A023), after NRC approved the EPU for GGNS on July 18, 2012 (ADAMS Accession No. ML121210020). Further, the licensee provided recommendations for future inspections of the GGNS replacement steam dryer on October 17, 2017 (ADAMS Accession No. ML17290B137). The NRC staff has completed its review of these results and recommendations, and concludes that the licensee has adequately performed steam dryer baseline inspections and prepared an acceptable long-term steam dryer inspection plan in accordance with Boiling Water Reactor (BWR) Vessel and Internals Project (BWRVIP)-139-A, "BWR Vessel and Internals Project, Steam Dryer Inspection and Flaw Evaluation Guidelines" (ADAMS Accession No. ML111662165), including General Electric (GE) Service Information Letter (SIL) 644, "BWR Steam Dryer Integrity" (ADAMS Accession No. ML18096A667), to satisfy the GGNS License Condition 2.C(46)(g). The technical report BWRVIP-139-A provides guidelines for inspecting critical locations in the steam dryer based on configurations and relative stresses due to operating fluctuating loads to minimize the risk of loose parts.

### 2.0 SUMMARY OF NRC REVIEW

#### 2.1 Baseline Inspection results

The attachment to the licensee's letter dated June 30, 2017, provided the results of the steam dryer visual inspection for the first two scheduled RFOs after reaching full EPU conditions. The licensee conducted visual inspections of all accessible locations of the steam dryer in accordance with the BWRVIP-139-A. These baseline inspections were conducted during the first two scheduled RFOs (RFO 19, spring 2014 and RFO 20, spring 2016) after reaching full EPU conditions.

More than 500 inspections were recorded on the steam dryer outer diameter, and over 350 inspections were recorded on the steam dryer inner diameter. The inspection method used for the steam dryer inspections were visual examinations (VT-3 and VT-1). The VT-1 inspections were performed using the VT-1-1/32 method as required by BWRVIP-139-A.

#### 2.1.1 RFO 19 (Spring 2014) Inspection Results

RFO 19 was the first scheduled outage after reaching full EPU conditions. During this RFO, the first set of baseline inspections on the replacement steam dryer was conducted. No relevant indications were observed on any of the steam dryer inner diameter inspection locations. Only five relevant indications on steam dryer outer diameter inspection locations were observed and are listed below. Reinspection of the indications were scheduled for and completed by the licensee in RFO 20 to confirm no significant changes occurred.

- a) *Vane Bank C Azimuth 0 degrees (°) Tie Rod Bolting (SDOD BC TRB01)*: Abnormal discoloration on the bottom weld and bolt head. This indication was attributed to construction damage on the washer and subsequent crud buildup on the damaged washer. This was reinspected in RFO 20.
- b) *Lower Guide Surfaces Azimuth 0° (SDOD LG 000)*: Rubbing marks were observed on the inner surfaces consistent with steam dryer installation and/or removal from the vessel. There is no evidence of metal slivers or rolled metal. This was reinspected in RFO 20.
- c) *Seismic Support Block Azimuth 120° (SDOD SSB 120)*: Wear was observed on the lead-in-surface, consistent with the handling marks during steam dryer installation and/or removal from the vessel. The seismic support block marks were polished to remove the metal slivers. This was reinspected in RFO 20.
- d) *Seismic Support Block Azimuth 185° (SDOD SSB 185)*: Wear was observed on the lead-in-surface, consistent with the handling marks during steam dryer installation and/or removal from the vessel. The seismic support block marks were polished to remove the metal slivers. This was reinspected in RFO 20.
- e) *Seismic Support Block Azimuth 240° (SDOD SSB 240)*: Wear was observed on the lead-in-surface, consistent with the handling marks during steam dryer installation and/or removal from the vessel. The seismic support block marks were polished to remove the metal slivers. This was reinspected in RFO 20.

#### 2.1.2 RFO 20 (Spring 2016) Inspection Results (New Indications)

RFO 20 was the second scheduled RFO after reaching full EPU conditions. During this RFO, the second and final set of baseline inspections on the replacement steam dryer were conducted. No relevant indications were observed on any of the steam dryer inner diameter inspection locations. Two new relevant indications on steam dryer outer diameter inspection locations were observed and are listed below. Reinspection of the indications are scheduled for RFO 21 to confirm no significant changes occurred.

- a) *Seismic Support Block Azimuth 240° (SDOD SSB 240)*: Wear was observed on the lead-in-surface, consistent with the handling marks during steam dryer installation and/or removal from the vessel. This wear was in a different location than the previously

identified indication. The seismic support block marks were polished to remove the metal slivers. This is scheduled for reinspection in RFO 21.

- b) *Seismic Support Block Azimuth 300 ° (SDOD SSB 300)*: Wear was observed on the lead-in-surface, consistent with the handling marks during steam dryer installation and/or removal from the vessel. The seismic support block marks were polished to remove the metal slivers. This is scheduled for reinspection in RFO 21.

### 2.1.3 RFO 20 (Spring 2016) Reinspection of RFO 19 Indications and Results

All five relevant indications observed in RFO 19 were reinspected by the licensee in RFO 20 to identify any changes. In summary, the indication on Seismic Support Block Azimuth 120 ° (SDOD SSB 120) showed additional wear on the lead in surfaces, and all other indications showed no discernable changes. All indications are scheduled for reinspection in RFO 21 to confirm that no significant changes have occurred. Relevant indications will continue to be inspected during each RFO until the indication is shown to have stabilized. This is typically established with two subsequent reinspections with no changes noted after the indication is initially identified. Once an indication is shown to have stabilized, inspections will continue at the regularly scheduled frequency.

## 2.2 Steam dryer Long Term Inspection Plan

Attachment 2 to the licensee's letter dated October 17, 2017, provided long-term inspection details for the GGNS steam dryer.

The above mentioned document provides recommendations for long-term or future inspections of the replacement steam dryer. It also identifies the type of visual examination (VT-1 or VT-3) method.

The long-term inspection plan also provides the required frequency of inspections as Frequent (F), Less Frequent (LF), and Infrequent (IN), and the corresponding details are as follows:

- F, LF, 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 be reinspected at a frequency not to exceed five refueling cycles.
- LF = 50 percent of components will be inspected in each subsequent reinspection outage.
- IN = 25 percent of components will be inspected in each subsequent reinspection outage.

The licensee's dryer inspection recommendations are sound and are based on the following considerations:

- Typical BWR practice, engineering judgment, experience with original equipment steam dryers, and industry recommendations as detailed in BWRVIP-139-A.

- Areas susceptible to fatigue cracking, based on BWR steam dryer experience and dryer stress analysis, are examined using VT-1. Inspection frequency varies and is F, LF, or IN based on the dryer components' susceptibility to cracking.
- Locations for potential damage in the region of the steam dryer support lugs of the replacement dryer for GGNS (is of improved design compared to the original steam dryer) be examined using visual examination method VT-1.
- GGNS steam dryer was instrumented to acquire on-dryer data during initial power ascension to EPU. The dryer instrumentation was subsequently removed with small remnants remaining. The long-term plan recommends inspection of the dryer instrumentation remnants for loose parts and weld for cracks with inspection frequency LF using VT-1, while the rest of the area of the remnants are inspected with inspection frequency IN using VT-3.
- Locations prone to handling damage (lower ring at the guide rod and vessel support bracket azimuths and at the middle support ring where the vessel support brackets land) are recommended to be examined using VT-3 at each RFO when the steam dryer is removed.

The long-term inspection plan also addresses scope expansion if a relevant indication is found in any of the weld locations during the recommended inspections in fatigue susceptible locations. Similar weld locations are recommended to be examined during the same RFO. Scope expansion is recommended to include, as 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 show a relevant indication, all dryer locations that contain this type of component are recommended for inspection. If a relevant indication is found during the general area examination in a location, the scope of the inspection is expanded to include all similar mirror symmetric dryer locations. The long-term inspection plan also provides subsequent reinspection guidelines.

Based on a review of the licensee's long-term inspection plan, the NRC staff finds that the plan is comprehensive in providing details on inspection frequencies, reinspection guidelines, and inspection scope expansion based on dryer operating experience, dryer stress analysis results, and BWRVIP-139-A guidance.

### 3.0 CONCLUSION

Based on the review, as summarized above, the NRC staff concludes that the licensee has adequately performed steam dryer baseline inspections and prepared an acceptable long-term steam dryer inspection plan, in accordance with the guidelines in BWRVIP-139-A, including GE SIL-644, to satisfy License Condition 2.C(46)(g).

A complete baseline inspection of the GGNS replacement steam dryer was performed during the two subsequent RFOs (RFO 19 and RFO 20) after attaining EPU conditions. The baseline inspections were consistent with the guidance provided in BWRVIP-139-A. Based on a review of the licensee's engineering evaluation, the NRC staff concludes that none of the steam dryer indications identified in RFO 19 or RFO 20 challenge the structural integrity or function of the steam dryer.

The long term dryer inspection plan is comprehensive in providing details on inspection frequencies, reinspection guidelines, and inspection scope expansion based on BWR dryer operating experience, dryer stress analysis results, and BWR-VIP-139-A guidance.

The NRC staff finds that GGNS replacement steam dryer baseline inspection results and the long-term dryer inspection plan, submitted in accordance with License Condition 2.C(46)(g), are acceptable because they are in accordance with BWR dryer experience and BWRVIP-139-A, including GE SIL 644 recommendations.

SUBJECT: GRAND GULF NUCLEAR STATION, UNIT 1 – REVIEW OF THE STEAM DRYER’S LONG-TERM INSPECTION PLAN AND BASELINE RESULTS (EPID L-2018-LRO-0015) DATED DECEMBER 11, 2018

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**ADAMS Accession No. ML18344A612**

**\*via email**

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