



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION**

REGION III  
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December 21, 2015

EA-14-237

Mr. Thomas A. Vehec  
Vice President  
NextEra Energy Duane Arnold, LLC  
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Palo, IA 52324-9785

**SUBJECT: DUANE ARNOLD ENERGY CENTER – NRC SUPPLEMENTAL INSPECTION  
REPORT 05000331/2015011 AND ASSESSMENT FOLLOW-UP LETTER**

Dear Mr. Vehec:

In November of 2012, During Refueling Outage 23, your staff failed to install torus coating under suitable controlled conditions as required by Title 10, *Code of Federal Regulations* (CFR), Part 50, Appendix B, Criterion IX, "Control of Special Processes." This performance deficiency resulted in the failure to ensure that Emergency Core Cooling Systems (ECCSs) capability to provide their mitigating function was maintained because the amount of non-bonded coating exceeded the ECCS suction strainer debris loading margin established by design evaluations.

On October 20, 2014, the U.S. Nuclear Regulatory Commission (NRC) completed a Special Inspection at your Duane Arnold Energy Center, Unit 1. Based on the results of the Special Inspection, documented in NRC Inspection Report (IR) 05000331/2014011 ([ML15050A653](#)) on February 19, 2015, and the final significance determination documented in NRC IR 05000331/2015010 ([ML15106A595](#)), dated April 16, 2015, the NRC assigned a White finding Action Matrix input to the Mitigating System cornerstone in the first quarter of 2015.

In response to this Action Matrix input, the NRC informed you that a supplemental inspection under Inspection Procedure 95001, "Supplemental Inspection for One or Two White Inputs in a Strategic Performance Area," would be required.

On June 9, 2015, you informed the NRC that Duane Arnold Energy Center was ready for the supplemental inspection.

On November 6, 2015, the NRC completed the supplemental inspection and discussed the results of this inspection during the combined exit meeting and Regulatory Performance Meeting. During the Regulatory performance meeting Ms. Karla Stoedter, Branch Chief, Region III, Division of Reactor Projects, discussed the implementation of your corrective actions with you and other members of your staff. The results are documented in the enclosed report.

The NRC performed this supplemental inspection to determine if: (1) the root and contributing causes for the significant issues were understood, (2) the extent of condition and extent of cause for the identified issues were understood, and (3) your completed or planned corrective actions were sufficient to address and prevent repetition of the root and contributing causes.

The NRC determined that your staff's evaluation identified the primary root causes of the issue to be (1) less than adequate coating application specification and work instructions, and (2) less than adequate project oversight and control. Your staff determined that less than adequate guidance for the coating curing schedule and less than adequate contingency planning for areas of low thickness during the coating application were contributing causes for this issue. To correct these issues and prevent recurrence, your staff revised coating specifications for protective coating inside and outside primary containment to require wet film thickness measurements during coating application. Your staff also prohibited the use of the coating material for which the specifications and work instructions were determined to be less than adequate. Your staff also implemented an Enterprise Risk Process, to provide an additional parallel process, to address the root cause for less than adequate project oversight and control. Your staff informed the NRC that the implementation of Enterprise Risk requires further review and completion of effectiveness reviews by your staff to ensure the process will adequately address the root causes to prevent recurrence. The inspectors determined while the Effectiveness Review was ongoing, other processes at Duane Arnold Energy Center met the Commission's rules and regulations. Pending the adequate effectiveness review for the Enterprise Risk process, this program should be effective in providing additional oversight for projects that meet the licensee's definition of Enterprise Risk. The NRC has determined that completed or planned corrective actions should be sufficient to address the performance that led to the White finding. Therefore, the performance issue will not be considered as an Action Matrix input after the end of the fourth quarter of 2015.

After reviewing Duane Arnold Energy Center, Unit 1, performance in addressing the White finding subject of this Inspection Procedure 95001, "Supplemental Inspection for One or Two White Inputs in a Strategic Performance Area," the NRC concluded your actions met the objectives of Inspection Procedure 95001, "Supplemental Inspection for One or Two White Inputs in a Strategic Performance Area." Therefore, in accordance with the guidance in Inspection Manual Chapter 0305, "Operating Reactor Assessment Program," the White finding will only be considered in assessing plant performance for a total of four quarters. As a result, the NRC determined the performance at Duane Arnold Energy Center, Unit 1, to be in the Licensee Response Column of the Reactor Oversight Program Action Matrix as of January 1, 2016.

The NRC inspectors documented one Severity Level IV violation with no associated finding. The NRC is treating this violation as Non-Cited Violation (NCV) consistent with Section 2.3.2.a of the Enforcement Policy which appears on the NRC's Web site at <http://www.nrc.gov/about-nrc/regulatory/enforcement/enforce-pol.html>.

No NRC-identified or self-revealing findings were identified during this inspection.

If you contest the subject or severity of the NCV, 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 III; the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; and the NRC Resident Inspectors at the Duane Arnold Energy Center.

T. Vehec

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In accordance with 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding," of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC's Public Document Room or from the Publicly Available Records (PARS) component of the NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Sincerely,

*/RA/*

Christine A. Lipa, Branch Chief  
Engineering Branch 2  
Division of Reactor Safety

Docket No. 50-331  
License No. DPR-49

Enclosure:  
Inspection Report 05000331/2015011  
w/Attachment: Supplemental Information

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U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No.: 50-331  
License No.: DRP-49

Report No.: 05000331/2015011

Licensee: NextEra Energy Duane Arnold, LLC

Facility: Duane Arnold Energy Center

Location: Palo, IA

Dates: November 2, 2015 – November 6, 2015

Inspectorss: M. Jones, Reactor Inspectors (Lead)  
J. Draper, Resident Inspectors

Approved by: C. Lipa, Chief, Engineering Branch 2  
Division of Reactor Safety

Enclosure

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## SUMMARY

Inspection Report (IR) 05000331/2015011; 11/2/2015 – 11/6/2015; Duane Arnold Energy Center, Unit 1; Supplemental Inspection – Inspection Procedure (IP) 95001.

The report covered a 1-week period of inspection by a reactor engineer and resident inspector from Region III, Division of Reactor Safety and Division of Reactor Projects, respectively. Based on the results of this inspection, one Severity Level IV Non-Cited Violation (NCV) was identified. All violations of U.S. Nuclear Regulatory Commission (NRC) requirements are dispositioned in accordance with the NRC's Enforcement Policy dated July 9, 2013. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 5, dated February 2014.

### **NRC-Identified and Self-Revealed Findings**

#### **Cornerstone: Mitigating System**

The NRC staff performed this supplemental inspection in accordance with IP 95001 "Inspection for One or Two White Inputs in a Strategic Performance Area," to assess the licensee's evaluation associated with the failure to install torus coating under suitable controlled conditions in November 2012. The NRC staff previously characterized this issue as having (low to moderate) safety significance [White], as documented in NRC Special Inspection Team IR 05000331/2014011 ([ML15050A653](#)), and the final significance determination documented in NRC IR 05000331/2015010 on April 16, 2015. During this supplemental inspection, the inspectors determined that the licensee performed a comprehensive evaluation of the self-revealed torus coating delamination event, which was identified during an initial walkdown of the torus interior during refuel outage (RFO) 24, on October 9, 2014. The licensee identified the primary root causes of the issue to be (1) less than adequate coating application specifications and work instructions, and (2) less than adequate project oversight and control.

The less than adequate coating application specification and work instruction issues were limited to a particular type of coating in the torus applied in a manner not consistent with qualification. The licensee has taken corrective actions to ensure the coating material used and the specifications used to apply them, will not be used. Additionally the licensee has revised the coating application specifications for coatings used inside and outside primary containment to ensure critical parameters are identified and monitored during the application of coating materials. The licensee is implementing a Enterprise Risk Process to further ensure projects that meet the site definition of Enterprise Risk, are appropriately planned and implemented. The licensee is performing effectiveness reviews to verify the adequacy of the corrective actions. The licensee also intends to review the population of condition reports generated through RFO 25, looking for any identified issues with oversight of quality related field activities and project contingency planning. The licensee intends to conduct additional interviews to determine the effectiveness of the Enterprise Risk process to identify critical steps/activities requiring targeted field activity monitoring and hold points and the need to develop contingency plans for critical activities.

Given the licensee's acceptable performance in addressing the failure to install torus coating under suitable controlled conditions, the [White] finding associated with this issue will only be considered in assessing plant performance for a total of four quarters in accordance with the guidance in Inspection Manual Chapter 0305, "Operating Reactor

Assessment Program," dated April 9, 2015. Duane Arnold Energy Center will transition from the Regulatory Response Column of the NRC's Action Matrix to the Licensee Response Column effective at the beginning of the first quarter of 2016 (January 1, 2016). (Section 40A4)

- Severity Level IV. Inspectors identified a Severity Level IV NCV of Title 10, Code of Federal Regulation (CFR) 50.73 (a)(2)(v) and 50.73 (a)(2)(vii) for the licensee's failure to submit an Licensee Event Report within 60 days of discovery of a condition that could have prevented the both trains of the residual heat removal and containment spray systems from fulfilling their safety function. The licensee's corrective actions included entering the issue into the Corrective Action Process as AR 02089138.

The finding was evaluated using the traditional enforcement process because not accurately reporting events has the potential to impact or impede the regulatory process. The finding was determined to be a Severity Level IV violation of 10 CFR 50.73 (a)(2)(v) and 50.73 (a)(2)(vii) based on example 6.9.d.9 of the NRC Enforcement Policy. This example states that a licensee failing to make a report required by 10 CFR 50.72 or 50.73 is an example of a Severity Level IV violation.

Because this violation involves the traditional enforcement process and does not have an underlying technical violation that would be considered more-than-minor, inspectors did not assign a cross-cutting aspect to this violation in accordance with Inspection Manual Chapter 0612, Appendix B. (Section 40A3)

#### **Licensee-Identified Violations**

No violations were identified.

## REPORT DETAILS

### 4. OTHER ACTIVITIES

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

##### .1 (Closed) Licensee Event Report 05000331/2015-002-00: Unanalyzed Condition Due to Degraded Primary Containment Suppression Pool Coating

###### a. Inspection Scope

On June 1, 2015, Duane Arnold Energy Center (DAEC) submitted Licensee Event Report (LER) 2015-002-00 following the discovery of delaminated coating in the suppression pool, or torus. On October 9, 2014, during a walkdown of the torus interior during a refueling outage (RFO), the licensee identified areas of torus coating delamination. The torus had been recoated during the prior RFO in 2012. The licensee determined that during the torus recoat project in 2012, much of the coating had initially been applied at a thickness less than that required by the coating specification, and that this occurred because the appropriate wet film thickness (WFT) measurements were not taken during the application process. The licensee attempted to resolve this issue by applying a secondary coat to build up the thin areas.

The licensee determined that the direct cause for the delamination of the torus coating was that the conditions for applying the second layer of torus coating were not met. The licensee also identified that the root causes for the delamination were less than adequate coating application specification and work instructions and less than adequate project oversight and control. Because the quantity of delaminated coating exceeded the licensee's original design consideration for the Emergency Core Cooling System (ECCS) suction strainers, the licensee concluded that an unanalyzed condition existed and submitted LER 2015-02-00. The licensee performed a past operability review and concluded that an event or condition that alone could have prevented a loss of safety function did not occur.

During the 2014 RFO, the licensee removed the delaminated coating from the torus. The licensee developed corrective actions to prevent recurrence to revise the licensee's specifications for protective coatings to require WFT measurements be taken during coating application and revised the fleet administrative procedure for Project Management to implement the Enterprise Risk Process to provide adequate project oversight for projects meeting the definition of Enterprise Risk.

The inspectors reviewed the LER, the licensee's past operability review, and other licensee documents and determined that the LER was not submitted within 60 days of the discovery of the event as required by Title 10, *Code of Federal Regulations* (CFR), Part 50.73(a)(1). Specifically, the inspectors determined that the reportable event was discovered by the licensee at a date prior to March 31, 2015, the event date documented in the report. On November 4, 2014, the licensee completed Prompt Operability Determination 1997546, which documented the amount of coating that was delaminated and the amount of material that was allowed by the design consideration. At this time, the licensee had enough information to identify that the amount of delaminated material exceeded the amount allowed by design basis calculations. Additionally, on March 23, 2015, the licensee responded, in writing, to the preliminary White finding and concurred with the U.S. Nuclear Regulatory Commission (NRC) characterization



of the issue. At this time, the licensee had enough information to identify that an unanalyzed condition existed and that it significantly degraded plant safety. This resulted in an untimely LER, which is a violation of 10 CFR 50.73(a)(1), however, because the report was made for the unanalyzed condition, and it is unlikely that any different regulatory or licensing action or decision would have been made had the report been submitted on time, the violation was determined to be of minor significance and severity.

Documents reviewed are listed in the Attachment to this report. This LER is closed.

This event follow-up review constituted one sample as defined in Inspection Procedure (IP) 71153-05.

b. Findings

Introduction: The inspectors identified a Severity Level IV Non-Cited Violation (NCV) of 10 CFR 50.73(a)(2)(v) and 10 CFR 50.73(a)(2)(vii) for the licensee's failure to submit a LER within 60 days after the discovery that the torus coating delamination could have prevented both trains of the residual heat removal and containment spray systems from fulfilling their safety function.

Description: On December 8, 2014, the licensee completed a past operability review (POR) (POR 1999648-01) of the torus coating delamination event. Through this POR, the licensee concluded that all the systems that take a suction from the torus (reactor core isolation cooling, high pressure coolant injection, low pressure coolant injection, and core spray) were fully operable but degraded due to loss of margin caused by the delaminated torus coating.

On February 19, 2015, after reviewing the licensee's POR, the NRC Special Inspection Team documented a preliminary White finding and violation associated with this coating delamination event in Inspection Report (IR) 05000331/2014011. In the report, the NRC documented that this determination was made because of the team's conclusion that "the capability of ECCS to provide their mitigating function was not ensured because the amount of non-bonded coating exceeded the ECCS suction strainer debris loading margin established by design evaluations."

On February 27, 2015, the licensee, in writing, declined the opportunity to discuss the issue in a Regulatory Conference, and on March 23, 2015, the licensee submitted a written response in which they stated that "NextEra concurs with the categorization and basis for the finding." It also stated that "NextEra's analyses identified that there were inadequate quality controls during the application of torus coating which led to unqualified torus coating in excess of design margins." The NRC issued the final White Notice of Violation on April 16, 2015.

On March 31, 2015, the licensee identified the need to submit an LER to report the unanalyzed condition that resulted from the delamination of material in excess of the original design consideration for the ECCS suction strainers, and on June 1, 2015, the licensee submitted LER 2015-002 to report the above condition, but stated that delamination never resulted in a loss of safety function of reactor core isolation cooling, high pressure coolant injection, low pressure coolant injection, or core spray.

The NRC Determined that the licensee failed to report the loss of safety function based on the conclusions reached by the NRC Special Inspection team's documented White finding and violation, as supported by the guidance provided in NRC Inspection Manual Chapter (IMC) 0326, "Operability Determination and Functionality Assessment for Conditions Adverse to Quality."

Specifically, the team concluded "the licensee had not demonstrated reasonable assurance that the ECCS pumps would have remained functional based on the information provided by the licensee as of February 4, 2015." This conclusion was based on "multiple areas of uncertainty that, in aggregate, degrade a condition that already resulted in small predicted margins." The inspection report listed four examples of this uncertainty, specifically:

- The event resulted in a significant increase in the debris loading of the ECCS suction strainers.
- The original analysis assumed the debris mass was generated in the drywell and transported to the torus and strainers. The as-found conditions resulted in additional debris generated in the torus, being delivered to the strainers before the drywell-generated debris would be transported to the strainers. This scenario would result in strainer surface area being directly blocked off by the transported chips prior to any other debris arriving at the strainer surface. The net effect would be that the fibrous and other debris arriving later would have a reduced surface area to build a bed on. Additionally, the flow area of the strainer would be reduced, increasing velocity through the open area of the strainer. This would increase head loss and could exceed the relatively small margins predicted by the empirical correlations used by the licensee POR. These empirical correlations assumed all the fibrous and coating debris are generated at and transported from the drywell.
- The performance deficiency resulted in small margins for residual heat remover and core spray during runout conditions. Section 6.3.2.2.8 of the Updated Final Safety Analysis Report, "Evaluation of Residual Heat Remover (Low Pressure Coolant Injection) Pump Runout Conditions," and Section 15.2.1, "Loss of Coolant Accidents," discuss runout conditions during the first ten minutes of a loss of coolant accident (LOCA), and assume no operator actions. Section 6.3.1, "Design Bases and Summary Description," states "Automatic actuation is provided such that no operator action is required until ten minutes after an accident, to allow for operator assessment and decision..."
- There is uncertainty as to what the coating debris size characteristics would be under LOCA conditions because degraded (i.e., no longer qualified) coating (Carboguard 6250N) characteristics have not been studied under LOCA conditions. If the coatings failed as particulate it is highly likely that the strainers would fail on net positive suction head. This assertion 14 is based on the Office of Nuclear Reactor Regulation staff's observations of the empirical correlation's response to fine particulate in the form of sludge. If the failed coatings remain in chip form as the licensee asserts, then the scenario described by the second bullet above becomes applicable.

According to the guidance provided in NRC IMC 0326, Section 3.09 "Reasonable Expectation," "the SSCs [system structure or components] may be considered operable when there is evidence that the possibility of failure of a SSC has increased, but not to the point of eroding confidence in the reasonable expectation that the SSC remains

operable. The supporting basis for the reasonable expectation of the SSC operability should provide degree of confidence that the SSC remain operable.” Based on the uncertainties associated with the licensee’s assurance that the ECCS pumps would have remained functional, a reasonable expectation that the shutdown cooling and accident mitigation functions was not assured. Furthermore, since February 4, 2015, when this information was provided to the licensee, the licensee did not perform any additional evaluation to address the above uncertainties or to provide a reasonable expectation that the shutdown cooling and accident mitigation functions was assured. Therefore, with the issuance the final White Notice of Violation on April 16, 2015, the licensee was able to recognize that the ECCS pumps were not capable of performing the shutdown cooling and accident mitigation functions, and as a result met the threshold to be reported under the requirements of 10 CFR 50.73.

Analysis: The inspectors determined that the licensee’s failure to submit the LER after concurring with the NRC’s categorization and basis for the White finding was a performance deficiency, however the inspectors determined that this performance deficiency was not of more than minor safety significance. Therefore, it was not a finding as defined in the reactor oversight process.

The inspectors determined that this issue impacted the regulatory process since LERs submitted based on the reporting criteria in 10 CFR 50.73(a)(2)(v) are also considered for reporting under Performance Indicator MS05, “Safety System Functional Failures,” in accordance with IMC 0608, “Performance Indicator Program.” Since the issue impacted the regulatory process, it was dispositioned through the Traditional Enforcement process. The inspectors determined that this issue was a Severity Level IV violation based on Section 6.9, “Inaccurate and Incomplete Information or Failure to Make a Required Report.” Example d.9 of Section 6.9 specifically includes, “A licensee fails to make a report required by 10 CFR 50.72 or 10 CFR 50.73,” is an example of a Severity Level IV violation.

Because the inspectors did not identify a finding of more than minor significance and cross-cutting aspects did not get assigned to traditional enforcement violations, the inspectors did not assign a cross-cutting aspect.

Enforcement: Title 10 CFR Part 50.73(a)(2)(v)(B) and (D) required the licensee, in part, to submit a LER within 60 days after the discovery of any event or condition “that could have prevented the fulfillment of the safety function of... systems that are needed to” remove residual heat and mitigate the consequences of an accident, respectively. Additionally, 10 CFR 50.73(a)(2)(vii)(B) and (D) required the licensee, in part, to submit an LER for any event “where a single cause or condition caused at least one independent train or channel to become inoperable in multiple systems or two independent trains or channels to become inoperable in a single system design to” remove residual heat and mitigate the consequences of an accident, respectively.

Contrary to the above, on May 22, 2015, 60 days after the licensee concurred, in writing, with the NRC’s categorization and basis for the white finding, the licensee failed to submit an LER reporting to the NRC that the condition could have prevented the fulfillment of safety functions. Specifically, as of the start date of this inspection, November 2, 2015, the licensee had not reported this condition to the NRC.

The licensee's corrective actions included initiating AR 2089138. Because the issue was entered into the licensee's Corrective Action Program, the Severity Level IV violation is being treated as an NCV consistent with Section 2.3.2 of the NRC Enforcement Policy. **(SL IV 05000331/2015011-01, Failure to Submit an LER)**

4OA4 Supplemental Inspection (95001)

a. Inspection Scope

This inspection was conducted in accordance with IP 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area," to assess the licensee's evaluation of one White inspection finding in the Mitigating Systems Cornerstone. The inspection objectives were to:

- Provide assurance that the root causes and contributing causes of risk-significant performance issues are understood;
- Provide assurance that the extent of condition and extent of cause of risk-significant issues are identified; and
- Provide assurance that licensee corrective actions to risk-significant performance issues are sufficient to address the root causes and contributing causes, and to prevent recurrence.

DAEC entered the Regulatory Response column of NRC's Action Matrix in the first quarter 2015 as a result of one inspection finding of low to moderate (White) safety significance. The White finding was associated with a performance deficiency issued in NRC IR 05000331/2014011 ([ML15050A653](#)) dated February 19, 2015, for DAEC's failure to install torus coating under suitable controlled conditions in November 2014. The finding was characterized as having (White) safety significance based on the results of a Phase 3 risk analysis performed by a region-based senior reactor analyst, as discussed in NRC IR 05000331/2014011, dated February 19, 2015, and the final significance determination documented in NRC IR 05000331/2015010 ([ML15106A595](#)), dated April 16, 2015.

NextEra Duane Arnold staff informed the NRC on June 9, 2015, that DAEC was ready for the supplemental inspection and that the Root Cause Evaluation (RCE), Condition Report (CR) 1999648, "Torus Coating Delamination," Revision 4, had been completed. The evaluation was performed to determine the root and contributing causes that led to the failure to install torus coating under suitable controlled conditions. The White finding was issued with a cross-cutting aspect in the area of Human Performance, Field Presence because senior managers did not ensure supervisory and management oversight of work activities, including contractors and supplemental personnel. [H.2]

The licensee also performed a safety culture evaluation as a part of the evaluation.

The inspectors reviewed the licensee's RCE in addition to other evaluations conducted in support and as a result of the RCE. The inspectors reviewed corrective actions that were taken or planned to address the identified causes. The inspectors also held discussions with licensee personnel to ensure that the root and contributing causes, and the contribution of safety culture components were understood and corrective actions taken or planned were appropriate to address the causes and preclude repetition.

## 2.1 EVALUATION OF INSPECTION REQUIREMENTS

### Problem Identification

- a. IP 95001 specified that the inspection staff determine that NextEra's evaluation of the issue documents who identified the issue (i.e., licensee-identified, self-revealing, or NRC-identified) and under what conditions the issue was identified.

The RCE concluded that the areas of coating delamination were identified during a walkdown of the torus interior during RFO 24, on October 9, 2014. The licensee conducted this walkdown under Surveillance Test Procedure NS590013, "Suppression Chamber Visual Examination of Submerged Areas". The self-revealed torus coating delamination was first documented in CR 1997546, and evaluated in Root Cause 1999648.

The inspectors determined that the RCE adequately identified who and under what conditions the issue was identified.

- b. Determine whether the evaluation documented how long the issue existed, and whether there were any prior opportunities for identification.

The RCE documented that the torus was recoated in RFO 23 to address license renewal commitments regarding the primary containment. The evaluation stated that the RFO 23 Torus Recoat Project started the coating application process on November 5, 2012. During the coating application process, the licensee documented that wide spread areas failed to meet required coating thickness specification, per the product data sheet. The licensee documented these issues in CR 1821308, dated November 8, 2012, and implemented actions to achieve specified coating thickness.

The RCE documented that tests and inspections were performed following the completion of rework activities in RFO 23. These inspections and tests did not identify areas of delamination. The licensee documented that the torus was sealed and entered following these activities and was not re-entered until the next RFO, RFO 24, 2 years later. The root cause also documented that no signs of coating delamination were observed during cycle 24. In order to draw this conclusion, the licensee developed a list of all activities and evolutions that had the possibility to provide early detection of coating delamination during cycle 24. These evolutions included operation of ECCS that draw a suction from the torus. The root cause did not identify any issues associated with these evolutions since any fouling of ECCS suction strainers would have caused some measureable corresponding erratic pump behavior (i.e., swinging motor amps, erratic discharge pressure/flow indication, and unusual noises/vibrations).

The inspectors determined that the RCE adequately identified how long the issue existed and whether there were any prior opportunities for identification.

- c. Determine whether the licensee's RCE documented the plant specific risk consequences and compliance concerns associated with the issue.

The RCE concluded that that an event or condition that alone could have prevented a loss of safety function did not occur. Additionally, the evaluation stated that based on the level of uncertainties in the POR, it was concluded that an unanalyzed condition existed. Therefore, this event was reported to the NRC on March 31, 2015 under EN 50943 pursuant to 10 CFR 50.72(b)(3)(ii).

The RCE discusses the results of a past operability review performed by NextEra Duane Arnold. The POR evaluated the impact on the Net Positive Suction Head of the ECCS and Reactor Core Isolation Cooling due to torus secondary coating delamination.

The POR concluded that the ECCS and Reactor Core Isolation Cooling pumps were capable of performing their safety functions as described in the current licensing basis but were degraded over the time period between RFO 23 and RFO 24. The licensee noted that NRC IR 2014011 identified several uncertainties in the evaluation such as the fact that the original ECCS suction strainer loading analysis assumed the debris mass was generated in the drywell and transported to the torus and strainers. A LOCA under this assumption could lead to the ECCS suction strainer surface areas being blocked by the delaminated coating prior to the arrival of the drywell debris. An additional uncertainty was coating debris size characteristics during LOCA conditions. Specifically, Carboguard 6250N characteristics have not been studied under LOCA conditions. Therefore it was determined that the event had a delta core damage frequency between 1.0E-5/yr (upper bounding significance) and 1.0E-6/yr (lower bounding significance).

The Inspectorss noted the licensee responded to NRC Special IR 2014-011, dated February 19, 2015, transmitting the White violation in writing by letter titled, "30 Day Response to Reactive Inspection Report," ([ML15085A051](#)) dated March 23, 2015. In this letter the licensee concurred with the categorization and basis for the finding, and the cross cutting aspect associated with the White finding, for the failure to install torus coating under suitable and controlled conditions as required by 10 CFR Part 50, Appendix B, Criterion IX, "Control of Special Processes."

Based upon the above documented observations, the inspectors concluded the licensee adequately evaluated the risk consequences associated with this issue. The licensee reached a similar conclusion to that reached by NRC Inspectors and Risk Analysts in their determination that the event had a delta core damage frequency between 1.0E-5/yr (upper bounding significance) and 1.0E-6/yr (lower bounding significance). However, inspectors also concluded that the licensee failed to document that the degraded torus coating, was a condition that alone could have prevented a loss of safety function to occur. As a result, the inspectors documented a Severity Level IV NCV in Section 4OA3 of this report for the licensee's failure to report that the torus coating delamination could have prevented both trains of the residual heat removal and containment spray systems from fulfilling their safety function. See Section 4OA3 for details.

## **2.2 ROOT CAUSE, EXTENT OF CONDITION, AND EXTENT OF CAUSE EVALUATION**

- a. IP 95001 specifies that the inspection staff determine whether the licensee evaluated the issue using a systematic methodology to identify the root and contributing causes.

The licensee used the following systematic methods to complete RCE 1999648:

- support/refute matrix;
- events and causal factor charting; and
- barrier analysis.

The inspectors determined that the licensee evaluated the issue using a systematic methodology to identify root and contributing causes.

- b. IP 95001 specifies that the inspection staff determine whether the licensee's RCE was conducted to a level of detail commensurate with the significance of the issue.

The inspectors determined that the RCE was conducted to a level of detail commensurate with the significance of the problem.

The licensee's RCE included a support/refute matrix to determine the probable causes for this event. The licensee then used these probable causes in a barrier analysis to determine which barriers were missing, inadequate, not used, or successful. Then, the licensee constructed an event and causal factor chart to determine the root and contributing causes. The licensee conducted interviews of personnel involved with the Torus Recoat Project from several organizations, including DAEC, Florida Power and Light, Williams Specialty Services, and Underwater Engineering Services, Incorporated. The licensee's RCE documented the root causes of the issue to be (1) the licensee's use of less than adequate coating specification and work instructions and (2) the licensee's less than adequate torus coating project oversight and control. The licensee determined that the contributing causes included: (1) less than adequate guidance for the coating curing schedule and (2) less than adequate contingency planning for areas of low millage in the torus coating.

Based on the extensive work performed for this RCE, the inspectors concluded that the RCE was conducted to a level of detail commensurate with the significance of the problem.

- c. IP 95001 specifies that the inspection staff determine whether the licensee's RCE included a consideration of prior occurrences of the issue and knowledge of operating experience (OE).

The inspectors determined that the RCE adequately included consideration of prior occurrences of the problem and knowledge of prior operating experience.

In the root cause analysis, the licensee included an evaluation of internal and external OE. The licensee reviewed internal OE sources such as the Duane Arnold Corrective Action Program as well as external OE sources such as NRC generic communications and OE from the Institute of Nuclear Power Operations. The licensee determined that one OE Report from Peach Bottom was similar, however this operating experience occurred approximately the same time as the Duane Arnold torus recoat, so the issues that occurred at Peach Bottom were not fully understood by the licensee during the Duane Arnold torus recoat.

Based on the licensee's detailed evaluation and conclusions, the inspectors determined that the licensee's RCE included a consideration of prior occurrences of the problem and knowledge of prior OE.

- d. IP 95001 specifies that the inspection staff determine whether the licensee's RCE addresses the extent of condition and extent of cause of the issue.

In its root cause analysis, the licensee considered the extent of condition associated with the coating failure. The licensee determined that the same coating was not used for any

other safety-related application. However, the licensee determined that similar coatings in the plant have had failures, though none of these failures occurred on safety-related equipment installed in the plant.

The licensee's evaluation also considered the extent of cause associated with the root and contributing causes. For the root cause of the less than adequate coating specification and work instructions, the licensee determined that only three other coatings are used for safety-related applications at Duane Arnold, and the specifications used for those coating are adequate. Additionally, the licensee updated their specifications for safety-related coatings, ACP 1602 and ACP 1603, to include WFT testing.

For the root cause of less than adequate oversight, the licensee determined that there were no issues with inadequate oversight of other major projects completed in the past two RFOs. The licensee has several major projects expected in the next RFO that could be affected by less than adequate oversight of field activities, and the licensee has determined that the corrective actions to this root cause will ensure adequate oversight of those activities.

The inspectors concluded that the licensee's RCE addressed the extent of condition and the extent of cause of the issue.

- e. IP 95001 specifies that the inspection staff determine whether the licensee's root cause, extent of condition, and extent of cause evaluations appropriately considered the safety culture components as described in IMC 0310, dated December 4, 2014.

The licensee reviewed the safety culture components as described in IMC 0310. In this review, the licensee identified multiple components in the cross-cutting area of Human Performance that applied to the root causes of this event, including: Resources (H.1) due to the less than adequate work instructions, Field Presence (H.2) due to the lack of field presence by DAEC contract coordinators to ensure WFT measurements, Challenge the Unknown (H.11) due to the licensee's failure to question the plan for a second coat, and Consistent Process (H.13) due to the lack of a systematic approach for the decision to apply the second coat. The licensee also identified that one component in the cross-cutting area of Problem Identification and Resolution, Self-Assessments (P.6), applied to the second root cause of the event because the licensee's Nuclear Oversight and Quality Control groups had missed opportunities to identify and prevent this event. The licensee determined that the identified corrective actions would address these safety culture weaknesses.

The inspectorss determined that the licensee's RCE included a proper consideration of whether a weakness in any safety culture component was a root cause or a significant contributing cause of the issue.

## **2.3 CORRECTIVE ACTIONS**

- a. IP 95001 specifies the inspection staff to determine whether (1) NextEra, Duane Arnold specified appropriate corrective actions for each root and/or contributing cause, or (2) an evaluation stating no actions are necessary is adequate.

The licensee's RCE concluded the root and contributing of the issue to be:



- RC1: Less than adequate coating application specification and work instructions;
- RC2: Less than adequate project oversight and control;
- CC1: Less than adequate guidance for curing schedule; and
- CC2: Less than adequate contingency planning for areas of low millage.

NextEra Duane Arnold's corrective actions to address the root and contributing causes were assigned in accordance with NextEra procedure PI-AA-100-1005, "Root Cause Analysis." Corrective actions for each root and contributing cause include:

- CAPR1: Revise Specification BECH-MRS-A148, Torus Coating Installation Speciation to require the coating application contractor to measure the WFT during coating application. This action was completed under EC-279576. Note that Coating Program procedures, ACP 1602, "Specification for Protective Coatings in Areas Outside the Primary Containment," and ACP 1603, "Protective Coatings for Service Level 1 Applications Inside the Reactor Containment," were also revised to require WFT measurements be taken during coating application. This corrective action to prevent recurrence address RC1.
- CAPR2: Implement the Enterprise Risk Process to provide adequate project oversight for special processes. This CAPR addresses RC2.
- RC2CA1: Update PR-AA-100-1000, Nuclear Contract Management, to better define the expectations for interface with Nuclear Oversight.
- RC2CA2: Update the following forms to add clarifying details regarding interfacing with Nuclear Oversight department.
  1. PR-AA-100-1000-F01, Contractor Coordinator Checklist
  2. PR-AA-100-100-F02, Scope of Work/Specification Checklist
  3. PR-AA-100-1004, Detailed Monitoring Plan
- RC2CA3: Provide project managers with formal briefing on CR 1999648, Torus Coating Delamination, causes and corrective actions. The briefing will focus on:
  1. Project and contract oversight responsibilities in PR-AA-100-1000;
  2. Defining critical attributes and design requirements and how to ensure quality; and
  3. Develop contingency plans to address unknowns.
- RC2CA4: Review the Field Activity Monitoring Plans developed for projects meeting the definition of Enterprise Risk to determine if the appropriate Critical Steps/Activities, as defined in PR-AA-1004, Field Activity Monitoring, have been identified in work order instructions, the work order instructions are sufficiently defined to meet first time quality, and target field activity observations and line management hold points have been defined and close any gaps identified
- CC1CA1: Revise ACP 1603 to prohibit use of Carboguard 6250N with additional layers until the vendor provides a properly qualified recoat window specification. Note that associated specification BECH-MRS-A148, Torus Coating Installation Specification, has been taken to historical status and cannot be used to approve Carboguard 6250N as an approved coating.
- CC2CA1: Review the contingency plans developed for projects meeting the definition of Enterprise Risk to determine if the appropriate contingency plans, as required by OM-AA-100, Nuclear Fleet Outage Program, have been identified in work order instructions, the work order instructions are sufficiently defined to

meet first time quality, and target field activity observations and line management hold points have been defined and close any gaps identified.

- CC2CA2: Develop and implement a case study on CR1999648 for all project management. This case study will specifically including the procedural requirements for contingency planning. The case study will include a review of the torus delamination event, the level of contingency planning that was in place prior to the start of RFO 23, and a review of the contingency planning that could/should have been in place (regarding less than adequate torus coating thickness) prior to the start of RFO 23. The case study will review all contingency planning requirements from existing DAEC procedures.

The inspectors determined that NextEra Duane Arnold specified appropriate corrective actions for each root cause and contributing cause for the White finding.

- b. Determine whether the licensee prioritized the corrective actions with consideration of the risk significance and regulatory compliance.

The licensee documented 12 corrective actions for root causes, contributing causes, safety culture, and interim assessment. At the time of the inspection, the licensee had completed all corrective actions, with the exception of the conduct of a case study with leadership and engineering on the issue which was being conducted while inspectors were on site and performance of Final Effectiveness Reviews scheduled to be completed January 31, 2017.

The inspectors determined that the licensee adequately prioritized the corrective actions with consideration of the risk significance and regulatory compliance.

- c. Determine whether the licensee established a schedule for implementing and completing the corrective actions.

The licensee has developed six Effectiveness Reviews for the root and contributing causes of the White finding, and has scheduled to complete these reviews by January 17, 2017. These effectiveness reviews include:

RC1: Less than Adequate Coating Application Specification and Work Instructions

RC1 - Review all Service Level 1 coating applications made in Cycle 25 and RFO 25 to validate compliance to their applicable coating specification requirements for WFT and dry film thickness. Success will be zero non-conformances.

RC2: Less than Adequate Project Oversight and Control of Special Processes

RC2 - Conduct a CR search of Cycle 25 and RFO 25. Review all enterprise project CRs specifically looking for any identified issues with oversight of quality related field activities and project contingency planning. Success will be measured no unsatisfactory Enterprise Risk project oversight issues.

RC2 - Conduct interviews with Project Managers and Design Engineers to determine the effectiveness of the Enterprise Risk Process to identify critical steps/activities requiring targeted field activity monitoring and hold points and the need to develop contingency plans for critical activities.

CC1: Less than Adequate Guidance for Curing Schedule

CC1 - Review completed RFO 25 coating activities that used Carboguard 6250N. Success will be showing Carboguard 6250N was not applied with additional layers until the vendor provided a properly qualified recoat window specification.

CC2: Less than Adequate Contingency Planning for Areas of Low Millage

CC2 - Conduct a CR search of Cycle 25 and RFO 25. Review all Enterprise Risk project CRs specifically looking for any identified issues with oversight of quality related field activities and project contingency planning. Success will be measured by no unsatisfactory Enterprise Risk project contingency plans.

CC2 - Conduct interviews with Project Managers and Design Engineers to determine the effectiveness of the Enterprise Risk Process to identify critical steps/activities requiring targeted field activity monitoring and hold points and the need to develop contingency plans for critical activities.

The inspectors determined that the licensee adequately established a schedule for implementing and completing the corrective actions.

- d. Determine whether the licensee developed quantitative or qualitative measures of success for determining effectiveness of the corrective actions to prevent recurrence.

The licensee has established measures of success for RC1, RC2, CC1, and CC2 listed in this previous section. The licensee success measure for each RC and CC includes:

- RC1: Success is defined as zero non-conformances;
- RC2: Success will be measured by the identified issues being less than 10 percent of total CR documents from a search for each contributing cause;
- CC1: Success will be showing Carboguard 6250N was not applied with additional layers until the vendor provided a properly qualified recoat window specification; and
- CC2: Success will be measured by no unsatisfactory Enterprise Risk project contingency.

The inspectors determined that the licensee adequately developed quantitative or qualitative measures of success for determining effectiveness of the corrective actions to prevent recurrence.

40A6 Exit Meeting Summary

The inspectors presented the inspection results to Mr. T. Vehec and other members of licensee management and staff on November 6, 2015. The licensee representatives acknowledged the observations and violation presented. The inspectors asked licensee management whether any materials examined during the inspection should be considered proprietary. The licensee indicated no proprietary information was provided.

## SUPPLEMENTAL INFORMATION

### KEY POINTS OF CONTACTS

#### Licensee Personnel

T. Vehec, Site Vice President  
S. Huebsch, Design Engineering Supervisor  
M. Davis, Licensing Manager  
B. Preston, Engineering Design Manager  
B. Wohlers Program Manager  
W. Simmons, Nuclear Oversight Manager  
R. Murrell, Licensing Engineer  
L. Swenzinski, Licensing Engineer  
S. Brown, Engineering Director

#### U.S. Nuclear Regulatory Commission

C. Lipa, Division of Reactor Safety, Engineering Branch 2, Chief  
K. Stoedter, Division of Reactor Projects, Branch 1, Chief  
M. Jones, Reactor Inspectors  
J. Draper, Resident Inspectors

### LIST OF OPENED, CLOSED, AND DISCUSSED

#### Opened and Discussed

None

#### Closed

05000331/2014011-01	VIO	Failure to Install Torus Coating in Accordance with Established Processes (Section 4OA5.1.d(1))
05000331/2015-002-00	LER	Unanalyzed Condition Due to Degraded Primary Containment Suppression Pool Coating

## LIST OF DOCUMENTS REVIEWED

The following is a partial list of documents reviewed during the inspection. Inclusion on this list does not imply that the NRC inspectors reviewed the documents in their entirety, but rather that selected sections or portions of the documents were evaluated as part of the overall inspection effort. Inclusion of a document on this list does not imply NRC acceptance of the document or any part of it, unless this is stated in the body of the inspection report.

- 5059SCRN -10105; Primary Containment Coating; dated 04/05/13
- ACP 1203.25; Engineering Specifications; Rev. 12
- ACP 1602; Specification for the Protective Coating in Areas Outside the Primary Containment (Service Level II, III, IV); Rev. 13
- ACP 1603; Protective Coating for Service Level I Application Inside the Reactor Containment; Rev. 6
- ACP 1606; Monitoring for Service Level I Protective Coatings Inside the Reactor Containment; Rev. 0
- AR 01999648; Additional Coating Delamination Found in Torus; dated 10/16/14
- AR 02089138; NRC 95001 Inspection LER 2015-002 Reporting Issues; dated 11/05/15
- AR 1805834; OE from Peach Bottom Torus Recoat; dated 09/22/12
- AR 1852058; 1P099(Spare) Coating Damage; dated 02/27/13
- AR 1867153; 1P099(Spare) Coating Damage (2<sup>nd</sup> Instance); dated 04/18/13
- AR 1868322; 1P099(Spare) Coating Repair; dated 04/23/13
- AR 1997546; Coating Delamination Found in Bay 1 of the Torus; dated 10/09/14
- AR 2089138; NRC 95001 Inspection LER 2015-002 Reporting Issues; dated 11/05/15
- AR 293541; 017609 NRC IN 97-13: "Deficient Conditions Associated with Protective Coatings"; dated 04/24/97
- BECH-MRS-A148; Torus Coating Installation Specification; Rev. 0
- BECH-MRS-A148; Torus Coating Installation Specification; Rev. C
- Coating Application Challenge Review; dated 11/01/12
- EC-274627; Primary Containment Coating; Rev. 3
- EN 50943; Unanalyzed Condition Due to Degraded Torus Coating; dated 03/31/15
- EN-AA-108-1001; Procedure for Failure Investigation Process; Rev. 2
- LER 05000331/2015-002-00; Unanalyzed Condition Due to Degraded Primary Containment Suppression Pool Coating; dated 06/01/15
- Letter from D. Meyer, Carboline, to G. Dolderer, Florida Power & Light; RE: Carboguard 6250 N Cure Schedule; dated 01/26/12
- Letter from D. Meyer, Carboline, to G. Dolderer, Florida Power & Light, RE: Carboguard 6250 N cure; October 30, 2012
- Letter from T. Vehec, NextEra Energy Duane Arnold, to the NRC; 30 Day Response to Reactive Inspection Report; dated 03/23/15
- Letter from T. Vehec, NextEra Energy Duane Arnold, to the NRC; Response to Reactive Inspection Report; dated 02/27/15
- MA-AA-100-1010; Work Package Planning Quality Guideline; Rev. 1
- MA-AA-203; Work Order Planning Process; Rev. 14
- MD-050; Maintenance Directive - Protective Coatings; Rev. 4
- NG-15-0212; NextEra Energy Duane Arnold, LLC Readiness for 95001 Supplemental Inspection; dated 06/09/15
- NRC IR 05000331/2014011; Duane Arnold Energy Center – Reactive Inspection Report and Preliminary White Finding; dated 02/19/15
- NRC IR 05000331/2015010; Final Significance Determination of a White Finding with Assessment Followup and Notice of Violation; dated 04/16/15

- PI-AA-100-1005; Root Cause Analysis; Rev. 6
- PI-AA-100-1007; Apparent Cause Evaluation; Rev. 5
- PI-AA-104-1000; Corrective Action; Rev. 6
- PI-AA-204; Condition Identification and Screening Process; Rev. 17
- POD 1997546; Torus Secondary Coating Delamination; dated 11/04/14
- PR-AA-100-1000; Nuclear Contract Management; Rev. 8
- PR-AA-100-1001; Project Management; Rev. 5
- PR-AA-100-1001; Project Management; Rev. 6
- PR-AA-1004; Field Activity Monitoring Plan; Rev. 3
- PR-AA-1004; Field Activity Monitoring Plan; Rev. 4
- Product Data Sheet; Carboguard 6250 N; dated 03/2011
- RCE 1999648; Torus Coating Delamination; Rev. 4
- Shift Communication Log for Situation Room; Torus Recoat Project; dated 11/07/12
- Shift Turnover Report; DAEC Torus Recoat Project; dated 11/03/12 – 11/08/12
- Ventilation Plan; Torus Recoat Project N-3812; Rev. 0
- WM-AA-1000; Work Activity Risk Management; Rev. 12
- WM-AA-1000; Work Activity Risk Management; Rev. 13
- WM-AA-1000; Work Activity Risk Management; Rev. 9
- WM-AA-100-1000; Work Activity Risk Management; Rev. 4
- WM-AA-201; Work Order Identification, Screening and Validation Process; Rev. 9
- WO 40132857; EC-274627: Perform Recoat of Torus Interior; dated 10/17/12
- WO 40256155; 1P099(Spare) Coating Repair; dated 01/23/14

## LIST OF ACRONYMS USED

ADAMS	Agencywide Document Access and Management System
CFR	<i>Code of Federal Regulations</i>
CR	Condition Report
DAEC	Duane Arnold Energy Center
ECCS	Emergency Core Cooling System
IMC	Inspection Manual Chapter
IP	Inspection Procedure
IR	Inspection Report
LER	Licensee Event Report
LOCA	Loss of Coolant Accident
NCV	Non-Cited Violation
NRC	U.S. Nuclear Regulatory Commission
OE	Operating Experience
PARS	Publicly Available Records
POR	Past Operability Review
RCE	Root Cause Evaluation
RFO	Refueling Outage
WFT	Wet Film Thickness

T. Vehec

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Sincerely,

*/RA/*

Christine Lipa, Branch Chief  
Engineering Branch 2  
Division of Reactor Safety

Docket Nos. 50-331; 72-032  
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