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Waterford Steam Electric Station, Unit 3
504-739-6660

W3F1-2025-0034 10 CFR 2.201

July 7, 2025

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

Subject: Reply to a Notice of Violation, EAF-RIV-2025-0090

Waterford Steam Electric Station, Unit 3
NRC Docket No. 50-382
Renewed Facility Operating License No. NPF-38

Reference 1: NRC Letter to Waterford Steam Electric Station, Unit 3 – Final Significance Determination of a White Finding, Notice of Violation, and Follow-Up Assessment letter; NRC Inspection Report 05000381/2025091, dated June 5, 2025 (Accession No. ML 25149A059)

Reference 2: NRC Letter to Waterford Steam Electric Station, Unit 3 – NRC Inspection Report 05000381/2025090 and Preliminary White Finding, dated April 9, 2025 (Accession No. ML 25097A205)

Entergy Operations, Inc. (Entergy) submits the attached Reply to a Notice of Violation in accordance with the instructions provided in Reference 1.

This letter contains no new regulatory commitments.

Should you have any questions concerning this issue, please contact John Twarog, Regulatory Assurance Manager, at 504-739-6747.

Respectfully,

JS/jmg

Enclosure: Reply to a Notice of Violation, EAF-RIV-2025-0090

cc: Regional Administrator, US NRC Region IV
NRC Senior Resident Inspector – Waterford Steam Electric Station, Unit 3
NRC Project Manager – Waterford Steam Electric Station, Unit 3
R4Enforcement@nrc.gov

Enclosure

W3F1-2025-0034

Reply to a Notice of Violation, EAF-RIV-2025-0090

Waterford Steam Electric Station, Unit 3
Reply to a Notice of Violation, EAF-RIV-2025-0090

Introduction:

On June 5, 2025, the NRC issued Inspection Report 05000382/2025091 to Entergy Operations, Inc. (Entergy) for Waterford Steam Electric Station, Unit 3. The Inspection Report stated that, after consideration of information developed during the inspection and the information presented at the Regulatory Conference (held on May 21, 2025), the NRC had concluded the finding for the failure to properly develop and implement adequate maintenance instructions for the fuel linkage connection to the mechanical governor for Emergency Diesel Generator (EDG) A, was appropriately characterized as White, a finding of low to moderate safety significance.

The attachment to the Inspection Report also stated that Entergy had 30 calendar days from the date of the letter to submit a written statement if the description in Inspection Report 05000382/2025090 does not accurately reflect our position. This document provides Entergy's Reply to a Notice of Violation to accurately reflect its position utilizing the latest related and docketed NRC Inspection Report 05000382/2025091.

Background:

NRC Inspection Report 05000382/2025091 states:

> Title 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," requires, in part, that activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and that the instructions, procedures, or drawings shall include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished. The licensee established work orders WO-00434438 (replacement of the rod ends), WO-00482368 (first replacement of the governor for the train A emergency diesel generator), WO-00579374 (second replacement of the governor for the train A emergency diesel generator), and WO-54199975 (reassembly of the rod end linkage after it was found disconnected), in part, to meet this requirement.
>
> Contrary to the above, from June 2016 to February 4, 2025, the licensee failed to adequately develop and implement instructions, procedures, or drawings for an activity affecting quality of a type appropriate to the circumstances, and to include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished. Specifically, the licensee's work orders for the replacement of the rod ends, replacement of the governor, and reconnecting of the rod end joint for emergency diesel generator A failed to include adequate maintenance and post-maintenance inspection instructions. The instructions did not include appropriate quantitative or qualitative acceptance criteria for the installation of all required parts, to

> include tightness checks of adjacent connections and linkages and post-maintenance inspections to ensure that mechanical binding did not occur. This resulted in the failure of emergency diesel generator A to run.

In the May 21, 2025 Regulatory Conference on this issue, Entergy provided that it concurred with the performance deficiency but not the NRC's significance determination.

The NRC's Final Significance Determination is Inconsistent with NRC Guidance

The NRC Final Significance Determination Letter dated June 5, 2025, makes the following statements:

> Concerning the exposure time for EDG A, you and your staff presented that the offset of the governor linkage arm (1/4 inch offset) occurred during the January 2024 maintenance activity and resulted in increased interference which resulted in the loss of preload. Given the lack of clarity on whether the interference alone or the interference combined with engine vibration are what resulted in the cap screw backing out of the connection, the NRC Significance Determination Process usage rules support an exposure time of Time/2 from January through October 2024. However, since EDG A had 24 hours of run time elapsed during that window, *it is reasonable* to use an exposure time from the time after the first 24 hours of run time until the repairs were completed. [Emphasis added.]

Entergy asserts that these conclusions in the NRC's letter are not justified based on the best information available. The evidence presented at the Regulatory Conference provides reasonable assurance that exposure time should begin at the ultimate loss of preload, and that occurred on October 7, 2024. Due to a series of shutdown sweeps, preload was ultimately lost on October 7, 2024, and not before; once preload was lost, engine operational vibration caused the cap screw to back out and the linkage to become disconnected. Using 24 hours of actual demonstrated EDG runtime to bracket the exposure time is overly conservative and arbitrary in light of the evidence available.

Entergy offers the following three points that accurately reflects our position:

i. EDG A Remained Operable So Long as Preload Existed

A significant assumption informing the NRC's probabilistic risk assessment is the date EDG A lost operability. Though a January 2024 maintenance activity compromised the EDG A governor linkage configuration, the linkage remained intact for the better part of the year, even supporting repeated EDG A stops and starts. Entergy maintains that EDG A remained operable until October 7, 2024, when the pertinent cap screw lost preload. The NRC Inspection Report asserts exposure time should be measured from the point at which EDG A completed 24 hours of run time after the January 2024 maintenance activity. This assumption is unduly conservative and not based on best available information.

Relevant guidance regarding operability is found in NRC Inspection Manual Chapter 0326, Section 06.04, Reasonable Assurance of Operability, which states, in part:

> Reasonable assurance does not mean absolute assurance that the SSC is operable. The SSC may be considered operable when there is

> evidence that the possibility of failure of an SSC has increased, but not to the point of eroding confidence in the reasonable assurance that the SSC remains operable. The supporting basis for the reasonable assurance of SSC operability should provide a high degree of confidence that the SSC remains operable.

Reasonable assurance is defined as having a high, but not absolute, level of confidence that a system or component will function as intended. Reasonable assurance is a standard used where absolute certainty is impractical or unattainable. In the context of safety-related systems, reasonable assurance is crucial for demonstrating that the system can perform its required safety functions.

During the Regulatory Conference, Entergy provided evidence that once preload on the cap screw is lost, operational vibration will rapidly drive cap screw loosening and lead to disconnection of the joint. Before preload is lost, there is a high degree of confidence that the SSC remains operable. Studies demonstrated that the primary mechanism responsible for degrading the initial cap screw torque[1] (or more accurately, preload), was the repeated impact of the lever corner striking the chamfered edge of the Heim joint.[2] These impacts occurred during engine shutdown, when the lever rapidly swept from the minimum to maximum fuel positions.[3] During the period in question, engine shutdown occurred on several occasions. Each adverse strike generated during engine shutdown incrementally reduced the joint preload and caused localized material removal at the point of contact. A conceptual illustration of the progressive preload loss resulting from each adverse strike is shown in Figure 1. Preload degradation occurred in discrete steps, coinciding with each engine shutdown event. Only after complete preload loss did engine vibration become a factor, at which point it initiated the unthreading of the cap screw.

Once the corner of the lever has been removed due to repeated adverse strikes, subsequent diesel generator operation under load does not contribute to further preload loss. Therefore, if the EDG starts with any remaining preload in the cap screw joint, there is no load transfer that would lead to additional preload degradation or unthreading of the cap screw. In other words, so long as preload remained, the possibility of failure of the EDG A linkage had increased, but not to the point of eroding confidence in the reasonable assurance that the EDG A remained operable.

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1 Though unknown, this initial torque value likely was greater than 50 ft/lbs.

2 The Heim joint's inherent freedom of movement includes both axial rotation around its shank and angular displacement about the spherical bearing. This design is essential in dynamic systems, such as mechanical linkages exposed to vibration, as it allows the joint to pivot and follow the natural motion path of the assembly while reducing stress concentrations.

3 Vibration testing demonstrated that no further preload degradation occurred with the engine in the normal loaded positions. This vibration testing, while limited to a uniaxial setup, was conservatively performed by applying a magnitude equal to the vector sum of all directional components in the most adverse orientation—transverse to the cap screw shank axis. This direction is well recognized for its propensity to induce relative slip between components within the clamped joint, thereby promoting bolt loosening.

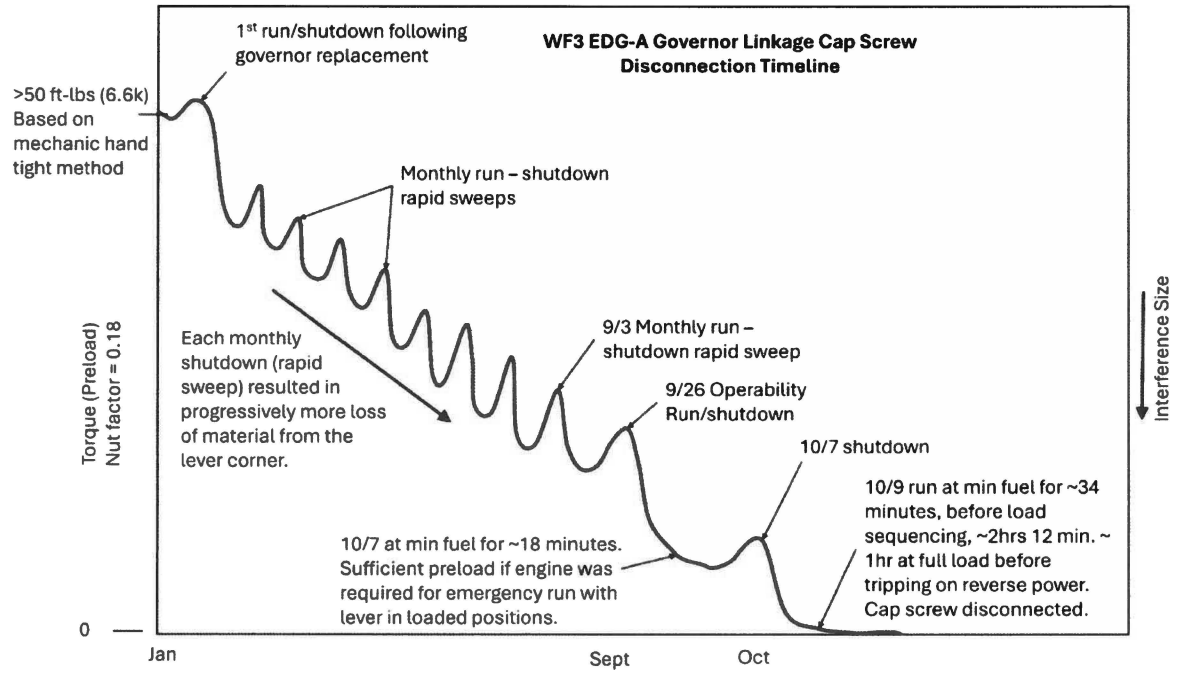

Figure 1: Illustration of Progressive Preload Loss Consistent with EDG-A Shutdown Sweeps

In its Final Significance Determination Letter, the NRC notes:

> Overall, the information provided represented a basis for identifying the likely causal factors that contributed to the actual failure that occurred on October 9, 2024. However, uncertainty remains regarding the condition of the affected components and the corresponding potential impact of those conditions and components on the ability to support a design basis function for a 24-hour mission time should a design basis demand have occurred prior to October 7, 2024.[4]

Contrary to the NRC's indication, any uncertain conditions were appropriately bounded in Entergy modeling and studies using appropriate conservatisms. As a result, the available evidence provides reasonable assurance the EDG A remained operable so long as cap screw preload remained. The NRC's stated uncertainty regarding a 24-hour run time is akin to requiring "absolute assurance" that the EDG A remained operable, contrary to NRC guidance in IMC 0326.

NRC also noted in its Final Significance Determination Letter:

> Given the lack of clarity on whether the interference alone or the interference combined with engine vibration are what resulted in the cap screw backing out of the connection, the NRC Significance Determination

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4 NRC Letter to Waterford Steam Electric Station, Unit 3, *Final Significance Determination of a White Finding, Notice of Violation, and Follow-Up Assessment*; NRC Inspection Report 05000381/2025091 at 1, dated June 5, 2025 (*available at* Accession No. ML 25149A059) (hereinafter "SDP Letter").

> Process usage rules support an exposure time of Time/2 from January through October 2024. However, since EDG A had 24 hours of run time elapsed during that window, it is reasonable to use an exposure time from the time after the first 24 hours of run time until the repairs were completed.[5]

To the contrary, best available information provides clarity on what resulted in the cap screw backing out of the connection: it was vibration only. With the engine in the loaded running position, there is no longer any interference between the Heim joint and the lever—particularly after the lever corner has been worn away by the series of adverse strikes. Under these conditions, once preload is fully lost, engine vibration becomes the sole remaining force acting to unthread the cap screw.

Testing provides reasonable assurance that, in the absence of preload, vibration alone is sufficient to cause the cap screw to back out within minutes to hours. This outcome is consistent with the October 9, 2024 run, during which the engine operated under load for approximately 2.2 hours before tripping on reverse power. Therefore, the time during which the cap screw was subject to unthreading forces from engine vibration alone is considered to be 2.79 hours, which is the total run time on October 9, 2024 before tripping on reverse power.

During the Regulatory Conference on May 21, 2025, Entergy met the "reasonableness" criterion to show that the EDG A remained operable until loss of pre-load on October 7, 2024, resulting in an exposure time of 3.53 days. Though the January 2024 maintenance activity rendered loss of pre-load of the cap screw possible, preload was not lost and EDG A (the SSC) remained operable until October 7, 2024. As a result, and consistent with the guidance of NRC Manual Chapter 0326, Section 06.04, EDG A should have been considered operable until October 7, 2024, because prior to that time there was "evidence that the possibility of failure of an SSC [had] increased, but not to the point of eroding confidence in the reasonable assurance that the SSC remain[ed] operable."

ii. Preload Was Lost on October 7, 2024

In its Final Significance Determination Letter, the NRC called into question whether preload was lost on October 7, 2024. The following paragraphs respond to the NRC's questions and reiterate the reasonable assurance preload was lost October 7, 2024.

First, the NRC questioned whether Entergy's testing established the cause of preload loss, writing, "during discussion, no clear evidence was given for how the continued loss of preload on the bolt occurred once the corner of the lever arm was worn off from the interference with the Heim joint chamfer."[6] To the contrary, testing discussed during the Regulatory Conference demonstrated that ten adverse sweeps of the lever—from minimum to maximum fuel position—produced material loss at the lever corner consistent with the wear observed on the actual component. These sweeps occurred exclusively during shutdown events. Each rapid sweep event resulted in stepwise reductions in preload and localized material loss. This stepwise degradation pattern is evident in the progression shown in Figure 1. The number of adverse strikes observed under testing conditions (*i.e.*, ten) closely aligns with the operational history, with the final strike occurring during the October 7, 2024 shutdown and resulting in complete preload loss, as shown in Figure 1, aboveFigure 1. Following this loss of preload, engine-

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5 Id. at 2.

6 *Id.* at 2.

induced vibration during the October 9, 2024 run led to the cap screw backing out fully within the 2.79 hours of operation prior to the unit tripping on reverse power.

The NRC also wrote, "[t]he available information appears to support that a low initial cap screw preload condition was present prior to the test run on October 9, 2024, which corresponded to a successful runtime of 2.79 hours on that date prior to the cap screw backing out resulting in tripping of the EDG."[7]

This comment implies that EDG-A completed a successful run on October 9, 2024. EDG-A did not complete a successful run, however, and instead tripped on reverse power 2 hours and 47 minutes into the planned 24-hour operation. (*See* Figure 2). This trip corresponds to the cap screw fully backing out, resulting in the loss of connection between the governor lever and the fuel rack. Put another way, this unsuccessful run actually proves that preload was already lost: without preload, operational vibration was sufficient to cause the cap screw to unthread completely.

If the EDG was able to start with any remaining preload in the cap screw joint, there was no load transfer due to the Heim joint freedom of movement during operation that would cause further degradation or unthreading. Preload was only lost incrementally during shutdown events.

Once preload was fully lost—following a final adverse strike—engine-induced vibration became the dominant factor in initiating unthreading of the cap screw. A separate set of tests was conducted to evaluate this post-preload-loss regime. These tests also remained conservative, utilizing only uniaxial (transverse to the cap axis) vibration, whereas actual engine excitation is multidirectional and broadband.

Despite this limitation, testing showed that the cap screw could fully unthread within minutes to hours after preload loss. In two of twelve trials initiated with zero preload, the cap screw completely backed out. In several others, it backed out between one-half and three-quarters of its threaded length within an hour before testing was halted for efficiency. Given the conservative configuration—uniaxial vibration and a constrained joint—these partial displacements are considered functional joint failures, and actual engine conditions would likely produce even faster unthreading.

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7 *Id.* at 1.

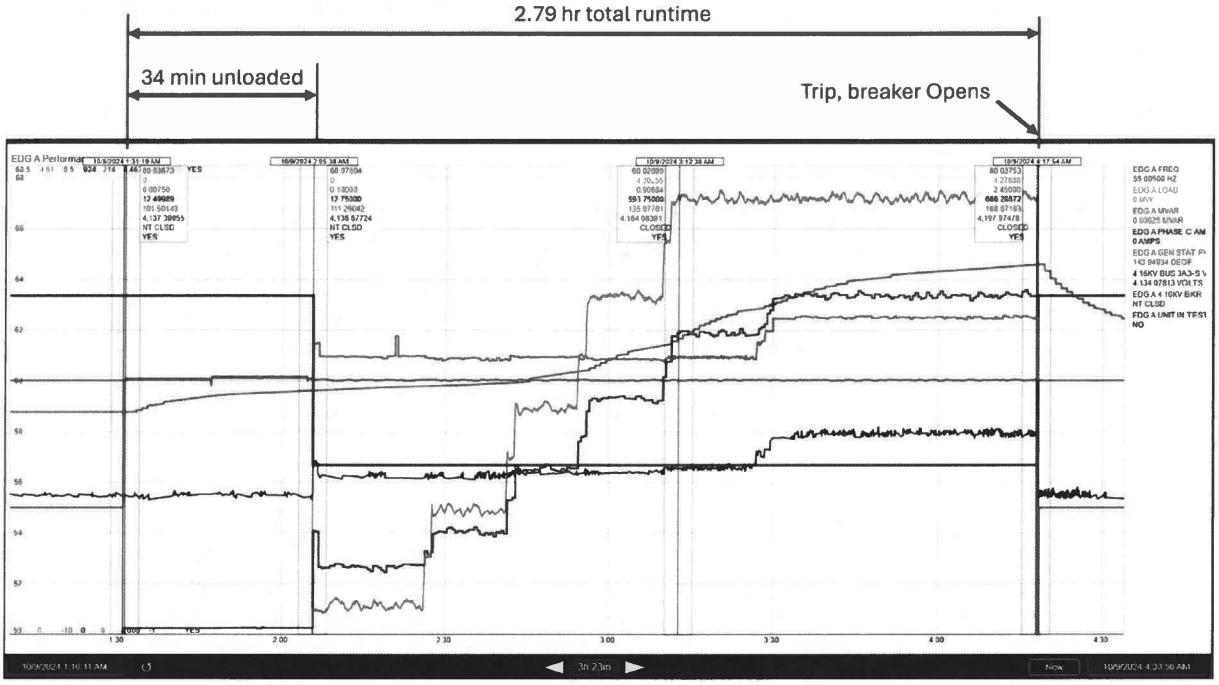

Figure 2: Plot of EDG-A Run on October 9, 2024

As to the October 9, 2024 run time, the NRC questioned whether Entergy's conclusions were supported by its test results:

> [T]he data presented conveyed only two test runs of approximately a dozen that were performed in the lab. As stated in the meeting, these other test runs were stopped with the cap screw pre-load lost and the cap screw still remaining threaded into the lever arm despite vibrations for an hour to hours into the tests. That data conflicts with the conclusion that once the pre-load on the cap screw is lost it only takes minutes for the cap screw to completely back out of the joint due to vibration. This could mean that not all preload was lost, and the engine vibration alone results in the final loss of preload and in the cap screw coming out of the connection with the lever.[8]

The two test runs presented during the May 21, 2025 Regulatory Conference included video evidence demonstrating complete unthreading of the cap screw within minutes when starting from a no-preload condition. In one case, full unthreading occurred in approximately 10 minutes; in the other, it occurred in about 42 minutes. Additional test runs—not included in the presentation—showed the cap screw backing out between one-half and three-quarters of its threaded length before the tests were halted for efficiency. Collectively, these results support the conclusion that cap screw unthreading could have occurred during the October 9, 2024 engine run within a timeframe of minutes to hours, as presented during the conference and documented in SOCOTEC Report LA250493-R-001.

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8 *Id.* at 2.

The testing was performed under conservative conditions that were less favorable to unthreading than the conditions that existed for EDG A: each trial used new cap screws installed in freshly tapped threads, with vibration applied uniaxially at a fixed frequency. The test configuration also constrained axial movement, utilizing a single Heim joint with limited freedom relative to the cap screw.

By contrast, the actual engine environment imposes broadband, multidirectional vibration and permits greater axial movement of the joint components—conditions that are more conducive to cap screw unthreading. Given that partial to complete unthreading was observed under the more restrictive test setup, it is reasonable to conclude that full disengagement would be even more likely under in-service conditions.

The NRC's letter also called into question Entergy's testing in several respects. The NRC wrote:

> While the laboratory testing results presented were useful and provided important information, it was not conclusive to capture the full range of parameters of concern. The presentation provided a plausible conclusion; however, there are several factors that were not addressed that indicate this is one possible outcome and not necessarily the most likely one. First, the statement of engineering equivalency did not specifically address many different variables between the testing setup versus the actual EDG A configuration. The governor, lever arm, heim joint, and threaded arm connection to other control surfaces is difficult to model in an experimental mock-up.[9]

Entergy acknowledges that the test configuration does not fully replicate the complexity of the actual linkage between the governor lever and the fuel rack. Importantly, however, the testing represents a conservative, engineered surrogate that captures the critical interaction driving the observed behavior—specifically, the interference between the lever corner and the chamfer on the Heim joint during transitions from minimum to maximum fuel. The setup was intentionally constrained to minimize axial movement of the Heim joint, which under actual engine vibration would assist in driving the cap screw out once complete preload was lost. In this respect, the configuration of the cap screw backout test is conservative, as real-world conditions with axial vibration would be more severe. The cap screw would therefore be expected to back out even more quickly than demonstrated under testing conditions.

Additionally, although the tests applied uniaxial vibration, the amplitude corresponded to the vector sum of all measured engine vibration components, applied transverse to the cap screw axis. This orientation is recognized—per established methods such as Junker testing—as the most detrimental to bolt preload retention. Therefore, in the fretting-vibration test configuration, this vibration envelopes the impact of the real-world vibration on the Heim joint preload. As such, the fretting-vibration test configuration conservatively envelops the effects of actual engine vibration on Heim joint preload.

Given these conservatisms, the testing demonstrates with high confidence that vibration alone—under loaded fuel conditions and in the absence of lever interference—does not cause preload loss, as even the full vector sum vibration amplitude applied in the most detrimental transverse direction did not result in preload degradation.

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9 *Id.* at 2.

In summary, transverse uniaxial vibration envelopes the vibratory contribution to preload loss, while it underrepresents the axial motion that accelerates cap screw unthreading once preload is lost. Therefore, the report's conclusions—that engine vibration alone does not degrade preload, and that complete backout occurs within a minutes-to-hours timeframe once preload is lost—are well-supported by the testing.

The NRC further challenged Entergy's testing parameters, noting "[t]here are many variables that could impact the disassembly of the heim joint (i.e., loss of cap screw preload and backing out) such as direction of movement, frequency of movement, movement orientation, condition of bolt threads, condition of lever arm threads, and movement between the lever arm and the heim joint."[10] Entergy acknowledges that the cited variables could influence the disassembly of the Heim joint from the governor lever. However, the test conditions were intentionally conservative with respect to all identified factors—particularly regarding the time required for the cap screw to fully unthread and release the joint.

Disassembly of the Heim joint from the lever cannot occur until the joint has experienced a complete loss of preload. While the initial preload was not known and no specific torque value was prescribed, it was likely in excess of 50 ft-lbs, consistent with the torque typically applied by a mechanic using a standard wrench on a ½-inch cap screw. As shown in Figure 1, preload degradation was progressive and occurred incrementally—not instantaneously.

Testing confirmed that this progressive loss was driven by repeated mechanical interference between the corner of the governor lever and the chamfered face of the Heim joint. These adverse interactions occurred during rapid (~1-second) sweeps from minimum to maximum fuel position at engine shutdown. Each impact contributed to localized material removal at the lever corner. After approximately ten such strikes, the test lever exhibited material loss consistent with what was observed on the lever on the engine, closely matching the number of EDG-A shutdowns since the governor replacement in January 2024.

Once preload was fully lost, engine-induced vibration became the dominant driver for cap screw unthreading. The vibration tests were deliberately conservative: new cap screws were used with freshly cut threads, and vibration was applied uniaxially and at a fixed frequency. The Heim joint was also constrained from moving axially along with the screw—unlike actual engine conditions, where multidirectional, broadband vibration and joint mobility would increase the likelihood and rate of unthreading. Despite these limitations, the tests demonstrated that full unthreading could occur within minutes to hours after preload loss.

Moreover, actual in-service conditions would likely introduce additional aggravating factors such as thread wear, galling, or increased clearance, all of which would further reduce resistance to loosening and accelerate cap screw unthreading following preload loss.

Entergy's studies include appropriate conservatisms to reflect operational conditions that led to the disconnection of the EDG A governor linkage. The information offered by Entergy represents the best available information, consistent with NRC guidance in IMC 0609, Section 04.06, that "it is expected that both licensees and the NRC will use information that is most reflective of the circumstances associated with the inspection finding and is available at the time of the significance determination." Entergy maintains that the conclusion that preload was lost on October 7, 2024, is reasonable and supported by the best available information.

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10 *Id.* at 2.

iii. EDG Run Time is Not the Best Available Indicator of EDG Operability

NRC's conclusion that the exposure time should be calculated based on the period of 24-hour run time is conservative in a manner inconsistent with the guidance of NRC Manual Chapter 0308, Attachment 3. Section 02.05 of that guidance discusses the responsibility for Significance Determinations and states, in part, "[t]he staff is obligated to be clear about the basis for any SDP result and to consider licensee-provided information. The staff *is not obligated to have "proof" of the assumptions* made relative to an SDP result basis." (Emphasis added.) Section 03.03 discusses the specific principles and attributes of the risk-informed SDP tools, and its paragraph (j) states:

> All technical judgments made by the staff within any probabilistic-based SDP tool should have bases that are clearly observable as "reasonable," as well as reasoned, using *best available information*, and *not purposefully biased in a conservative manner simply because of uncertainties that are applicable in both conservative and non-conservative directions.* (Emphasis added.)

Based on the NRC Final Significance Determination, the NRC concluded that a "defensible and reasonable approach to bracket the exposure time is to account for 24 hours of actual demonstrated EDG runtime." This philosophy is analogous to having "proof" and is purposefully biased in a conservative manner, contrary to the guidance in the MC 0308 and the reasonable research-supported conclusions presented by Entergy at the Regulatory Conference.

Conclusion:

The Entergy evaluation of the EDG A linkage issue and explanation of the appropriate exposure time was provided in the May 21, 2025 Regulatory Conference. Entergy asserts that while pre-load of the cap screw was being lost over time since January 2024, it was not lost to the point of inoperability of EDG A until October 7, 2024. Therefore, after carefully considering the available information, and the limitations as described in NRC Inspection Manual Chapter 0609, while not appealing the Final Significance Determination documented in Inspection Report 05000382/2025091, Entergy provides this information to reiterate its position and as a Reply to a Notice of Violation.

CERTIFICATION REFERENCE FORM

(Typical)

Letter Number: W3F1-2025-0034

Subject: Reply to a Notice of Violation, EAF-RIV-2025-0090

Certifiable Statement(s): Use one of the following methods to identify certifiable statements in the table below:

1. Identify location in submittal (e.g., page 3, para 2, sentence 1) OR,
2. Paste in the exact words of the statement(s) OR,
3. State "see attachment" and attach a copy of the correspondence with the certifiable statements indicated (e.g., by redlining, highlighting, or underlining, etc.).

Each statement or section of information being certified should be uniquely numbered to correspond with the supporting documentation listed below.

Objective Evidence or Basis of Peer Review: List the supporting documents in the table below and attach a copy of the documents OR give basis of peer review. Large documents need not be attached.

Certifiable Statement(s)	Objective Evidence or Basis of Peer Review
1. See attached Spreadsheet	Inspection Report 05000382/2025091, page 1 of 9
2. See attached Spreadsheet	Inspection Report 05000382/2025091, page 2 of 9
3. See attached Spreadsheet	SOCOTEC Letter - LA250493-L-016, Page 7 of 9
4. See attached Spreadsheet	NRC IMC 0326 Section 06.04
5. See attached Spreadsheet	SOCOTEC Letter - LA250493-L-016, Page 3 of 9
6. See attached Spreadsheet	SOCOTEC Letter - LA250493-L-016, Page 3 of 9
7. See attached Spreadsheet	SOCOTEC Letter - LA250493-L-016, Page 5 of 9
8. See attached Spreadsheet	SOCOTEC Letter - LA250493-L-016, Page 4 of 9
9. See attached Spreadsheet	SOCOTEC Letter - LA250493-L-016, Page 8 of 9
10. See attached Spreadsheet	SOCOTEC Letter - LA250493-L-016, Page 5-6 of 9
11. See attached Spreadsheet	SOCOTEC Letter - LA250493-L-016, Page 4 of 9
12. See attached Spreadsheet	SOCOTEC Letter - LA250493-L-016, Page 5 of 9
13. See attached Spreadsheet	SOCOTEC Letter - LA250493-L-016, Page 5 of 9
14. See attached Spreadsheet	SOCOTEC Letter - LA250493-L-016, Page 6 of 9
15. See attached Spreadsheet	SOCOTEC Letter - LA250493-L-016, Page 6-7 of 9

CERTIFICATION REFERENCE FORM

Certifiable Statement(s)	Objective Evidence or Basis of Peer Review
16. See attached Spreadsheet	SOCOTEC Letter - LA250493-L-016, Page 4 of 9
17. See attached Spreadsheet	SOCOTEC Letter - LA250493-L-016, Page 5-6 of 9
18. See attached Spreadsheet	NRC IMC 0609, Section 04.06

Individual certifying the statement(s): Certification may be documented using email, telecom, "sign off" sheet, or inter-office memorandum. The form of documentation should specifically identify the information being certified.

Joseph Cole

Digitally signed by Joseph Cole
DN: cn=Joseph Cole, ou=Regulatory Assurance, email=jcole5@entergy.com
Date: 2025.07.03 06:02:39 -05'00'

Name:	Department:	Date
	Regulatory Assurance	7/3/2025

Peer Review: Prior to signing for certification, determine if a Peer Review is required per section 5.3.2.c. Indicate "N/A" if not required.

Name	Department	Date

Certification of "Reply to a Notice of Violation, EAF-RIV-2025-0090"			
1	Page 1 of 10	NRC Inspection Report 05000382/2025091 states: Title 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," requires, in part, that activities affecting quality shall be	Inspection Report 05000382/2025091, page 1 of 9
2	Page 2 of 10	"Concerning the exposure time for EDG A, you and your staff presented that the offset of thegovernor linkage arm....	Inspection Report 05000382/2025091, page 2 of 9
3	Page 2 of 10	....at the ultimate loss of preload, and that occurred on October 7, 2024	SOCOTEC Letter - LA250493-L-016, Page 7 of 9
4	Page 2 of 10	Relevant guidance regarding operability is found in NRC Inspection Manual Chapter 0326, Section 06.04, Reasonable Assurance of Operability, which states, in part: Reasonable assurance does not mean absolute assurance that the SSC is operable. The SSC may be considered operable when there is evidence that the possibility of failure of an SSC has increased, but not to the point of eroding confidence in the reasonable assurance that the SSC remains operable. The supporting basis for the reasonable assurance of SSC operability should provide a high degree of confidence that the SSC remains operable.	NRC IMC 0326 Section 06.04
5	Page 3 of 10	*Studies demonstrated that the primary mechanism responsible for degrading the initial cap screw torque (or more accurately, preload), was the repeated impact of the lever corner striking the chamfered edge of the Heim joint.*	SOCOTEC Letter - LA250493-L-016, Page 3 of 9
6	Page 3 of 10	*Once the corner of the lever has been removed due to repeated adverse strikes, subsequent diesel generator operation under load does not contribute to further preload loss. Therefore, if the EDG starts with any remaining preload in the cap screw joint, there is no load transfer that would lead to additional preload degradation or unthreading of the cap screw.*	SOCOTEC Letter - LA250493-L-016, Page 3 of 9
7	Page 3 of 10	Only after complete preload loss did engine vibration become a factor	SOCOTEC Letter - LA250493-L-016, Page 5 of 9
8	Page 5 of 10	*any uncertain conditions were appropriately bounded in Entergy modeling and studies using appropriate conservatisms.*	SOCOTEC Letter - LA250493-L-016, Page 4 of 9
9	Page 5-9 of 10	*the time during which the cap screw was subject to unthreading forces from engine vibration alone is considered to be 2.79 hours*	SOCOTEC Letter - LA250493-L-016, Page 8 of 9
10	Page 5-6 of 10	*Following this loss of preload, engine-induced vibration during the October 9, 2024 run led to the cap screw backing out fully within the 2.79 hours of operation prior to the unit tripping on reverse power.*	SOCOTEC Letter - LA250493-L-016, Page 5-6 of 9
11	Page 6 of 10	*instead tripped on reverse power 2 hours and 47 minutes into the planned 24-hour operation. (See Figure 2). This trip corresponds to the cap screw fully backing out, resulting in the loss of connection between the governor lever and the fuel rack.*	SOCOTEC Letter - LA250493-L-016, Page 4 of 9

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12	Page 6 of 10	*there was no load transfer due to the Heim joint freedom of movement during operation that would cause further degradation or unthreading*	SOCOTEC Letter - LA250493-L-016, Page 5 of 9
13	Page 9 of 10	*Once preload was fully lost—following a final adverse strike—engine-induced vibration became the dominant factor in initiating unthreading of the cap screw. A separate set of tests was conducted to evaluate this post-preload-loss regime. These tests also remained conservative, utilizing only uniaxial (transverse to the cap axis) vibration, whereas actual engine excitation is multidirectional and broadband*	SOCOTEC Letter - LA250493-L-016, Page 5 of 9
14	Page 6 of 10	*cap screw could fully unthread within minutes to hours after preload loss. In two of twelve trials initiated with zero preload, the cap screw completely backed out. In several others, it backed out between one-half and three-quarters of its threaded length within an hour before testing was halted for efficiency*	SOCOTEC Letter - LA250493-L-016, Page 6 of 9
15	Page 6-7 of 10	*Additional test runs—not included in the presentation—showed the cap screw backing out between one-half and three-quarters of its threaded length before the tests were halted for efficiency. Collectively, these results support the conclusion that cap screw unthreading could have occurred during the October 9th engine run within a timeframe of minutes to hours, as presented during the conference and documented in SOCOTEC Report LA250493-R-001 [2].* *The testing was performed under conservative conditions that were less favorable to unthreading: each trial used new cap screws installed in freshly tapped threads, with vibration applied uniaxially at a fixed frequency. The test configuration also constrained axial movement, utilizing a single Heim joint with limited freedom relative to the cap screw.* *By contrast, the actual engine environment imposes broadband, multidirectional vibration and permits greater axial movement of the joint components—conditions that are more conducive to cap screw unthreading. Given that partial to complete unthreading was observed under the more restrictive test setup, it is reasonable to conclude that full disengagement would be even more likely under in-service conditions*	SOCOTEC Letter - LA250493-L-016, Page 6-7 of 9

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16	Page 6-7 of 10	*The cap screw would therefore be expected to back out even more quickly than demonstrated under testing conditions.* *Additionally, although the tests applied uniaxial vibration, the amplitude corresponded to the vector sum of all measured engine vibration components, applied transverse to the cap screw axis. This orientation is recognized—per established methods such as Junker testing—as the most detrimental to bolt preload retention. Therefore, in the fretting-vibration test configuration, this vibration envelopes the impact of the real-world vibration on the Heim joint preload. As such, the fretting-vibration test configuration conservatively envelops the effects of actual engine vibration on Heim joint preload.* *Given these conservatisms, the testing demonstrates with high confidence that vibration alone—under loaded fuel conditions and in the absence of lever interference—does not cause preload loss, as even the full vector sum vibration amplitude applied in the most detrimental transverse direction did not result in preload degradation.*	SOCOTEC Letter - LA250493-L-016, Page 4 of 9

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17	Page 9 of 10	*Disassembly of the Heim joint from the lever cannot occur until the joint has experienced a complete loss of preload. While the initial preload was not known and no specific torque value was prescribed, it was likely in excess of 50 ft-lbs, consistent with the torque typically applied by a mechanic using a standard wrench on a ½-inch cap screw. As shown in Figure 1, preload degradation was progressive and occurred incrementally—not instantaneously.* *Testing confirmed that this progressive loss was driven by repeated mechanical interference between the corner of the governor lever and the chamfered face of the Heim joint. These adverse interactions occurred during rapid (~1-second) sweeps from minimum to maximum fuel position at engine shutdown. Each impact contributed to localized material removal at the lever corner. After approximately ten such strikes, the test lever exhibited material loss consistent with what was observed on the lever on the engine, closely matching the number of EDG-A shutdowns since the governor replacement in January 2024.* *Once preload was fully lost, engine-induced vibration became the dominant driver for cap screw unthreading. The vibration tests were deliberately conservative: new cap screws were used with freshly cut threads, and vibration was applied uniaxially and at a fixed frequency. The Heim joint was also constrained from moving axially along with the screw—unlike actual engine conditions, where multidirectional, broadband vibration and joint mobility would increase the likelihood and rate of unthreading. Despite these limitations, the tests demonstrated that full unthreading could occur within minutes to hours after preload loss.* *Moreover, actual in-service conditions would likely introduce additional aggravating factors such as thread wear, galling, or increased clearance, all of which would further reduce resistance to loosening and accelerate cap screw unthreading following preload loss.*	SOCOTEC Letter - LA250493-L-016, Page 5-6 of 9
18	Page 9 of 10	"consistent with NRC guidance in IMC 0609, Section 04.06, that it is expected that both licensees and the NRC will use information that is most reflective of the circumstances associated with the inspection finding and is available at the time of the significance determination."	NRC IMC 0609, Section 04.06