



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

SAFETY EVALUATION REPORT

DOCKET NO. 72-32

EXEMPTION REQUEST FOR NEXTERA ENERGY DUANE ARNOLD, LLC

DUANE ARNOLD ENERGY CENTER

INDEPENDENT SPENT FUEL STORAGE INSTALLATION

1.0 SUMMARY

By letter dated October 21, 2021 (Agencywide Documents Access and Management System [ADAMS] Accession No. ML21294A280), as supplemented by letter dated December 10, 2021 (ADAMS Accession No. ML21344A186), and January 6, 2022 (ADAMS Accession No. ML22006A105), NextEra Energy Duane Arnold, LLC (NEDA or the licensee) submitted a one-time exemption request to the U.S. Nuclear Regulatory Commission (NRC) for the Duane Arnold Energy Center (DAEC) Independent Spent Fuel Storage Installation (ISFSI), in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 72.7, "Specific exemptions," from the requirements of 10 CFR 72.212 (a)(2), (b)(2), (b)(3), (b)(4), (b)(5)(i), (b)(11), and 72.214. Specifically, the one-time exemption request would, if granted, permit a failed fuel can (FFC) and its contents at DAEC to exceed the limits specified in Table 1-1t in Appendix B, Technical Specifications (TS), of NRC Certificate of Compliance (CoC) No. 1004, Renewed Amendment No. 17 (ADAMS Package Accession No. ML21109A325).

As discussed in its October 21, 2021 request, as supplemented on December 10, 2021, and January 6, 2022, NEDA identified a failed fuel assembly which, when stored with a modified FFC, would exceed the CoC Appendix B, TS Table 1-1t requirement that "[t]he total weight of each failed fuel can plus all its content shall be less than 705 lb [pounds (lb)]." The modifications to the relevant FFC would be evaluated against the criteria in 10 CFR 72.48 to determine whether they require either a license or CoC amendment. NEDA is proposing to modify an FFC to accommodate a damaged bail handle on a certain boiling water reactor failed fuel assembly.

NEDA's proposed modification to the FFC would provide the damaged bail handle adequate clearance during loading operations to lower the failed fuel assembly into place without interference from surrounding components, allowing the fuel assembly to be safely lowered into its final position. Because of its proposed modification to the FFC, NEDA cannot lift the FFC in the normal manner. Instead, it would have to use additional lifting hardware to accomplish this. The additional hardware to be used will cause the relevant FFC and its contents to exceed the 705-pound weight limit in CoC No. 1004, Renewed Amendment No. 17. If the exemption is granted, NEDA would be allowed to load a failed fuel assembly in an FFC, within a DAEC Dry Shielded Cask (DSC) No. 30 fuel cell, where the combined weight of the failed fuel assembly plus the FFC exceeds the 705-lb limit. As a condition of this exemption, however,

Enclosure

NEDA would also be required to leave at least two adjacent DSC fuel cells empty to increase the available margin for weight.

This safety evaluation report documents the NRC staff's review and evaluation of the exemption the NRC staff is considering granting for DAEC ISFSI. Under 10 CFR 72.7, "Specific exemptions," the Commission may, upon application by any interested person or upon its own initiative, grant such exemptions from the requirements of 10 CFR Part 72 as it determines are authorized by law and will not endanger life or property or the common defense and security, and are otherwise in the public interest.

2.0 BACKGROUND

DAEC began operation in 1974 and is owned and operated by NEDA. DAEC permanently shut down its reactor on August 10, 2020. By letter dated August 27, 2020 (ADAMS Accession No. ML20240A067), NEDA submitted its certification of permanent cessation of power operations, and by letter dated October 12, 2020 (ADAMS Accession No. ML20286A317), NEDA certified that all fuel had been removed from the reactor as required under the provisions of 10 CFR 50.82.

The NRC staff reviewed and approved the Standardized NUHOMS® 61BTH Type 2 dry shielded canister (DSC), and the related basket structural analysis, as part of Amendment No. 10 to CoC No. 1004 (ADAMS Accession Nos. ML17338A113 and ML17338A114), and the FFC as part of Amendment No. 13 to CoC No. 1004 (ADAMS Accession Nos. ML17338A117 and ML17338A118). The Standardized NUHOMS® System FFC consists of a liner with an integral bottom lid assembly, and a removable top lid, designed to contain a failed fuel assembly and any associated fuel fragments/rubble to ensure assumptions made in the criticality analysis for the quantity and location of fuel rod material are maintained.

In its submittal dated October 21, 2021, as supplemented on December 10, 2021, and January 6, 2022, NEDA is proposing to modify an FFC to accommodate a damaged bail handle on a certain boiling water reactor failed fuel assembly. The proposed modification to the FFC would provide the damaged bail handle adequate clearance during loading operations to lower the failed fuel assembly into place without interference from surrounding components, allowing the fuel assembly to be safely lowered into its final position. Because of its proposed modification to the FFC, NEDA cannot lift the FFC in the normal manner. Instead, it will have to use additional lifting hardware to accomplish this. The additional hardware to be used will cause the relevant FFC and its contents to exceed the 705-pound weight limit in CoC No. 1004, Renewed Amendment No. 17. If the exemption is granted, NEDA would be allowed to load a failed fuel assembly in an FCC, within a DAEC DSC No. 30 fuel cell, where the combined weight of the failed fuel assembly plus the FCC exceeds the 705-lb limit.

The NRC staff notes that the design of the modified FFC is not a part of this exemption request, and that the licensee plans to design the modified FFC and then perform a review of the proposed change following the change process in 10 CFR 72.48, "Changes, tests, and experiments."

3.0 PROPOSED ACTION

CoC No. 1004 constitutes the approval and contains the conditions for the use of the Standardized NUHOMS® Horizontal Modular Storage System for the storage of spent nuclear fuel under the general licensing provisions of 10 CFR 72.210. The proposed action is for the

NRC to grant NEDA an exemption from the requirements of 10 CFR 72.212(b)(3), (b)(5)(i), (b)(11), and 72.214, which require general licensees to comply with the terms, conditions, and specifications of the CoC No. 1004, Renewed Amendment No. 17 and from the requirements of 10 CFR 72.212(a)(2), (b)(2), and (b)(4) to the extent those three provisions require licensees to use casks exactly as described in the relevant TS.

As discussed in its October 21, 2021, exemption request, as supplemented on December 10, 2021, and January 6, 2022, NEDA has identified a failed fuel assembly which weighs nominally 676 lb. As discussed above, this failed fuel assembly must be stored in a modified FFC because of a bent bail handle extending beyond the perimeter of the dry shielded canister fuel compartment. When this failed fuel assembly is stored with the modified FFC, the total weight will exceed the physical parameter limit for failed fuel, specified in CoC No. 1004, Renewed Amendment No. 17, Appendix B, TS, Table 1-1t, which states: "The total weight of each failed fuel can plus all its content shall be less than 705 lb." As a result, NEDA is requesting an exemption to load an FFC such that the FFC and its contents exceed the TS limit for the DAEC ISFSI.

More specifically, NEDA is requesting NRC's approval for the FFC in question, plus all its contents, to weigh up to 800 lb. NEDA further states that, should this exemption be granted, the FFC in question would be loaded within DSC No. 30, which is the final DSC in the near-term loading campaign and the final loading campaign for DAEC. In addition, as discussed below, NEDA states that it is committing to leave a minimum of two adjacent fuel cells in DSC No. 30 empty.

4.0 SAFETY EVALUATION

Under 10 CFR 72.7, "[t]he Commission may, upon application by any interested person or upon its own initiative, grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest."

Authorized by Law

The Commission has the legal authority to issue exemptions from the requirements of 10 CFR Part 72 as provided in 10 CFR 72.7. The NRC staff has determined that issuance of this exemption is consistent with the Atomic Energy Act of 1954, as amended, and not otherwise inconsistent with NRC regulations or other applicable laws. Therefore, issuance of the exemption is authorized by law.

Will Not Endanger Life or Property or the Common Defense and Security

The NRC staff reviewed the exemption request submitted by NEDA for the DAEC ISFSI and concludes, as discussed below, that the proposed exemption from the requirements of 10 CFR 72.212 (a)(2), (b)(2), (b)(3), (b)(4), (b)(5)(i), (b)(11), and 72.214, would not cause the Standardized NUHOMS® storage system to encounter conditions beyond those for which it has already been evaluated and demonstrated to meet the applicable safety requirements in 10 CFR Part 72.

The NRC staff followed the guidance in NUREG-2215, "Standard Review Plan for Spent Fuel Dry Cask Storage Systems and Facilities," published in April 2020 (ADAMS Accession No. ML20121A190) to conduct its review. The NRC staff's review focused primarily on the effect of

the proposed maximum weight increase on the structural design of the Standardized NUHOMS® storage system, as it is the technical area that is affected by this exemption request. The NRC staff also evaluated the potential safety impacts of granting the exemption, as applicable, in the areas of thermal performance, radiation shielding, confinement, and nuclear criticality, and concluded that these areas either remain unaffected, or not adversely affected (e.g., provide additional safety margin) by the proposed exemption. This is because the changing the maximum weight of a single FFC and its contents would not pose any additional concerns beyond those previously evaluated by the NRC staff in the review for CoC No.1004, Renewed Amendment 14.

Structural Review for the Requested Exemption

The licensee is seeking to increase the maximum weight of a single FFC and its contents, which under the current requirements found in Table 1-1t of Appendix B, TS, to CoC No. 1004, must be less than 705 lb. The licensee is plans to store one BWR failed fuel assembly in an FFC, in DSC No. 30 at the DAEC ISFSI. Once loaded, the FFC and its contents would together weigh 800 lb. DSC No. 30 is a NUHOMS-61BTH Type 2 DSC. As described in Appendix T of the Standardized NUHOMS® storage system Final Safety Analysis Report (FSAR) (ADAMS Accession No. ML21022A396), the 61BTH DSC is designed for storage of up to 61 BWR fuel assemblies, each weighing up to 705 lb.

The licensee evaluated the structural effects of the 800 lb, loaded FFC in Section 3.e of its October 21, 2021, exemption request as supplemented on December 10, 2021, and January 6, 2022. As discussed in the request and supplements, the licensee would load the 800 lb FFC in DSC No. 30. Although it would not load additional FFCs in DSC No. 30, it will load other fuel assemblies, which each have a maximum weight of 676 lb. In addition, the licensee committed to leave at least two cells empty adjacent to the heavier FFC. The 61BTH DSC design was evaluated for 61 BWR fuel assemblies weighing up to 705 lb each (as stated in the Standardized NUHOMS® FSAR), but would instead be loaded with 58 BWR fuel assemblies weighing a maximum of 676 lb and one FFC weighing 800 lb. Thus, the licensee's loading plan would result in a net reduction in the total weight stored in DSC No. 30 of nearly 3,000 lb relative to the maximum evaluated in the 61BTH DSC design.

Given the overall reduction in total weight of the stored fuel in the DSC, the NRC staff concludes that the proposed change in the exemption request (i.e., increasing the maximum weight of one loaded FFC to 800 lb) would only affect the design of the fuel basket. This is because a fuel basket panel is the only structural component that directly supports a single fuel assembly. Although other structural components indirectly support the fuel assembly, those components support the weight of all the fuel assemblies, rather than the weight of the single, relevant, assembly. Thus, the overall reduction in weight means those other components are not affected by this change, and, therefore, the fuel basket is the only structural component that is affected by increasing the weight in a particular fuel basket cell while not increasing the total weight. The previously approved evaluations presented in the Standardized NUHOMS® FSAR remain applicable or are sufficiently bounding to demonstrate that the established design criteria for other important to safety systems, structures, and components are met.

The 61BTH fuel basket provides a portion of the lateral support for the FFC. As discussed in the licensee's submittal dated October 21, 2021, as supplemented by letters dated December 10, 2021, and January 6, 2022, the FFC is 178.50 inches long and is supported laterally by the fuel basket for 164 inches and by the top grid assembly for 14.50 inches. The top grid assembly supports the top 14.50 inches of the FFC, and the fuel basket supports the FFC components

below the top grid assembly. Thus, the fuel basket supports the FFC liner, the spacer, the bottom cover of the FFC, and the fuel assembly. The oversleeve and top cap of the FFC are supported by the top grid assembly. Thus, based on weights for individual components presented in the exemption request, the fuel basket supports approximately 725 lb of the 800 lb loaded FFC.

The previously approved FSAR analysis of the 61BTH fuel basket is presented in Section T.3.6.1.3.1 of the Standardized NUHOMS® FSAR. The fuel basket analysis calculated applied pressures on the basket plates for the normal and accident load cases defined in FSAR Appendix T for the NUHOMS-61BTH system. In Section 3.e of the exemption request, the licensee used this established methodology to demonstrate that the proposed change (i.e., increasing the maximum weight of one loaded FFC to 800 lb) in the exemption request results in only a small (almost 1%) increase in pressures on the basket plates of the compartment with the 800 lb FFC. The staff reviewed the FSAR methodology and the licensee's calculations of the applied pressure and finds that the licensee's analysis is consistent with the FSAR methodology and is representative of actual conditions.

In Table 1 of the exemption request dated October 21, 2021, as supplemented on December 10, 2021, and January 6, 2022, the licensee presented a summary of the maximum stresses and allowable stresses for the fuel basket in the normal and accident load cases that were calculated from the previous FSAR analysis. The licensee used these stresses, taken from Section T.3 of the FSAR, to identify the critical load case. The licensee analyzed the stress in the fuel basket from the critical load case (i.e., the load case that resulted in the smallest margin between the maximum stresses and the allowable stresses) to demonstrate that the heavier FFC would not exceed the previously reviewed maximum stresses for the basket panel. The licensee used the same methodology and Ansys finite element model that was used for the previous FSAR analysis of the basket but modified the finite element model to account for the applied pressure for the heavier 800 lb FFC. Conservatively, the licensee did not change the applied pressure on any other compartment of the fuel basket, which correspond to 705 lb fuel assemblies. The licensee presented the resulting maximum stresses from this analysis in Table 2 of the exemption request. The results of the finite element analysis demonstrated that the maximum stresses in the fuel basket are unaffected by the heavier FFC. The maximum stresses were the same value and in the same location as the previously reviewed FSAR analysis, and all the stresses in the fuel basket remained less than the allowable stresses. The NRC staff reviewed the description and results of the finite element analysis presented in the supplements to the exemption request and finds that the analysis is sufficiently accurate for evaluating DSC No. 30 and follows the previously approved FSAR methodology for the structural analysis of the fuel basket.

The licensee depicted the stress contours in the basket assembly from the finite element analysis in Figure 2 of the exemption request. The stress contours show that the location of the maximum stresses in the fuel basket does not change from the previous analysis and these maximum stresses occur away from the compartment containing the 800 lb FFC. For clarity, the licensee depicted the stress contours in the 800 lb FFC compartment in Figure 3. As shown in Figure 3, the stress in the fuel compartment containing the 800 lb FFC was 4.2 kips per square inch (ksi). This is significantly below the maximum stresses experienced in the fuel basket of 21.5 ksi and the allowable stress of 23.4 ksi established in the FSAR following the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. The NRC staff reviewed the licensee's evaluation of the stresses in the fuel basket from the 800 lb FFC and finds the evaluation is reasonably accurate and demonstrates that the stresses in the DSC No. 30 fuel basket are below the design basis allowable stress limits.

The NRC staff reviewed the licensee's evaluation of the 800 lb FFC in Section 3.e of the exemption request and supplements to determine if there is reasonable assurance that the fuel basket will perform its structural function under normal, off-normal, and accident conditions with a single 800 lb, loaded FFC. Based on the staff's review of the applied pressure on the fuel basket and the use of the finite element analysis described above, the staff finds the licensee's evaluation of the 800 lb, loaded FFC in DAEC DSC No. 30 is consistent with the previously approved methodology in the Standardized NUHOMS® FSAR and the guidance in NUREG-2215. On the basis of its review, the NRC staff finds that there is reasonable assurance that the DAEC DSC No. 30 containing a single 800 lb loaded FFC and 58 BWR fuel assemblies weighing up to 705 lb is capable of fulfilling its structural function under all normal, off-normal, and accident conditions.

Further, the NRC staff concludes that because this exemption only increases the permissible weight of an FFC and its contents, the exemption is unrelated to the common defense and security.

The NRC staff reviewed the exemption request submitted by NEDA for the DAEC ISFSI and concludes, as discussed above, that the proposed exemption would not cause the Standardized NUHOMS® storage system to encounter conditions beyond those for which it has already been evaluated and demonstrated to meet the applicable safety requirements in 10 CFR Part 72, and that the proposed exemption would have no impact to common defense and security. Therefore, the NRC staff concludes granting the exemption would not endanger life or property or the common defense and security.

Otherwise in the Public Interest

According to NEDA, this exemption is in the interest of the public because the exemption, if granted, would allow timely storage of spent nuclear fuel at DAEC while minimizing radiological risks as well as maintaining the established schedule for transitioning the spent fuel from the pool to the dry storage facility, all of which would minimize potential radiological risk.

Absent this exemption, NEDA would only be able to meet the total weight requirement specified in CoC No. 1004, Renewed Amendment No. 17, Appendix B, TS, Table 1-1t, by dismantling the relevant failed fuel assembly and placing the resulting component pieces into separate FFCs within a DSC. Dismantling the failed fuel assembly and placing its dismantled components in multiple FFCs would result in increased risk to plant personnel and the environment including additional occupational radiation dose and the generation of additional radiological waste. Thus, based on the above, the NRC staff concludes that granting this exemption is otherwise in the public interest.

5.0 ENVIRONMENTAL CONSIDERATION

The NRC staff considered whether there would be any significant environmental impacts associated with the exemption. For the proposed action, the NRC staff performed an environmental assessment (EA) pursuant to 10 CFR 51.30. Based on the EA, the NRC staff concluded that the environmental impacts of granting this exemption will be no greater than those described in the EA for the NUHOMS® 61BTH System, CoC No. 1004, Renewed Amendment No. 17, direct final rule and that nothing about increasing the weight of this FFC would cause any corresponding changes to the environmental impacts discussed during the original amendment. No changes are being made in the types or quantities of effluents that

may be released offsite, and there is no significant increase in occupational or public radiation exposures. Accordingly, the NRC determined that a finding of no significant impact (FONSI) is appropriate, and an environmental impact statement is not warranted. The EA and the FONSI was published on February 2, 2022 in the *Federal Register* (87 FR 5847).

6.0 CONCLUSION

Based on the review, the NRC staff concludes that the requested exemption to allow NEDA to load a failed fuel assembly in an FFC such that the combined weight of the failed fuel assembly and the FCC is up to 800 lb, within a DAEC DSC No. 30 fuel cell, exceeding the 705 lb limit, while leaving two adjacent cells empty, is authorized by law; will not endanger life, property, or the common defense and security; and is otherwise in the public interest. Therefore, the NRC staff concludes the requested exemption meets requirements in 10 CFR 72.7.

Therefore, under 10 CFR 72.7, the NRC hereby grants NEDA a one-time exemption from 10 CFR 72.212 (a)(2), (b)(2), (b)(3), (b)(4), (b)(5)(i), (b)(11), and 72.214, permitting the DAEC ISFSI to deviate from the specific provision which requires the combined weight of a FFC and its contents be less than 705 lb, as contained in Table 1-1t in Appendix B, TS, of NRC CoC No. 1004, Renewed Amendment No. 17. With this exemption, the subject FFC plus all its contents may weigh up to 800 lb. As a condition of this exemption, however, NEDA is required to leave at least two adjacent DSC fuel cells empty, during the spent pool off-load campaign to increase the available margin for weight. All other relevant requirements shall be met.