

# NUCLEAR REGULATORY COMMISSION

Docket No. 50-331

NextEra Energy Duane Arnold, LLC

Duane Arnold Energy Center

Exemption

## I. Background.

By letter dated January 18, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19023A196), NextEra Energy Duane Arnold, LLC (NEDA, the licensee) certified to the U.S. Nuclear Regulatory Commission (NRC, the Commission) that it planned to permanently cease power operations at the Duane Arnold Energy Center (DAEC) in the fourth quarter of 2020. By letter dated March 2, 2020 (ADAMS Accession No. ML20062E489), NEDA updated its timeline and certified to the NRC that it planned to permanently cease power operations at DAEC on October 30, 2020. By letter dated August 27, 2020 (ADAMS Accession No. ML20240A067), NEDA certified to the NRC that power operations permanently ceased at DAEC on August 10, 2020, and in a letter dated October 12, 2020 (ADAMS Accession No. ML20286A317), that the fuel was permanently removed from the DAEC reactor vessel and placed in the spent fuel pool (SFP) as of October 12, 2020.

Based on the docketing of these certifications for permanent cessation of operations and permanent removal of fuel from the reactor vessel, as specified in Title 10 of the *Code of Federal Regulations* (10 CFR) section 50.82(a)(2), the 10 CFR part 50 renewed facility operating license for DAEC (No. DPR-49) no longer authorizes operation of the reactor or emplacement or retention of fuel in the reactor vessel. The facility is still authorized to possess and store irradiated (i.e., spent) nuclear fuel. Spent fuel is currently stored onsite at the DAEC facility in the SFP and in a dry cask independent spent fuel storage installation (ISFSI).

## **II. Request/Action.**

By letter dated July 16, 2020 (ADAMS Accession No. ML20198M579), NEDA requested an exemption from 10 CFR 50.54(w)(1) concerning onsite liability insurance. The exemption from 10 CFR 50.54(w)(1) would permit the licensee to reduce the required level of onsite property damage insurance from \$1.06 billion to \$50 million for DAEC.

The regulation at 10 CFR 50.54(w)(1) requires each licensee to have and maintain onsite property damage insurance to stabilize and decontaminate the reactor and reactor site in the event of an accident. The onsite insurance coverage must be either \$1.06 billion or whatever amount of insurance is generally available from private sources (whichever is less).

The licensee states that the risk of an incident at a permanently shutdown and defueled reactor is much less than the risk from an operating power reactor. In addition, since reactor operation is no longer authorized at DAEC, there are no events that would require the stabilization of reactor conditions after an accident. Similarly, the risk of an accident that would result in significant onsite contamination at DAEC is also much lower than the risk of such an event at operating reactors. Therefore, the licensee requested an exemption from 10 CFR 50.54(w)(1) to reduce its onsite property damage insurance from \$1.06 billion to \$50 million, commensurate with the reduced risk of an incident at the permanently shutdown and defueled DAEC site.

## **III. Discussion.**

Under 10 CFR 50.12, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR part 50 when (1) the exemptions are authorized by law, will not present an undue risk to public health or safety, and are consistent with the common defense and security; and (2) any of the special circumstances listed in 10 CFR 50.12(a)(2) are present.

The financial protection limits of 10 CFR 50.54(w)(1) were established after the Three Mile Island Nuclear Station, Unit 2 accident out of concern that licensees may be unable to

financially cover onsite cleanup costs in the event of a major nuclear accident. The specified \$1.06 billion coverage amount requirement was developed based on an analysis of an accident at a nuclear reactor operating at power, resulting in a large fission product release and requiring significant resource expenditures to stabilize the reactor and ultimately decontaminate and cleanup the site.

These cost estimates were developed based on the spectrum of postulated accidents for an operating nuclear reactor. Those costs were derived from the consequences of a release of radioactive material from the reactor. Although the risk of an accident at an operating reactor is very low, the consequences onsite and offsite can be significant. In an operating plant, the high temperature and pressure of the reactor coolant system (RCS), as well as the inventory of relatively short-lived radionuclides, contribute to both the risk and consequences of an accident. With the permanent cessation of reactor operations at DAEC and the permanent removal of the fuel from the reactor vessel, such accidents are no longer possible. As a result, the reactor vessel, RCS, and supporting systems no longer operate and have no function related to the storage of the irradiated fuel. Therefore, postulated accidents involving failure or malfunction of the reactor, RCS, or supporting systems are no longer applicable.

During reactor decommissioning, the largest radiological risks are associated with the storage of spent fuel onsite. In the exemption request dated July 16, 2020, the licensee discussed both design-basis and beyond design-basis events involving irradiated fuel stored in the SFP. The licensee determined that there are no possible design-basis events at DAEC that could result in an offsite radiological release exceeding the limits established by the U.S. Environmental Protection Agency's (EPA) early phase Protective Action Guides (PAGs) of 1 roentgen equivalent man (rem) at the exclusion area boundary, as a way to demonstrate that any possible radiological releases would be minimal and would not require precautionary protective actions (e.g., sheltering in place or evacuation). The NRC staff evaluated the radiological consequences associated with various decommissioning activities and the design-

basis accidents at DAEC, in consideration of the permanently shutdown and defueled condition. The possible design-basis accident scenarios at DAEC have greatly reduced radiological consequences. Based on its review, the NRC staff concluded that no reasonably conceivable design-basis accident exists that could cause an offsite release greater than the EPA PAGs.

The only incident that might lead to a significant radiological release at a decommissioning reactor is a zirconium fire. The zirconium fire scenario is a postulated, but highly unlikely, beyond design-basis accident scenario that involves loss of water inventory from the SFP resulting in a significant heatup of the spent fuel, and culminating in substantial zirconium cladding oxidation and fuel damage. The probability of a zirconium fire scenario is related to the decay heat of the irradiated fuel stored in the SFP. Therefore, the risks from a zirconium fire scenario continue to decrease as a function of the time since DAEC has been permanently shut down.

The Commission has previously authorized a lesser amount of onsite financial protection, based on this analysis of the zirconium fire risk. In SECY-96-256, "Changes to Financial Protection Requirements for Permanently Shutdown Nuclear Power Reactors, 10 CFR 50.54(w) and 10 CFR 140.11," dated December 17, 1996 (ADAMS Accession No. ML15062A483), the NRC staff recommended changes to the power reactor financial protection regulations that would allow licensees to lower onsite insurance levels to \$50 million upon demonstration that the fuel stored in the SFP can be air-cooled. In its Staff Requirements Memorandum to SECY-96-256, dated January 28, 1997 (ADAMS Accession No. ML15062A454), the Commission supported the NRC staff's recommendation that, among other things, would allow permanently shutdown power reactor licensees to reduce commercial onsite property damage insurance coverage to \$50 million when the licensee was able to demonstrate the technical criterion that the spent fuel could be air-cooled if the SFP was drained of water.

The NRC staff has used this technical criterion to grant similar exemptions to other decommissioning reactors (e.g., Maine Yankee Atomic Power Station, published in the *Federal Register* on January 19, 1999 (64 FR 2920); Zion Nuclear Power Station, published in the *Federal Register* on December 28, 1999 (64 FR 72700); Kewaunee Power Station, published in the *Federal Register* on March 24, 2015 (80 FR 15638); Crystal River Unit 3 Nuclear Generation Plant, published in the *Federal Register* on May 6, 2015 (80 FR 26100); Oyster Creek Nuclear Generating Station, published in the *Federal Register* on December 28, 2018 (83 FR 67365); Pilgrim Nuclear Power Station, published in the *Federal Register* on January 14, 2020 (85 FR 2153); and Three Mile Island Nuclear Station, Unit 1, published in the *Federal Register* on March 26, 2021 (86 FR 16241)). These prior exemptions were based on these licensees demonstrating that the SFP could be air-cooled, consistent with the technical criterion discussed above.

In its July 16, 2020, request, the licensee compared the DAEC fuel storage parameters with those used in NRC generic evaluations of fuel cooling included in NUREG/CR-6451, "A Safety and Regulatory Assessment of Generic BWR [Boiling-Water Reactor] and PWR [Pressurized-Water Reactor] Permanently Shutdown Nuclear Power Plants," dated August 1997 (ADAMS Accession No. ML082260098). The analysis described in NUREG/CR-6451 determined that natural air circulation would adequately cool fuel that has decayed for 7 months after operation in a typical BWR.

In SECY-00-0145, "Integrated Rulemaking Plan for Nuclear Power Plant Decommissioning," dated June 28, 2000, and SECY-01-0100, "Policy Issues Related to Safeguards, Insurance, and Emergency Preparedness Regulations at Decommissioning Nuclear Power Plants Storing Fuel in Spent Fuel Pools," dated June 4, 2001 (ADAMS Accession Nos. ML003721626 and ML011450420, respectively), the NRC staff discussed additional information concerning SFP zirconium fire risks at decommissioning reactors and associated implications for onsite property damage insurance. Providing an analysis of when

the spent fuel stored in the SFP is capable of air-cooling is one measure that can be used to demonstrate that the probability of a zirconium fire is exceedingly low.

The NRC staff further evaluated the issue of zirconium fires and presented an independent evaluation of an SFP subject to a severe earthquake in NUREG-2161, "Consequence Study of a Beyond-Design-Basis Earthquake Affecting the Spent Fuel Pool for a U.S. Mark I Boiling Water Reactor," dated September 2014 (ADAMS Accession No. ML14255A365). The specific reference plant used for this study is a General Electric (GE) Type 4 BWR with a Mark I containment. The analysis postulates a severe earthquake and evaluates the potential for the SFP to lose inventory and potentially uncover the spent fuel. This evaluation concluded that, for the representative BWR, spent fuel stored in a dispersed high-density configuration would be adequately cooled by natural circulation air flow within several months after discharge from a reactor if the pool was drained of water during a severe earthquake scenario. Specifically, the NUREG-2161 analysis identified that 107 days after shutdown, the stored fuel would have decayed sufficiently and be in a configuration that allows for air cooling of the fuel during a severe earthquake. This would prevent radiological releases without the need for additional mitigation actions; therefore, no release as a result of a zirconium cladding fire would be expected.

The NRC staff compared the DAEC facility with the reference plant in NUREG-2161 and identified that DAEC is also a GE Type 4 BWR with a Mark I containment. The staff also confirmed (see ADAMS Accession No. ML21089A207) that DAEC stores the spent fuel following a dispersed high-density loading pattern consistent with the dispersed high-density configuration assumed in NUREG-2161. Therefore, the NRC staff determined that the stored fuel in the DAEC SFP will remain in a coolable configuration following a design basis seismic event.

Based on the evaluation in SECY-96-256, as well as DAEC's conformance with the analysis in NUREG-2161, the NRC staff determined \$50 million to be an adequate level of

onsite property damage insurance for a decommissioning reactor once the spent fuel in the SFP is no longer susceptible to a zirconium fire. However, the NRC staff has postulated that there is still a potential for other radiological incidents at a decommissioning reactor that could result in significant onsite contamination besides a zirconium fire. In SECY-96-256, the NRC staff cited the rupture of a large contaminated liquid storage tank (~450,000 gallons) causing soil contamination and potential groundwater contamination as the most costly postulated event to decontaminate and remediate (other than an SFP zirconium fire). The postulated large liquid radiological waste storage tank rupture event was determined to have a bounding onsite cleanup cost of approximately \$50 million. Therefore, the NRC staff determined that the licensee's proposal to reduce onsite insurance to a level of \$50 million would be consistent with the bounding cleanup and decontamination cost, as discussed in SECY-96-256, to account for the postulated rupture of a large liquid radiological waste tank at the DAEC site, should such an event occur.

The NRC staff has determined that the licensee's proposed reduction in onsite property damage insurance coverage to a level of \$50 million is consistent with SECY-96-256 and subsequent insurance considerations resulting from additional zirconium fire risks as discussed in SECY-00-0145 and SECY-01-0100, as well as NUREG/CR-6451 and NUREG-2161. In addition, the NRC staff notes that similar exemptions have been granted to other permanently shutdown and defueled power reactors, upon demonstration that the criterion of the zirconium fire risks from the irradiated fuel stored in the SFP is of negligible concern. The NRC staff concluded that 10 months after the permanent cessation of power operations on August 10, 2020, sufficient irradiated fuel decay time will have elapsed at DAEC to decrease the probability of an onsite radiological release from a postulated zirconium fire accident to negligible levels. In addition, the licensee's proposal to reduce onsite insurance to a level of \$50 million is consistent with the maximum estimated cleanup costs for the recovery from the rupture of a large liquid radwaste storage tank.

The NRC staff also notes that in accordance with Revision 1 of the DAEC Post-Shutdown Decommissioning Activities Report (PSDAR) dated February 2, 2021 (ADAMS Accession No. ML21036A160), all spent fuel will be removed from the SFP and moved into dry storage at an onsite ISFSI by April 2022, and the probability of an initiating event that would threaten SFP integrity occurring before that time is extremely low, which further supports the conclusion that the zirconium fire risk is negligible

**A. The Exemption is Authorized by Law**

The requested exemption from 10 CFR 50.54(w)(1) would allow NEDA to reduce the minimum coverage limit for onsite property damage insurance. As stated above, 10 CFR 50.12 allows the NRC to grant exemptions from the requirements of 10 CFR part 50 when the exemptions are authorized by law.

As explained above, the NRC staff has determined that the licensee's proposed reduction in onsite property damage insurance coverage to a level of \$50 million is consistent with SECY-96-256. Moreover, the NRC staff concluded that 10 months after the permanent cessation of power operations, sufficient irradiated fuel decay time will have elapsed at DAEC to decrease the probability of an onsite and offsite radiological release from a postulated zirconium fire accident to negligible levels. In addition, the licensee's proposal to reduce onsite insurance to a level of \$50 million is consistent with the maximum estimated cleanup costs for the recovery from the rupture of a large liquid radiological waste storage tank.

The NRC staff has determined that granting the licensee's proposed exemption will not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission's regulations. Therefore, based on its review of the licensee's exemption request as discussed above, and consistent with SECY-96-256, the NRC staff concludes that the exemption is authorized by law.

**B. The Exemption Presents No Undue Risk to the Public Health and Safety**

The onsite property damage insurance requirements of 10 CFR 50.54(w)(1) were established to provide financial assurance that following a significant nuclear incident, onsite conditions could be stabilized and the site decontaminated. The requirements of 10 CFR 50.54(w)(1) and the existing level of onsite insurance coverage for DAEC are predicated on the assumption that the reactor is operating. However, DAEC permanently shut down on August 10, 2020, and permanently defueled as of October 12, 2020. The permanently shutdown and defueled status of the facility results in a significant reduction in the number and severity of potential accidents and, correspondingly, a significant reduction in the potential for and severity of onsite property damage. The proposed reduction in the amount of onsite insurance coverage does not impact the probability or consequences of potential accidents. The proposed level of insurance coverage is commensurate with the reduced consequences of potential nuclear accidents at DAEC. Therefore, the NRC staff concludes that granting the requested exemption will not present an undue risk to the health and safety of the public.

**C. The Exemption Is Consistent with the Common Defense and Security**

The proposed exemption would not eliminate any requirements associated with physical protection of the site and would not adversely affect the licensee's ability to physically secure the site or protect special nuclear material. Physical security measures at DAEC are not affected by the requested exemption. Therefore, the proposed exemption is consistent with the common defense and security.

**D. Special Circumstances**

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the regulation.

The underlying purpose of 10 CFR 50.54(w)(1) is to provide reasonable assurance that adequate funds will be available to stabilize reactor conditions and cover onsite cleanup costs

associated with site decontamination following an accident that results in the release of a significant amount of radiological material. Since DAEC permanently shut down on August 10, 2020, and permanently defueled as of October 12, 2020, it is no longer possible for the radiological consequences of design-basis accidents or other credible events at DAEC to exceed the limits of the EPA PAGs at the exclusion area boundary. The licensee has evaluated the consequences of highly unlikely, beyond-design-basis conditions involving a loss of coolant from the SFP. The analyses show that 10 months after the permanent cessation of power operations on August 10, 2020, the likelihood of such an event leading to a large radiological release is negligible. The NRC staff's evaluation of the licensee's analyses confirm this conclusion.

The NRC staff also finds that the licensee's proposed \$50 million level of onsite insurance is consistent with the bounding cleanup and decontamination cost as discussed in SECY-96-256, to account for the hypothetical rupture of a large liquid radiological waste tank at the DAEC site, should such an event occur. Therefore, the NRC staff concludes that the application of the current requirements in 10 CFR 50.54(w)(1) to maintain \$1.06 billion in onsite insurance coverage is not necessary to achieve the underlying purpose of the rule for the permanently shutdown and defueled DAEC reactor.

Under 10 CFR 50.12(a)(2)(iii), special circumstances are present whenever compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted, or that are significantly in excess of those incurred by others similarly situated.

The NRC staff concludes that if the licensee was required to continue to maintain an onsite insurance level of \$1.06 billion, the associated insurance premiums would be in excess of those necessary and commensurate with the radiological contamination risks posed by the site. In addition, such insurance levels would be significantly in excess of other decommissioning reactor facilities that have been granted similar exemptions by the NRC.

The NRC staff finds that compliance with the existing rule would result in an undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted and are significantly in excess of those incurred by others similarly situated.

Therefore, the special circumstances required by 10 CFR 50.12(a)(2)(ii) and 10 CFR 50.12(a)(2)(iii) exist.

#### **E. Environmental Considerations**

The NRC's approval of an exemption from insurance or indemnity requirements belongs to a category of actions that the Commission, by rule or regulation, has declared to be a categorical exclusion after first finding that the category of actions does not individually or cumulatively have a significant effect on the human environment. Specifically, the exemption is categorically excluded from the requirement to prepare an environmental assessment or environmental impact statement in accordance with 10 CFR 51.22(c)(25).

Under 10 CFR 51.22(c)(25), granting of an exemption from the requirements of any regulation of Chapter I to 10 CFR is a categorical exclusion provided that: (i) there is no significant hazards consideration; (ii) there is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite; (iii) there is no significant increase in individual or cumulative public or occupational radiation exposure; (iv) there is no significant construction impact; (v) there is no significant increase in the potential for or consequences from radiological accidents; and (vi) the requirements from which an exemption is sought involve surety, insurance, or indemnity requirements.

As the Director, Division of Decommissioning, Uranium Recovery, and Waste Programs, Office of Nuclear Material Safety and Safeguards, I have determined that approval of the exemption request involves no significant hazards consideration, as defined in 10 CFR 50.92, because reducing the licensee's onsite property damage insurance for DAEC does not:

- (1) involve a significant increase in the probability or consequences of an accident previously

evaluated; (2) create the possibility of a new or different kind of accident from any accident previously evaluated; or (3) involve a significant reduction in a margin of safety. The exempted financial protection regulation is unrelated to the operation of DAEC or site activities.

Accordingly, there is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite and no significant increase in individual or cumulative public or occupational radiation exposure. The exempted regulation is not associated with construction so there is no significant construction impact. The exempted regulation does not concern the source term (i.e., potential amount of radiation in an accident) or any activities conducted at the site. Therefore, there is no significant increase in the potential for, or consequences of, a radiological accident. In addition, there would be no significant impacts to biota, water resources, historic properties, cultural resources, or socioeconomic conditions in the region resulting from issuance of the requested exemption. The requirement for onsite property damage insurance involves surety, insurance, and indemnity matters only.

Therefore, pursuant to 10 CFR 51.22(b) and 51.22(c)(25), no environmental impact statement or environmental assessment need be prepared in connection with the approval of this exemption request.

#### **IV. Conclusions.**

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12(a), the exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security. Also, special circumstances are present as set forth in 10 CFR 50.12.

Therefore, the Commission hereby grants NEDA an exemption from the requirements of 10 CFR 50.54(w)(1) for DAEC. DAEC permanently ceased power operations on August 10, 2020. The exemption permits DAEC to lower the minimum required onsite insurance to \$50 million 10 months after permanent cessation of power operations.

The exemption is effective as of 10 months after permanent cessation of power operations at DAEC, which is June 10, 2021.

Dated: May 11, 2021

For the Nuclear Regulatory Commission.



Signed by Holahan, Patricia  
on 05/11/21

Patricia K. Holahan, Director,  
Division of Decommissioning, Uranium Recovery,  
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