

**NON-SENSITIVE SAFETY EVALUATION BY**  
**THE OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS**  
**FOR CRYSTAL RIVER UNIT 3**

1.0 **INTRODUCTION**

By application dated December 9, 2016, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16348A187), Duke Energy Florida, LLC (DEF), (the licensee) requested an amendment to Facility Operating License (FOL) DPR-72 for Crystal River Unit 3 (CR3) pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.90. The proposed change would remove from the facility operating license the existing cyber security license condition requiring the licensee to implement and maintain its Commission-approved cyber security plan.

The U.S. Nuclear Regulatory Commission (NRC) staff initially reviewed and approved the licensee's cyber security plan by CR3 License Amendment No. 238 dated July 29, 2011 (ADAMS Accession No. ML11193A028). License Amendment No. 238 also imposed the existing cyber security license condition which states: "The licensee shall fully implement and maintain in effect all provisions of the Commission-approved cyber security plan (CSP), including changes made pursuant to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The licensee's CSP was approved by License Amendment No. 238."

2.0 **REGULATORY EVALUATION**

The NRC staff considered the following regulatory requirements and guidance in its review of the current license amendment request.

- Protection of Digital Computer and Communication Systems and Networks, 10 CFR 73.54
- SECY-12-0088, The Nuclear Regulatory Commission Cyber Security Roadmap

3.0 **TECHNICAL EVALUATION**

3.1 Licensee's Requested Change

Amendment No. 238 to FOL DPR-72 for CR3 was issued on July 29, 2011. That Amendment revised Paragraph 2.D. of FOL DPR-72 to require the licensee to implement and maintain all provisions of its cyber security plan.

The licensee requested the removal of the existing cyber security license condition from the facility operating license.

The licensee stated that pursuant to 10 CFR 50.82(a)(2), the 10 CFR Part 50 license for CR3 no longer authorizes operation of the reactor or emplacement or retention of fuel in the reactor vessel and by the end of 2018 CR3 will store all spent nuclear fuel in dry cask storage at the Independent Spent Fuel Storage Installation (ISFSI). Further, all fuel stored in the CR3 spent fuel pools has been in the pools for at least four years. The licensee asserted that, with respect

to CR3, it is no longer "a licensee currently licensed to operate a nuclear power plant," and the cyber security requirements in 10 CFR 73.54 should no longer apply to CR3.

The licensee also quoted from SECY-12-0088:

By regulation, dry cask storage in ISFSIs allows spent fuel that has already been cooled in the spent fuel pool for 1 year to be surrounded by inert gas inside a storage cask. Licensees that are subject to 10 CFR 72.212, "Conditions of General License Issued Under § 72.210," (i.e., licenses limited to storage of spent fuel in casks) must also comply with specific portions of 10 CFR 73.55 requirements for physical security and the ASM (additional security measure) Orders, but are not subject to the provisions of 10 CFR 73.54, which specifically applies to operating reactors and COL (combined operating license) applicants.

The licensee provided summaries of 5 calculations that support the proposed cyber condition removal from a risk perspective. The licensee stated that in these calculations, doses were determined at the Exclusion Area Boundary (EAB) which is defined as the area that extends 4400 foot radius around the Reactor Building at CR3. Dose results were compared to two different standards applied to Emergency Planning. First, the results were compared to the radiation dose guidelines in the Environmental Protection Agency's Protective Action Guides to support the exemption from requirements for offsite planning zones. Second, the results were used to establish conformance to the guidance in Nuclear Energy Institute 99-01, "Development of Emergency Action Levels for Non Passive Reactors," (ADAMS Accession No. ML12326A805) Appendix C for permanently defueled plants. As a result of the radioactive decay since reactor shutdown, the radiological source term and the heat energy providing release motive forces are not expected to be sufficient to require declaration of a Site Area Emergency.

#### 1) Public and control room dose from a fuel handling accident

The licensee provided an updated calculation of the public dose at the EAB and low population zone, and dose to operators in the control room for a fuel handling accident in the spent fuel pools under permanent shutdown conditions, using the NRC-sponsored RADTRAD computer code. The licensee stated that results show very low doses, consistent with the calculation previously approved by the NRC as part of CR3 license amendment 199, approving an alternative source term (ADAMS Accession No. ML012430210). In particular, the results were more than 1,000 times lower than the 5 rem TEDE Control Room dose limit established in 10 CFR 50.67, and the site boundary and low population zone dose limits.

#### 2) Spent fuel pool time to uncover fuel analysis

The licensee provided a calculation of the time for the spent fuel pool water level to drop following the loss of active spent fuel pool cooling due to an accident. This calculation determined the length of time after an unmitigated loss of active cooling to the spent fuel pools at which certain water levels would be reached based on an initial water temperature of 110°F for a range of scenarios. Compensatory actions by the operator, including the addition of makeup water to maintain a stable water level, were not evaluated. The accident is characterized by two distinct phases: a transient heat-up phase and a steady boil-off/evaporation phase. The heat-up phase is a non-linear process wherein the temperature of the water increases asymptotically. This behavior is due to evaporative cooling and heat absorption by the concrete walls and floor and by the air space above the pools. After a time,

the heat-up phase either ceases due to the boiling point being reached or becomes linear below the boiling point. In either case, the rate of vaporization from the pools, whether by boiling or subcooled evaporation, reaches a steady state. The licensee determined that the steady-state boil-off/evaporation rates are relatively low. Based on this, the licensee stated that only minimal makeup flow would be required to maintain a stable water level indefinitely. If the makeup is at the same temperature as the spent fuel pool, then the required makeup flow rates are equal to the calculated boil-off/evaporation rates. If the makeup is colder than the spent fuel pool, then the required makeup flow rates are less. This is in part due to the fact that cold makeup water will expand slightly when it mixes with and reaches the temperature of the spent fuel pool. Additionally, the makeup water will cool the spent fuel pool slightly, thereby reducing the steady-state boil-off/evaporation rate. Without considering the second effect, the licensee computed the required makeup flow by multiplying the boil-off/evaporation rate by the ratio of spent fuel pool density to makeup water density. The licensee's analysis concluded that a flow of 6.1 gallons per minute or less would maintain water level and without any operator action it would take at least 22 days before the water level dropped to within 10 feet of the top of active fuel.

### 3) Maximum cladding and fuel temperature for uncovered spent fuel pool

The licensee provided an analysis to determine if the spent fuel decay heat is sufficiently low so that air cooling is adequate to maintain the clad temperature below the point of self-sustained zirconium oxidation. The licensee stated that the results of this analysis show that the surface temperature of the cladding in the spent fuel pools will not exceed the failure temperature for zirconium following a total loss of water from the pools due to adequate natural circulation and heat rejection to the outside through the walls and roof of the Fuel Handling Floor elevation. Additionally, the licensee stated that the acceptance criterion for this analysis, that the cladding surface temperature is maintained below 565°C, is also conservative. Per NUREG/CR-6451 (ADAMS Accession No. ML082260098), 565°C is the lowest temperature where incipient cladding failure might occur. Therefore, the licensee's analysis concludes that the fuel cladding is predicted to remain below the temperature for the onset of rapid oxidation (a zirconium fire), and no offsite emergency preplanning involving the plant is necessary.

### 4) Adiabatic spent fuel bundle heat-up

The licensee provided an analysis for the time for the hottest assembly to heat up from 30°C to 900°C. The licensee's calculation determined the time to be 19.7 hours. The licensee referred to the NRC Safety Evaluation for Maine Yankee Atomic Power Station, dated September 3, 1998 (ADAMS Accession No. 9809140214), which determined that 10 hours for the hottest location in the highest power assembly to reach 900°C was acceptable. Because the time for the hottest CR3 fuel assembly to adiabatically heat up from 30°C to 900°C is almost double the 10 hours calculated for the Maine Yankee Atomic Power Station, the licensee stated that the same staff conclusion should apply to CR3; therefore, there would be sufficient time for mitigative actions and, if necessary, offsite protective measures to be initiated after a postulated loss of water and before a postulated release of radioactivity resulting from spent fuel overheating.

### 5) Dose rates due to spent fuel assemblies in the spent fuel pool following drain down

The licensee provided a calculation to evaluate the radiological dose effects of a loss of water inventory from the CR3 spent fuel pool. The calculation was based on calculated direct and scattered dose rates from spent fuel assemblies in the CR3 spent fuel pool following a postulated drain down. The calculated dose rates for the control room and the exclusion area

boundary would be 0.008 mrem/hr or less. The licensee stated that the control room dose rates would be less than the acceptance criteria of 15mrem/hr and not require any personal occupancy control, and the offsite dose rates are well below the acceptance criteria of less than 1 rem over four days and 100 mrem over two hours to a member of the public.

### 3.2 NRC Staff Evaluation

The NRC staff has evaluated the licensee's application using the regulatory requirements and guidance above. The Cyber Security Rule, 10 CFR 73.54, applies to licensees "currently licensed to operate a nuclear power plant." The NRC staff has determined that 10 CFR 73.54 does not apply to reactor licensees that have submitted certifications of permanent cessation of operations and permanent removal of fuel under 10 CFR 50.82(a)(1) or under 10 CFR 52.110(a)(1) and whose certifications have been docketed by the NRC. Once the NRC has docketed these certifications, the licensee is no longer authorized to operate a nuclear power plant, and the requirements of 10 CFR 73.54 no longer apply. DEF provided the certifications required by 10 CFR 50.82(a)(1) for CR3 by letter dated February 20, 2013, and the certifications were docketed on March 13, 2013 (ADAMS Accession No. ML13058A380). Therefore, the Cyber Security Rule at 10 CFR 73.54 does not apply to CR3.

The NRC staff further notes that the licensee provided summaries of 5 calculations that support the proposed cyber license condition removal from a risk perspective.

The licensee determined that the fuel has cooled in the spent fuel pool for a sufficient time such that: a Site Area Emergency is not credible; radiological doses to the CR3 Control Room and offsite locations would be well below acceptance criteria; minimal makeup flow would be required to maintain a stable spent fuel pool water level indefinitely; the cladding in the spent fuel pools will not exceed the failure temperature for zirconium following a total loss of water from the pools; and there would be sufficient time for mitigative actions and, if necessary, offsite protective measures to be initiated after a postulated loss of water and before a postulated release of radioactivity resulting from spent fuel overheating.

The staff has reviewed the calculations and assessment made by the licensee and agrees with the results and conclusions. The NRC staff finds that the spent fuel has been in the spent fuel pool for longer than 3 years, which is a sufficient cooling period to mitigate the risk of heat-up to clad ignition temperature. The analyses above demonstrate that, even with the loss of active systems, significant time is available for compensatory actions. Additionally, even without compensatory actions, on and offsite doses would be within acceptable limits. Therefore the consequences of a cyber attack on those systems are much lower than while the plant was operating or the fuel in the spent fuel pool was not as cool. Accordingly, the NRC staff concludes that removal of the cyber security license condition is consistent with maintaining adequate protection of the public health and safety and the common defense and security.

### 3.3 Revision to License Condition 2.D.

By letter dated December 9, 2016, the licensee proposed to modify Paragraph 2.D. of FOL No. DPR-72, which provides a license condition to require the licensee to fully implement and maintain in effect all provisions of the NRC-approved CSP.

The license condition in Paragraph 2.D. of FOL No. DPR-72 for CR3 is modified to delete:

The licensee shall fully implement and maintain in effect all provisions of the Commission-approved cyber security plan (CSP), including changes made pursuant to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The licensee's CSP was approved by License Amendment No. 238, as supplemented by changes approved by License Amendment Nos. 242 and 245.

### 3.4 Technical Evaluation Conclusion

Based on its review of the licensee's submissions, the NRC staff concludes that the licensee's request to remove the existing cyber security license condition from the FOL is acceptable.

### 4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Florida State official, Ms. Cynthia Becker, Chief, Bureau of Radiation Control, Florida Department of Health, was notified of the proposed issuance of the amendment on March 31, 2017. The State official had no comments.

### 5.0 ENVIRONMENTAL CONSIDERATION

This amendment relates solely to safeguards matters, does not involve any significant construction impacts, and relates to modifications to systems used for security and/or materials accountability. Accordingly, this amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(12). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this amendment.

### 6.0 CONCLUSION

The NRC staff has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

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