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

December 27, 2011

Mr. Jon A. Franke, Vice President
Crystal River Nuclear Plant (NA2C)
ATTN: Supervisor, Licensing & Regulatory Programs
15760 W. Power Line Street
Crystal River, Florida 34428-6708

SUBJECT: CRYSTAL RIVER UNIT 3 NUCLEAR GENERATING – ISSUANCE OF AMENDMENT REGARDING DEPARTURE FROM A METHOD FOR EVALUATING THE AUXILIARY BUILDING OVERHEAD CRANE AND REVISIONS TO ASSOCIATED COMMITMENTS (TAC NO. ME5208)

Dear Mr. Franke:

The Nuclear Regulatory Commission (Commission) has issued the enclosed Amendment No. 239 to Facility Operating License No. DPR-72 for Crystal River Unit 3 Nuclear Generating Plant (CR-3) in response to your letter dated December 20, 2010, as supplemented by letters dated July 20, September 1, and October 5, 2011. The July 20, 2011, submittal entirely replaced the licensee's submittal dated December 20, 2010. Florida Power Corporation (the licensee) will be replacing the AB crane to support operating an onsite independent spent fuel storage installation, under its general license, in order to maintain full-core offload capacity in the spent fuel pools located in the CR-3 auxiliary building. In support of future dry shielded canister/transfer cask loading operation, the licensee is replacing the AB overhead crane. The licensee requested departure from a method for evaluating the auxiliary building overhead crane, revisions to the CR-3 Final Safety Analysis Report (FSAR), and changes to an associated commitment in the FSAR.

A copy of the safety evaluation is enclosed. The notice of issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

Siva P. Lingam for

Farideh E. Saba, Senior Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-302

Enclosures:
1. Amendment No. 239 to DPR-72
2. Safety Evaluation

cc w/enclosures: Distribution via ListServ

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FLORIDA POWER CORPORATION

CITY OF ALACHUA

CITY OF BUSHNELL

CITY OF GAINESVILLE

CITY OF KISSIMMEE

CITY OF LEESBURG

CITY OF NEW SMYRNA BEACH AND UTILITIES COMMISSION

CITY OF NEW SMYRNA BEACH

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ORLANDO UTILITIES COMMISSION AND CITY OF ORLANDO

SEMINOLE ELECTRIC COOPERATIVE, INC.

DOCKET NO. 50-302

CRYSTAL RIVER UNIT 3 NUCLEAR GENERATING PLANT

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 239
License No. DPR-72

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Florida Power Corporation, et al. (the licensees), dated December 20, 2010, as supplemented by letters dated July 20, September 1, and October 5, 2011, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in Title 10 of the *Code of Federal Regulations* (10 CFR) Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by approving changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. DPR-72 is hereby amended to read as follows:

   Technical Specifications

   The Technical Specifications contained in Appendix A as revised through Amendment No. 239, are hereby incorporated in the license. Florida Power Corporation shall operate the facility in accordance with the Technical Specifications.

3. Further, the license is amended to authorize revision to the Final Safety Analysis Report (FSAR), as set forth in the application dated July 20, 2011. The licensee shall update the FSAR Sections 5.1.1.1.h, 9.6.1.5.a.5, and 9.6.3.1 to specifically identify the design parameters for the auxiliary building overhead crane/fuel handling area crane and its support structure as described in the licensee's application dated July 20, 2011, and the NRC staff's safety evaluation attached to this amendment, and shall submit the revised description authorized by this amendment with the next update of the FSAR.

4. This license amendment is effective as of its date of issuance and shall be implemented within 180 days of issuance. The FSAR changes shall be implemented in the next periodic update to the FSAR in accordance with 10 CFR 50.71(e).

FOR THE NUCLEAR REGULATORY COMMISSION

Tracy J. Orf for

Douglas A. Broaddus, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Operating License

Date of Issuance: December 27, 2011

ATTACHMENT TO LICENSE AMENDMENT NO. 239

FACILITY OPERATING LICENSE NO. DPR-72

DOCKET NO. 50-302

Replace the following page of Facility Operating License No. DPR-72 with the attached revised page. The revised page is identified by amendment number and contains a vertical line indicating the area of change.

Remove	Insert
4	4

of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

2.C.(1) Maximum Power Level

Florida Power Corporation is authorized to operate the facility at a steady state reactor core power level not in excess of 2609 Megawatts (100 percent of rated core power level).

2.C.(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 239, are hereby incorporated in the license. Florida Power Corporation shall operate the facility in accordance with the Technical Specifications.

The Surveillance Requirements contained in the Appendix A Technical Specifications and listed below are not required to be performed immediately upon implementation of Amendment 149. The Surveillance Requirements shall be successfully demonstrated prior to the time and condition specified below for each.

a) SR 3.3.8.2.b shall be successfully demonstrated prior to entering MODE 4 on the first plant start-up following Refuel Outage 9.

b) SR 3.3.11.2, Function 2, shall be successfully demonstrated no later than 31 days following the implementation date of the ITS.

c) SR 3.3.17.1, Functions 1, 2, 6, 10, 14, & 17 shall be successfully demonstrated no later than 31 days following the implementation date of the ITS.

d) SR 3.3.17.2, Function 10 shall be successfully demonstrated prior to entering MODE 3 on the first plant start-up following Refuel Outage 9.

e) SR 3.6.1.2 shall be successfully demonstrated prior to entering MODE 2 on the first plant start-up following Refuel Outage 9.

f) SR 3.7.12.2 shall be successfully demonstrated prior to entering MODE 2 on the first plant start-up following Refuel Outage 9.

g) SR 3.8.1.10 shall be successfully demonstrated prior to entering MODE 2 on the first plant start-up following Refuel Outage 9.

h) SR 3.8.3.3 shall be successfully demonstrated prior to entering MODE 4 on the first plant start-up following Refuel Outage 9.

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 239 TO FACILITY OPERATING LICENSE NO. DPR-72

FLORIDA POWER CORPORATION, ET AL.

CRYSTAL RIVER UNIT 3 NUCLEAR GENERATING PLANT

DOCKET NO. 50-302

1.0 INTRODUCTION

By letter dated December 20, 2010 (Agencywide Document Access and Management System (ADAMS) Accession No. ML103560837), as supplemented by letters dated July 20, September 1, and October 5, 2011 (ADAMS Accession Nos. ML11256A074, ML113140510, and ML11280A122, respectively), Florida Power Corporation (FPC, the licensee) submitted a license amendment request for the Crystal River Unit 3 Nuclear Generating Plant (CR-3 or CR3). The July 20, 2011, submittal entirely replaced the licensee's submittal dated December 20, 2010. FPC will be constructing and operating an on-site independent spent fuel storage installation, as a general license, in order to maintain full-core offload capacity in the spent fuel pools located in the CR-3 auxiliary building (AB).

In support of future dry shielded canister/transfer cask loading operation and as result of replacing the AB overhead crane, the licensee requested approval of: (1) an exception to the application of tornado loads to the auxiliary building overhead crane specified in American Society of Mechanical Engineers (ASME) Nuclear Operations Group (NOG)-1, 2004, "Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)," (2) revisions to the design parameters applied to the auxiliary building overhead crane and its support structure to resolve conflicting licensing basis information; and (3) deletion of a commitment to remove all fuel stored in the pool adjacent to the cask loading pit during spent fuel cask handling based on the installation of a single-failure-proof cask handling system.

The supplements dated September 1, and October 5, 2011, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the Nuclear Regulatory Commission (NRC) staff's original proposed no significant hazards consideration determination as published in the *Federal Register* on September 6, 2011 (76 FR 55129).

2.0 REGULATORY ANALYSIS

The NRC staff reviewed the proposed method of analysis in accordance with General Design Criterion (GDC) 2, "Design Bases for Protection against Natural Phenomena," of Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10 of the *Code of Federal*

Regulations (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities" GDC 2 states:

> Structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions. The design bases for these structures, systems, and components shall reflect: (1) appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena and (3) the importance of the safety functions to be performed.

Section 1.4 of the CR-3 Final Safety Analysis Report (FSAR) describes the unit as designed and constructed with consideration of the proposed "General Design Criteria for Nuclear Power Plant Construction Permits" as published in the *Federal Register* (32 FR 10213) on July 11, 1967. Criterion 2, "Performance Standards (Category A)," of these criteria is similar to GDC 2 of Appendix A to 10 CFR Part 50, with the exception that the criterion used in design and constructing of CR-3 does not include consideration of the importance of the safety function to be performed.

Single-Failure-Proof Crane Guidelines:

In NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants" (ADAMS Accession No. ML070250180), the NRC staff provided regulatory guidelines for control of heavy load lifts to assure safe handling of heavy loads in areas where a load drop could impact on stored spent fuel, fuel in the reactor core, or equipment that may be required to achieve safe shutdown or permit continued decay heat removal. Section 5.1.1 of NUREG-0612 provides guidelines for reducing the likelihood of dropping heavy loads and provides criteria for establishing safe load paths; procedures for load-handling operations; training of crane operators; design, testing, inspection, and maintenance of cranes and lifting devices; and analyses of the impact of heavy load drops. The guidelines in Section 5.1.6 address measures to further reduce the probability of a load-handling accident through installation and operation of highly reliable load handling system. These measures include use of a single-failure-proof crane to improve reliability through increased factors of safety and through redundancy or duality in certain active components. Criteria for design of single-failure-proof cranes are included in NUREG-0554, "Single-Failure-Proof Cranes for Nuclear Power Plants" (ADAMS Accession No. ML110450636).

In Regulatory Issue Summary (RIS) 2005-25, Supplement 1, "Clarification of NRC Guidelines for Control of Heavy Loads" (ADAMS Accession No. ML071210434), the NRC staff announced the availability of revised guidance on handling systems and design of single failure proof cranes. The NRC staff presented this revised guidance in Revision I to Section 9.1.5, "Overhead Heavy Load Handling Systems" (ADAMS Accession No. ML062260190), of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," (hereafter, referred to as the Standard Review Plan (SRP)). This revised guidance endorsed the criteria for Type 1 cranes from ASME NOG-1-2004, for the design of new overhead heavy load handling systems as an acceptable method for satisfying the guidelines of NUREG-0554. The NRC staff considered the application of ASME NOG-1, 2004, criteria to the design of single-failure-proof handling systems an enhancement to NUREG-0554 guidelines.

Auxiliary Building and Fuel Handling Area Crane Design Basis:

The CR3 AB consists of a lower, reinforced concrete structure and a steel structure supporting the AB crane and the AB roof. The reinforced concrete portion extends from the AB foundation mat to the top of the spent fuel pool structure at the 162-foot elevation. The AB contains two spent fuel pools, Pool A and Pool B, separated by a removable gate. As shown on FSAR Figure 1-11, the pools are arranged along an east-west axis, with Pool B to the east and furthest from the reactor building. The southeast portion of Pool B contains a cask loading pit that is separated from the remainder of the pool by walls and a removable gate. The AB houses a cask decontamination pit located south of the cask loading pit. An elevated floor hatch at the 162-foot elevation, which allows access to the cask loading bay at the 119-foot grade elevation, is located at the extreme southern end of the AB. The crane runway was arranged to support movement of fuel transportation casks in the AB between the cask loading pit, the cask decontamination pit, and downward through the elevated hatch to a cask transport vehicle in the grade level cask loading bay. Thus, the crane runway extends along a north-south axis from above Pool B to the hatch over the cask loading bay.

In the license amendment request, the licensee described the configuration of the AB steel structure. The steel roof support structure consists of two major sections. The western section of the roof support structure has the top of the structural steel at about the 200-foot elevation and extends from the containment building outer wall over Pool A. The eastern section has the top of the structural steel at about the 209-foot elevation, and it covers Pool B, the cask loading pit, and the AB crane runway. The AB cask handling crane runway is supported by the AB steel crane/roof support structure. The crane rails are located at the 193-foot, 7-inch elevation. The crane rails are supported on steel crane girders, which are supported by vertical structural steel columns. The steel building columns are anchored to the concrete structure at the 143-foot and 162-foot elevations, and the steel columns for the cask loading bay are also anchored at grade, 119 foot elevation.

Section 5.1.1, "Classes of Structures and Systems," of the CR3 FSAR lists the AB (excluding the steel roof support structure) as a Class I structure. Section 5.4.1, "Structural Design Parameters," of the CR3 FSAR specifies the loads used in the design of Class I structures, which include tornado wind loads, tornado missiles, and the maximum hypothetical earthquake. Section 5.1.1 of the FSAR also listed the fuel handling area (AB) crane as a Class I system, but it was not designed as a single-failure-proof handling system during initial plant licensing. Section 9.6.1.5.a.5 of the FSAR describes that the AB crane (FHCR-5) and all supporting structures are designed to Seismic Class I. However, the support structure for the AB crane (the AB steel roof support structure) was not listed in FSAR Section 5.1.1 as a structure constructed to Class I or Class II criteria. Section 5.1.1.3 of the FSAR states: "The balance of structures, components, and systems are designed Class III." This statement indicates that the AB steel roof support structure was designed to Class III criteria. Through review of the original calculations, the licensee determined that the AB crane and steel roof support structure was designed for seismic, wind, and missile loads well below those associated with the Class I design criteria and consistent with Class III structural design criteria. Thus, the license amendment request proposed to resolve the discrepancy in the design of the AB crane and steel roof support structure through establishment of appropriate Seismic Class I structural design criteria and associated modifications to the AB crane and steel roof support structure.

The original CR3 licensing basis for protection of spent fuel from tornado missiles and certain heavy loads credited hollow box beams spanning the spent fuel pools that acted as missile shields. In order to resolve concerns with respect to continued cooling of spent fuel following a loss of a large area of the plant due to fires or explosions, the NRC staff approved permanent removal of the spent fuel pool missile shields in Amendment 226 to CR-3 Operating License DPR-72 (ADAMS Accession No. ML072550137) on October 24, 2007. The basis for approval of the amendment was that the consequences of credible tornado missiles would be bounded by the analyzed consequences of a fuel handling accident and that alternative means would be developed for protection against postulated heavy load handling accidents.

Based on the nonsingle-failure-proof design of the existing AB crane, CR-3 FSAR Section 9.6.3.1, "Spent Fuel Assembly Removal," currently contains the following description of fuel transfer operations:

> Following a decay period, the spent fuel assemblies will be removed from storage and loaded into the spent fuel shipping cask underwater for removal from the site. The Auxiliary Building Overhead Crane (FHCR-5) will be used to handle the casks. When the Auxiliary Building Overhead Crane is operated in the cask removal mode, there is no spent fuel stored in spent fuel pool B and the gate between pools A and B is in place and sealed.
>
> The spent fuel cask will not be moved over any stored spent fuel. The movement of the cask will be limited to the cask storage area in the pool (near column line K, Figure 1-11), to the adjacent decontamination pit (on column line M1), then through the hatch between column lines Q1 and S1 to a truck.

Spent fuel is currently stored in Pool B. With respect to future spent fuel movement to dry storage, CR-3 FSAR Section 9.6.4.7, "Auxiliary Building Cranes for Spent Fuel Casks," contains the following statement:

> At this time, CR3 does not have a single failure proof fuel cask crane. Also at this time, CR3 is not loading spent fuel casks. Loading spent fuel casks is planned for future years. Prior to making the first spent fuel cask lift, modifications will be made to the CR3 Auxiliary Building Crane to comply with single failure proof criteria.

3.0 TECHNICAL EVALUATION

3.1 Proposed Changes

The NRC staff evaluated the deviations from the existing CR-3 licensing basis and NRC guidance. The licensee proposed to support qualification of a new AB overhead crane (FHCR-5) as single-failure-proof in accordance with ASME NOG-1-2004 and to qualify and upgrade the crane support structure using the applicable load cases in ASME NOG-1-2004.

The licensee proposed performance of necessary physical modifications to upgrade the crane support structure from its original operational basis earthquake (OBE) seismic design basis to its proposed safe shutdown earthquake (SSE) seismic design basis. The licensee specifically requested NRC staff approval of the following:

1. An exception to ASME NOG-1-2004 pertaining to the application of tornado wind and tornado generated missile loading to FHCR-5 and its support structure. To support this request, CR-3 will prohibit/suspend cask handling operations when high wind conditions such as Tornadoes, Hurricanes, or Tropical Storms are forecast.

2. Revisions to the CR-3 Final Safety Analysis Report (FSAR) Sections 5.1.1.1.h and 9.6.1.5.a.5 to specifically identify the design parameters for FHCR-5 and its support structure. These changes resolve a deficiency due to conflicting licensing basis commitments.

3. Deletion of an FSAR commitment credited in the CR-3 Safety Evaluation Report dated July 5, 1974. This commitment is stated in FSAR Section 9.6.3.1, "Spent Fuel Assembly Removal." Due to the expansion of spent fuel storage over that originally considered, CR-3 can no longer unload fuel stored in the pool adjacent to the Cask Loading Pit for spent fuel cask handling. Additionally, unloading will be unnecessary with a single failure proof cask handling system.

3.2 Tornado Design Basis

The NRC staff evaluated the licensees proposed exclusion of tornado wind and missile loads from the set of load combinations evaluated for the AB cask handling crane. In Attachment 1 to the letter dated July 20, 2011, the licensee stated that the new crane design does not consider tornado loads because the AB steel roof support structure, the walls, and the roof above the spent fuel pool that enclose the FHCR-5 support structure were not designed to withstand tornado loads. This approach departs from ASME NOG-1-2004. As an alternative to the design code requirement in Section 4134(c) of ASME NOG-1-2004, the licensee has committed to not operate the crane for cask loading operations if an approaching or potential tropical storm, an approaching or potential hurricane, or a tornado watch or warning has been declared for the site in accordance with existing CR-3 plant procedures. As such, the licensee made the following commitment:

> Spent fuel cask loading activities using the Auxiliary Building overhead crane (FHCR-5) shall not commence if an approaching or potential tropical storm, an approaching or potential hurricane, or a tornado watch or warning has been declared for the site in accordance with CR-3 site procedures. If spent fuel loading activities with FHCR-5 are in progress when any of the above criteria are met, the load will be lowered to a safe location. Auxiliary Building overhead crane FHCR-5 will be moved to the south end of the Auxiliary Building, away from the spent fuel pools, and the crane secured.

The licensee also stated that it will modify and implement CR-3 site procedures and will conduct training, as needed, to implement this commitment before it performs a load test on FHCR-5. The licensee further stated that if severe weather arises unexpectedly during cask loading operations, it would determine the location for safe cask placement based on the activity underway when the weather condition occurs. The three safe locations identified for placement of the suspended transfer cask are (1) the cask loading pit, (2) the decontamination pit, and (3) the transfer trailer in the truck bay.

The licensee also stated that the CR-3 exceedance frequency for tornado strikes corresponding to a Category F2 tornado and above is estimated to be 2.25×10^{-6} per year. Based on the Fujita tornado intensity scale, a Category F2 tornado has wind speeds between 113 miles per hour and 157 miles per hour. During a spent fuel dry storage loading campaign, the mission time for the use of FHCR-5 involving the movement of heavy loads is estimated to be less than 200 hours per year. The exceedance frequency for strikes corresponding to a Category F2 tornado and above during FHCR-5 operation is therefore estimated to be 5.13×10^{-8} per year ($2.25 \times 10^{-6} \times 200/8760$). Because this estimate represents a low probability of occurrence, such an event is considered to be a very small threat to the safe conduct of the CR-3 independent spent fuel storage installation loading operations. In addition, the licensee has made a commitment not to operate the crane if an approaching or potential tropical storm, an approaching or potential hurricane, or a tornado watch or warning has been declared for the site. Because the weather conditions related to these declarations are the most likely to spawn tornados, the probability of a tornado strike while FHCR-5 is moving casks will be significantly lower than that calculated above. Therefore, the NRC staff found the licensee's request and commitment acceptable.

3.3 Seismic Evaluation

3.3.1 Introduction

The crane consists of a bridge frame comprising two girders that are connected by two end trucks mounted on wheels that roll in the transverse direction on the building runway girders. A trolley mounted on this frame on wheels rolls in the axial direction of the crane.

The crane is initially assumed to be parked on the AB runway girders. The drive wheels are assumed to be locked in place by a brake torque that is transmitted from the crane brake through the gear box and the drive wheel axles. The crane brakes are preloaded spring brakes that are set when an earthquake occurs or when the crane is not in service, and they are rated for certain static torque ratings. If the building is undergoing seismic motion, the crane will move in its transverse direction with the runway girders without rolling or sliding, as long as the drive wheel brake torque is not exceeded or, equivalently, as long as the traction between the drive wheels and the runway rails does not exceed the critical traction corresponding to the brake torque. Once the wheel traction exceeds the critical traction or, equivalently, once the torque on the drive wheels exceeds the brake torque, the crane is assumed to roll without slipping on the runway girders until a reversal of girder motion occurs. The crane will continue to roll until the girder motion is reversed. At this point, the brake torque reverses, and motion in the reverse direction will occur when the critical traction is again exceeded. The same effect occurs when the trolley is parked in place and the seismic motion occurs in the axial direction of the crane, perpendicular to the runway girders.

3.3.2 Evaluation

During the review, the NRC staff noticed that, on page 1 of Attachment 1 to the LAR, under AB design basis, the licensee stated the following:

> The steel support structure (from the 162[-]foot to the 209[-]foot elevation), including the building siding and roof, is not a Class 1 structure. As such, it is not designed or licensed to withstand tornado loads or to Class 1 seismic requirement. As the AB's steel structure is not classified as a Class I or Class II structure, it is by default Class III, in accordance with FSAR section 5.1.1.3.

The licensee also stated that it would include SSE loads in the analysis of AB structural members that serve as the crane support structure for CR-3 and that it would perform building modifications as a result of the new analyses. In addition, the licensee stated that the CR-3 FSAR specified no damping coefficients for Class III structures; therefore, the licensee intended to use the ASME NOG-1-2004 damping coefficients (4 percent for the OBE and 7 percent for the SSE) for the new coupled seismic analysis of the crane and crane support structure in accordance with ASME NOG-1-2004 guidelines.

The NRC staff also noticed that Section 9.6.1.5.a.5, "Fuel Handling System Equipment," of the CR-3 FSAR states that FHCR-5 and all supporting structures are seismic Class 1. However, in the LAR, the licensee stated that the steel support structure (from the 162-foot elevation to the 209-foot elevation), including the building siding and roof, is not a Class I structure.

In the letter dated February 23, 2011, the NRC staff asked the licensee to confirm the adequacy of the design, because the crane support structure is intended to continue to perform its safety function of supporting the loaded crane following an SSE, by providing the supporting documentation or information that demonstrates the satisfaction of the criteria addressed in Regulatory Position C.2 of Regulatory Guide (RG) 1.29, "Seismic Design Classification," and Paragraph II.8 of Section 3.7.2, "Seismic System Analysis," of the SRP.

In the letter dated July 20, 2011, the licensee stated that CR-3 was licensed to operate at full power in January 1977. The initial revision to the CR-3 FSAR was filed with the U.S. Atomic Energy Commission (AEC) on February 8, 1971, and was revised based on requests for additional information by approximately 40 amendments. The AEC issued the safety evaluation report (SER) for CR-3 on July 5, 1974. Because Revision 0 to the SRP was issued in November 1975, it was not part of the CR-3 licensing basis. Similarly, neither the CR-3 FSAR nor the AEC SER referenced RG 1.29. The NRC first applied RG 1.29 to CR-3 during the resolution of lessons learned from the accident at Three Mile Island.

Section 5.1.1.1.a of the CR-3 FSAR states that the AB is a Class I structure, except for the roof support structure. The roof support structure and crane support structure are one and the same in the FHCR-5 area. FSAR Section 9.6.1.5.a.5 states that the crane and all supporting structures are seismic Class I. This discrepancy between Chapter 5 and Chapter 9 of the FSAR was entered into the CR-3 corrective action program in November 2010. The review of the original Gilbert/Commonwealth, Inc., calculations confirmed that the roof support structure was not designed as a Class I structure.

The licensee also stated that improvements to the crane support structure are required to upgrade the new FHCR-5 to single-failure-proof status. The licensee intends to upgrade the CR-3 crane support structure as part of the crane upgrade project to withstand SSE seismic loads in accordance with NRC guidance on heavy load handling (ASME NOG-1-2004). The use of the damping values in ASME NOG-1-2004 for spectra portions that exceed the original design basis (OBE and extended to SSE) will not result in any significant difference when compared with the use of the damping values in RG 1.61, "Damping Values for Seismic Design of Nuclear Power Plants," Revision 1, issued March 2007. ASME NOG-1-2004 specifies damping values that are consistent with, or conservative in comparison to, the damping values in RG 1.61, which specifies various damping values depending on the application. The licensee will revise FSAR Sections 5.1.1.1 and 9.6.1.5 to reflect the upgraded design basis.

The NRC staff reviewed the licensee's responses and found them acceptable on the basis that the NRC issued Revision 0 to the SRP in November 1975 (1 year after the AEC issued the SER on CR-3), The licensee intends to upgrade the CR-3 crane support structure as part of the crane upgrade project to withstand SSE seismic loads in accordance with NRC guidance on heavy load handling (ASME NOG-1-2004), and it will update FSAR Sections 5.1.1.1 and 9.6.1.5 to reflect the upgraded design basis. Therefore, the NRC staff concern in question is resolved.

In the letter dated February 23, 2011, the NRC staff asked the licensee to provide technical justification for applying the ASME NOG-1-2004 crane structural damping values to the crane support structure instead of using the reconciled values (i.e., values applicable to the crane and crane support coupled structure that consider those damping values applied in the licensing analyses for other Class 1 steel structures at CR-3). This technical justification should address the rigidity of the connection between the reinforced concrete AB structure and the steel crane support structure.

In the letter dated July 20, 2011, the licensee stated that it analyzed the crane and crane support structure using a coupled model because the mass of the crane is large with respect to the crane runway and support structure. It used a response spectrum approach to analyze the coupled model. However, seismic requirements for the analysis of the crane and crane support structure, including damping values, differ. Therefore, the licensee defined and used OBE and SSE envelope spectra that concurrently bound the separate requirements for both the crane and crane support structure to achieve consistency and conservatism in the analysis. These spectra are consistent with those presented in the design input document prepared for the single-failure-proof upgrade of FHCR-5. The table below summarizes the constituent spectra and their damping values.

Constituents of Envelope Spectra for the Seismic Analysis of the Coupled Model

	STRUCTURE	CRANE
Constituent Spectra	GRS	FRS at a 162-foot elevation
Damping Considered in Present Analysis	1% OBE 1% SSE	4% OBE 7% SSE
CR-3 FSAR	1% welded steel 2.5% bolted steel	–
ASME NOG-1-2004	–	4% OBE 7% SSE
RG 1.61, Revision 1	3 - 5% OBE 4 - 7% SSE	-

The ground response spectra (GRS) at 1 percent damping were used as seismic input specific to building response. This selection was consistent with the original design of the steel building, which conservatively used the damping value specified in the FSAR for welded steel structures (1 percent) even though the building was primarily a bolted steel structure (2.5 percent). Although the design calculations for the steel building evaluate seismic input using the OBE design spectra, the new analysis evaluates both OBE and SSE GRS inputs, each considering 1 percent damping. Accepted structural damping values in Revision 1 to RG 1.61 are 3 percent (OBE) and 4 percent (SSE) for welded steel or bolted steel with friction connections and 5 percent (OBE) and 7 percent (SSE) for bolted steel with bearing connections. The 1 percent damping value used with GRS seismic input specific to the building analysis is thus conservative with respect to the recommended values in Revision 1 to RG 1.61 and is therefore in compliance.

The licensee also stated that the floor response spectra (FRS) at the 162-foot elevation of the underlying concrete building at 4 and 7 percent damping (OBE and SSE, respectively) were used as input specific to crane response. An uncoupled model would treat the crane as equipment and analyze it using FRS at the level of the crane runway girder (top of rail elevation 193 feet, 7 inches); however, a coupled model must incorporate input specific to the crane response into the overall seismic input that is applied to the base of the steel building structure, thus creating the need for the envelope spectra. The selection of 4 and 7 percent damping values used with FRS seismic input specific to the crane response were chosen for consistency with the crane damping requirements in ASME NOG-1-2004.

The licensee further stated that the current analysis uses a coupled model of the crane and steel crane support structure. Envelope spectra were defined to reconcile different seismic requirements for the crane and steel building in a conservative manner. The building analysis used GRS at 1 percent damping for OBE and SSE based on the original design basis of the steel crane support structure. This damping value is conservative with respect to the recommendations in Revision 1 to RG 1.61. Crane analysis used FRS at 4 and 7 percent damping for OBE and SSE, respectively, for consistency with the recommendations in ASME NOG-1-2004. GRS contributions govern the envelope spectra at relatively low frequencies, whereas FRS contributions govern them at relatively high frequencies. The crossing frequency was noted as 7.47 hertz for OBE and 7.85 hertz for SSE. A crossing frequency of 7.64 hertz represents an approximate average crossing frequency over various damping values of FRS and GRS constituents.

As the result of the review, the NRC staff found the following:

- Seismic Analysis Approach: The licensee used a coupled model of the crane and steel crane support structure. Envelope spectra were defined to reconcile different seismic requirements for the crane and steel building in a conservative manner. The crane analysis used FRS at 4 and 7 percent damping for OBE and SSE, respectively, consistent with the recommendations in ASME NOG-1-2004. The envelope of these GRS and FRS was used as the OBE and SSE seismic input to the coupled model. The GRS governs at relatively low frequencies, whereas the FRS governs at higher frequencies. The average crossing frequency is approximately 7.64 hertz, depending on specific GRS and FRS damping values.

- Structural Dynamics: The licensee stated that based on the relative flexibility of the steel crane support structure in comparison to that of the underlying concrete structure, the GRS portion of the envelope spectra controls the structure's seismic response more than the FRS portion does. Cumulative mass participation ratios confirm that the large majority of lateral response occurs at frequencies within the GRS portion. Note that the GRS damping considered is much less than that recommended in Revision 1 of RG 1.61.

- Alternative FRS Damping: The licensee also stated that if the damping values for the FRS contributions to the envelope spectra had been based on the recommendations for structural damping in Revision 1 to RG 1.61 instead of on those in ASME NOG-1-2004, a weighted average approach could have been used based on the numbers of different types of connections. Following this approach leads to a damping value of 6.84 percent for SSE. The SSE damping used is minimally higher than the weighted average value. This difference causes a maximum increase in envelope spectra of only 0.3 percent and only at frequencies above the crossing frequency. The licensee further stated that the effect that a small decrease in FRS damping has on structural response was evaluated using representative GTSTRUDL runs performed using a new SSE envelope spectra with conservative FRS damping of 6.5 percent, and the results were compared to those from corresponding runs at 7 percent FRS damping. As expected, increases in the interaction ratios of structural members were minimal-no member saw an increase of more than 0.003 (0.3 percent). For OBE, Revision 1 to RG 1.61 recommends using 5 percent damping for bolted structures with bearing connections. Because this structure is primarily a bolted structure with bearing connections, 5 percent damping would be reasonable. The new structural analysis uses a conservative 4 percent damping.

The NRC staff reviewed the licensee responses and found them acceptable because the damping guidance in Revision 1 to RG 1.61 for both the GRS and FRS contributions to the envelope spectra would not appreciably increase the seismic loads imposed on the steel crane support structure and would not impact the design of building modifications. The NRC staff concludes that the design of the crane and crane support structure meets the requirements in ASME NOG-1-2004, the intent of the guidance in Revision 1 to RG 1.61, and the intent of NUREG-0612 in regard to having a crane and crane support structure that will hold the maximum critical load during an SSE seismic event without a failure (i.e., load drop) that would reduce the function of equipment important to safety that is positioned below the crane at lower elevations. Therefore, the NRC staff concern in question is resolved.

The NRC staff asked the licensee to submit the design specification, design drawings, and calculations for the upgrade of the crane support structure for its review. In the letter dated July 20, 2011, the licensee stated that the modification package that installs the AB structural modifications is Engineering Change (EC) 70139, "Auxiliary Building Crane Upgrades." Revision 0 to EC 70139 issues the structural modifications to the AB. At a later date, after completion of the crane design, the licensee will revise EC 70139 to include final crane replacement information.

The analysis of the structure used three primary calculations: (1) S09-0036, (2) S10-0063, and (3) S10-0049. Calculation S09-0036, "Structural Analysis of the CR-3 Auxiliary Building for Cask Handling Crane (FHCR-5) Upgrade," evaluates the structure. An analysis model developed for the AB includes a stick model of the crane modeled in accordance with ASME NOG-1-2004, with properties provided by the crane vendor. The analysis includes the crane model since the mass of the crane is large with respect to the AB steel support structure and the decoupling criteria of ASME NOG-1 cannot be met. The placement of the crane bridge and trolley on the steel supporting structure is selected so that it captures the critical responses for the AB design. The GTSTRUDL calculation (S09-0036) uses the load cases in ASME NOG-1-2004 that match the load cases listed in the LAR.

The licensee also stated that the analysis revealed that several bracing members and connections are overstressed. Calculation S09-0036 is used as input to Calculation S10-0063, "Auxiliary Building Overhead Crane (FHCR-5) Supporting Steel Structure-Connection Evaluation." Calculation S10-0063 evaluates the overstressed connections and provides the design for the appropriate modifications. The overstressed beam and brace members are replaced based on the results of Calculation S09-0036.

The licensee further stated that calculation S10-0049, "Auxiliary Building Overhead Crane (FHCR-5) Supporting Steel Structure-ANSYS Model," is an ANSYS model of the AB, and it includes the stick model of the crane (supplied by the crane vendor). This calculation is not used to qualify the AB crane support structure; instead, this calculation is generated for use by the crane manufacturer and has been verified to match the GTSTRUDL calculation. The AB upgrade architect/engineer converted the GTSTRUDL model to an ANSYS model because that is the software the crane vendor uses in its analysis. The architect/engineer sent the ANSYS model of the AB structure (with a stick model of the crane) to the crane vendor for use in a coupled analysis of the crane and support structure.

During the review, the NRC staff noted that in Section 8.2, "Crane Model," of Calculation S09-0036, attached to the letter dated July 20, 2011, the licensee stated that the properties of the crane model are based on information provided by the crane vendor. In an e-mail dated

September 21, 2011, from the NRC to the licensee for CR-3, the NRC staff asked the licensee to confirm that all of the rails (main girders and bridges) are stable and restrained during seismic analysis as required by Figure 4154.3-1, "Crane Mathematical Model for Seismic Analysis," and as specified in Table 4154.3-1, "Restraint Condition at Nodes," of ASME NOG-1-2004.

In the letter dated October 5, 2011, the licensee stated that the crane manufacturer provided it with a simplified model of the new FHCR-5 for use in the structural analysis of the AB portions that serve as the crane support structure. The licensee used this input to prepare Calculation S09-0036, which is the GTSTRUDL model for the combined AB and simplified crane model. After preparing Calculation S09-0036, the licensee created a matching ANSYS model to model the AB and simplified crane model. The crane manufacturer used this model to analyze its crane. The boundary conditions at trolley and runway rails in the calculations are in accordance with ASME NOG-1-2004, Section 4154.3, "Boundary Conditions at Trolley and Runway Rails," which states that "Boundary conditions for the crane model shall be consistent with those specified in paragraph 4153.6, Fig. 4154.3-1, and Table 4154.3-1." The design criteria document (FPC118-PR-001) specifies the boundary conditions used.

The licensee also stated that the crane rails are stable and restrained in accordance with the requirements of ASME NOG-1-2004. The existing field conditions match the conditions that are modeled in the analysis. The analysis of FHCR-5 and the structure model the boundary conditions specified in Figure 4154.3-1 of ASME NOG-1-2004. In addition, FHCR-5 features include the "additional holding mechanisms" referred to in NOG-1-2004, Section 4153.6. The "additional holding mechanisms" are the seismic restraints on the bridge and trolley. The licensee further stated that the crane manufacturer has analyzed the seismic restraints for both the trolley and bridge for the worst case design loads and has determined that the seismic restraints are structurally adequate for these design loads.

Further, the licensee stated that the design of the crane ensures that the criteria in Section 4153.6 of ASME NOG-1-2004 are met: "The crane bridge (including gantry legs, if applicable) and trolley shall be provided with devices so that they remain on their respective runways during and after a seismic event."

The NRC staff reviewed the licensee's responses and found them acceptable because the load cases used in the analysis include SSE seismic loading. Because the original structure was designed to only OBE seismic loading, extensive modifications are required. EC 70139 will implement these modifications. The damping values used in the analysis are from ASME NOG-1-2004, and from the original design basis. A comparison of the structural damping values in Revision 1 to RG 1.61 to the damping values in ASME NOG-1-2004 was above evaluated. The modifications specified in EC 70139 will result in a crane and supporting structure that meet the single-failure-proof criteria in ASME NOG-1-2004. The crane manufacturer has analyzed the seismic restraints for both the trolley and bridge for the worst case design loads and has determined that the seismic restraints are structurally adequate for these design loads. As such, a load drop will not occur during an SSE seismic event. Therefore, upon completion of the necessary modifications to the AB cask handling crane and roof support structure, the design would resolve the FSAR structural design basis discrepancy by establishing a new design basis for the AB cask handling crane and roof support structure.

3.4 Protection of Stored Fuel

The licensee proposed to delete the commitment included in Section 9.6.3.1, "Spent Fuel Assembly Removal," of the CR-3 FSAR, which states:

> When the Auxiliary Building Overhead Crane is operated in the cask removal mode, there is no spent fuel stored in spent fuel pool B and the gate between pools A and B is in place and sealed.

The licensee stated that this commitment would prevent FPC from performing cask loading operations because there are an insufficient number of available storage locations in Pool A to remove all spent fuel from Pool B.

Instead, the licensee proposed to conduct spent fuel transfer cask handling using a single failure proof lifting system, comprised of the new FHCR-5, along with lifting devices and interfacing lift points meeting the guidance in NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," Section 5.1.6. The use of a single failure proof lifting system for the cask movements is an acceptable alternative to evaluating the consequences of potential load drops and providing appropriate mitigation, consistent with the guidelines of NUREG-0612. The use of a single failure proof handling system significantly reduces the likelihood of a load drop event. Thus, the cask drop event described in the CR-3 Safety Evaluation Report, Section 9.1.2 (dated July 5, 1974), involving a dropped cask striking the edge of the pool deck and rolling or tumbling into the adjacent spent fuel pool causing damage to stored fuel would no longer be considered a credible event. Similarly, there is no need to install and seal the gate between the two spent fuel pools during cask transfer operations because a cask drop that could damage pool B and drain both pools, would not be considered a credible event. The licensee stated that crane operation would be procedurally controlled, consistent with existing heavy load handling program commitments described in Section 9.6.4, "Control of Heavy Loads Program Description."

This change is consistent with the statement included in CR3 FSAR Section 9.6.4.7, "Auxiliary Building Cranes for Spent Fuel Casks," which described that a single failure proof handling system would be installed prior to beginning spent fuel storage cask handling. The existing FSAR description and proposed handling system upgrade provide reasonable assurance that cask loading activities would be completed safely with fuel in Sent Fuel Pool B, and, therefore, the proposed change is acceptable.

3.5 Summary

Based on its review, the NRC staff concludes that the licensee proposed to perform analyses to qualify the new single-failure-proof AB overhead crane (FHCR-5) in accordance with ASME NOG-1-2004 and to perform calculations to qualify and upgrade the crane support structure using the applicable load cases in ASME NOG-1-2004. The licensee will perform modifications as required to upgrade the crane support structure from its original OBE seismic design basis to its proposed SSE seismic design basis, taking an exception to ASME NOG 1-2004 pertaining to the application of tornado wind and tornado-generated missile loading to FHCR-5 and its support structure. To support this request, the licensee will prohibit or suspend cask handling operations when high-wind conditions, such as tornadoes, hurricanes, or tropical storms, are forecast. The licensee will also revise FSAR Sections 5.1.1.1.h and

9.6.1.5.a.5 to specifically identify the design parameters for FHCR-5 and its support structure. These changes, along with the deletion of an FSAR commitment in FSAR Section 9.6.3.1 credited in the CR-3 SER dated July 5, 1974, resolve a discrepancy between Chapter 5 and Chapter 9 of the FSAR. Because of the expansion of spent fuel storage over that originally considered, CR-3 can no longer unload fuel stored in the pool adjacent to the cask loading pit for spent fuel cask handling. Additionally, unloading will be unnecessary with a single-failure-proof cask handling crane. The licensee has provided reasonable assurance that FHCR-5 can operate safely in support of future dry shielded canister and transfer cask loading operations, and CR-3 will prohibit or suspend cask handling operations when high-wind conditions, such as tornadoes, hurricanes, or tropical storms, are forecast. Therefore, the NRC staff found the licensee's request and commitment acceptable.

4.0 REGULATORY COMMITMENT

In Attachment 5 of its letter dated July 20, 2011, the licensee has committed to the following with regards to its requested exception to ASME NOG-1-2004 requirements for the AB overhead crane (FHCR-5):

Commitment	Due Date
Spent fuel loading activities using the Auxiliary Building overhead crane (FHCR-5) shall not commence if an Approaching or Potential Tropical Storm, an Approaching or Potential Hurricane, or a Tornado Watch or Warning has been declared for the site in accordance with CR-3 site procedures. If spent fuel loading activities with FHCR-5 are in progress when any of the above criteria are met, the load will be lowered to a safe location. Auxiliary Building overhead crane FHCR-5 will be moved to the south end of the Auxiliary Building, away from the spent fuel pools, and the crane secured.	Procedures will be modified and implemented, and training conducted, as needed, prior to performing a load test on FHCR-5.

5.0 STATE CONSULTATION

Based upon a letter dated May 2, 2003, from Michael N. Stephens of the Florida Department of Health, Bureau of Radiation Control, to Brenda L. Mozafari, Senior Project Manager, Nuclear Regulatory Commission, the State of Florida does not desire notification of issuance of license amendments.

6.0 ENVIRONMENTAL CONSIDERATIONS

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (September 6, 2011; 76 FR 55129). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

7.0 CONCLUSION

The Commission 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) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of these amendments will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: Dan Hoang
Steve Jones

Date: December 27, 2011

December 27, 2011

Mr. Jon A. Franke, Vice President
Crystal River Nuclear Plant (NA2C)
ATTN: Supervisor, Licensing & Regulatory Programs
15760 W. Power Line Street
Crystal River, Florida 34428-6708

SUBJECT: CRYSTAL RIVER UNIT 3 NUCLEAR GENERATING – ISSUANCE OF AMENDMENT REGARDING DEPARTURE FROM A METHOD FOR EVALUATING THE AUXILIARY BUILDING OVERHEAD CRANE AND REVISIONS TO ASSOCIATED COMMITMENTS (TAC NO. ME5208)

Dear Mr. Franke:

The Nuclear Regulatory Commission (Commission) has issued the enclosed Amendment No. 239 to Facility Operating License No. DPR-72 for Crystal River Unit 3 Nuclear Generating Plant (CR-3) in response to your letter dated December 20, 2010, as supplemented by letters dated July 20, September 1, and October 5, 2011. The July 20, 2011, submittal entirely replaced the licensee's submittal dated December 20, 2010. Florida Power Corporation (the licensee) will be replacing the AB crane to support operating an onsite independent spent fuel storage installation, under its general license, in order to maintain full-core offload capacity in the spent fuel pools located in the CR-3 auxiliary building. In support of future dry shielded canister/transfer cask loading operation, the licensee is replacing the AB overhead crane. The licensee requested departure from a method for evaluating the auxiliary building overhead crane, revisions to the CR-3 Final Safety Analysis Report (FSAR), and changes to an associated commitment in the FSAR.

A copy of the safety evaluation is enclosed. The notice of issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

/RA by SLingam for/

Farideh E. Saba, Senior Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-302

Enclosures:
1. Amendment No. 239 to DPR-72
2. Safety Evaluation

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NAME	SLingam	CSola	MMurphy (A)	GCasto	BMizzuno	DBroaddus (TOrf for)	FSaba (SLingam for)
DATE	12/7/11	12/7/11	11/02/11	11/15/11	12/20/11	12/23/11	12/27/11

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