Progress Energy

Crystal River Nuclear Plant
Docket No. 50-302
Operating License No. DPR-72

Ref: 10 CFR 50.90

July 20, 2011
3F0711-04

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

Subject: Crystal River Unit 3 – License Amendment Request #310, Revision 1, Departure from a Method of Evaluation for the Auxiliary Building Overhead Crane, Revisions to Associated Commitments, and Response to Request for Additional Information (TAC No. ME5208)

References:
1. NRC to CR-3 email dated February 23, 2011, subject ME5208 Final RAIs. (ML110550663 and ML110550667)
2. Crystal River Unit 3 to NRC Letter dated December 20, 2010, "Crystal River Unit 3 – License Amendment Request #310, Revision 0, Departure from a Method of Evaluation for the Auxiliary Building Overhead Crane, and Revisions to Associated Commitments (ML103560837)"

Dear Sir:

Pursuant to 10 CFR 50.90, Florida Power Corporation (FPC), doing business as Progress Energy Florida, Inc. (PEF), hereby provides Revision 1 to License Amendment Request (LAR) #310, and the response to a Request for Additional Information forwarded by Reference 1. Crystal River Unit 3 (CR-3) will be constructing and operating an on-site Independent Spent Fuel Storage Installation (ISFSI) as a general licensee under the provisions of 10 CFR 72, Subpart K in order to maintain full-core offload capacity in the spent fuel pools. The spent fuel pools are located in the CR-3 Auxiliary Building (AB). In support of future dry shielded canister/transfer cask loading operations, FPC is replacing the existing AB overhead crane with a new single failure proof crane designed in accordance with ASME NOG-1-2004, "Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)."

FPC proposes to perform analyses to qualify the new single failure proof AB overhead crane (FHCR-5) in accordance with ASME NOG-1-2004, and perform calculations to qualify and upgrade the crane support structure using the applicable load cases in ASME NOG-1-2004. FPC will perform modifications as required 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. FPC specifically requests NRC 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

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Progress Energy Florida, Inc.
Crystal River Nuclear Plant
15760 W. Powerline Street
Crystal River, FL 34428

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 crane.

This submittal replaces Reference 2, LAR #310, Revision 0, in its entirety.

Neither the CR-3 Improved Technical Specifications nor the Facility Operating License are affected by this LAR.

A new regulatory commitment is identified in Attachment 4.

FPC requests approval of this proposed LAR by December 20, 2011, with a 180 day implementation period. This time frame is required to perform all modification activities and preparations to commence cask handling operations.

In accordance with 10 CFR 50.91, a copy of this application is being provided to the designated State of Florida Official.

The CR-3 Plant Nuclear Safety Committee has reviewed this request and recommended it for approval.

If you have any questions regarding this submittal, please contact Mr. Dan Westcott, Superintendant, Licensing and Regulatory Programs at (352) 563-4796.

Sincerely,

Jon A. Franke
Vice President
Crystal River Nuclear Plant

JAF/pk

Attachments:
1. Background, Description of the Proposed License Amendment Request, and Technical Analysis
2. No Significant Hazards Consideration Determination, Applicable Regulatory Requirements, and Environmental Impact Evaluation
3 Proposed Revised Final Safety Analysis Report Pages – Marked-Up Pages
4. List of Regulatory Commitments
5. Response to Request for Additional Information

Enclosures:
A. Drawings of Existing Auxiliary Building Roof Steel Framing
B. CD-ROM of Auxiliary Building Modification Drawings and Installation Instructions (EC 70139)

cc: NRR Project Manager
Regional Administrator, Region II
Senior Resident Inspector
State Contact

STATE OF FLORIDA

COUNTY OF CITRUS

Jon A. Franke states that he is the Vice-President, Crystal River Nuclear Plant for Florida Power Corporation, doing business as Progress Energy Florida, Inc.; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission the information attached hereto; and that all such statements made and matters set forth therein are true and correct to the best of his knowledge, information, and belief.

Jon A. Franke
Vice President
Crystal River Nuclear Plant

The foregoing document was acknowledged before me this 20 day of July, 2011, by Jon A. Franke.

Signature of Notary Public
State of Florida

CAROLYN E. PORTMANN
Commission # DD 937553
Expires March 1, 2014
Bonded Thru Troy Fain Insurance 800-385-7019

(Print, type, or stamp Commissioned Name of Notary Public)

Personally Known ✓ -OR- Produced Identification ______

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302/LICENSE NUMBER DPR-72

LICENSE AMENDMENT REQUEST #310, REVISION 1

ATTACHMENT 1

BACKGROUND, DESCRIPTION OF THE PROPOSED LICENSE AMENDMENT REQUEST, AND TECHNICAL ANALYSIS

BACKGROUND, DESCRIPTION OF THE PROPOSED LICENSE AMENDMENT REQUEST, AND TECHNICAL ANALYSIS

1.0 Background

The purpose of the Crystal River Unit 3 (CR-3) Dry Fuel Storage project is to design, build and place into operation an Independent Spent Fuel Storage Installation (ISFSI). Florida Power Corporation (FPC) has selected the Transnuclear (TN) Standardized NUHOMS system as the dry spent fuel storage system for use at the CR-3 ISFSI under a 10 CFR 72, Subpart K, general license (Certificate Number 1004). The TN Standardized NUHOMS system provides for the horizontal storage of a Dry Shielded Canister (DSC) inside a ventilated, concrete horizontal storage module (HSM). Each DSC has a capacity to store up to 32 spent fuel assemblies. The ISFSI will be located within the CR-3 Protected Area and will be designed to provide storage capacity for a total of 80 HSMs.

CR-3 was originally designed and licensed for Spent Fuel shipping cask loading with two spent fuel pools separated by a removable gate, a cask loading pit and a cask decontamination pit located in the Auxiliary Building (AB). A 120-ton overhead crane (FHCR-5) was provided to lift and position fuel transportation casks in the AB and to deliver them to a transport vehicle through an elevated hatch to a grade level truck bay. FHCR-5 was designated as a Class I component but was not designed as single failure proof during initial plant design and licensing.

Auxiliary Building (AB) Design Basis

The AB, with the exception of the steel roof support structure, is designated as a Class I structure as described in the CR-3 Final Safety Analysis Report (FSAR), Section 5.1, "Structural Design Classification." The concrete portion of the AB, which extends from the foundation mat to the 162 foot elevation at the top of the spent fuel pool, has been designed for the loads listed in FSAR Section 5.4.1.2, "Abnormal Loads (Protection of Safeguards)," which include seismic and tornado loads (including tornado generated missiles). The steel crane/roof support structure including the building siding and roof was designed to withstand Operational Basis Earthquake (OBE) loads based on Ground Response Spectra. However, it was not designed to withstand Safe Shutdown Earthquake (SSE) loads, tornado loads, or tornado generated missile loads.

FHCR-5 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 steel columns for the cask loading bay are also anchored at grade, 119 foot elevation. The steel crane/roof support structure was designed for a wind load of 110 miles per hour (mph).

A review of the CR-3 FSAR and design basis calculations indicate the following were used in design of the AB steel crane support structure

Wind/Hurricane	Licensing Basis: Per applicable building code requirements (Ref.: FSAR 5.1.2.4). Design Basis: 110 mph basic wind speed used in calculations.
Tornado	Licensing Basis: Per applicable building code requirements (Ref.: FSAR 5.1.2.4). The Florida Building Code does not require structural design to include a tornado load case. Design Basis: AB crane support structure is not designed for tornado wind or missile.
Seismic	Licensing Basis: A deficiency exists in the CR-3 licensing basis (Nuclear Condition Report 434494) due to conflicting statements of the seismic qualification for integrated FHCR-5 structures and components: Per FSAR 5.1.1.1.a, the Auxiliary Building roof support structure, integral to the FHCR-5 crane support structure, is not Class I. Per FSAR 5.1.1.1.h, FHCR-5 as an independently manufactured component is Class I. Per FSAR 9.6.1.a.5, FHCR-5 and all supporting structures are Seismic Class I. Design Basis: The original plant design calculations included a seismic analysis for the crane support structure using an Operating Basis Earthquake* in response to ground acceleration of 0.05g horizontal and 0.033g vertical. This approach is consistent with FSAR Sections 5.1.2.3 and 5.2.1.2.9.a for the seismic design of Class II structures. Use of ground level OBE response spectra is the basis for the development of coefficients that were used to develop equivalent static seismic acceleration values at the various building elevations. Forces, based on these accelerations, were then used to design the various structural members of the AB crane support structure.

*Operational Basis Earthquake (OBE) = Design Basis Earthquake (DBE) = Seismic load based on 0.05g horizontal ground motion

Safe Shutdown Earthquake (SSE) = Maximum Hypothetical Earthquake (MHE) = Seismic load based on 0.10g horizontal ground motion

2.0 Description of Changes and Proposed License Amendment Request

To support the safe movement of the DSC and transfer cask (TC) within the CR-3 AB during cask loading operations, the AB overhead crane (FHCR-5) is being replaced with a new single failure proof crane that meets the criteria specified in ASME NOG-1-2004, "Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)." FHCR-5 will be a Type I crane as defined in ASME NOG-1-2004, Section 1150. This new crane will be used to move a loaded or unloaded TC between the cask loading pit, the decontamination pit, and the transfer trailer in the truck bay. The new FHCR-5 overhead crane has an upgraded main hook design rated load of 130 tons, a 10-ton increase over the original FHCR-5 capacity. Portions of the AB, which serve as crane support structure, are being analyzed and upgraded to meet the seismic demand requirements of a SSE.

Further discussion of the application of SSE loads to the crane and crane support structure are provided in the Technical Analysis section which follows. A conservative approach was taken utilizing a spectrum which envelopes the original design basis ground response spectra (GRS) and floor response spectra (FRS) consistent with ASME NOG-1-2004. The crane model is included in the analysis since the mass of the crane is large with respect to the Auxiliary Building steel crane/roof support structure and the decoupling criteria of ASME NOG-1-2004 cannot be met. The placement of the crane bridge and trolley on the steel supporting structure is

selected in such a way that it captures the critical responses for the design of the Auxiliary Building.

FPC has reviewed the load combinations specified in ASME NOG-1-2004 and the load cases used in the original CR-3 design basis calculations. To assure compatibility between the building and crane design, FPC is using the following load cases:

Load Combinations Used to Structurally Qualify Auxiliary Building Steel Structure

Load Combination	Allowable Stress Increase
$D + L + L_c$	None
$D + L + L_c + I_V$	None
$D + L + L_c + I_T$	None
$D + L + L_c + I_L$	None
$D + L + W$	1.33
$D + L + L_c + E$	1.33
$D + L + L_c + E'$	Elastic Limit
$D + L + L_c + I_V + W_o$	1.33
$D + L + L_c + I_T + W_o$	1.33
$D + L + L_c + I_L + W_o$	1.33
$D + L + L_c + E + W_o$	1.33
$D + L + L_c + E' + W_o$	Elastic Limit
$D + L + E + W_o$	1.33
$D + L + E' + W_o$	Elastic Limit

$L = L_f + L_r$

D	=	Dead Load Including Crane Members
L_f	=	Floor Live Load
L_r	=	Roof Live Load
L_C	=	Crane Live Load
W	=	Wind Load, 110 miles per hour (mph)
W_O	=	Operating Wind Load, 39 mph
E	=	Earthquake Load (OBE)
E'	=	Earthquake Load (MHE) (Note: This is same as SSE)
$I_{V,T,L}$	=	Crane Impact Load (vertical, transverse, longitudinal)

Key areas of differences in the load cases above, and the load cases specified in ASME NOG-1-2004 and/or the original design basis calculations are as follows:

1. There is no tornado load case in the load cases shown above that will be used to qualify the AB for the upgraded FHCR-5 crane. ASME NOG-1-2004, Section 4140, includes a load case for tornado wind. Section 4134(c) specifies that tornado wind and tornado generated missiles be considered. An exception to ASME NOG-1-2004 is being requested, and administrative controls, as committed in Attachment 4, are proposed to minimize the likelihood that FHCR-5 will be handling a spent fuel cask during tornado conditions.

2. SSE seismic loads are included in the table above. SSE loads were not included in the original CR-3 design basis calculations for the crane support structure. In the process of upgrading FHCR-5 to single failure proof criteria, FPC is adding these SSE loads to the analysis of AB structural members that serve as the crane support structure, and FPC will perform building modifications as a result of the new analyses. The ASME NOG-1-2004 damping coefficients (4% for OBE and 7% for SSE) are being applied to the crane and crane support structure in the new seismic analysis, along with original GRS damping values and spectra where original damping values and spectra govern. Note that an envelope response spectrum is being used in which the GRS spectrum with 1% SSE damping (as was used in the original design basis calculations for Class I structures) controls at lower frequencies. The FRS spectrum with NOG-1 damping values governs at higher frequencies. FPC is performing a coupled seismic analysis of the new crane and the AB steel support structure in accordance with ASME NOG-1-2004. The RAI-2 response that is attached evaluates the differences between ASME NOG-1-2004 damping coefficients and application of Regulatory Guide (RG) 1.61 (2007) damping coefficients and demonstrates that they are essentially equivalent. The resulting loads on the crane support structure from using ASME NOG-1-2004 vs. RG 1.61 (2007) damping coefficients are considered equivalent for this type of calculation. The comparison between ASME NOG-1-2004 damping coefficients and RG 1.61 (2007) damping coefficients is also summarized in the Technical Analysis that follows.

   All applicable ASME NOG-1-2004, Section 4140, load cases will be applied to the crane and crane support structure, except the tornado load case (ASME NOG-1-2004, Section 4140, load case P_c14). The crane is an indoor crane and no wind load is applicable to the crane design. Wind loads are only applied to the AB crane support structure. Operating wind loads in these load cases will be combined with seismic loads to ensure that the building and crane are analyzed in a consistent manner. Operating wind load is based on minimum sustained tropical storm force winds. Note that ASME NOG-1-2004 load cases combining wind and seismic exceed the CR-3 design basis for Seismic Class I structures, as CR-3 design basis for seismic does not include wind loads acting simultaneously with seismic loads. Appropriate modifications will be performed to the building members that serve as the crane support structure.

   Load cases that include abnormal loads, as defined in NOG-1-2004, Section 4136(c) are not applicable since there are no pressurized fluid systems in the vicinity that can affect the crane or its supports. The construction load is calculated using the crane rated load.

License Amendment Request (LAR) #310, Revision 1, requests NRC approval of the following:

1. An exception to ASME NOG-1-2004 criteria pertaining to the application of tornado wind and tornado generated missile loading to the AB overhead crane and crane support structure. This constitutes approval of a departure from one requirement of an approved method of evaluation used for the design and structural analysis of the new single failure proof AB overhead crane. To support this change request, CR-3 will prohibit/suspend cask handling operations when high wind conditions such as tornadoes, hurricanes, and tropical storms are forecast. The proposed commitment is shown in Attachment 4.

2. Approval of 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 revisions will also reconcile a deficiency in the licensing basis, as described in the FSAR, where the classification of the crane/roof support structure and crane are inconsistently stated. The inconsistencies are illustrated below by providing statements from the FSAR:

FSAR Section 5.1.1.1 states:
Class I – Structures, Components, and Systems

a. *Buildings and Structures*
   - ◊ *Auxiliary building (excluding the steel roof support structure)*

h. *Miscellaneous Systems and Components*
   - ◊ *Fuel handling area crane*

Note: 5.1.1.1.h is referring to the classification of the fuel handling area crane, FHCR-5, as an independently manufactured component

FSAR Section 9.6.1.5.a.5 states:

a. *The Auxiliary Building Overhead Crane (FHCR-5):*

   5. *is designed to ensure no loss of function from seismic disturbance while lifting rated maximum capacity loads. The crane and all supporting structures are designed to Seismic Class I.*

The seismic design of the upgraded FHCR-5 and its support structure will be in accordance with NOG-1-2004, along with original GRS damping and spectra where original GRS damping values and spectra govern. This is demonstrated in the Technical Analysis that follows. Attachment 3 includes the proposed FSAR changes.

Note: Damping and response spectra for seismic design are only in accordance with NOG-1-2004 where NOG-1 exceeds original design basis. An envelope spectrum is used such that if original GRS spectra with 1% damping yields higher accelerations in the lower frequency range, corresponding accelerations are used in the design. NOG-1 damping and FRS spectra control as frequencies increase (i.e., yield higher accelerations than GRS at higher frequencies).

3. Deletion of an FSAR commitment that was credited in the CR-3 Safety Evaluation Report, dated July 5, 1974. CR-3 FSAR, Section 9.6.3.1, "Spent Fuel Assembly Removal," currently 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."

   This FSAR commitment is no longer required or applicable with a single failure proof cask handling crane that will preclude a cask drop event by design. Attachment 3 includes the proposed FSAR changes.

Neither the CR-3 Improved Technical Specifications nor the Facility Operating License are affected by this LAR.

3.0 TECHNICAL ANALYSIS

3.1 ASME NOG-1-2004 Exception

FPC is using ASME NOG-1-2004 for the design of the new FHCR-5. ASME NOG-1-2004 has been endorsed by the NRC in Regulatory Issue Summary (RIS) 2005-25, Supplement 1, "Clarification of NRC Guidelines for Control of Heavy Loads," as an acceptable method for meeting the guidance in NUREG-0554, "Single-Failure-Proof Cranes for Nuclear Power Plants." The new FHCR-5 will meet the criteria in ASME NOG-1-2004 for a Type I crane except for ASME NOG-1-2004, Section 4134(c), "Tornado Wind."

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 of ASME NOG-1-2004, Section 4134(c), a commitment is being made 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. The following new commitment is proposed:

> 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.

CR-3 site procedures will be modified and implemented, and training will be conducted, as needed, in order to implement this commitment prior to performing a load test on FHCR-5.

During cask loading operations, if severe weather arises unexpectedly, the location for safe cask placement will be determined depending upon the activity under way when the weather condition occurs. The following three safe locations are identified for placement of the suspended TC: (a) the cask loading pit; (b) the decontamination pit; and (c) the transfer trailer in the truck bay.

Probability of a Tornado Strike During FHCR-5 Operation

At CR-3, the exceedance frequency for tornado strikes corresponding to Category F2 and above is estimated to be 2.25 x 10^{-6} per year. Category F2 corresponds to a tornado with wind speeds between 113 mph and 157 mph, per the Fujita scale. During a spent fuel dry storage loading campaign, the mission time for the use of FHCR-5 involving movement of heavy loads is estimated to be less than 200 hours per year. The exceedance frequency for strikes

corresponding to Category F2 and above tornadoes during FHCR-5 operation is therefore estimated to be 5.13 x 10^{-8} per year (2.25 x 10^{-6} x 200/8760). This represents a low probability of occurrence, and therefore is considered to be a very small threat to the safe conduct of the CR-3 ISFSI loading operations. In addition, a commitment is made 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. Since these conditions are the most likely to spawn tornados, the probability of a tornado strike when FHCR-5 is being operated to move casks will be significantly lower than that calculated above.

3.2 FSAR Sections 5.1.1 and 9.6.1.5 Revisions and Seismic Design of the Crane Support Structure

The steel structure of the Auxiliary Building, above elevation 162 ft, serves as both the FHCR-5 crane support/trolley rails and the support for the roof above the crane. In Section 5.1.1.1.a of the FSAR the Auxiliary Building roof support structure is excluded as being classified as Seismic Class I. It is not listed in FSAR Section 5.1.1.2 as a structure classified as Seismic Class II so by FSAR Section 5.1.1.3, *"The balance of structures components and systems are designed Class III."* Review of the original calculations show that the design is not consistent with Seismic Class I. This is evident as the structure is not designed for SSE seismic loading, and is only designed for OBE seismic loading. Section 5.1.1.1.h, *"Miscellaneous Systems and Components,"* refers to FHCR-5 as Class I; this is interpreted to mean to the design and qualification of FHCR-5 as a component manufactured and supplied for installation in the CR-3 Auxiliary Building.

In referring to FHCR-5, FSAR Section 9.6.1.5.a.5 is clear in stating, *"The crane* (FHCR-5) *and all supporting structures are designed to Seismic Class I."* The FSAR changes requested herein will resolve this deficiency in the licensing basis for CR-3, and the associated modifications to the Auxiliary Building steel crane and roof support structure will provide a single failure proof crane designed to current NRC guidance.

CR-3 recognizes that the current design of the crane support structure is inadequate to support a single failure proof crane. As part of the Dry Fuel Storage Project, Engineering Change 70139 is upgrading the crane and the crane support structure to meet the design requirements of NOG-1-2004, "Rules for Construction of Overhead and Gantry Crane (Top Running Bridge, Multiple Girder)." NOG-1-2004 requires a coupled analysis that includes both the crane and its support structure (due to the mass of the crane relative to the mass of the structure). As a result of this upgrade, the Auxiliary Building crane support structure is being modified such that it can withstand SSE seismic loads in combination with other loading conditions specified in NOG-1-2004, Section 4140 (with the exception of tornado loading). The upgraded support structure is designed to support the crane with a lifted load and an SSE event without a crane failure or load drop. Structural damping values specified in NOG-1-2004, Section 4153.8 are used in the structural analysis, together with those used in the original design. These NOG-1 damping values are nearly identical to damping values specified in Regulatory Guide 1.61 (2007). Minor differences in damping values between NOG-1-2004 and Regulatory Guide 1.61 (2007), as applicable to the Auxiliary Building structure, are justified in the Request for Additional Information #2 (RAI-2) Response, which is included as Attachment 5 to this LAR. An excerpt of RAI-2 is as follows:

> "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. Building analysis used ground response spectra (GRS) at 1% 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 recommendations from NRC RG 1.61 (2007). Crane analysis used floor response spectra (FRS) at 4% and 7% damping for OBE and SSE, respectively, consistent with recommendations from ASME NOG-1-2004. The envelope of these GRS and FRS were used as the OBE and SSE seismic input to the coupled model. At relatively low frequencies, the GRS governs, while the FRS governs for higher frequencies. The average crossing frequency is approximately 7.64 Hz, depending on specific GRS and FRS damping values."

Based on its relative flexibility compared with the underlying concrete structure, seismic response of the steel crane support structure is controlled more by the GRS portion of the envelope spectra than the FRS portion. 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 NRC RG 1.61 (2007).

If the damping values for the FRS contributions to the envelope spectra had been based on recommendations for structural damping in NRC RG 1.61 (2007), rather than from ASME NOG-1-2004, a weighted average approach could have been used for SSE damping based on the numbers of different types of connections. Following this approach leads to damping value of 6.84% for SSE. For SSE, the damping used is minimally higher than the weighted average value. This difference causes a maximum increase in envelope spectra of only 0.3%, and only at frequencies above the crossing frequency. The effect that a small decrease in FRS damping has on structural response was evaluated using GTSTRUDL runs performed using a new SSE envelope spectra with conservative FRS damping of 6.5%, with results compared to those from corresponding runs at 7% 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%). For OBE, RG 1.61 (2007) recommends use of 5% damping for bolted structures with bearing connections. Since this structure is primarily a bolted structure with bearing connections, 5% would be reasonable for damping. The new structural analysis uses 4% damping, which is conservative.

Based on the above, following damping guidance from NRC RG 1.61 (2007) 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. It is concluded that the design of the crane and crane support structure meet both the requirements of ASME NOG-1 and the intent of RG 1.61 (2007).

As a result of the structural analysis that is described above, extensive modifications will be required to upgrade from original OBE seismic design basis to an SSE seismic design basis. Modifications will be implemented by Engineering Change 70139, "Auxiliary Building Crane Upgrades." Modifications are described further in response to RAI-4.

To reflect the upgrade of FHCR-5 to single failure proof status, and to accurately reflect the proposed licensing basis, FPC requests approval of changes to FSAR Sections 5.1.1.1.h and 9.6.1.5.a.5 provided in Attachment 3.

3.3 Deletion of FSAR Commitment

CR-3 FSAR, Section 9.6.3.1, "Spent Fuel Assembly Removal" 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."

This requirement will prevent FPC from performing cask loading operations because it is not currently possible to remove all spent fuel from pool B. This FSAR commitment was made during initial CR-3 licensing prior to any spent fuel being loaded into pool B and is credited in the CR-3 Safety Evaluation Report, Section 9.1.2, "Spent Fuel Storage," dated July 5, 1974. Industry expectations regarding spent fuel storage and offsite shipping options at that time were different from today's reality of high density spent fuel pool storage.

This FSAR commitment is being deleted because spent fuel transfer cask handling with FHCR-5 will be conducted 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. With a single failure proof lifting system, including the new FHCR-5, a load drop accident will be an extremely low probability event below the threshold requiring consideration. 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 is not considered credible. Similarly, there is also 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, is no longer considered a credible event. Crane operation will be procedurally controlled. Therefore, this commitment, intended to protect the fuel and pool inventory, is no longer required.

FPC requests approval of the FSAR changes to FSAR Section 9.6.3.1 provided in Attachment 3.

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302/LICENSE NUMBER DPR-72

LICENSE AMENDMENT REQUEST #310, REVISION 1

ATTACHMENT 2

REGULATORY ANALYSIS

NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION, APPLICABLE REGULATORY REQUIREMENTS AND ENVIRONMENTAL IMPACT EVALUATION

NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

Proposed License Amendment Request (LAR) #310, Revision 1, seeks NRC approval of the method of analysis used in the qualification of new fuel handling crane, FHCR-5, and portions of the Auxiliary Building (AB) that serve as the crane support structure. LAR #310 also requests NRC approval to revise the Crystal River Unit 3 (CR-3) Final Safety Analysis Report (FSAR) description of the FHCR-5 crane and its support structure, and delete a commitment in the FSAR. The deleted commitment, related to use of the existing FHCR-5 for cask handling, is no longer required as a result of replacing crane FHCR-5 with a single failure proof design meeting the guidance in ASME NOG-1-2004, "Rules for Construction of Overhead and Gantry Cranes, (Top Running Bridge, Multiple Girder)." Specifically, FPC requests the following:

a) Approval for a departure from the requirements of an approved method of evaluation used for the design and structural analysis of the new single failure proof AB overhead crane pertaining to tornado loads. Administrative controls are proposed to minimize the likelihood that FHCR-5 will be handling a spent fuel cask during tornado conditions.

b) Revisions to the CR-3 FSAR Sections 5.1.1 and 9.6.1.5 to specifically identify the design parameters for FHCR-5 and its support structure.

c) Approval to delete an FSAR commitment related to the use of the existing FHCR-5 for cask handling.

1. Does not involve a significant increase in the probability or consequences of an accident previously evaluated.

The proposed LAR does not involve plant equipment used to operate or shutdown the reactor or in the mitigation of accidents described in Chapter 14 of the FSAR. FHCR-5 will be restricted from movement over fuel stored in either of the spent fuel pools by administrative controls and designated safe load paths when moving spent fuel casks, and it will be single failure proof so a cask load drop accident affecting stored spent fuel is prevented. The change provides justification for an exception to a Code requirement pertaining to the design and qualification of the new single failure proof crane in the AB. The new crane will meet the design specifications in ASME NOG-1-2004, with the exception of Section 4134 (c). The change also includes 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. The revised FSAR description of the crane will meet the intent of the original description and will ensure the crane will exceed the design requirements of the original design. With the replacement of the crane, the occurrence of a cask load drop accident is not considered credible. As a result, the proposed change does not increase the probability or consequences of a load drop accident previously evaluated that could impact stored fuel and/or pool structural integrity.

Therefore, the proposed change does not involve significant increase in the probability or consequences of an accident previously evaluated.

2. Does not create the possibility of a new or different kind of accident from any accident previously evaluated.

The power generation portion of the plant is unaffected by the proposed change, which is limited to the design and analysis of a new overhead crane in the AB. The location and design functions of the AB overhead crane remain as they are currently described in the CR-3 FSAR. Overall, the design of the crane is being enhanced to single failure proof in order to reduce the likelihood of an uncontrolled lowering of the load due to an unforeseen malfunction or subcomponent failure. Portions of the design and analysis of the crane require NRC approval because they deviate from the NRC-endorsed design code for single failure proof cranes and the CR-3 licensing basis. The new single failure proof crane will be used to move a loaded or unloaded transfer cask between the cask loading pit, the decontamination pit, and the transfer trailer in the truck bay. Any credible event involving the fuel handling evolutions are bounded by existing FSAR analyses.

Therefore, the proposed change will not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does not involve a significant reduction in the margin of safety.

This proposed LAR involves the replacement of the existing non-single failure proof AB overhead crane with a new single failure proof crane. The new crane will meet the design specifications found in ASME NOG-1-2004, with the exception of Section 4134 (c). ASME NOG-1-2004 has been endorsed by the NRC in Regulatory Issue Summary (RIS) 2005-25, Supplement 1, "Clarification of NRC Guidelines for Control of Heavy Loads," as an acceptable means of meeting the criteria in NUREG-0554, "Single Failure Proof Cranes for Nuclear Power Plants." The ASME NOG-1-2004 design code has been found by the NRC to provide adequate protection and safety margin against the uncontrolled lowering of the lifted load. The occurrence of a cask load drop accident is considered not credible when the load is lifted with a single failure proof lifting system meeting the guidance in NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," Section 5.1.6, "Single Failure Proof Handling Systems." As a result, the proposed change has no adverse impact on new fuel, stored spent fuel, cooling capacity of the pool, or structural integrity of the pool. Similarly, the margin of safety for the operation and safe shutdown of the plant will not be affected by the proposed change.

Therefore, the proposed change does not involve a significant reduction in the margin of safety.

Based on the above, Florida Power Corporation (FPC) concludes that the proposed license amendment request presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c) and, accordingly, a finding of "no significant hazards consideration" is justified.

APPLICABLE REGULATORY REQUIREMENTS

The proposed change is not a risk-informed change. The operation of the AB crane will be the same as is currently described in the CR-3 FSAR. The NRC has endorsed ASME NOG-1-2004 for licensees to use in the design and analysis of single failure proof cranes at nuclear power plants. Because FPC is deviating from that design code, NRC approval of that deviation is being requested.

FPC has evaluated the regulatory requirements and criteria applicable to the proposed LAR. Heavy loads must be handled in a manner that does not jeopardize the ability of the plant to operate safely, to be shut down and maintained in a safe shutdown condition, and to mitigate potential accidents and other design basis operational events. FPC has determined that the new overhead crane is consistent with the following applicable regulatory requirements, guidance or criteria, except as noted in this LAR:

1. NRC Regulatory Issue Summary 2005-25, Supplement 1, "Clarification of NRC Guidelines for Control of Heavy Loads," dated May 29, 2007

2. ASME NOG-1-2004, "Rules for Construction of Overhead and Gantry Cranes, (Top Running Bridge, Multiple Girder)"

ENVIRONMENTAL IMPACT EVALUATION

10 CFR 51.22(c)(9) provides criteria for and identification of licensing and regulatory actions eligible for categorical exclusion from performing an environmental assessment. A proposed amendment to an operating license for a facility requires no environmental assessment if operation of the facility in accordance with the proposed amendment would not:

(i) involve a significant hazards consideration,
(ii) result in a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, and
(iii) result in a significant increase in individual or cumulative occupational radiation exposure.

Florida Power Corporation (FPC) has reviewed this License Amendment Request (LAR) and has determined that it meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22, no environmental impact statement or environmental assessment needs to be prepared in connection with the issuance of the proposed license amendment request.

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302/LICENSE NUMBER DPR-72

LICENSE AMENDMENT REQUEST #310, REVISION 1

ATTACHMENT 3

PROPOSED REVISED FINAL SAFETY ANALYSIS REPORT PAGES – MARKED-UP PAGES

5. CONTAINMENT SYSTEM AND OTHER SPECIAL STRUCTURES

Containment for Crystal River Unit 3 is provided by the reactor building, including its steel liner and the Reactor Building Isolation Systems. The concrete structure also provides shielding from the fission products which could be airborne in the building under accident conditions. The Reactor Building Spray System and the Reactor Building Emergency Cooling System each provide cooling capability to assure that internal temperature and pressure remain within design conditions following an accident.

Other special structures are those structures which house equipment which is vital to monitoring containment integrity, vital to safe shutdown of the reactor, or contain significant quantities of radioactive materials.

5.1 STRUCTURAL DESIGN CLASSIFICATION

The plant structures, components, and systems have been classified according to their function and the degree of integrity required to protect the public.

5.1.1 CLASSES OF STRUCTURES AND SYSTEMS

5.1.1.1 CLASS I

Those structures, components, and systems, including instruments and controls, whose failure might cause or increase the severity of a Loss-of-Coolant Accident (LOCA) or result in an uncontrolled release of radioactivity, and those structures and components which are vital to safe shutdown and isolation of the reactor are designated Class I. When a system as a whole is referred to as Class I, certain portions not associated with loss-of-function of the systems may have been designated Class II or III, as appropriate. Figure 5-1 shows the location and designation of major Class I structures. A listing of Class I structures, components, and systems follows:

<u>Class I - Structures, Components, and Systems</u>

a. Building and Structures
   - ◊ Reactor building (including all penetrations, equipment hatch and air locks, concrete shell, liner, and interior structures)
   - ◊ Auxiliary building (excluding the steel roof support structure)
   - ◊ Control complex
   - ◊ Emergency diesel generator building (including the radiator exhaust air deflector wall and its support structure [Ref. 68])
   - ◊ Intermediate building
   - ◊ NSSS intake structure
   - ◊ Emergency Feedwater Tank Enclosure
   - ◊ Diesel Driven Emergency Feedwater Pump Enclosure

b. NSSS Components

- ◊ Reactor vessel
- ◊ Reactor internals (including Fuel Assemblies and control rods)
- ◊ Control Rod Drive Mechanisms (CRDMs) (and support)
- ◊ Incore Monitoring System (pressure parts)
- ◊ Inadequate Core Cooling System
- ◊ Steam generators (and supports)
- ◊ Pressurizer (and supports)
- ◊ Reactor Coolant System (RCS) piping (including Pressurizer surge and spray piping and valves)
- ◊ Reactor Coolant Pumps (RCPs), motors, and supports
- ◊ Atmospheric relief valves
- ◊ Emergency feedwater control valves of the Emergency Feedwater Initiation and Control System (EFIC)

c. Plant Protection Systems

- ◊ Makeup and Purification System (MU) (including makeup pumps, makeup tank, letdown coolers, letdown filters, seal return cooler, process and instrument piping, and valves)
- ◊ Core flooding tanks (including process and instrument piping, and valves)
- ◊ Decay Heat Removal System (DH) (including decay heat pumps, decay heat coolers, process and instrument piping, and valves)
- ◊ Borated Water Storage Tank (BWST)
- ◊ Reactor Building Spray System (BS) (including spray pumps, spray headers and nozzles, process and instrument piping, and valves)
- ◊ Reactor building fan cooling units (including fans and motors, demisters, cooling coils, and connecting air handling ducts)
- ◊ Reactor Protection System (RPS) (Including Protection channel cabinets)
- ◊ Engineered Safeguards Actuation System (ESAS) (including channel cabinets, actuation cabinets, and ES sections of control boards)
- ◊ Piping penetrations and associated isolation valves

d. Cooling Water Systems

- ◊ Decay Heat Closed Cycle Cooling Water Systems A & B (including surge tank, pumps, heat exchangers, process and instrument piping, and valves)
- ◊ Decay Heat Sea Water Cooling Systems A & B (including pumps, heat exchangers, process and instrument piping, and valves)
- ◊ Nuclear Services Closed Cycle Cooling Water System (including pumps, heat exchangers, process and instrument piping, and valves)
- ◊ Nuclear Services Sea Water Cooling System (including pumps, heat exchangers, process and instrument piping, and valves)
- ◊ Chilled Water Cooling System for control complex and penetration cooling

e. Emergency Power Supply System

- ◊ Diesel generators and fuel oil storage tanks
- ◊ DC Power Supply System and inverters
- ◊ Power distribution lines to equipment required for emergency
- ◊ Switchgear and power centers supplying the ES features
- ◊ Control console
- ◊ Motor control centers

f. Spent Fuel Cooling System

- ◊ Pumps, heat exchangers, interconnecting piping and valves

g. Ventilation Systems

- ◊ Ventilation System for Spent Fuel Cooling System pump area
- ◊ Reactor Building Recirculation System
- ◊ Ventilation System for diesel generator building
- ◊ Ventilation System for Decay Heat Closed Cycle Cooling System pump area
- ◊ Ventilation System for control complex *
- ◊ Reactor building isolation valves

h. Miscellaneous Systems and Components

- ◊ Emergency Feedwater System (including pumps, Emergency Feedwater Tank, and associated process and instrument piping, and valves)
- ◊ Nitrogen Pressurization System for core flooding tanks
- ◊ Spent fuel handling bridge**
- ◊ New and spent fuel storage racks
- ◊ Reactor building polar crane
- ◊ Fuel handling area crane*** |
- ◊ Water gates in fuel storage pools
- ◊ Dedicated shutdown panel

i. Radioactive Waste Disposal System

- ◊ Reactor coolant bleed tanks
- ◊ Concentrated radioactive waste storage tank
- ◊ Concentrated boric acid tanks
- ◊ Waste gas decay tanks
  - ➢ Liquid outlet piping to and including the second isolation valve downstream from each of the above tanks is seismic Class I.
- ◊ Miscellaneous waste storage tank
- ◊ Spent resin storage tank
- ◊ Neutralizer tank
  - ➢ Liquid outlet piping to and including the first isolation valve downstream from each of the above tanks is seismic Class I.

◊ Reactor coolant drain tank
◊ Reactor building sump pumps
◊ Decay heat pit sump pumps

j. Sampling System

◊ All piping and valves inside the reactor building through and including the isolation valve outside the reactor building.

* The portion of the Control Complex Ventilation System associated with isolation of the Equipment Room Relief line is not Class 1 per the CR3 licensing basis but does function to preserve the Control Room Habitability Boundary.

** To preclude dislodging the fuel handling bridge and associated bridge trolleys during a seismic disturbance, an anti-derailing device has been attached to the bridge frame and trolley frame. The device has been designed using a static analysis to a seismic loading equivalent to 0.5 g.

*** The Fuel handling area crane (FHCR-5), as a component, is Seismic Class I and single failure proof per ASME NOG-1-2004 (except for tornado and tornado missile loads) and the crane support structure is qualified to NOG-1 through a coupled analysis with the crane.

5.1.1.2 Class II

Those structures, components, and systems which are important to reactor operation but not essential to safe shutdown and isolation of the reactor, and whose failure would not result in the release of substantial amounts of radioactivity, are designated Class II. A listing of Class II structures, components, and systems follows:

Class II - Structures, Components, and Systems

a. Buildings and Structures

◊ Substation
◊ Cable bridge next to discharge canal
◊ Duct bank

b. Ventilation Systems

◊ Reactor Building Purge Ventilation System (excluding isolation valves)
◊ Fuel Handling Area Ventilation Supply System
◊ Auxiliary Building Ventilation Supply System
◊ Auxiliary Building Circulation System
◊ Auxiliary Building Ventilation Exhaust System
◊ Ventilation System for reactor cavity area
◊ Turbine building switchgear room
◊ Controlled Access Exhaust Ventilation System
◊ Ventilation System for cooling reactor building penetrations
◊ Ventilation System for Emergency Feedwater System pump area

c. Nuclear Steam Supply System (NSSS)

◊ Portions of Integrated Control System (ICS) not included in Class I

g) "Licensing Report for Additional Loading Patterns in Crystal River Unit 3 Pools A & B" (Holtec Report No: HI-2063579 – September 2006), submitted to the NRC as part of LAR 292 and approved by Amendment 227.

The spent fuel stored in both SFP A and SFP B is to be arranged based on fuel burn-up and enrichment characteristics in accordance with the limits presented in plant Technical Specifications.

9.6.1.3 Fuel Transfer Tubes

The Fuel Transfer Tubes (FHX-1A, FHX-1B) are horizontal tubes are provided to convey fuel and other materials between the Reactor Building and the fuel handling area of the Auxiliary Building. These tubes contain tracks for the fuel transfer carriage, gate valves in the fuel handling area of the Auxiliary Building, and a flanged closure on the Reactor Building. The Fuel Transfer Tubes connect the Spent Fuel Pool to the Fuel Transfer Canal at the lower depth, where space is provided for the rotation of the fuel transfer carriage basket containing a fuel assembly. That portion of the Fuel Transfer Tubes and penetrations which are designed and utilized as the Reactor Building boundary is designed to the Seismic Class I criteria.

9.6.1.4 Fuel Transfer Canal

The Fuel Transfer Canal is a passageway in the Reactor Building extending from the reactor vessel boundary to the Reactor Building wall. It is formed by an upward extension of the primary shield walls. The enclosure is a reinforced concrete structure lined with stainless steel plate to form a canal above the reactor vessel which is filled with borated water for refueling.

The deep portion of the Fuel Transfer Canal is used for storage of the reactor vessel internals, Core Support Assembly, and Plenum Assembly during refueling, however, the deep portion is not large enough to support all these components at any one time.

9.6.1.5 Fuel Handling System Equipment

The Reactor Building Fuel Handling System consists of two fuel handling bridges, Main Bridge (FHCR-1) and Auxiliary Bridge (FHCR-2); two fuel transfer carriage upenders; and associated equipment. The Auxiliary Fuel Handling Bridge, FHCR-2, is now primarily used as a movable working platform with no fuel movement capability.

The Spent Fuel Pool Fuel Handling System consists of one Fuel Handling Bridge (FHCR-3); two fuel transfer carriage upenders (FHCR-4A, FHCR-4B); new fuel elevator (FHCR-6); cask loading area; cask wash area; Spent Fuel Pools A & B storage racks; New Fuel Storage Pit; and associated equipment.

The Main Fuel Handling Bridge (FHCR-1) is a dual mast machine made up of the following components:

1. Bridge
2. Trolley
3. Fuel element mast
4. Control rod mast
5. Pneumatic System
6. Sensotec load cells (2)
7. Position indicators (Bridge and Trolley)
8. Digital Elevation Display

9. Z-Z axis tapes

Control Consoles of an improved design with quick disconnects are installed on FHCR-1. This feature allows removal of the Control Console from the Reactor Building's harsh environment during power operation.

The Spent Fuel Handling Bridge (FHCR-3) is a single mast machine made up of the following components:

1. Bridge
2. Trolley
3. Multi-Function Fuel Element/Control Rod Mast
4. Pneumatic System
5. Sensotec Load cell
6. Position indicators (Bridge and Trolley)
7. Digital Elevation Display
8. Z-Z axis tape

The following fuel handling equipment is designed to Seismic Class I requirements:

◊ Auxiliary Building Overhead Crane (FHCR-5)
◊ Spent Fuel Pool Gate (FHX-2)
◊ Spent Fuel Cask Pit Gate (FHX-3)
◊ Access Platform for the Spent Fuel Pit Missile Shield Crane (FHCR-7)

The Fuel Handling Bridges, Fuel Transfer System, and New Fuel Elevator are not designed to Seismic Class I requirements because at the time of their design and fabrication Safety Guide 13, which requires such classification, was not in effect. However, the following criteria were used in the equipment design:

a. An earthquake force of 0.5g simultaneously applied in the horizontal and vertical directions shall not cause failure of any component or derailment of the bridge, trolley, or carriage.
b. Design of the Fuel Transfer Tubes and cover flanges are in accordance with the requirements of the ASME Code, Section III, Class B, including addenda through Winter, 1967.
c. The New Fuel Elevator is welded to the Spent Fuel Pool liner which is designed to Seismic Class I requirements. All root and final pass welds during construction and installation were inspected and accepted in accordance with ASME Section III, Appendix IX. The elevator is equipped with numerous brakes and limit switches which prevent the new fuel element from dropping.

The Spent Fuel Pit Missile Shield Crane (FHCR-7) and the Auxiliary Building Overhead Crane (FHCR-5) are arranged as shown in Figure 1-11. The Auxiliary Building Overhead Crane is equipped with one main and two auxiliary hoists, rated at 72 tons (Main), 9 tons (Auxiliary) and 1.5 tons (Fuel Hoist), respectively. Equipment and materials associated with the Auxiliary Building Overhead Crane, trolleys, and hoists comply with governing regulations and with the applicable standard specifications and codes of USAS, ASTM, ASME, IPCEA, NEMA, EEI, IEEE, UL, and EOCI, relative to design and fabrication. Installation and testing of the Auxiliary Building Overhead Crane and associated equipment is performed and governed by specifications, standards, and procedures set forth by Florida Power Corporation.

The following conservative and optimized design, factors of safety, and operating procedures have been implemented in order to preclude any possibility of fuel handling accidents during all modes of handling..

a. The Auxiliary Building Overhead Crane (FHCR-5):

   1. is designed and fabricated such that all parts have a factor of safety of at least five, based on the ultimate strength of the materials employed, when handling capacity load. The

hoist cable has a safety factor of ten based on the ultimate strength of materials employed, when handling capacity load.

2. main hook is designed such that it is capable of inching the maximum load and controlling the maximum load within 1/32-inch on both lifting and lowering operations. The crane is also designed to operate continuously under maximum loads with no adverse effects due to over-heating.
3. is provided with two automatic independent brakes, one electrical and one mechanical on the crane hoist mechanism. The electrical braking system operates automatically upon interruption or termination of crane power.
4. is provided with limit switches to preclude the possibility of upward over-travel of the main and auxiliary hooks in the hoisting direction.
5. is designed to ensure no loss of function from seismic disturbance while lifting rated maximum capacity loads. The crane is ~~and all supporting structures are~~ designed to Seismic Class I. The portion of the Auxiliary Building (AB) that serves as crane support structure was originally designed for only Design Basis Earthquake (DBE) seismic loads and was not designed as a Seismic Class I structure. As part of the Dry Fuel Storage Project, Engineering Change 70139 upgraded both the crane and crane support structure to single failure proof criteria (except for tornado and tornado missile loads) as specified in ASME NOG-1-2004, "Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)." As a result of this upgrade, the Auxiliary Building crane support structure has been modified such that it can withstand Maximum Hypothetical Earthquake (MHE) seismic loads in combination with other loading conditions specified in ASME NOG-1-2004, Section 4140. Floor response spectra and structural damping values specified in ASME NOG-1-2004, Section 4153.8 are used in the structural analysis, together with those used in the original design basis ground response spectra (GRS) and 1% MHE damping at lower frequencies where GRS governs. These damping values are approximately equal to the damping values specified in Regulatory Guide 1.61 (2007) and minor differences in damping values have been shown to have a negligible effect on member and connection loads.
6. main and auxiliary hooks are magnetic particle tested and, in addition, are periodically either radiographed and/or ultrasonic inspected in accordance with plant procedures.
7. individual fuel assembly handling using the Auxiliary Building Overhead Crane may be performed, in compliance with established safe load paths, with either the 1.5 ton auxiliary hook or the main hook for all areas except Row 1 of the New Fuel Storage Racks. Fuel assemblies are placed in Row 1 using the 1.5 ton hook only. The main hook has physical limitations that prevent it from accessing Row 1.

b. The New Fuel Storage Racks are anchored to the floor of their respective storage areas. Spent Fuel Pool A & B storage racks are not physically attached to the pool floor. The uplift and insertion force of the Spent Fuel Handling Bridge is restricted by overload and underload setpoints such that a force in excess of 500 lbs above or below the weight of the fuel mast and fuel assembly is not exerted on the racks during fuel assembly insertion and withdrawal activities.

9.6.2 SYSTEM DESCRIPTION AND EVALUATION

9.6.2.1 Receiving and Storing Fuel

New fuel assemblies are received in shipping containers inside the fuel handling area of the Auxiliary Building. The new fuel containers are unloaded from the truck utilizing the Auxiliary Building Overhead Crane. The shipping containers are placed on the fuel handling floor. The containers are then opened and the new fuel elements are rotated to the vertical position. The new fuel elements are then removed by means of a manually operated tool suspended from the Auxiliary Building Overhead Crane. The new fuel element is then inspected and placed in the New Fuel Storage Pit or the Spent Fuel Pools.

Prior to or during refueling the reactor, the new fuel elements are transferred by the Auxiliary Building Overhead Crane from the New Fuel Storage Pit to the Spent Fuel Pool in the fuel handling area of the Auxiliary Building to be ready for transfer into the Reactor Building via the Fuel Transfer Tubes.

6. When irradiated fuel assemblies are in the Spent Fuel Pool, the Auxiliary Building Ventilation Exhaust System servicing the Spent Fuel Pool area is required. Procedures exist to test the ventilation filter trains.
7. Only one new fuel assembly may be handled at a time outside of approved fuel containers with FHCR-5.
8. Non-fuel Special Nuclear Material (SNM) will be limited to 400 grams total onsite, and no more than 15 grams of non-fuel SNM in any one package or location. Non-fuel SNM assemblies containing beryllium, graphite or hydrogenous material enriched in deuterium shall be stored and shipped separate from other non-fuel SNM. Implementing these restrictions from 10 CFR 71.53 for shipping SNM ensures the non-fuel SNM onsite is less than the quantity necessary for a critical mass.
9. Radiation monitors capable of detecting excessive radiation levels and alarming personnel are provided in fuel handling and storage areas.

9.6.3 CAPABILITY FOR ONSITE STORAGE OR OFFSITE DISPOSAL

CR3 is licensed for storage of 1474 fuel assemblies. Before that limit is reached, it will be necessary for CR3 to consider additional onsite storage capacity or offsite disposal. The original CR3 design assumed that spent fuel would not be stored in Spent Fuel Pool B. That pool area was to have been used for cask loading. Therefore, rearrangement of Spent Fuel Pool B will be required prior to implementing spent fuel cask operations.

The following discussion is general information to describe the provisions that have been made in the design of CR3 to accommodate transfer of spent fuel either onsite or offsite. However, the handling of heavy loads for cask movement will be subject to review by FPC and the NRC in accordance with the requirements of Bulletin 96-02, "Movement of Heavy Loads Over Spent Fuel, Over Fuel In The Reactor Core, Or Over Safety-Related Equipment."

9.6.3.1 Spent Fuel Assembly Removal

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.

The handling of the spent fuel cask into and out of the cask loading area will be performed with a minimum of water (approximately 6,000 gallons) contained in the loading area. Should the spent fuel cask be dropped during this operation and rupture the cask loading area floor, the 6,000 gallons of water could flow onto floor elevation 95 feet 0 inches. Floor drains are positioned in respective equipment cubicles throughout elevation 95 feet 0 inches to dissipate this volume of water to the Auxiliary Building sump, thus precluding any damage to major safety related equipment. Should any leakage develop related to Spent Fuel Pool B, the sump pumps which are located below elevation 95 feet 0 inches have the capacity to transfer the anticipated volume to the miscellaneous waste storage tank.

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302/LICENSE NUMBER DPR-72

LICENSE AMENDMENT REQUEST #310, REVISION 1

ATTACHMENT 4

LIST OF REGULATORY COMMITMENTS

LIST OF REGULATORY COMMITMENTS

The following table identifies those actions committed to by Florida Power Corporation (FPC) in this document. Any other statements in this submittal are provided for information purposes and are not considered to be regulatory commitments. Please notify the Superintendent, Licensing and Regulatory Programs of any questions regarding this document or any associated regulatory commitments.

Regulatory Commitments	Due Date/Event
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.

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302/LICENSE NUMBER DPR-72

LICENSE AMENDMENT REQUEST #310, REVISION 1

ATTACHMENT 5

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

The NRC sent Crystal River Unit 3 (CR-3) five questions in a email dated February 23, 2011 in a Request for Additional Information (RAI) (Reference 1). The following is submitted to respond to the NRC questions on Revision 0 of this License Amendment Request (LAR) (Reference 2). The responses to these questions resulted in Revision 1 to this LAR #310.

NRC RAI Background

By letter dated December 20, 2010, Florida Power Corporation (FPC or the licensee) submitted Crystal River Unit 3 (CR3) – License Amendment Request (LAR) # 310, Revision 0, "Departure from a Method of Evaluation for the Auxiliary Building Overhead Crane and Revisions to Associated Commitments." In Attachment 1 to the LAR, page 1 of 6, under Auxiliary Building (AB) design basis, the licensee stated:

> *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 requirements. 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.*

In Attachment 1 to the LAR, the licensee described that FPC would be including SSE loads in the analysis of AB structural members that serve as the crane support structure, and that FPC would perform building modifications as a result of the new analyses. In addition, the licensee described that the CR3 FSAR specified no damping coefficients for Class III structures, so FPC intended to use the ASME NOG-1-2004 damping coefficients (4% for OBE and 7% for SSE) for the new coupled seismic analysis of the crane and crane support structure, which would be performed in accordance with ASME NOG-1-2004 guidelines.

NRC RAI-1

Section 9.6.1.5.a.5 of the CR3 Final Safety Analysis Report (FSAR), "Fuel Handling System Equipment," states that the FHCR-5 crane and all supporting structures are Seismic Class 1. To confirm the adequacy of design since the crane support structure is intended to continue to perform its safety function of supporting the loaded crane following an SSE, please provide supporting documentation or information demonstrating the satisfaction of the criteria addressed in Section C.2 of Regulatory Guide 1.29, "Seismic Design Classification," and Paragraph II.8 of NUREG-0800, "Standard Review Plan," Section 3.7.2.

CR-3 Response to RAI-1

Crystal River Unit 3 (CR-3) was licensed to operate at full power in January 1977. The initial revision of the CR-3 Final Safety Analysis Report (FSAR) was filed with the Atomic Energy Commission (AEC) on February 8, 1971, and was revised based on requests for additional information by approximately 40 amendments. The AEC Safety Evaluation Report (SER) on CR-3 was issued on July 5, 1974. Revision 0 of the NUREG-0800, Standard Review Plan was issued in November 1975; therefore this was not part of the CR-3 licensing basis. Similarly,

there is no reference to Regulatory Guide (RG) 1.29 in the CR-3 FSAR or AEC SER. RG 1.29 was first applied to CR-3 during resolution of post-Three Mile Island issues.

The CR-3 FSAR, Section 5.1.1.1.a, states that the Auxiliary Building is Class I, except for the roof support structure. The roof support structure and crane support structure are one and the same in the area of FHCR-5. 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. Per review of the original Gilbert Commonwealth calculations, it has been confirmed that the roof support structure was not designed as a Class I structure.

Improvements to the crane support structure are required to upgrade the new FHCR-5 crane to single failure proof status. CR-3 intends to upgrade the crane support structure as part of the crane upgrade project to be able to withstand Safe Shutdown Earthquake (SSE) seismic loads, in accordance with NRC guidance on heavy load handling (ASME NOG-1-2004). Use of damping values used in NOG-1, for spectra portions that exceed the original design basis (OBE and extended to SSE), will not result in any significant difference as compared to use of RG 1.61 (2007) damping values. See Response to RAI-2 for further discussion on damping values. Regulatory Issue Summary (RIS) 2005-25, Supplement 1, "Clarification of NRC Guidelines for Control of Heavy Loads," identifies ASME NOG-1-2004 as an acceptable method for satisfying the guidelines of NUREG-0554, "Single Failure-Proof Cranes for Nuclear Power Plants." ASME NOG-1-2004 specifies damping values that are consistent with or conservative to the damping values specified in Regulatory Guide 1.61 (2007), "Damping Values for Seismic Design of Nuclear Power Plants. RG 1.61 (2007) specifies various damping values depending on the application. In the response to RAI-2, NOG-1 damping values are compared to RG 1.61 (2007) structural damping values that are applicable to this Auxiliary Building crane support structure.

FSAR Sections 5.1.1.1 and 9.6.1.5 will be updated to reflect the upgraded design basis. These updated FSAR sections will be incorporated into LAR 310, Revision 1 for NRC approval.

CR-3 believes that the actions described in response to RAI-2 will meet the intent of NUREG-0612 with respect 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 positioned below the crane at lower elevations.

NRC RAI-2

Provide technical justification for application of the ASME NOG-1-2004, crane structural damping values to the crane support structure rather than using 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 CR3). This technical justification should address the rigidity of the connection between the reinforced concrete auxiliary building structure and the steel crane support structure.

CR-3 Response to RAI-2

The response to RAI-2 follows the general outline below:

- **Seismic Analysis Approach** – summary of Ground Response Spectra (GRS) and Floor Response Spectra (FRS) spectra and damping values used to create envelope spectra for analysis of coupled crane / crane support structure model.

- **Alternative FRS Damping** – demonstrate the effect of applying NRC RG 1.61 (2007) damping values to FRS portion of envelope spectra

    - **Weighted Average Damping** – determine new FRS damping values based on number of different type of connections in steel crane support structure
    - **'New' Envelope Spectra** – illustrate difference in seismic input by using new FRS damping
    - **Effect on Member Forces** – demonstrate the effect of seismic input with new FRS on structural response using representative model runs
    - **Structural Dynamics Explanation** – discuss physical reasons for results of using new FRS damping

- **Summary and Conclusion** – describe key points of discussion and the general conclusion

Seismic Analysis Approach

The crane and crane support structure (steel building) were analyzed using a coupled model (i.e., the model incorporated the dynamic characteristics of both the crane and building in order to capture dynamic response feedback between the two components) since the mass of the crane is large with respect to the crane runway and support structure. The coupled model was analyzed using a response spectrum approach. However, seismic requirements for the analysis of the crane and crane support structure differ, including damping values. Therefore, OBE and SSE envelope spectra were defined and utilized which concurrently bound the separate requirements for both the crane and crane support structure to achieve consistency and conservatism in analysis. These spectra are shown in Figure 1 and Figure 2 below, consistent with those presented in the design input document prepared for single-failure proof upgrade of the CR-3 FHCR-5 Aux. Bldg. crane (*Design Criteria Document for Crystal River Unit 3 Auxiliary Building Evaluation for Crane Upgrade,* FPC118-PR-001). The constituent spectra and their damping values are summarized in Table 1 below, with additional details provided in the following paragraphs.

Table 1: Constituents of Envelope Spectra for Seismic Analysis of Coupled Model

	Structure	Crane
Constituent Spectra	GRS	FRS @ EL. 162'
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
NRC RG 1.61 (2007)	3-5% OBE 4-7% SSE	-

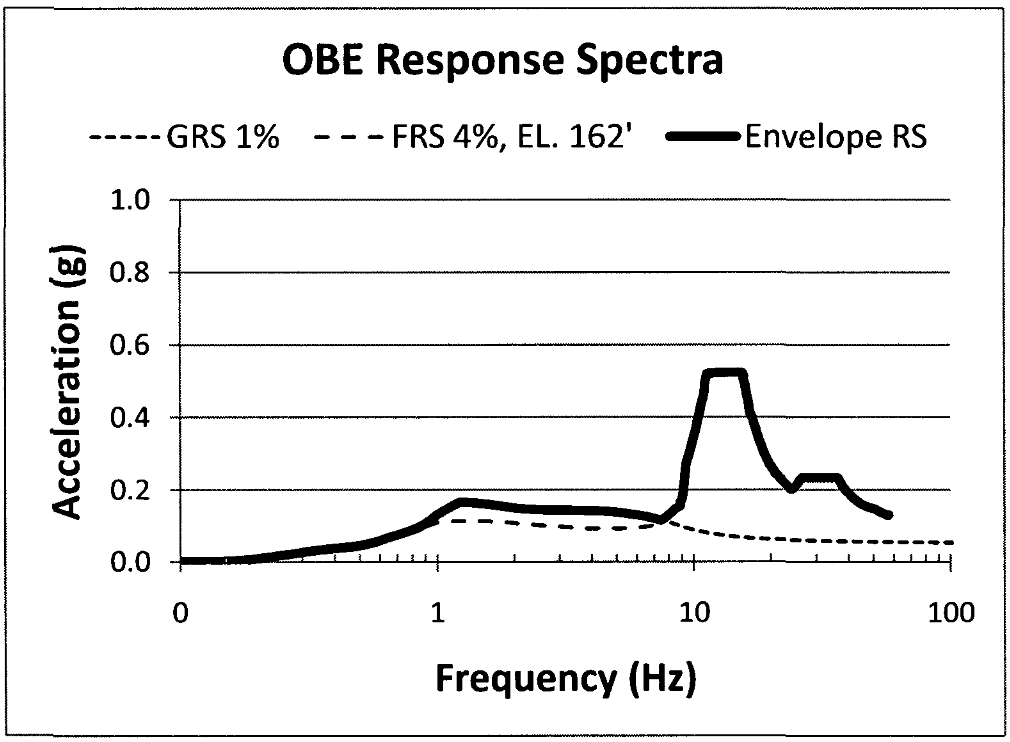

Figure 1: OBE Envelope Response Spectra for Aux. Bldg. Steel Structure

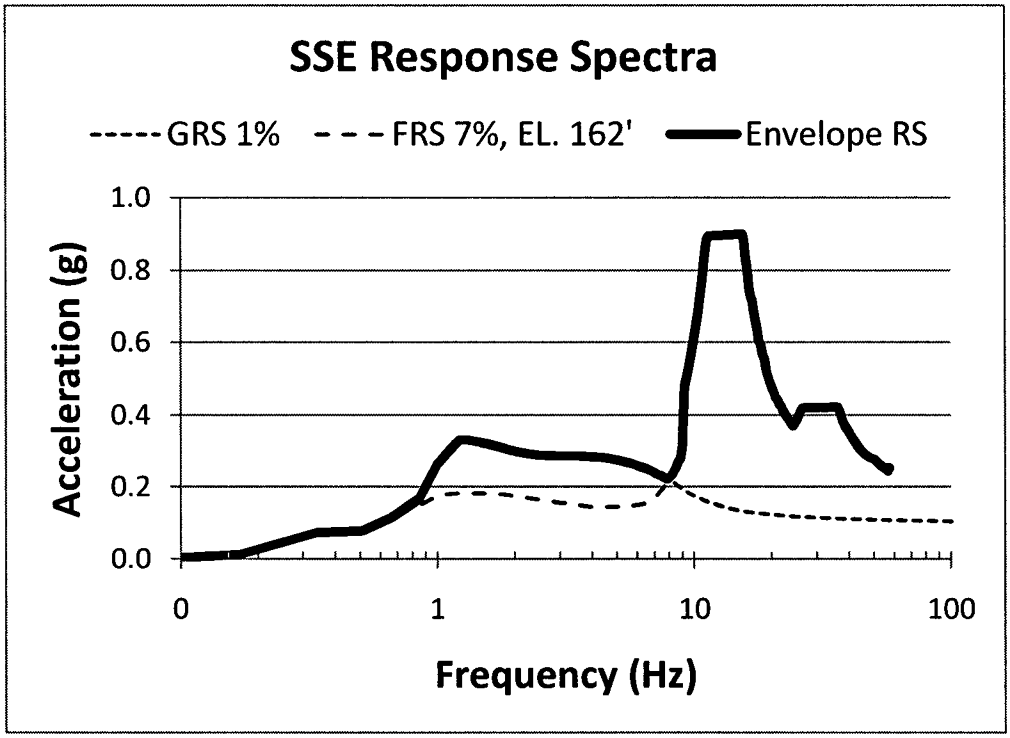

Figure 2: SSE Envelope Response Spectra for Aux. Bldg. Steel Structure Crane Support Structure (Steel Building)

The ground response spectra (GRS) at 1% damping was used as seismic input specific for building response. This 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%) despite being a primarily bolted steel structure (2.5%). While 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% damping. Accepted structural damping values in the more recent NRC RG 1.61 (2007) are 3% (OBE) and 4% (SSE) for welded steel or bolted steel with friction connections, and 5% (OBE) and 7% (SSE) for bolted steel with bearing connections. The 1% damping value used with GRS seismic input specific to the building analysis is thus conservative with respect to recommended values in RG 1.61 (2007) and therefore in compliance.

Crane

The floor response spectra (FRS) at elevation 162' of the underlying concrete building at 4% and 7% damping (OBE and SSE, respectively) were used as input specific for crane response. In an uncoupled model, the crane would be treated as equipment and analyzed using a floor response spectra at the level of the crane runway girder (top of rail elevation 193'-7"); however, in a coupled model, input specific to the crane response must be incorporated into the overall seismic input being applied to the base of the steel building structure, thus creating the need for the envelope spectra. The selection of 4% and 7% damping values used with FRS seismic input specific to the crane response were chosen to be consistent with crane damping requirements in ASME NOG-1-2004.

Crossing Frequency

As noted in Appendix 2 of FPC118-PR-001, the envelope spectra is governed by GRS contributions at relatively low frequencies, and by FRS contributions at relatively high frequencies. The crossing frequency was noted as 7.47 Hz for OBE, and 7.85 Hz for SSE (see Figure 1 and Figure 2). A crossing frequency of 7.64 Hz represents an approximate average crossing frequency over various damping values of FRS and GRS constituents.

Response of the steel crane support structure should be governed by the portion of the envelope spectra below the crossing point (GRS portion) due to its inherent flexibility relative to the stiffness of the underlying concrete structure (further justification provided in 'Structural Dynamics Explanation' section). The FRS contribution was included primarily to support the independent seismic analysis by the crane vendor, in case the crane has high-frequency sensitive components. Using a single envelope spectrum incorporating GRS and FRS constituents is therefore a conservative approach for seismic input to the coupled model.

Alternative FRS Damping

It was demonstrated earlier that the GRS constituent is already conservative with respect to damping recommendations in NRC RG 1.61 (2007). The FRS was included as seismic input to the coupled model for purposes of crane evaluation only (using damping values of 4% and 7% recommended by ASME NOG-1-2004 for OBE and SSE, respectively). A comparison between NOG-1-2004 and RG 1.61 (2007) was performed to characterize the effect of applying alternative damping values to the FRS constituent of the envelope spectra.

Weighted Average Damping

As described earlier, recommended structural damping values in NRC RG 1.61 (2007) are 3% (OBE) and 4% (SSE) for welded steel or bolted steel with friction connections, and 5% (OBE) and 7% (SSE) for bolted steel with bearing connections. Additionally, RG 1.61 (2007) allows "weighted average" damping values for SSE damping based on the number of each types of connections in a given steel structure. Based on a detailed review of building drawings and planned modifications, current modification plans leave just 15 friction and 16 welded joints out of 564 total connections. Therefore, the applicable weighted average damping value for SSE is calculated below:

SSE: $4\% + (7\% - 4\%) \cdot (1 - 31/564) = 6.84\%$

"Weighted average" is not discussed for OBE damping values. If this structure were to be designed strictly in accordance with RG 1.61 (2007), use of 5% damping for OBE would be considered appropriate, as this structure is primarily a structure with bearing type bolted connections. Therefore, the 4% damping used in this structural analysis is considered conservative. For SSE, 6.84% is only slightly lower than the approach used (7%). The overall effect of this slight decrease is described below.

'New' Envelope Spectra

It was shown in Appendix 2 of FPC118-PR-001 that a frequency-dependent damping modification factor approach can be conservatively used here to adjust response spectra accounting for different damping values. More specifically, the Lin and Chang, 2003 method (Lin and Chang, A study on damping reduction factor for buildings under earthquake ground motions, *Journal of Structural Engineering* (ASCE) 2003; 129(2):206-214) is used. A damping reduction factor (*B*) approximately estimates the ratio of seismic response for one damping ratio with that at 5% damping:

$$B = \frac{SA(T,\xi)}{SA(T,\xi = 5\%)}$$

Where:

B	=	damping reduction factor
SA	=	spectral acceleration
T	=	response period (= 1/ω)
ξ	=	damping ratio

The damping reduction factor for a given damping value (ξ) can be estimated based on Lin and Chang, 2003, by:

$$B(T,\xi) = 1 - \frac{aT^{0.30}}{(T+1)^{0.65}}, \qquad a = 1.303 + 0.436\ln(\xi)$$

Using this method consistent with Appendix 2 of FPC118-PR-001, a 'new' envelope spectra incorporating FRS damping of 6.84% at frequencies greater than the crossing point is generated. This 'new' envelope spectra is presented graphically in Figure 3, superimposed on the existing envelope spectra.

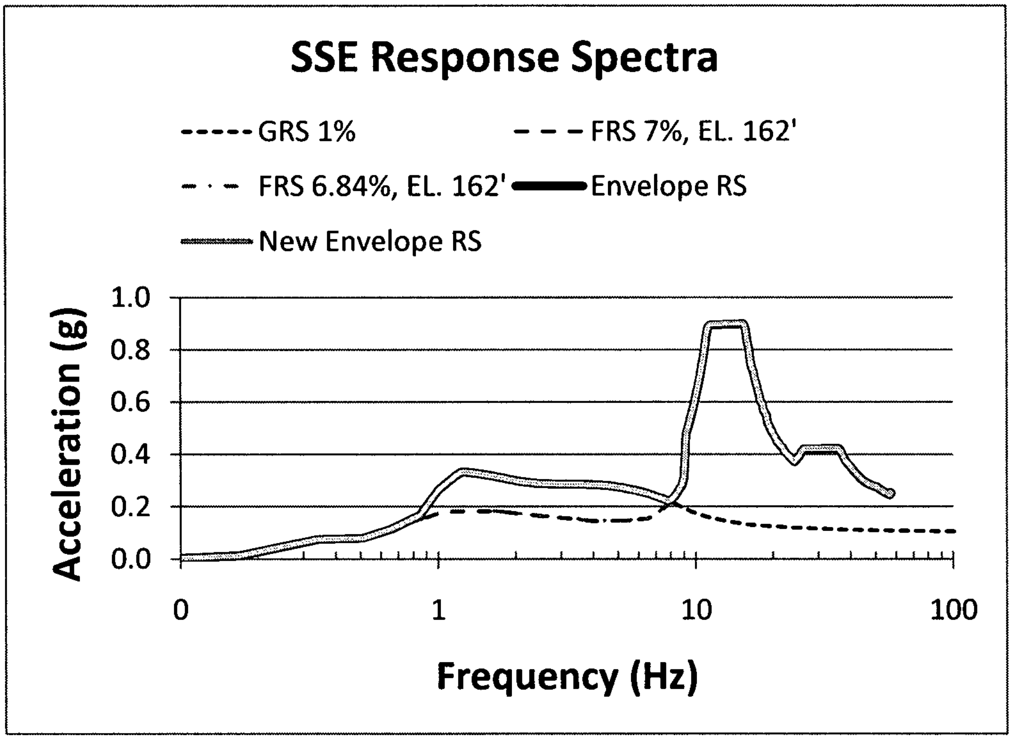

Figure 3: New SSE Envelope Response Spectra Reflecting Decrease in FRS Damping

Note that the 'new' envelope spectra is only marginally higher than the 'old' envelope spectra, and only in the FRS-governed region at frequencies higher than the crossing point. The maximum increase in spectra in this frequency range can be determined quantitatively, based on the damping modification factors. Where the difference in spectra between two damping ratios is desired and neither spectra is at 5% damping, the ratio of damping reduction factors can be used:

$$\frac{SA(T,\xi_1)}{SA(T,\xi_2)} = \frac{B(T,\xi_1)}{B(T,\xi_2)}$$

Note that the damping reduction factor is monotonic for $\omega > 1.667$ Hz ($T < 0.857$ sec), asymptotically increasing for $\xi > 5\%$ and asymptotically decreasing for $\xi < 5\%$. The frequency range of interest here is from 7.64 Hz (envelope spectra crossing point) to 50 Hz (effectively rigid). In that range, the maximum ratio of response spectra with damping ratio for $\xi > 5\%$ is at $\omega = 50$ Hz ($T = 0.02$ sec). Therefore:

$$\max\left[\frac{SA(T,\xi = 6.84\%)}{SA(T,\xi = 7.00\%)}\right] = \frac{B(T = 0.02,\xi = 6.84\%)}{B(T = 0.02,\xi = 7.00\%)} = \frac{1 - \dfrac{0.133(0.02)^{0.30}}{(1.02)^{0.65}}}{1 - \dfrac{0.144(0.02)^{0.30}}{(1.02)^{0.65}}} = \frac{0.959}{0.956} = 1.003$$

Based on the above, the maximum ratio of response spectra in the range of interest for damping of 6.84% compared with 7% is 1.003, representing only a 0.3% increase. For engineering purposes, this is considered a negligible increase, especially when considered in the context of steel building response (discussed in detail in 'Structural Dynamics Explanation' section).

Effect on Member Forces

To further demonstrate the effect that a small change in FRS damping has on response of the steel crane support structure, representative GTSTRUDL runs were performed using the existing SSE model with a modified envelope spectra reflecting 6.5% FRS damping as opposed to the previous 7% FRS damping. The GRS portion of the envelope spectra was unchanged, at 1% damping. Note that a value of 6.5% damping is conservative here, as it represents a weighted average SSE damping value for 94 welded or friction-type connections out of 564 total connections, more than three times the 31 such connections in the actual steel crane support structure (see 'Weighted Average Damping' section). Using the same methodology as in the previous section, a 6.5% damping FRS is at most approximately 1% higher in the frequency range of interest than a 7% damping FRS.

Three GTSTRUDL models (7, 55, and 91) were re-run, chosen to capture the range of member responses due to different crane positions (north, middle, and south positions), each with the trolley in the center of the crane bridge and with a loaded and raised hook. For each model, three seismic load cases were run, representing the different seismic input directional combinations considered (E-W + vertical, N-S + vertical, and SRSS of all three directions).

Results from these runs were compared with the corresponding previous runs with 7% FRS damping, and confirm that structural members do not see significant additional loading by decreasing the FRS damping to 6.5%. Out of all structural members besides the crane girders, the average increase in governing interaction ratio is 0.0001, with no member seeing an increase of more than 0.003. Filtering out members with very little load (interaction ratio less than 0.2), this increase in interaction ratio is on average 0.06% with a maximum of 0.79%. Crane girders are similarly affected by the decrease in damping, seeing a maximum increase in bending and shear interaction of only 0.002 and 0.0002, respectively. Based on engineering judgment, these minor increases in member forces are considered negligible and not to impact the proposed design of the building modifications.

Structural Dynamics Explanation

Although the amplitude of the envelope spectra is highest in the frequency range governed by the FRS, the physical explanation for why the GRS portion of the envelope spectra governs the response of the steel crane support structure is briefly described below, based on principles of structural dynamics.

The floor response spectra at elevation 162' is characterized by amplification of the relatively high-frequency modes of the concrete building below. Based on the Auxiliary Building floor response spectra at elevation 119', 143', and 162' (elevations within the underlying concrete building) (CR-3 Seismic Qualification SP-5209, Figures 11, 12, 12A, 13, and 13A), the main concrete structure underlying the steel crane support structure has a primary mode at approximately 11-15 Hz and a secondary mode at approximately 26-36 Hz. In the frequency range near these modes, the FRS is predictably higher than the GRS; at lower frequencies, the FRS and the GRS are essentially equivalent. As an example to demonstrate the amplification only at these relatively high-frequency concrete structure modes, the FRS and GRS are illustrated in Figure 4 below, both at 2% and 5%. Notice that the GRS and FRS are essentially identical at frequencies below the broadened modes of the concrete building.

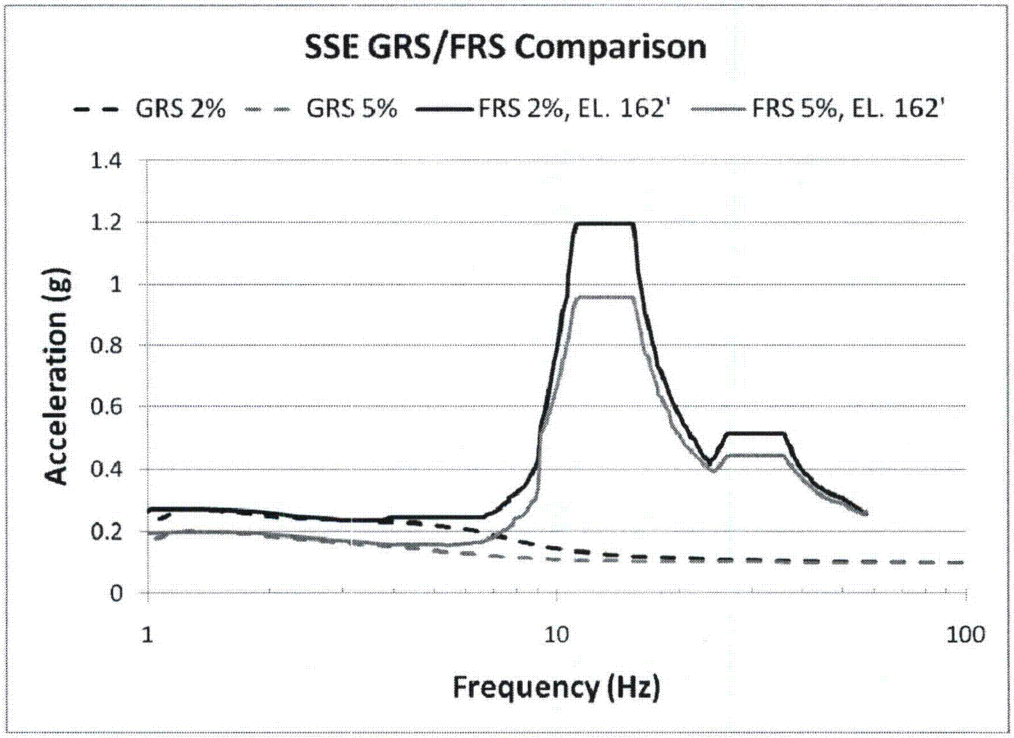

Figure 4: Example Comparisons of GRS and FRS Response Spectra at Equal Damping

The frequencies of the primary concrete building modes are important because of how they affect the response of the steel crane support structure, primarily for two reasons:

- Being steel, the crane support structure is expected to be significantly more flexible than the concrete structure. This expectation is confirmed based on the Auxiliary Building floor response spectra at elevation 193'-7" and 209'-1" (elevations within the steel crane support structure) (CR-3 Seismic Qualification SP-5209, Figures 25A-C and 26A-C), where it can be identified that the steel crane building support structure has a primary E-W mode at approximately 1-1.4 Hz, a primary N-S mode at approximately 1.8-2.4 Hz, and vertical modes at approximately 1-1.3 Hz and 4.2-6.3 Hz. These modes are all below the envelope spectra crossing frequency between GRS and FRS contributions (7.64 Hz).

More rigorously, the cumulative mass participation ratios for each direction illustrate that the primary steel building response occurs in the frequency range where the GRS controls the envelope response spectra. The cumulative mass participation ratios of modes below 7.64 Hz and of all modeled modes extracted from GTSTRUDL, for each direction, are shown in Table 2 below. Note that the 'missing mass' not represented in the modes modeled is added back numerically. These cumulative mass participation ratios were found to be relatively insensitive to locations of the crane and hook, with variability between configurations on the order of +/- 0.01 for lateral directions and +/- 0.05 for vertical.

Table 2: Cumulative Mass Participation Ratios

	Direction		
	N-S	**E-W**	**Vertical**
Fraction ω < 7.64 Hz	0.93	0.75	0.28
Fraction Modeled	0.97	0.99	0.81

Note that in the horizontal directions, the large majority of mass participation occurs at modes lower than the envelope response spectra crossing point, confirming that the GRS portion governs the majority of lateral seismic response of the steel crane support structure. For the majority of structural members, GTSTRUDL results indicate that contributions to member stresses from horizontal seismic motion are significantly more than those from vertical motion. Therefore, after modal combinations (bounding of SRSS and CQC) and directional combinations (bounding of ABSSUM of either horizontal and vertical or SRSS of all three directions) as defined in sections 7.6.2 and 7.6.4 of FPC118-PR-001, the overall effect of the modes above the envelope response spectra crossing point on the structural response of the steel crane building support structure can be considered minor.

- High frequency seismic motions are not generally significant for evaluating structural capacity of plant structures. Quoting an NEI letter to NRC dated January 14, 2008:

> "EPRI report 1015108, *The Effect of High-Frequency Ground Motion on Structures, Components and Equipment in Nuclear Power Plants*, summarizes a significant amount of empirical and theoretical evidence, and regulatory precedents, that support the conclusion that high-frequency (HF) seismic motions over about 10 Hz are non-damaging to typical nuclear plant structures, systems and large components (with the possible exception of HF-sensitive components)."

Since the identified modes of the concrete building are above 10 Hz, the amplified regions in the FRS are expected to be non-damaging with respect to the steel crane support structure. Note that the FRS was included in the envelope spectra (with damping values as recommended by ASME NOG-1-2004) primarily because it is unknown whether the crane itself is a HF-sensitive component.

For the reasons described in this section, it is predictable that the portion of the envelope spectra governed by GRS seismic motion controls the overall response characteristics of the steel crane support structure. Therefore, the overall seismic response is relatively insensitive to small damping changes in the FRS portion of the envelope spectra.

Summary and Conclusion

Seismic Analysis Approach

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. Building analysis used GRS at 1% 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 recommendations from NRC RG 1.61 (2007). Crane analysis used FRS at 4% and 7% damping for OBE and SSE, respectively, consistent with recommendations from ASME NOG-1-2004. The envelope of these GRS and FRS were used as the OBE and SSE seismic input to the coupled model. At relatively low frequencies, the GRS governs, while the FRS governs for higher frequencies. The average crossing frequency is approximately 7.64 Hz, depending on specific GRS and FRS damping values.

Structural Dynamics

Based on its relative flexibility compared with the underlying concrete structure, seismic response of the steel crane support structure is controlled more by the GRS portion of the envelope spectra than the FRS portion. 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 NRC RG 1.61 (2007).

Alternative FRS Damping

If the damping values for the FRS contributions to the envelope spectra had been based on recommendations for structural damping in NRC RG 1.61 (2007), rather than from 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% 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%, and only at frequencies above the crossing frequency. 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%, with results compared to those from corresponding runs at 7% 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%). For OBE, RG 1.61 (2007) recommends use of 5% damping for bolted structures with bearing connections. Since this structure is primarily a bolted structure with bearing connections, 5% would be reasonable for damping. The new structural analysis uses 4% damping, which is conservative.

Based on the above, following damping guidance from NRC RG 1.61 (2007) 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. It is concluded that the design of the crane and crane support structure meet the requirements of both ASME NOG-1 and the intent of RG 1.61 (2007).

<u>NRC RAI-3</u>

Section 5.1.2.2 of the CR3 Final Safety Analysis Report (FSAR), "Class I Design Bases," describes that structures, components, and systems designated as Class I* have been designed in accordance with the Seismic Class I design criteria to prevent fall down only. However, Class I* structures and components were not specifically identified or listed in the CR3 FSAR. Section 5.1.1.1 of the CR3 FSAR, "Class I," described that structures whose failure could result in an*

uncontrolled release of radioactivity are designated Class I, and listed the Auxiliary Building (excluding the steel roof support structure) and the fuel handling area crane as Class I.

The Auxiliary Building steel roof support structure extends over the spent fuel pool and the fuel handling area crane. Absent analyses demonstrating otherwise, the staff considers that the proposed design classification for the main structural members of the AB roof support structure (Class III) reasonably could allow the structural members to fall on the spent fuel, the spent fuel pool structure, and the fuel handling area crane, which then (directly or indirectly due to failure of the crane with a suspended load) could result in an uncontrolled release of radioactivity. Neither the license amendment request nor the NRC staff safety evaluation supporting CR3 License Amendment Number 226 to Facility Operating License DPR-72, which authorized removal of the spent fuel pool missile shields, addressed potential failure of the auxiliary building roof support structure. Therefore, consistent with the licensing basis for structural classification presented in the CR3 FSAR, provide justification for classifying the AB roof support structure as Class III rather than Class I.*

<u>CR-3 Response to RAI-3</u>

It should be pointed out that the Auxiliary Building Roof is composed of two sections. These two interfacing sections of roof are over the spent fuel pool. Drawing 521-102 shows the two sections of roof. The western portion of the roof with Top-of-Steel (TOS) at Elevation 200'-4" covers the spent fuel pool from the containment wall to approximately Column Line 302-A. The eastern portion of the roof with a TOS Elevation 209'-1" covers the spent fuel pool from approximately Column Line 302-A to Column Line 301. This eastern portion of the Auxiliary Building roof is further continued on Drawing 522-004. This eastern portion of the Auxiliary Building with a TOS elevation of 209'-1" (shown on both drawings 521-102 and 522-004) is included in the analysis for the FHCR-5 upgrade. The western portion is not a part of the project to make FHCR-5 a single failure proof crane. The interface with the western portion of the building was considered in the FHCR-5 upgrade analysis. The drawings referenced above are provided in Enclosure A of this submittal.

The docket files at CR-3 demonstrate that the original Revision 0 of the FSAR described that the Auxiliary Building was Class I, "excluding the roof steel supporting structures." This exclusion was changed editorially without changing its meaning in FSAR Amendment 40 (dated July 3, 1974) to "excluding the steel roof support structure."

Review of the Auxiliary Building design basis calculations demonstrates that the roof and roof support structure (both east and west portions) were designed to withstand the Operating Basis Earthquake (OBE), but not the Safe Shutdown Earthquake (SSE) applied to Seismic Class I or Seismic Class I*. Class I* was a classification developed several years after original licensing of CR-3. Class I* essentially means a System, Structure, or Component (SSC) is designed to withstand SSE levels, but is not safety related and will not fall to impact safety related components or create a release of radiation.

The concern raised by this RAI has been documented in CR-3's corrective action program (Nuclear Condition Report 470447). One of the actions from this NCR was to revise Calculation S06-0010. This calculation originally provided the technical basis for the removal of the tornado missile shields to support CR-3 License Amendment Number 226. A new section has been

added to this calculation to include an evaluation that shows the roof over the spent fuel pool and the corresponding roof support structure is adequate to withstand a SSE event. This evaluation included using SSE design loads to show no failure of the roof. The review concludes code compliance is not achieved, but members and connections remain within the elastic limits of the components. Revision of this calculation concludes the removal of the missile shields is still justified for both design basis tornado borne missiles and a SSE level seismic event. There is no anticipated damage to spent fuel from either of these two events.

In addition to the revision of S06-0010, the following actions have been completed, or have been added to the CR-3 corrective action program. First, calculations that support the FHCR-5 upgrade show the roof system over the crane (and over the eastern portion of the spent fuel pool) has been analyzed to meet SSE levels in accordance with the requirements of NOG-1-2004. The seismic damping factors in NOG-1-2004 are approximately equivalent to those defined in RG 1.61 (2007), together with those from the original design basis. Note that NOG-1-2004 damping values and spectra developed for these damping values are only used at higher frequencies where NOG-1-2004 design criteria govern. At lower frequency portions of the response spectra, original design basis GRS spectra are used (1% SSE damping) since GRS controls the design at lower frequencies and yield higher accelerations. The minor differences in damping values between NOG-1 and RG 1.61 for FRS damping in the higher frequency portion of the envelope response spectra have been shown to have an insignificant effect on design loads and member stresses (refer to RAI-2). The results of this analysis, to NOG-1-2004 requirements, show some modifications are required. These modifications will bring the roof into NOG-1 code compliance which is more restrictive than the requirements to reclassify the roof to Seismic I* requirements. For example, NOG-1-2004 combines operating wind load with seismic load and a fully loaded crane hook, which is not a combination considered in original Class I or Class I* design.

The second action is included in the CR-3 corrective action and is not directly related to the FHCR-5 project. This second action is to complete an analysis of the western portion of the roof that includes those portions of the eastern portion of the Auxiliary Building necessary to provide a comprehensive evaluation of the Auxiliary Building metal structure. The load combinations in this new analysis will be consistent with the existing CR-3 licensing basis and will not match the load combinations in NOG-1-2004 load cases as these are not applicable. This second analysis, which will include SSE seismic load cases, will provide the formal basis for upgrading the Auxiliary Building roof and roof support structure to Seismic Class I*.

<u>NRC RAI-4</u>

In section 2.0 of the LAR, "Description of Changes and Proposed Amendment Request," it is noted in part that the licensee is upgrading the FHCR-5 to a single-failure-proof crane Type I crane, as defined in ASME NOG-1-2004 design document, and is also upgrading the crane support structure. Please provide the design specification, design drawings and calculations for the upgrade of the crane support structure.

CR-3 Response to RAI-4

The modification package that installs the Auxiliary Building structural modifications is EC 70139, "Auxiliary Building Crane Upgrades." EC 70139, Rev. 0 issues the structural modifications to the Auxiliary Building. At a later date, after completion of the crane design, EC 70139 will be revised to include final crane replacement information.

EC 70139, Attachment Z23 is Enercon Document Number FPC118-PR-001 and is titled "Design Criteria Document (DCD) for Crystal River Unit 3 Auxiliary Building Evaluation for Crane Upgrade." This Design Criteria Document serves as the guideline / specification for the Auxiliary Building structural analysis. Load cases specified in the DCD are generated from enveloping load cases from the original design basis and load cases specified in NOG-1-2004. Key changes between current analysis and original analysis are that the portions of the Auxiliary Building that serve as crane support structure were originally designed for OBE seismic loads, and current analysis per NOG-1-2004 requires analysis for SSE seismic loads. In addition, NOG-1-2004 has load combinations that combine operating wind and seismic. Original design basis load cases did not combine wind and seismic. Damping values used in calculations are per NOG-1-2004, together with those of the original design basis for the crane and for the building portions that serve as crane support structure. For discussion of how these damping values compare with RG 1.61 (2007) damping values, see response to RAI-2. Load cases in this DCD match load cases in License Amendment Request #310. From this DCD, several supporting calculations were generated.

There were three primary calculations used in the analysis of the structure. The first calculation is S09-0036, "Structural Analysis of the CR-3 Auxiliary Building for Cask Handling Crane (FHCR-5) Upgrade." The structure is evaluated in Calculation S09-0036 in which an analysis model for the Auxiliary Building has been developed that includes a stick model of the crane modeled in accordance with ASME NOG-1 with properties provided by the crane vendor. The crane model is included in the analysis since the mass of the crane is large with respect to the Auxiliary Building 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 in such a way that it captures the critical responses for the design of the Auxiliary Building. The GTSTRUDL calculation (S09-00036) uses load cases from NOG-1-2004, which match the load cases listed in the LAR.

As a result of the analysis, several bracing members and connections are found to be 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 per Calculation S09-0036. A summary of the required modifications to the Auxiliary Building is provided below in Table 3. The total numbers of modifications do not equal the total of connections discussed in RAI-2 since some connections do not need to be modified.

Table 3: Summary of required modifications to the Auxiliary Building

Type of Modification	Total No.	Drawings
Vertical Bracing Member Replacement	9	522-041 SH. 1 *(Attachment Z107)** 522-006 *(Attachment Z103)*
Vertical Bracing Connections	51	522-041 SH. 1 thru 9, 24 *(Attachment Z107, Z108, Z45, Z46, Z47, Z48, Z49, Z50, Z51, and Z122)* 522-006 *(Attachment Z103)*
Horizontal Bracing Connections at Roof EL. 209'-1" (between column line I1 & J1)	2	521-142 SH. 1 *(Attachment Z100)* 521-102 *(Attachment Z96)*
E-W Member Connections at Roof EL. 209'-1" (at column line S1)	2	522-041 SH. 14 *(Attachment Z73)* 522-004 *(Attachment Z102)*
N-S Member Connections at Roof EL. 209'-1" (between column line P1 & Q1)	2	522-041 SH. 1 & 4 *(Attachment Z107 and Z46)* 522-004 *(Attachment Z102)*
N-S Member Connections (Purlin) at Roof EL. 209'-1"	98	521-142 SH. 1 *(Attachment Z100)* 522-041 SH. 15 *(Attachment Z91)* 521-102 *(Attachment Z96)* 522-004 *(Attachment Z102)*
E-W Member Connections at EL. 189'-9" (at column line S1)	3	522-041 SH. 1 & 17 *(Attachment Z107 & Z104)* 522-004 *(Attachment Z102)*
Horizontal Bracing Connections at Floor EL. 162'-0" (between column line N1 & O1)	1	522-041 SH. 10 & 15 *(Attachment Z52 & Z91)* 522-003 *(Attachment Z101)*

Type of Modification	Total No.	Drawings
E-W Member Moment Connections at Floor EL. 162'-0"	8	522-041 SH. 10, 12, 13, 20, 23 *(Attachment Z52, Z70, Z72, Z106, Z121)* 522-003 *(Attachment Z101)*
E-W Member Connections at EL. 162'-0" (at column line L, at column line S1, and between column line M1 & N1)	5	522-041 SH. 10 & 16 *(Attachment Z52 & Z92)* 522-003 *(Attachment Z101)*
N-S Member Connections at EL. 162'-0"	32	522-041 SH. 10,14,15,16 *(Attachment Z52, Z73, Z91, Z92)* 522-003 *(Attachment Z101)*
Miscellaneous N-S Member Connections	8	522-041 SH. 1,10,17 *(Attachment Z107, Z52, & Z104)* 522-003 *(Attachment Z101)*
Crane Girder Bracket Connections	15	521-142 SH. 2, 5, 6 *(Attachment Z105, Z117, Z118)* 522-041 SH. 11, 21, 22 *(Attachment Z53, Z111, Z120)* 521-102 *(Attachment Z96)* 522-004 *(Attachment Z102)*
Column Connections to Concrete Floor	13	521-142 SH. 3 & 4 *(Attachment Z109 & Z110)* 522-041 SH. 18 & 19 *(Attachment Z93 & Z95)*
Concrete Tie Beam between 301-S_1 and 302A-S_1 Concrete Column Pier	1	422-057 *(Attachment Z119)*

*Attachment numbers in the right hand column refer to the EC 70139 Attachment number showing proposed modifications. Drawings referenced above, plus modification installation instructions, are provided in Enclosure B of this submittal.

A third calculation, S10-0049, "Auxiliary Building Overhead Crane (FHCR-5) Supporting Steel Structure – ANSYS Model" is an ANSYS model of the Auxiliary Building, which includes the stick model of the crane (supplied by the crane vendor). This calculation is not used for qualification of the Auxiliary Building crane support structure. This calculation is generated for use by the crane manufacturer, and has been verified to match the GTSTRUDL calculation. The GTSTRUDL model was converted to an ANSYS model by the AB upgrade architect/engineer

(A/E), as that is the software the crane vendor uses in analysis. The ANSYS model of the Auxiliary Building structure (with a stick model of the crane) was sent from the A/E to the crane vendor for use in a coupled analysis of the crane and support structure.

Additional information regarding analysis: Neither Chapter 5 or Chapter 9 of the FSAR refers to a specific method of analysis or a specific model for the Auxiliary Building structural analysis (i.e. static vs. dynamic analysis, or a specific computer code). For OBE seismic loading, FSAR Chapter 5.2.1.2.9.a specifies that allowable stresses be maintained per AISC Specification for the Design and Erection of Structural Steel for Buildings" – 1963 edition. These allowable stress levels are maintained. No license amendment is needed with respect to method of analysis or design code used.

Summary: Structural analyses have been performed to demonstrate that the upgraded Fuel Handling Crane (FHCR-5) and its supporting structure is designed in accordance with NOG-1-2004. Load cases from NOG-1-2004 and load cases from the original design basis calculations have been combined to create the load cases specified in License Amendment Request #310. LAR #310 does request an exception to tornado loading and recommends compensatory measures. The load cases used in the analysis include SSE seismic loading. As the original structure was designed to only OBE seismic loading, extensive modifications are required. These modifications will be implemented by Engineering Change 70139, "Auxiliary Building Crane Upgrades." Damping values used in the analysis are from NOG-1-2004, together with those of the original design basis. A comparison of RG 1.61 (2007) structural damping values to NOG-1-2004 damping values is provided in response to RAI-2. The modifications specified in EC 70139 will result in a crane and supporting structure that meet the single failure proof criteria of NOG-1-2004. This means that a load drop will not occur during an SSE seismic event.

NRC RAI-5

In Attachment 3 of the LAR, the licensee is proposing to revise FSAR Section 9.6.3.1, Spent Fuel Assembly Removal, by deleting, "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. However, in the letter dated February 8, 2007, Crystal River Unit 3 – LAR # 294, Revision 0, Elimination of Spent Fuel Pool Missile Shields, in Attachment A, page 1 of 6, in the second to the last paragraph, the licensee stated that, "the primary example being movement of the containment tendon surveillance equipment performed once every five years. CR-3 plans to retain the missile shields for this and other potential heavy load lifts over the SFP." Please address this discrepancy.

CR-3 Response to RAI-5

There is no discrepancy. The gate between pools A and B is a vertical water tight barrier installed below the pool water level to prevent water flow between the pools and to prevent damage to one pool from draining water from the adjacent pool. The missile shields are horizontal box beams that span across the top of the pools at Elevation 162' to prevent tornado generated missiles from impacting spent fuel assemblies located in the pools. The commitment stated above was added to the FSAR by Amendment 36, dated December 21, 1973 apparently in response to RAI question 9.20.g The docket files do not demonstrate conclusively the source of

this addition. However, this project to upgrade the crane and its support structure to ASME NOG-1-2004 will provide a single failure proof crane to obviate the need for the commitment.

Please see the letter dated August 23, 2007, 'Crystal River Unit 3 - License Amendment Request #294, Revision 0, Elimination of Spent Fuel Pool Missile Shields, Supplement #1'. In that Supplement, the following two commitments are made:

1. FPC will permanently remove the missile shields upon approval of this LAR (i.e., LAR # 294)
2. Alternate means of complying with NUREG-0612 requirements will be established

Missile shields were removed after receiving NRC approval in October 2007. This action was approved in order to support NRC efforts to close unresolved issues related to large area fires, and balanced those needs and the primary protective feature provided by the missile shields (i.e., tornado missile protection).

The criteria in NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," Section 5.1.2 were used to evaluate the acceptability of using tendon tension Inservice Inspection equipment with the missile shields removed. The objectives of the guidelines in NUREG-0612 are to assure that either (1) the potential for a load drop is extremely small; (2) the consequences of a load drop are acceptable. The specific section that deals with heavy loads around the spent fuel pool is Section 5.1.2. In order to satisfy the requirements of Section 5.1.2 the lifting device must meet one of four criteria.

1. Satisfy Single failure proof criteria
2. Provide mechanical/electrical stops to prevent movement of device within 15 feet of spent fuel pool
3. Provide mechanical/electrical stops to prevent movement of device within 25 feet of "hot" fuel.
4. Provide a load drop analysis to show no damage to fuel elements beyond what has already been analyzed.

Two controlling scenarios were evaluated: 1) testing a dome tendon which requires the equipment to be in closest proximity horizontally to the pools, and 2) testing a hoop tendon at the nearest buttresses which creates the greatest distance between the testing jack and the suspended work platform beneath the jack.

Scenario 1:

The testing is taking place on the dome tendons. This places the hydraulic ram at the closest horizontal distance to the pool and at its maximum vertical distance to the pool. However, at this testing location the distance between the hydraulic jack and the working platform is its smallest point. Any potential failure of the hydraulic jack cable will cause the least amount of kinetic energy to be imparted to the working platform and no failure of the working platform is anticipated.

NUREG-0612 specifies that special lifting devices (such as the tendon work platforms) should satisfy the guidelines of ANSI N14.6 - 1978. The design criteria in Section 3 of N14.6 states that load bearing members of the lifting device shall be capable of lifting three times the combined weight of the device without having the resulting stresses exceed the minimum tensile yield strength of the members. The device shall also be capable of lifting five times the same weight without exceeding the ultimate tensile strength.

Criteria 1 of Section 5.1.2 is to meet the single-failure-proof criteria. The requirements of a single-failure-proof lifting device are outlined in Section 5.1.6. Section 5.1.6 states that special lifting devices in addition to meeting Section 3 of ANSI N14.6 shall also meet Section 6 of ANSI N14.6. These sections state that the lifting device should have either a dual-load-path hoisting systems, or the design of the special lifting device shall have twice the normal stress design factor.

- The Upper Support Frame is designed for hurricane winds, seismic forces, and the full dead and live loads of the platform and jack. The work platforms would not be in use for tendon surveillance if hurricane conditions were expected, so hurricane loads would not be applicable. The frame was analyzed to the elastic yield stress and the designed with a load factor of four to an allowable stress that is 60% of the yield. Therefore, the frame was designed to far exceed the factor of 3 mentioned in N14.6. It also meets the intent of Section 6 of N14.6.

- The hydraulic jack is supported by one cable/hoist that is rated for 10000 pounds. The jack is reported to weigh 8500 pounds. It is not known from the vendor calculations what safety factor is used to derive the 10000 pound rating. From this it is assumed the single hoist system for the jack does not meet the intent of the NUREG design criteria.

- The working platform is supported by four drive cables that have a 10-to-1 Safety factor and also supported during movement over the pool area by four safety cables of the same size and strength as the drive cables. This provides adequate redundancy for supporting the working platform. It is concluded that the working platform meets the intent of Sections 5.1.1, 5.1.2 and Section 5.1.6 of the NUREG.

In this scenario it is concluded that the stress limits on the working platform meet the NUREG design criteria for a single-failure-proof and the potential for a load drop is extremely small.

Scenario 2:

The testing is taking place on the hoop tendons at Buttress #5 or #6. In this case the horizontal distance between a falling jack and the spent fuel pool is at a maximum. This scenario also has the potential for the working platform to be at a greater distance from the hydraulic jack.

For scenario 2 the potential exists that the distance between a falling jack and the working platform is such that partial failure of the platform may occur. Due to the redundancy of the platform restraint system it is unlikely that the both the jack and platform will fall. Therefore, consider only the jack as a potential dropped load.

For criteria 2 and 3 above a search of NUREG-0612 shows the basis of the 15 feet and 25 feet isolation basis is due to a tipping shipping cask. The actual separation distance can be smaller than 15 feet as long as the dropped object does not impact spent fuel. The distance from the RB buttresses to the pool is close to 25 feet. Since the jack is only 5 feet long and will be close to the buttresses there is ample separation from the pool. This also assumes that the jack has the energy to fall all the way to the spent fuel building's operating floor. Inspection of the roof steel drawing shows there is robust steel framing supporting the roof panel. If the falling jack were to fall through the roof significant loss of kinetic energy would occur. Therefore, in the unlikely event that the falling jack would fall through the working platform and then through the building roof it still would not reach the pool.

In this scenario it is concluded in the Load Drop Discussion below that a falling jack is outside the pool and consequences of a drop are inconsequential. The second commitment will be fulfilled by upgrading FHCR-5 to a single-failure proof crane. Spent fuel transfer cask handling with FHCR-5 will be conducted using a single failure proof lifting system, comprised of the new FHCR-5, along with lifting devices and interfacing lift points meeting the requirements in NUREG-0612, Section 5.1.6. This effectively eliminates the possibility of a dropped cask damaging the stored fuel, or the fuel pool structures in a manner that may result in a loss of pool water inventory.

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302/LICENSE NUMBER DPR-72

LICENSE AMENDMENT REQUEST #310, REVISION 1

ENCLOSURE A

DRAWINGS OF EXISTING AUXILIARY BUILDING ROOF STEEL FRAMING

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302/LICENSE NUMBER DPR-72

LICENSE AMENDMENT REQUEST #310, REVISION 1

ENCLOSURE B

CD-ROM OF AUXILIARY BUILDING MODIFICATION DRAWINGS AND INSTALLATION INSTRUCTIONS (EC 70139)

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

"AUXILIARY BUILDING SOUTH STEEL FRAMING ROOF AT ELEV 209 1" CRANE RUNWAY STEEL AT ELEV 193 7" "

WITHIN THIS PACKAGE

D-01

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

"AUXILIARY BUILDING NORTH STEEL FRAMING ROOF STEEL PLAN-CRANE RUNWAY, ROOF ELEV 200' – 4" & 209' – 1" "

WITHIN THIS PACKAGE

D-02