**Florida Power**
CORPORATION
Crystal River Unit 3
Docket No. 50-302
Operating License No. DPR-72

May 3, 2000
3F0500-02

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

Subject: Response to NRC Request for Additional Information Regarding Enhanced Spent Fuel Storage – License Amendment Request (LAR) #239 (TAC No. MA6754)

References: 1. FPC to NRC letter, 3F0999-07, dated September 16, 1999, "License Amendment Request #239, Revision 0, Enhanced Spent Fuel Storage"

2. NRC letter to FPC, 3N0300-04, dated March 3, 2000, "Crystal River Unit 3 – Request for Additional Information – Enhanced Spent Fuel Pool Storage Amendment (TAC No. MA6754)"

Dear Sir:

This letter submits the Florida Power Corporation (FPC) response to the NRC request for additional information (RAI) regarding License Amendment Request (LAR) #239, Revision 0. By letter dated September 16, 1999, FPC submitted LAR #239, Revision 0, requesting changes to the Crystal River Unit 3 (CR-3) license to allow replacement of the fuel racks in spent fuel pool B. The NRC forwarded the RAI to FPC by letter dated March 3, 2000.

The response to RAI item no. 1 contains information considered by Westinghouse Electric Company, LLC, to be proprietary, and as such, should be withheld from public disclosure. The proprietary version of the response is provided as Attachment A. The Westinghouse application for withholding proprietary information from public disclosure pursuant to 10 CFR 2.790 is provided as Attachment B. The non-proprietary version is provided as Attachment C. The response to RAI item no. 2 is provided as Attachment D. The response to RAI item no. 3 is included with the response to item no. 1 in Attachments A and C.

There are no new regulatory commitments made in this submittal. If you have any questions regarding this submittal, please contact Mr. Sid Powell at (352) 563- 4883.

Sincerely,
Ted Williams
Ted E. Williams for
T. H. Taylor
Director, Nuclear Engineering and Projects

THT/rer



A001

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

Attachments:

A. Response to NRC Request for Additional Information, Item Numbers 1 and 3 (Proprietary) – Westinghouse Electric Company, LLC
B. Westinghouse Application for Withholding Proprietary Information from Public Disclosure
C. Response to NRC Request for Additional Information, Item Numbers 1 and 3 (Non-Proprietary)
D. Response to NRC Request for Additional Information, Item Number 2

# FLORIDA POWER CORPORATION
# CRYSTAL RIVER UNIT 3
# DOCKET NO. 50-302/LICENSE NO. DPR-72

## ATTACHMENT B

## LICENSE AMENDMENT REQUEST #239, REVISION 0

## Enhanced Spent Fuel Storage

## Westinghouse Application for Withholding Proprietary Information From Public Disclosure

(Cover plus 8 pages)

Westinghouse Electric Company

Box 355
Pittsburgh Pennsylvania 15230-0355

April 19, 2000

CAW-00-1394

Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Attention: Mr. Samuel J. Collins

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: Response to NRC Request for Additional Information, Item Numbers 1 and 3, Crystal River Unit 3, License Amendment Request No. 239

Dear Mr. Collins:

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit CAW-00-1394 signed by the owner of the proprietary information, Westinghouse Electric Company LLC. The affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.790 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying Affidavit by Florida Power Corporation.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference this letter, CAW-00-1394 and should be addressed to the undersigned.

Very truly yours,

H. A. Sepp, Manager
Regulatory and Licensing Engineering

Enclosures

cc: T. Carter/NRC (5E7)

0457s.doc

CAW-00-1394

# AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

SS

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared H. A. Sepp, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC ("Westinghouse"), and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

H. A. Sepp, Manager
Regulatory and Licensing Engineering

Sworn to and subscribed
before me this 19th day
of April, 2000

Notary Public

Notarial Seal
Carole J. DiBiase, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Sept. 16, 2003
Member, Pennsylvania Association of Notaries

(1) I am Manager, Regulatory and Licensing Engineering, in the Nuclear Services Division, of the Westinghouse Electric Company LLC ("Westinghouse"), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rulemaking proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10CFR Section 2.790 of the Commission's regulations and in conjunction with the Westinghouse application for withholding accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse Electric Company LLC in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.790 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information which is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10CFR Section 2.790, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in the Response to NRC Request for Additional Information, Item Numbers 1 and 3, (Proprietary), April 2000, in support of Florida Power Corporation's submittal to the Commission, transmitted via Florida Power Corporation letter and Application for Withholding Proprietary Information from Public Disclosure, Mr. H. A. Sepp, Manager, Regulatory and Licensing Engineering, Westinghouse, to the Document Control Desk, Attention Mr. Samuel J. Collins. The proprietary information was provided by Westinghouse Electric Company LLC.

This information is part of that which will enable Westinghouse to:

(a) Assist the customer to obtain NRC approval.

Further this information has substantial commercial value as follows:

(a) Westinghouse plans to sell the use of similar information to its customers for the purpose of meeting NRC requirements for licensing documentation.

(b) Westinghouse can sell support and defense of the technology to its customers in the licensing process.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar products for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar design programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended for the development of replacement modules.

Further the deponent sayeth.

## PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.790 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) contained within parentheses located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.790(b)(1).

## COPYRIGHT NOTICE

The reports transmitted herewith each bear a Westinghouse copyright notice. The NRC is permitted to make the number of copies of the information contained in these reports which are necessary for its internal use in connection with generic and plant-specific reviews and approvals as well as the issuance, denial, amendment, transfer, renewal, modification, suspension, revocation, or violation of a license, permit, order, or regulation subject to the requirements of 10 CFR 2.790 regarding restrictions on public disclosure to the extent such information has been identified as proprietary by Westinghouse, copyright protection notwithstanding. With respect to the non-proprietary versions of these reports, the NRC is permitted to make the number of copies beyond those necessary for its internal use which are necessary in order to have one copy available for public viewing in the appropriate docket files in the public document room in Washington, DC and in local public document rooms as may be required by NRC regulations if the number of copies submitted is insufficient for this purpose. Copies made by the NRC must include the copyright notice in all instances and the proprietary notice if the original was identified as proprietary.

# FLORIDA POWER CORPORATION
# CRYSTAL RIVER UNIT 3
# DOCKET NO. 50-302/LICENSE NO. DPR-72

## ATTACHMENT C

## LICENSE AMENDMENT REQUEST #239, REVISION 0

## Enhanced Spent Fuel Storage

## Response to NRC Request for Additional Information

## Item Numbers 1 and 3 (Non-Proprietary)

## Westinghouse Electric Company, LLC

(Cover plus 23 pages)

**NRC RAI 1.**

Florida Power Corporation indicated in their submittal, that the calculated seismic loading stresses in a fully loaded rack will not exceed that of Standard Review Plan (SRP) Section 3.8.4 which was used as a guide. With respect to the stress calculations using the ANSYS computer code for the dynamic fluid-structure interaction analyses, the following information is requested:

a) The FLUID80 element of ANSYS is used for the dynamic 3-D fluid-rack (single- and multiple-rack) interaction analysis. Explain how this element interacts with the rack elements (i.e., separation, sliding, responses (e.g., displacement) at the common nodal points) under the safe-shutdown earthquake (SSE) loading condition.

**Response:**

The water within and surrounding the rack modules is modeled using ANSYS® FLUID80 (3-D contained fluid) fluid elements. The fluid elements are coupled to master degrees of freedom on the edges of the rack, in the direction normal to the face of the rack under consideration. There is no vertical coupling of the fluid elements to the rack, since the rack is open at the top, and has flow holes on the baseplate, allowing the water to move freely in a vertical direction. a,c

[

]a,c

b) Provide the results of any existing experimental study that verifies the correct or adequate simulation of the fluid coupling utilized in the numerical analyses for the fuel assemblies, racks and walls. If there is no such experimental study available, provide the technical justification on how the current level of the ANSYS code verification is adequate for engineering applications and that it should be accepted without further experimental verification work.

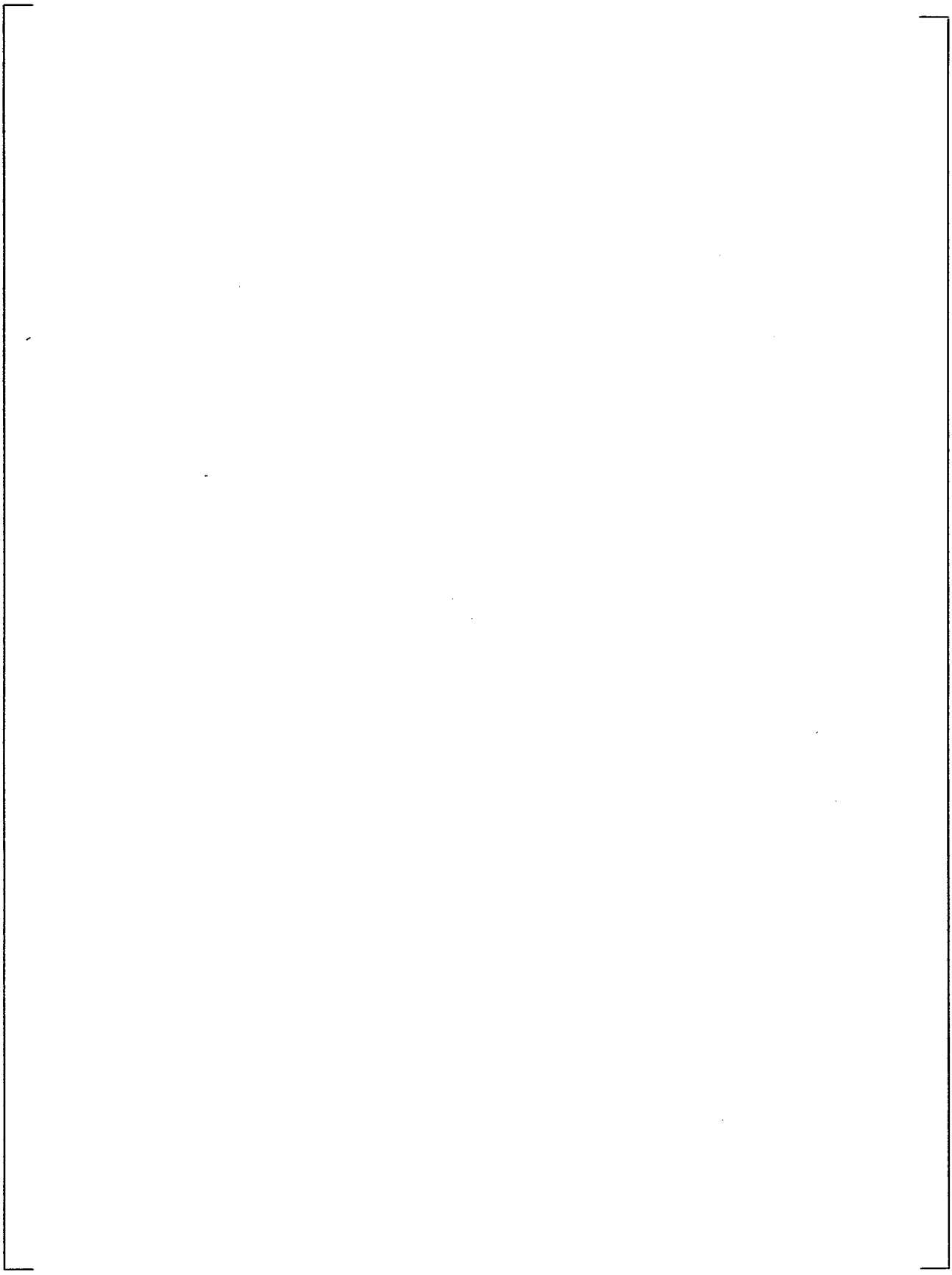
**Response:**

Two studies demonstrate and verify that the ANSYS® FLUID80 (3-D contained fluid) element is appropriate for modeling fluid/structure interaction. One study compares experimental fluid/structure interaction response results to finite element modeling results, using the ANSYS® contained fluid element. The other study verifies that the ANSYS® contained fluid element can be used to obtain a solution that closely matches the theoretical solution of a solid cylinder vibrating in water.

The work described in Reference 1 is a comparison of experimental fluid/structure interaction results, to results obtained by finite element modeling using the ANSYS® contained fluid element. The comparison of the results shows good agreement. The results demonstrate that the ANSYS® contained fluid element can be used to model the hydrodynamic mass effect of water on a submerged structure. Descriptions of the test apparatus and the finite element models can be found in Reference 1. The work described in Reference 1 is part of the Westinghouse methodology for evaluating baffle-former-barrel bolting distributions, documented in Reference 2. Reference 3 documents NRC approval of the methodology. a,c

[ ]

a,c



a,c

**Figure 1 - Hydrodynamic Model of a Cylinder in Water Using Half Symmetry**

## Table 1
## Calculation of Hydrodynamic Mass for a Cylinder in Water (See Figure 1)

a,c

| | | | |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

c) Indicate whether there was any numerical convergency and/or stability problem(s) during the nonlinear, dynamic single- and multi-rack analyses using the ANSYS code. If there were any, how was the problem overcome?

**Response:**

There were no instances of numerical convergency and/or stability problems during the analyses.

d) Provide the largest magnitude of the hydrodynamic pressure distribution along the height of the rack during the fluid and rack interaction for each case of the 3-D single- and multi-rack analyses. Indicate if any negative hydrodynamic pressures occurred, and if so, provide an explanation for these negative pressures.

**Response:**

The water pressure distribution along adjacent rack walls during the seismic time history is presented for the 12 x 8 single rack model. The results from the 12 x 8 single rack model are presented for two reasons. For the single rack model, only the 12 x 8 rack configuration was modeled because it has the most conservative seismic response due to its geometry (Reference 6, Section 3.4.3.2). In addition, the rack displacement and fuel impact force results from the 12 x 8 single rack model compared well with the whole pool multiple rack (WPMR) analysis, as is shown in Table 3-5 of Reference 6. Therefore, the results presented for the 12 x 8 rack model are representative of the results obtained for the other rack models used in the seismic analyses. a,c

a,c

**Figure 2 - Map of ANSYS® FLUID80 Elements Used to Graph Water Pressure**

a,c

**Figure 3 - Fluid Element 80023 Water Pressure vs. Time**

a,c

**Figure 4 - Fluid Element 80043 Water Pressure vs. Time**

a,c

**Figure 5 - Fluid Element 80063 Water Pressure vs. Time**

a,c

**Figure 6 - Fluid Element 80030 Water Pressure vs. Time**

a,c

**Figure 7 - Fluid Element 80050 Water Pressure vs. Time**

a,c

**Figure 8 - Fluid Element 80070 Water Pressure vs. Time**

e) Provide the deformation shape and magnitudes of the deformations of the rack from the bottom to the top for the single-rack SSE analysis when the maximum displacement at the rack top corner occurs.

**Response:**

Figure 9 shows the rack and the global coordinate system. The rack wall deformation profiles from the 12 x 8 single-rack model are listed in Tables 2 and 3, and plotted in Figures 10 and 11. The time, indicated in the titles of Tables 2 and 3, is the time during the time history analysis when the top corner of the rack reaches its largest displacement. The relative displacements are calculated by taking the difference between the nodal displacement on the rack wall, and the seismic time history displacement that represents the movement of the pool wall.

a,c

**Figure 9 - 12 x 8 Spent Fuel Storage Rack**

## Table 2
## Rack Wall X-Direction Displacement at Time = 2.560 sec.

a,c

| | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## Table 3
## Rack Wall Y-Direction Displacement at Time = 3.008 sec.

a,c

| | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

a,c

**Figure 10 - Rack Wall X-Direction Displacement**

a,c

**Figure 11 - Rack Wall Y-Direction Displacement**

## References


1. Harkness, Alexander W., and Schwirian, Richard E., "An Efficient Finite Element Method for the Representation of Fluid Structure Interaction in Large Structural Transient Dynamic Analyses," Proceedings of the ASME Fluids Engineering Division, FED-Vol. 247, ASME, 1998.

2. Westinghouse Report, WCAP-15030-NP-A, "Westinghouse Methodology for Evaluating the Acceptability of Baffle-Former-Barrel Bolting Distributions Under Faulted Load Conditions," Westinghouse Electric Company, December 1998.

3. Safety Evaluation by the Office of Nuclear Reactor Regulation, WCAP-15029, "Westinghouse Methodology for Evaluating the Acceptability of Baffle-Former-Barrel Bolting Distributions Under Faulted Load Conditions," November 10, 1998.

4. Chung, H., and Chen, S. S., "Hydrodynamic Mass," Topics in Fluid Structure Interaction, ASME, 1984.

5. Fritz, R. J., "The Effect of Liquids on the Dynamic Motions of Immersed Solids," Transactions of the ASME, February 1972.

6. Attachment D of License Amendment Request #239, Revision 0.

**NRC RAI 3.**

On page 3-14 of the Westinghouse Report, Revision 0, August 1999, the rack construction materials are discussed.

a) Please specify the materials of fabrication for all rack components including the weld materials. For example, American Society of Mechanical Engineers (ASME) SA240 304 for all sheet metal and ASME Type 308 L for weld material.

b) Please specify which ASME/American Society for Testing and Materials standards are used for each material listed above.

**Response:**

The material of fabrication used for the base plates, support plates, cells, and leveling pad is stainless steel SA240 Type 304L, and complies with NF-2000, Class 3, Subsection NF, Section III, of the ASME Boiler and Pressure Vessel Code.

The material of fabrication used for the screw of the leveling pad assembly is stainless steel SA564, Type 630 (17-4PH), and complies with NF-2000, Class 3, Subsection NF, Section III, of the ASME Boiler and Pressure Vessel Code.

The weld material is stainless steel 308L filler wire and complies with Section II, SFA 5.9 of the ASME Boiler and Pressure Vessel Code.

The neutron absorption material is Boral supplied by AAR Advanced Structures, Inc. Boral is a sintered metallic material of boron carbide and type 1100 alloy aluminum. The boron carbide conforms to the American Society for Testing and Materials (ASTM), ASTM C750-89, "Standard Specification for Nuclear Grade Boron Carbide Powder", Nuclear Grade Type III. The aluminum alloy extrusion conforms to ASTM B221-96, "Standard Specification for Aluminum Alloy Extruded Bars, Rods, Wire, Shapes and Tubes", Type 1100.

# FLORIDA POWER CORPORATION
# CRYSTAL RIVER UNIT 3
# DOCKET NO. 50-302/LICENSE NO. DPR-72

## ATTACHMENT D

## LICENSE AMENDMENT REQUEST #239, REVISION 0
## Enhanced Spent Fuel Storage

## Response to NRC Request for Additional Information
## Item Number 2

**NRC RAI 2**

With respect to the calculations for determination of spent fuel pool (SFP) capacity per SRP Section 3.8.4 and American Concrete Institute (ACI) 349-80, the following information is requested:

**RAI 2(a)** Describe the applied loading conditions including the weights of racks and fuel assemblies.

**Response:**

The analysis of the Auxiliary Building with the new spent fuel racks is contained in Florida Power Corporation (FPC) Analysis Calculation S99-0166, Revision 0, "Analysis of Spent Fuel Pool Structure for New Racks" (Reference 1). The analysis used the weights indicated on the Westinghouse detailed design drawing (Reference 4).

The FPC calculation referenced above used the following weights as design inputs:

| Description | Quantity used in Analysis | Dead Weight used in Analysis | Total Dead Weight |
|---|---|---|---|
| Normal Fuel Element | 932 | 1,750 pounds | 1,631,000 pounds |
| 12 cell x 8 cell rack | 2 | 11,390 pounds | 22,780 pounds |
| 12 cell x 9 cell rack | 2 | 13,000 pounds | 26,000 pounds |
| 10 cell x 13 cell rack | 2 | 15,570 pounds | 31,140 pounds |
| 10 cell x 13 cell rack | 1 | 14,390 pounds | 14,390 pounds |
| 11 cell x 13 cell rack | 1 | 17,300 pounds | 17,300 pounds |
| Rack support pads | 124 | 25 pounds | 3,100 pounds |

In the analysis, the above weights were converted to an equivalent dead weight pressure loading. Dead weight of racks and fuel = 3.25 kips/square foot (ksf).

The dead weight of the five foot thick concrete floor was taken from the previous calculation, Gilbert and Associates, Inc., (GAI) Report No. 1949 (Reference 2). This weight was calculated using five feet of concrete with a typical concrete density of 150 pounds per cubic foot. The dead weight of the concrete is determined to be 0.75 ksf.

The weight of the water in the spent fuel was considered a Live Load. This load also was taken from GAI Report No. 1949. The analysis assumed there would be no change in water volume with the rack replacement. The Live Load was calculated based on 40.17 feet of water at 62.4 pounds per cubic foot average density. (The 40.17 feet used in the calculation is the depth of the water when the SFP is at normal level, based on normal level at plant elevation 158'6" and the bottom of the pool at elevation 118'4".) The Live Load of the water is determined to be 2.51 ksf.

The Operating Basis Earthquake (OBE) and Safe Shutdown Earthquake (SSE) loads are based on the Floor Response Spectra for the Auxiliary Building, Elevation 119' (Reference 5). This elevation corresponds to the approximate bottom of the spent fuel pool. The peak of the response curve was used in the seismic analysis. The peak was then multiplied by 1.5 to account for possible multi-mode affects. This resulted in the following design accelerations:

| | |
|---|---|
| OBE Horizontal | = 0.81 g |
| OBE Vertical | = 0.54 g |
| SSE Horizontal | = 1.62 g |
| SSE Vertical | = 1.08 g |

**RAI 2(b)** Discuss whether there are any changes in the factors of safety of the SFP walls and slab due to the increased weights of racks and fuel assemblies. If there are any changes, provide the calculated factors of safety of the SFP walls and slab in a tabular form for the axial, shear, bending and combined stress conditions.

**Response:**

GAI performed the analysis of the spent fuel pool configuration in June 1977. This report, GAI Report No. 1949, referenced in FSAR Section 9.6.1.2.2, served as design input into the new analysis as discussed in Question 2a. This analysis used ACI Code 318-63 as the design reference (Reference 3). The loading was analyzed using the "Working Stress Design Method" for normal operating conditions and the "Ultimate Strength Design Method" for tornado, maximum hypothetical earthquake, and missile impact conditions. Loads considered were Dead Load (DL), Live Load (LL), Wind Load (WL), Equipment Load (EL), Operating Basis Earthquake (OBE), Tornado Missiles, and Safe Shutdown (SSE) – also called the Maximum Hypothetical Earthquake.

This earlier analysis used a combined dead weight of the fuel and racks equivalent to 2.45 ksf. As discussed in the above response to RAI 2(a), the new analysis derived a fuel and rack dead weight of 3.25 ksf. This change in weight required a reanalysis of the Spent Fuel Pool. The results of this new analysis are presented here. In preparing the new analysis it was assumed that no changes would occur due to loading from WL, EL, and the Tornado Missile. Therefore, they were not reevaluated in the new analysis. In addition, the replacement racks do not affect these load cases.

The following tables present information from FPC Calculation S99-0166 (Reference 1). The NRC requested Factors-of-Safety (FS) for shear stresses and axial stresses. The calculation did not directly derive these values. For shear stresses, the calculation made the statement that the spans were relatively short and the depth of the floor slab (five feet) would indicate shear stresses are not critical. Axial stresses also were not directly calculated. The calculation showed that bending (flexure) stresses control the design.

For flexure in the North-South direction, the following values were derived in FPC Calculation S99-0166:

| Load Combination | Allowable Stress Limit (ksf) | Calculated Stress (ksf) | Factors-of-Safety (FS) (Allowable Stress/ Calculated Stress) |
|---|---|---|---|
| Normal load combination (DL + LL + OBE) | 20.2 | 10.02 | 2.02 |
| Abnormal load combination 1.25 (DL + LL + SSE) | 35.4 | 16.92 | 2.09 |
| SRP Section 3.8.4, normal condition, U = 1.4D + 1.4G +1.9E | 35.4 | 22.5 | 1.57 |
| Impact load, using 100% increase in rack and fuel weight, Normal case with OBE | 20.2 | 11.5 | 1.76 |
| Impact load, using 100% increase in rack and fuel weight, Abnormal case with SSE | 35.4 | 16.6 | 2.13 |

For flexure in the East-West direction, the following values were derived in FPC Calculation S99-0166:

| Load Combination | Allowable Stress Limit (ksf) | Calculated Stress (ksf) | Factors-of-Safety (FS) (Allowable Stress/ Calculated Stress) |
|---|---|---|---|
| Normal load combination (DL + LL + OBE) | 14.0 | 10.02 | 1.4 |
| Abnormal load combination 1.25 (DL + LL + SSE) | 28.2 | 16.92 | 1.67 |
| SRP Section 3.8.4, normal condition, U = 1.4D + 1.4G +1.9E | 28.2 | 15.8 | 1.78 |

**RAI (2c)** The calculated maximum pool temperature for a full-core off-load is 157°F. Please provide technical justifications for exceeding the required maximum temperature of 150°F per the ACI Code 349 limits for normal operation or other long-term period.

**Response:**

ACI Code 349-90, Appendix A, Section A.4.1 states:

> *"The following temperature limitations are for normal operation or any other long term period. The temperature shall not exceed 150°F except for local areas, such as around penetrations, which are allowed to have increased temperatures not to exceed 200°F."*

Section A.4.2 of Appendix A further states:

> *"The following temperature limitations are for accident or any other short term period. The temperatures shall not exceed 350°F for the surface. However, local areas are allowed to reach 650°F from steam or water jets in the event of a pipe failure."*

As referenced in CR-3 FSAR Section 9.6.1.2.2, "Spent Fuel Storage", GAI Report No. 1949, submitted by FPC letter 3F0178-02, is CR-3's licensing basis for the spent fuel storage pool structure with high capacity fuel storage racks. The 160°F temperature has been analyzed and the results are discussed in the GAI report, subsection 5.7.3, titled Steady State Water Temperature of 160°F. That section states that local cracking of the concrete is expected, but that since these are local conditions due to secondary stresses, which are self-limiting, the structural capacity of the spent fuel pool is considered to remain adequate at that temperature.

This temperature of 160°F is the design basis temperature for the spent fuel pool resulting from a full core offload. Therefore, the 157°F is acceptable because it is bounded by the design and licensing basis temperature of 160°F.

**List of Acronyms**

| | |
|---|---|
| ACI | American Concrete Institute |
| ASME | American Society Mechanical Engineers |
| ASTM | American Society of Testing and Materials |
| CR-3 | Crystal River Unit 3 |
| DL | Dead Load |
| EL | Equipment Load |
| FEM | Finite Element Model |
| FPC | Florida Power Corporation |
| FS | Factors-of-Safety |
| ksf | Kips per Square Foot |
| LL | Live Load |
| NRC | Nuclear Regulatory Commission |
| OBE | Operating Basis Earthquake |
| SFP | Spent Fuel Pool |
| SRP | Standard Review Plan |
| SSE | Safe Shutdown Earthquake |
| WL | Wind Load |

**References**

1. Florida Power Analysis/Calculation S99-0166, Revision 0, "Analysis of Spent Fuel Pool Structure for New Racks."

2. Gilbert and Associates, Inc. (GAI) Report No. 1949, "Investigation of the Structural Safety of the Spent Fuel Pool Due to the Installation of High Capacity Fuel Racks," June 27, 1977 (submitted by FPC letter 3F0178-02, dated January 9, 1978, to Director, Office of Nuclear Reactor Regulation).

3. American Concrete Institute (ACI) Code 318-63, "Building Code Requirements for Reinforced Concrete."

4. Westinghouse Design Drawing 0798C15, Sheet 1 of 2, Revision 1.

5. Environmental and Seismic Qualification Program Manual (ESQPM), Revision 11.

# FLORIDA POWER CORPORATION
# CRYSTAL RIVER UNIT 3
# DOCKET NO. 50-302/LICENSE NO. DPR-72

## ATTACHMENT A

## LICENSE AMENDMENT REQUEST #239, REVISION 0

## Enhanced Spent Fuel Storage

## Response to NRC Request for Additional Information

## Item Numbers 1 and 3 (Proprietary)

## Westinghouse Electric Company, LLC

(Cover plus 23 pages)