Progress Energy

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

Ref: 10 CFR 50.54(f)

February 26, 2009
3F0209-02

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

Subject: Crystal River Unit 3 – Response to "Crystal River Nuclear Plant, Unit 3 - Request for Additional Information, Regarding Response to Generic Letter 2004-02 (TAC NO. MC4678)"

References:
1. CR-3 to NRC letter dated February 29, 2008, "Crystal River Unit 3 – Supplemental Response to NRC Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors""
2. CR-3 to NRC letter dated August 4, 2008, "Crystal River Unit 3 – Supplemental Response to NRC Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," Revision 1"
3. NRC to CR-3 letter dated December 2, 2008, "Crystal River Nuclear Plant, Unit 3 – Request for Additional Information, Regarding Response to Generic Letter 2004-02 (TAC NO. MC4678)"

Dear Sir:

On February 29, 2008, Florida Power Corporation (FPC), doing business as Progress Energy Florida, Inc., provided a supplemental response to Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," for Crystal River Unit 3 (CR-3). That supplemental response (Reference 1) was prepared using guidance for the preparation of GL supplemental responses submitted to the Nuclear Energy Institute (NEI) by the Nuclear Regulatory Commission (NRC) for industry distribution.

On August 4, 2008, FPC provided a revision to the supplemental GL 2004-02 response for CR-3 (Reference 2). That revision to the supplemental response provided corrected information to Specific Guidance for Review Area #3, "Specific Information Regarding Methodology for Demonstrating Compliance," Section #o, "Chemical Effects," Subsection #7, "WCAP Base Model."

By letter dated December 2, 2008, the NRC informed FPC that additional information was needed in order to conclude there is reasonable assurance that GL 2004-02 has been satisfactorily addressed for CR-3 (Reference 3).

A116
NRR

Attachment 1 contains the FPC response to the NRC Request for Additional Information (RAI). As allowed by Reference 3 above, FPC will respond to RAI #7, and how the in-vessel downstream effects are addressed for CR-3, within 90 days of issuance of the final NRC staff Safety Evaluation on WCAP-16793-NP.

Attachment 2 contains the List of Regulatory Commitments contained in this submittal.

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

Sincerely,

J.A. FRANKE, FOR

Dale E. Young
Vice President
Crystal River Nuclear Plant

DEY/dwh

Attachments: 1. Response to Request for Additional Information

2. List of Regulatory Commitments

xc: NRC Project Manager
NRC Regional Office
NRC Resident Inspector

STATE OF FLORIDA

COUNTY OF CITRUS

Jon A. Franke states that he is the Director Site Operations, 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
Director Site Operations
Crystal River Nuclear Plant

The foregoing document was acknowledged before me this 26 day of February 2009, by Jon A. Franke.

Signature of Notary Public
State of Florida

CAROLYN E. PORTMANN
Notary Public - State of Florida
My Commission Expires Mar 1, 2010
Commission # DD 524380
Bonded By National Notary Assn.

(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

ATTACHMENT 1

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING RESPONSE TO GENERIC LETTER 2004-02

RAI #1 **Because the jacketed mineral wool zone of influence (ZOI) was validly reduced from 17D to 4D (17 times pipe diameter to 4 times pipe diameter), please verify that the pipe breaks were subsequently moved systematically to ensure that the amount of debris created was maximized.**

FPC Response to RAI #1

Using a ZOI of 4D for jacketed mineral wool results in a spherical ZOI with a maximum radius of 12 feet based on the hot leg pipe diameter of 36 inches. All jacketed mineral wool within 12 feet of any location on each hot leg was considered as a potential debris source. Only a small portion of the Main Steam lines and Feedwater lines, both of which are currently insulated with jacketed mineral wool, fall within this 12 foot distance. A similar approach was used for the 28 inch cold leg piping, 12 inch decay heat drop line, and smaller diameter piping such as the pressurizer surge line and spray line. All jacketed mineral wool within the 4D ZOI of any of these lines will be replaced with Reflective Metal Insulation (RMI) coincident with the steam generator replacement during Refuel Outage 16 in the fall of 2009. In addition, all jacketed Nukon and encapsulated mineral wool (both of which assume a ZOI of 17D) will be removed from within the D-Rings during Refueling Outage 16.

Although Crystal River Unit 3 (CR-3) expects to exit the steam generator replacement outage with all fiber insulation removed from the applicable ZOIs within the D-Rings, chemical effects head loss testing was performed with the assumption that 10 cubic feet of Nukon will remain. This provides some margin for unforeseen circumstances, and also bounds the debris source term generated from a small break Loss of Coolant Accident involving the letdown line outside the D-Rings.

RAI #2 **Please provide verification that the fibrous size distribution used during testing was prototypical or conservative compared to the size distribution predicted by the transport evaluation.**

FPC Response to RAI #2

The debris preparation procedure used NUKON fiberglass sheets that were cut into twelve inch pieces, then shredded with a shredder and inspected to verify that the debris produced fell in size Classes 1 through 4 of NUREG/CR-6808, "Knowledge Base for the Effect of Debris on Pressurized Water Reactor Emergency Core Cooling Sump Performance," Table 3-2. The size classes reported in NUREG/CR-6224, "Parametric Study of the Potential for BWR ECCS Strainer Blockage Due to LOCA Generated Debris," Table B-3, are identical to those reported in NUREG/CR-6808. It is noted that neither of these NUREG reports specify the percentage of debris included in each class. NEI 04-07, "Pressurized Water Reactor Sump Performance Evaluation methodology, Rev. 0, Volume 1, May 2006," Section 3.4.3.3.1, defines "small fines" as debris composed of Classes 1 through 6 of NUREG/CR-6224. Classes 5 and 6 are larger than Classes 1 through 4. Therefore, the CR-3 fiber was verified to be generally finer than that required by the NEI 04-07 baseline methodology. Fibers existed in a range of sizes from single individual fibers to small (approximately <1 inch) tufts of fiber before additional processing.

Fiber was observed to be substantially smaller than the category defined in NEI 04-07 as "large pieces". The category of "small fines" as described in NEI 04-07 could be applied to the fiber used in the CR-3 testing based solely on the observed condition of the fiber at the end of the dry processing steps. As discussed below, additional mixing of the fiber with electric paint mixers, combined with the method used to introduce the debris into the test tank, breaks the fiber down further.

After these initial characteristics were met, the shredded fiber was weighed in the desired quantities. The debris was then boiled for at least five minutes to remove the binder and ensure that the fiber would not float. After boiling, the debris was vigorously mixed with water in a confined volume with an electric paint mixer to further break up debris clumps. The paint mixer was typically applied again immediately before each batch of debris was added to the test tank.

Two tests were performed to demonstrate acceptable CR-3 strainer performance. Both tests used the debris preparation procedure as described above. However, the second test, which was a fiber-only test with the purpose of (1) visually observing the debris bed formation pattern on the strainer top hats and (2) confirming that the low head loss and high turbidity during the first test was due to substantial clean screen area, utilized additional agitation with the paint mixer. The additional mixing was performed to ensure the fiber was essentially reduced to nearly all individual fines to maximize suspension and transport characteristics. The photo below shows the resulting fiber bed and the distribution of fiber fines.

Based on the CR-3 debris generation and debris transport analyses, the amounts and size distribution of fiber that reaches the sump strainer is:

Fiber Debris Size	Quantity at Sump	
Fines	1.84 cubic feet	53 percent
Small Pieces (<6 inches)	1.60 cubic feet	47 percent
Latent Fiber (considered to be fines)	30 pounds (~12.5 cubic feet)	

Although the final fiber size distribution was not quantitatively characterized after processing with the paint mixer, there were no substantial clumps of insulation observed. The agitation with a paint mixer effectively reduced the fiber to individual fines and small clusters. The photo above of a representative fiber bed from Test #2 shows that the bed is uniform with no lumps that would be indicative of a larger mass or clump of insulation fibers. Although the insulation in this photo received additional agitation compared to the insulation in Test #1, both tests are believed to bound the fiber size distribution predicted by the transport evaluation. Therefore, the fibrous size distribution during testing is considered conservative compared to the debris generation and debris transport analyses.

RAI #3 **Please provide details of the debris addition procedures used. Please include a description of the fibrous concentration during debris addition and the method of adding fibrous debris to the test tank. Please provide verification that the debris introduction processes did not result in non-prototypical settling or agglomeration of debris.**

FPC Response to RAI #3

Strainer head loss testing was performed during multiple independent tests, using different test protocols, in accordance with generic Alion test procedures and CR-3-specific test plan ALION-PLN-ENER-4724-04, "Test Plan: Progress Energy GSI-191 Containment Sump Screen Chemical Effects Testing for Crystal River 3 Nuclear Plant." Each test used pump flow rates and debris quantities scaled to the surface area of the test strainers.

Test #1

Test #1 was performed specifically for the conditions expected to exist following steam generator replacement in the fall of 2009. For this test, the particulate and fiber debris were added directly above the sump to ensure full entrainment in the flow stream and minimize the opportunity for settling outside the sump area. Chemical precipitates were added directly over a sparger along the back wall of the tank and allowed to be carried into the sump by the flow stream. Between each debris addition, the tank was recirculated until head loss was stabilized. The debris addition sequence was as follows:

The full particulate load, including latent dirt and dust, was added to the test tank, directly over the sump.

The fiber was added to the tank, directly over the sump, at a concentration of 1 pound (maximum) of fiber per 4 gallons of water.

Paint chips were added to the tank, directly over the sump.

Chemicals were added to the tank over the sparger.

Additional paint chips were added to the tank, directly over the sump.

All of the debris was prepared and staged in 5 gallon buckets of water. Each debris addition evolution was performed by gently releasing the material into the flow stream. During this test, water clarity never improved to the point where an assessment could be made regarding debris accumulation on the strainer versus settling in low turbulence zones within the sump pit (the lack of clarity is attributed to remaining clean screen area, such that the debris bed did not filter out all of the particulates and precipitates). However, when the tank was drained, some amount of fiber was found on the floor of the sump pit in the immediate vicinity of the top hats. Also, as expected, a significant amount of precipitates was found on the floor of the sump pit and the tank, since the precipitates remained in solution for the entire test.

Test #2

The sequence of debris addition for Test #2 was selected to allow visual confirmation of fiber loading on the strainers and, more specifically, to validate the presence of clean strainer surface area that was indicated by the low head loss and high turbidity observed in Test #1.

For this test, the fiber was added prior to the particulate debris to allow complete visibility of the tank contents. The fiber (at a concentration of 1 pound (maximum) per 4 gallons of water) was added outside of the sump area and allowed to carry over the sump wall and into the sump pit. This method allowed the transport of fibers to match expected plant transport behaviors as much as practical. When the entire post-steam generator replacement fiber load was added (theoretical 0.18 inch uniform bed thickness) and no fibers remained in suspension, the following observations were made:

Approximately 15 percent of the outside surfaces of the strainers were clean.

Strainers closest to the point of debris addition were almost completely covered on the outside surface, while strainers furthest away were about 40 percent clean.

All strainers were 50-75 percent clean on the inside surface.

No debris was observed on the bottom of the sump pit or on the bottom of the tank (all fiber was attached to strainer surfaces).

Additional fiber was then added until the strainer was visually verified to be 100 percent covered. The total fiber volume added to this point equated to a theoretical uniform bed thickness of 0.36 inches. The test continued with the addition of particulates, additional fiber, and chemical precipitates; however, the additional testing is considered "informational" only, and does not provide any relevant data for the CR-3 post-steam generator replacement condition.

Summary

Multiple tests were performed to demonstrate acceptable sump performance with the expected debris load following insulation replacement in the fall of 2009. The debris addition sequence used in Test #1 is consistent with that identified in the NRC's revised review guidance (March 2008), while Test #2 was consistent with the draft September 2007 review guidance for determining whether a thin bed will form. The September 2007 guidance was in effect during the CR-3 testing. Both tests demonstrated that adequate clean screen surface area exists with a theoretical 0.18 inch thick fiber bed. The debris introduction processes used during each test did not result in non-prototypical settling or agglomeration of debris.

RAI #4 **Please verify that the stirring used to prevent debris settlement did not non-prototypically affect bed formation.**

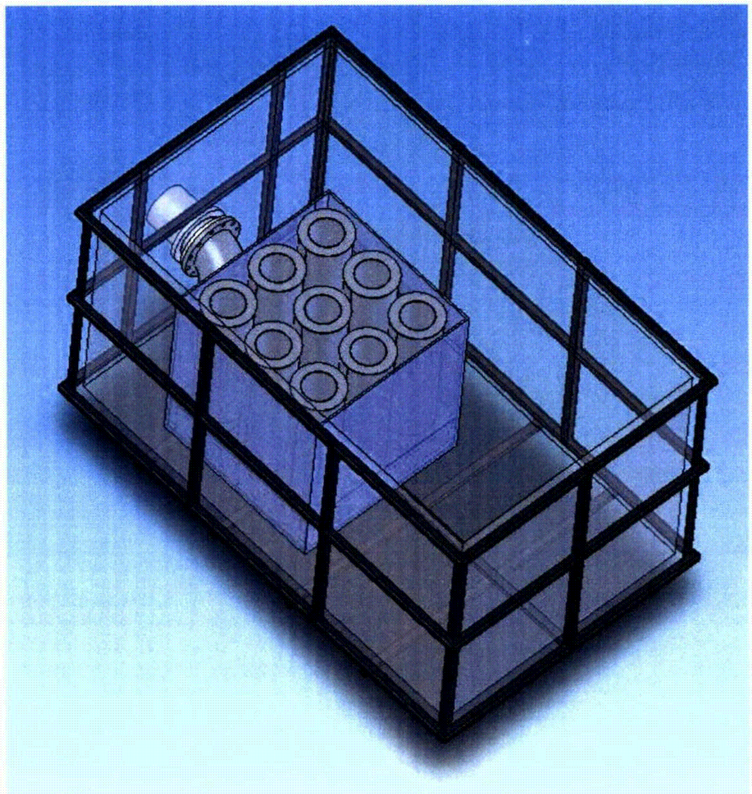
FPC Response to RAI #4

Chemical Effects Testing for the CR-3 strainers was performed at the Alion test facility in Warrenville, IL, and monitored by Progress Energy personnel. The test utilized an approximately 6 feet tall by 6 feet wide by 10 foot long tank with a prototypical "top hat" strainer array. The strainer assembly was surrounded on all sides by panels designed to simulate sump pit walls (similar to the sump pit in the CR-3 reactor building). Pump suction was from the base of the sump, and the water was returned to the tank through a sparger located at the bottom of the tank along the back wall.

The sparger served to maintain the debris in suspension so that it could be transported to the sump pit and strainers. In addition, stirring was manually accomplished by slowly skimming the broad end of an oar across the bottom of the tank to lift any debris that may have settled, allowing it to be entrained in the current and transported to the sump pit.

The walls of the sump pit provided a physical boundary between the strainer array and the turbulence caused by the sparger and the oar. Therefore, the stirring did not non-prototypically affect the debris bed formation.

A model of the test assembly for Test #1, showing the 3 x 3 strainer array surrounded by walls on all four sides, is shown below. Test #2 used a similar arrangement, but with a 3 x 2 top hat strainer array.



RAI #5 **Given the potential issues with debris preparation and introduction into the test tank, please verify that a debris bed could not form over a majority of the strainer and that adequate open area would remain to prevent significant head losses (e.g., please provide assurance that the head loss tests that were conducted resulted in prototypical or conservative head losses).**

FPC Response to RAI #5

As discussed in the preceding responses, the CR-3 head loss tests were designed to provide prototypical, if not conservative, debris bed formation. The CR-3 sump strainers are located in a recessed sump pit at the end of a corridor, far removed from the source of the majority of the fiber debris. Fiber debris, as well as other types of debris, must be swept along the floor and over a curb surrounding the sump pit before reaching the 8-wide by 4-deep array of vertical "top hat" strainers.

Test #2 most closely replicates the expected introduction of fiber into the sump pit. This test utilized a 3-wide by 2-deep array of top hats, with the fiber introduced "upstream" of the sump pit. The fiber exhibited a clear preference to be drawn to the first top hats encountered (i.e., closest to the upstream sump wall). It is expected that the CR-3 top hats would be loaded in a similar fashion, with the rows of top hats furthest from the walls experiencing relatively light debris bed formation. It is recognized that the presence of particulate debris can influence the development of a debris bed. However, based on the significant amount of clean screen area observed (see response to Question 3), and the results of Test #1 described below, it is reasonable to expect that sufficient clean screen area will exist, regardless of the precise manner in which the debris bed develops.

Test #1 used a more conservative approach for introducing fiber and particulate debris into the sump pit. Since the debris was added directly above the sump, it was more likely to be evenly distributed among the top hats. Due to the addition of particulates prior to fiber in this test and the resultant lack of water clarity, the distribution pattern and debris bed formation could not be observed. Subsequent drain-down of the test tank did show that all top hats received some amount of fiber. Unfortunately, much of the particulate and precipitate-laden debris bed did not remain adhered to the top hats after the pump was shut off, resulting in sloughing of material to the bottom of the sump pit or top hats when the system was drained. This prevented an accurate quantification of clean screen area. However, based on the low head loss during this entire test, and the enduring turbidity of the system, it can be concluded that sufficient clean screen area existed on the strainers.

RAI #6 Please provide the amount (percentage by type) of debris that settled in the agitated areas of the test tank.

<u>FPC Response to RAI #6</u>

The particulate and fiber debris was added directly above the sump pit during Test #1. The particulate debris was added first and was able to pass through the top hats and become well distributed throughout the tank before the fiber additions began. The fiber was not given much of an opportunity to settle outside the sump pit, and only a small amount would be expected to bypass the strainers. The broad end of an oar was used (one time) to encourage debris that had settled on the tank floor to re-enter the flow stream and transport to the sump pit.

Limited observations could be made during the test due to high turbidity. Post-test inspections did not identify any fiber outside the sump pit. There were a couple of small piles of particulate debris located in remote areas where turbulence would be lowest. Due to the relatively high flow rate in the test tank during this test, it is expected that the lower density material (fiber and ground silica) would easily stay in suspension. The higher density material (silica sand and paint chips) would be more likely to settle in areas of lower turbulence. Based on the post-test inspections, the following amounts of each debris type are estimated to have settled during the test:

Estimate of Debris that Settled in
<u>Agitated Areas of the Test Tank</u>

Fiber	0 percent
Coatings Surrogate (ground silica)	0 percent
Dirt/Dust Surrogate (silica sand)	<10 percent
Paint Chips	<15 percent

The initial steps of Test #2 were performed to visually demonstrate that clean screen area will exist with the fiber load at CR-3 following insulation replacement activities in 2009. As such, the applicable portion of the test only used fiber debris. The absence of particulate debris enabled the un-obscured viewing of the tank contents. All fiber was observed to be attached to the top hats (0% settled in tank).

RAI #7 **The NRC staff considers in-vessel downstream effects to not be fully addressed at Crystal River 3 (CR3), as well as at other PWRs. The licensee's submittal refers to the draft Westinghouse topical report, WCAP-16793-NP. The NRC staff has not issued a final safety evaluation (SE) for WCAP-16793-NP. The licensee may demonstrate that in-vessel downstream effects issues are resolved for CR3 by showing that the CR3 plant conditions are bounded by the final WCAP-16793-NP and the corresponding final NRC staff SE, and by addressing the conditions and limitations in the final SE. The licensee may alternatively resolve this item by demonstrating, without reference to WCAP-16793-NP or the staff SE, that in-vessel downstream effects have been addressed at CR3. In any event, the licensee should report how it has addressed the in-vessel downstream effects issue within 90 days of issuance of the final NRC staff SE on WCAP-16793-NP. The NRC staff is developing a regulatory issue summary to inform the industry of the staff's expectations and plans regarding resolution of this remaining aspect of GSI-191.**

FPC Response to RAI #7

FPC will respond to RAI #7, and how the in-vessel downstream effects are addressed for CR-3, within 90 days of issuance of the final NRC staff Safety Evaluation on WCAP-16793-NP.

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER - UNIT 3

DOCKET NUMBER 50 - 302 / LICENSE NUMBER DPR - 72

ATTACHMENT 2

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 actions discussed in the submittal represent intended or planned actions by FPC. They are described to the NRC for the NRC's information and are not regulatory commitments. Please notify the Supervisor, Licensing and Regulatory Programs of any questions regarding this document or any associated regulatory commitments.

Commitment	Due Date
FPC will respond to RAI #7, and how the in-vessel downstream effects are addressed for CR-3.	Within 90 days of issuance of the final NRC staff Safety Evaluation on WCAP-16793-NP.