September 17, 2008

Mr. J. A. Stall
Senior Vice President, Nuclear and
Chief Nuclear Officer
Florida Power and Light Company
P.O. Box 14000
Juno Beach, Florida 33408-0420

SUBJECT: ST. LUCIE PLANT, UNIT 1 - REQUEST FOR ADDITIONAL INFORMATION (RAI) RELATED TO GENERIC LETTER 2004-02, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY SUMP RECIRCULATION AT PRESSURIZED-WATER REACTORS" (TAC NO. MC4710)

Dear Mr. Stall:

By letters dated September 1, 2005 (Agencywide Document Access and Management System (ADAMS) Accession No. ML052490339) and June 30, 2008 (ADAMS Accession No. ML081840513), you submitted documentation to demonstrate acceptable containment sump performance, consistent with Generic Letter (GL) 2004-02,"Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors." Part of the technical basis for your position relies on results from testing at the VUEZ facility by Alion Science and Technology.

As discussed by Mr. John A. Grobe, Associate Director for Engineering and Safety Systems, in a telephone call with you on September 10, 2008, we have identified several critical issues with the test protocol used in the testing at VUEZ, as reflected in the request for additional information (RAI) provided in the enclosure. We have had many interactions with Alion and your staff over the last year in an attempt to resolve issues with the testing protocol, including a site visit to observe testing at VUEZ. Although progress has been made in resolving some of these issues, the most significant issues affecting the VUEZ test protocol have not been adequately addressed. Our review of information provided by Alion on the VUEZ testing has led us to conclude that it is highly unlikely that reliance on the VUEZ testing performed to date to demonstrate strainer adequacy will provide you with an adequate technical basis to resolve GL 2004-02. As such, you may need to consider an alternate approach to demonstrate adequate performance of your containment sump. Should an alternate approach be utilized, response to the specific RAIs is not necessary.

To enable a timely resolution of Generic Letter 2004-02 for your plant, we request that you provide to us by October 3 your plan for demonstrating adequate sump performance. This plan should describe the approach to be taken and a completion schedule for any needed additional testing or other actions, including submittal of additional documentation, as necessary, to provide the technical basis for your conclusion of acceptability of your sump performance, in accordance with GL 2004-02.

This plan must consider the concerns identified in the enclosed RAIs. A telephone call is an acceptable method to initiate communication on your plans and schedule. We expect that we will need to conduct a public meeting with you after October 3 to discuss your plan in more detail.

You will also need to submit an extension request in accordance with the established process from SECY-06-0078, *Status of Resolution of GSI-191, "Assessment of [Effect of] Debris Accumulation on PWR Sump Performance"* (ADAMS Accession No. ML053620174). A detailed description of your plans and schedule will need to be included in the extension request.

Note that the enclosed RAIs are from a portion of our review of your responses to GL 2004-02 and do not represent a comprehensive set of RAIs. The RAIs associated with other portions of our review will be sent to you over the next two months.

Should you have any questions on the issues discussed in this letter, contact me at 301-415-2020.

Sincerely,
/RA by Brendan T. Moroney for/

Brenda L. Mozafari, Senior Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-335

Enclosure: Request for Additional Information

cc w/encl: See next page

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Should you have any questions on the issues discussed in this letter, contact me at 301-415-2020.

Sincerely,
/RA by Brendan T. Moroney for/

Brenda L. Mozafari, Senior Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-335

Enclosure: Request for Additional Information

cc w/encl: See next page

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REQUEST FOR ADDITIONAL INFORMATION

ST. LUCIE UNIT 1, RELATED TO GENERIC LETTER 2004-02, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY SUMP RECIRCULATION AT PRESSURIZED-WATER REACTORS"

TAC NO MC4710

1. Chemical Effects

a) The NRC staff is interested in how a given licensee determines that the test parameters selected for the VUEZ loops provide test results that are conservative with respect to chemical effects. This is particularly important since test results may show that certain dissolved species remain in solution instead of forming precipitate in the period of interest. With respect to test pH, higher pH conditions may favor greater dissolution of important materials, such as aluminum, while near neutral pH values would provide conditions that favor precipitation of aluminum hydroxide type species. Please describe how the pH profile used in testing for your plant performed at VUEZ assures conservative or realistic quantities of dissolved materials as well as precipitate generation.

b) VUEZ chemical effects tests are initially conducted for an extended period at an intermediate temperature to account for the test equipment's inability to test at the short-term, peak post-accident temperatures. Please provide the basis for considering that this is conservative with respect to material degradation (e.g., corrosion of aluminum).

c) The existing VUEZ testing does not address the effect of a sudden temperature drop from a heat exchanger and the potential for thermal cycling. During interactions with Alion, the staff was informed that efforts were under way to analyze this effect. Please provide justification to explain why thermal cycling would not affect your plant's chemical effects test results.

d) The protocol for the tests observed by the staff at VUEZ was to boil the Temp-Mat™ and Nukon® fibers to drive off the binder or lubricant material prior adding the fiber to the tanks. The water used to boil the fibrous debris is drained off and never added to the test tank. Bench scale testing by Alion indicates that this water contains silicon and sodium. Why is it acceptable to not include the dissolved materials from the fibers in the test tank given that they may contribute to the formation of chemical precipitates such as sodium aluminum silicate? Please provide a justification for not including the materials leached out of the fibers during boiling in the 30-day tank test.

e) For the VUEZ tests observed by the staff, care was taken to thoroughly mix the tank fluid (by mechanical mixing) after the addition of the boric acid. This was done because, as VUEZ personnel indicated, it can take longer than 4 hours for complete mixing of the test tank fluid. This same procedure is not used when the buffer, the HCl, the HNO_3, and the last portion of LiOH are added later in the test. This is due in part to the inability to get a mechanical mixer in the tank due to physical limitations caused by the volume taken up by coupons and baskets of material in the tank at the time of those additions. The mixing of these chemicals into the bulk fluid will take even longer due to the complex geometries and uneven flow zones created by the coupons and baskets. The reason that this is a potential concern to the staff is that the timed removal of coupons and baskets is based on the time allowed to interact with these chemicals. If the chemicals are not well mixed then the coupons and baskets may not be getting the chemical interaction they are assumed to get prior to removal. As an example: An aluminum coupon is placed in the tank at time zero. The chemicals are then added and the time of interaction of that coupon, as modeled based on the time of exposure to containment spray, begins. After four hours of interaction the coupon is removed. However if the chemicals, or the coupon/basket, were isolated in a low flow / unmixed zone of the tank, the actual time of interaction may be far less. Please describe how this potential phenomenon is accounted for in the testing for your plant.

f) In the VUEZ testing many of the debris sample baskets used for the testing are shaped like a tray, allowing for fluid interaction with the material in the basket through only one open “screened” surface. Thus, due to the geometry of the sample baskets, there is only minimal flow of water past the samples, which reduces the ability of the test fluid to interact with the sample materials. This problem is compounded when the baskets are densely packed with debris, which the staff observed for several tests with large debris quantities, including cases where one material was densely packed on top of a second material inside the basket, providing this material a shielding effect from the test fluid. In addition, several of the tests observed by the staff required large quantities of debris that filled a significant fraction of the available test tank volume. Stacked or closely spaced baskets have the potential to limit further the interaction of the test fluid with the sample materials in the baskets. In addition, the staff observed in one test that a sample coupon was inserted in the test tank with one side very close or adjacent to the wall of the test tank, which appeared to prevent significant flow of the test fluid to approximately half of the coupon surface area. All of these issues are tied to the staff’s larger concern that the sample materials added to the test tank may not be able to interact with the test fluid in a representative manner. As a result, fewer chemical species could be dissolved into the test fluid, and therefore there may be a non-representative reduction in the potential for formation of chemical precipitates in the VUEZ test loop. Please describe the packing of

sample baskets and basket orientations used in your plant's testing. In addition, please provide justification that your plant's testing, and procedures for preparing baskets, provided realistic or conservative levels of dissolved materials.

2. Head Loss

a) The method used for forming the debris bed in the VUEZ loops does not allow for prototypical bed formation (as a bed would be formed by flow through a strainer). The staff observed inconsistencies in the bed formations and in one instance noted that the debris was manually adjusted to cover an opening in the bed. In general, the beds at VUEZ appear more porous than beds made of similar debris in larger scale array tests. In addition to these observations, the staff has noted that the VUEZ debris bed head loss, prior to the addition of the components which provide the chemical effects head loss, are generally significantly lower than head losses from large scale tests with similar debris loads. The position that the initial head loss is of no consequence to the result because it is only being used as a multiplier has not been accepted by the staff. The staff considers it likely that the bed pouring process is a significant factor causing these non-prototypical differences. Please provide an evaluation that shows that the debris beds formed during the VUEZ testing was prototypical of the debris beds expected to form in the plant. Compare the initial, non-chemical, VUEZ head loss results with the head loss results obtained during larger scale testing of the strainer module. Alternately, provide an evaluation that justifies the use of the bump up factor as applied to the larger scale test results.

b) The specific methodology and technical basis for using a bump-up factor to account for the head loss due to chemical effects is not clear to the staff. The bump-up approach is based on the theory that the incremental head loss from a given quantity of chemical precipitate (after scaling) will be the same for the VUEZ debris bed as for the plant condition. One of the important assumptions upon which this theory depends is that the VUEZ debris bed and the actual plant debris bed should have sufficiently similar characteristics with respect to filtering out and spatially accumulating the chemical precipitates. Based upon testing conducted to date, it is not clear to the staff that geometric differences and other factors do not influence the debris bed's properties (e.g., porosity, compression, thickness), and thus add significant uncertainty to the bump-up factor approach. It is also not clear how the bump-up approach ensures that boreholes or differential-pressure effects do not adversely affect the scaling approach. That is, would the additional chemical head loss result in differential pressure phenomena that could negate the assumptions used for temperature scaling of the test results to plant sump temperatures. Please provide a justification with evidence that the bump up approach is valid in light of the staff's questions.

c) During a series of pre-tests conducted prior to the staff's trip to VUEZ, sensitivity tests associated with the sequencing of debris into the test tank showed a significant difference in head loss associated with varying the arrival sequence of debris on the test screen for the same debris loading. In one case, the debris was added homogeneously, which resulted in a low head loss. However, in the heterogeneous case, the test was stopped prematurely after the head loss had rapidly increased to a value approximately 20 times greater than the homogeneous case. The staff questioned the basis for such a large discrepancy between these two cases and questioned why the homogeneous addition sequence is representative. Further, because the bump-up approach implicitly assumes similarity between the debris bed formed in the larger tank test to the bed formed in the VUEZ loop, it is not clear why the same debris addition sequence should not be used for both tests. Please provide justification for the acceptability of using different debris addition sequences for the array test and the VUEZ test and then applying the results of one as a multiplier for the other. Alternately, verify that the same debris addition sequence was used for both tests.

d) Alion stated that a generic fiber size distribution was used for the VUEZ testing. The staff expectation is that an appropriate procedure for preparing fine fiber be implemented (which is particularly important for the thin bed test, since for many plants, fines may be the only debris size that actually covers the entire strainer), and that the surrogate debris used matches the plant-specific size distributions from the debris transport calculation. The staff's observations at VUEZ showed that the prepared debris contained chunks that seemed to disrupt the formation of uniform debris beds. Further, since a fixed quantity of water was used to form all of the debris slurries, the cases with the highest debris loadings had the most concentrated and agglomerated debris slurries, which resulted in the formation of the most clumpy and non-uniform beds. Also, Alion did not generally perform a verification that the size distribution of the prepared debris was adequate prior to adding it to the test loop. Please provide justification that the VUEZ testing was conducted with debris that was prepared to prototypically or conservatively represent plant debris and that the addition of this debris to the test facility did not result in non-prototypical debris agglomeration or debris bed formation.

e) Alion stated that the full load debris beds were used for VUEZ testing because they resulted in the highest head losses. Due to the bed morphology, it is possible that the addition of chemical debris to a thin bed could result in higher head losses than the addition of the same chemical debris to a thicker bed that had a higher non-chemical head loss. Please provide an evaluation that justifies that the total head loss resulting on a chemically laden thin bed would not exceed the head loss associated with a chemically laden full load debris bed. Alternately, verify that a thin bed test was conducted at VUEZ.

f) Related to the question above, Alion has stated that larger bump-up factors were calculated for maximum load cases as opposed to thin-bed cases based on previous VUEZ testing. Provided that these early tests were not unduly influenced by issues such as debris coarseness and bed pouring, and that general principles can be deduced from these results that are applicable to other plants' test conditions, then it may be appropriate to use these tests as a basis to rule out the conduct of future thin bed tests. Please provide the technical basis for determining the appropriate theoretical thickness of the beds in the VUEZ tests so that the staff can evaluate the acceptability of the general assumption that thin bed testing is not required.

g) It is not clear whether the flat plate in the small VUEZ loops can be scaled for circumscribed or partially circumscribed conditions (e.g., modeling effective bed thicknesses, circumscribed / partially circumscribed flow areas and approach velocities). These geometric effects may be partially responsible for reduced head loss seen for test conditions in the VUEZ loop as compared to the large tank with the top hat arrays. Please provide an evaluation that justifies that the testing performed in the VUEZ loops prototypically modeled the plant debris bed with respect to these issues.

h) It is important to ensure gas release and boreholes do not disrupt debris bed structure. Alion has stated that improvements have been made to address this issue for the small VUEZ loops, and that the limited experience to date has not shown there is a gas issue with the large VUEZ loop. Following the improvements to the small loops, observations made during the staff's trip to VUEZ showed that significant portions of two of the four beds floated away within several hours of formation. Please provide assurance that gas release did not affect the results of the testing at VUEZ.

i) During the staff's visit, inward warping of the debris bed away from the walls of the "chimney" was observed on two tests. Such warping of the debris bed could result in a significant amount of the flow passing through the thinner cross section of the debris bed nearest the chimney walls. Additionally, as a result of the modification to reduce the potential for gas trapping beneath the bed, the suction piping was modified to draw primarily from the edges of the screen. This suction arrangement could increases the proportion of flow passing through the warped edges of the debris bed, exacerbating the staff's concern that warping of the debris bed may result in the measurement of non-prototypically low head losses. Please provide an evaluation justifying that non-prototypical bypass did not occur during the chemical effects testing at VUEZ.

j) Confidence should exist that the VUEZ tests are repeatable. However, based upon the staff's observations from the trip to VUEZ, evidence for the repeatability for the debris bed formation process was not conclusive.

Although some of the tests appeared to demonstrate repeatability, other tests demonstrated significant variability. Among the tests observed by the staff included two pre-test cases, four test cases, and two repeat test cases that became necessary when significant portions of two debris beds floated away. Please provide justification that the testing conducted at VUEZ provides confidence that results are repeatable.

k) Between the flow rate measurement, flow control, head loss measurement, and temperature measurement, there could be a relatively high uncertainty associated with the head loss results. (Variances of independent random variables are additive.) In addition, uncertainties associated with temperature could affect the timing of the corrosion process – for example, Alion approximated in its test procedure that corrosion rates double about every 18 °F – and thus the timing of precipitate induced head loss. Another potential source of uncertainty in the tests is the removal of several liters of test fluid in order to allow addition of all of the debris and buffering chemicals. Three liters of fluid are also removed as samples. This removal results in the fluid volume of the test tank being reduced and the concentrations of the chemicals in the loop being varied from the test specification. Please explain how the physical volume change due to addition of debris was accounted for in the modeling of chemical concentrations. Small quantities of particulate that are considered non-transportable are not included in some licensee's tests to assess their chemical impacts. Considering the very large scaling factor applied to this test loop, seemingly small variances can be multiplied many times. Considering the above examples, please provide justification that the test results from the small VUEZ loops were not adversely affected by uncertainty.

l) The staff noted several quality assurance issues associated with the testing. During one of the tests that was nearly completed, the staff observed a sample material basket that had been resting screen-side down (presumably for the duration of the test), such that no basket surfaces were open for fluid interaction with the test fluid. As a result, no leached material from the debris samples in this sample basket could have participated in the test. During tests for a different plant, the procedure required that boiled Temp-Mat™ be added to the tank; however, the Temp-Mat™ that was added to the tank did not appear to the staff to have been boiled. After significant parts of two of the four formed debris beds floated away, the vendor then stated that it was not clear that the Temp-Mat™ had been boiled and attributed the partial floatation of the two debris beds to the Temp-Mat™ not having been boiled. Later, it was stated that the Temp-Mat™ was boiled. The confusion in this case indicates that adequate records were not kept or were not available to the personnel performing the testing. Please provide justification that quality assurance issues that could affect test results did not occur during chemical effects testing at VUEZ.