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SOUTHERN COMPANY
Energy to Serve Your World℠

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NL-08-0551

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555-0001

Joseph M. Farley Nuclear Plant
Final Supplemental Response to NRC Generic Letter 2004-02

Ladies and Gentlemen:

By letter dated February 28, 2008, Southern Nuclear Operating Company (SNC) provided a supplemental response for Joseph M. Farley Nuclear Plant (FNP) Units 1 and 2, to Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," dated September 13, 2004.

As approved by NRC letter dated December 21, 2007, certain information requested by GL 2004-02 was not included in the SNC February 28, 2008 supplemental response letter pending completion of chemical effects testing and evaluation of the down stream effect on the fuel, with this information to be submitted by April 30, 2008. The requisite testing and evaluation has been completed and the remaining responses are enclosed, fulfilling this commitment.

The other commitment to be completed by April 30, 2008 was to update engineering guidance procedure that is part of the FNP design change process to include guidance for reviewing the impact of a proposed change on the documentation that forms the design basis for the response to GL 2004-02. This update has also been completed, fulfilling this commitment.

The only remaining GL 2004-02 commitment is replacement of the Unit 2 Safety Injection (SI) throttle valves, which is scheduled to be completed in the Fall 2008 refueling outage, as approved by NRC letter dated August 29, 2007.

Mr. L. M. Stinson states he is a Vice President of Southern Nuclear Operating Company, is authorized to execute this oath on behalf of Southern Nuclear Operating Company and to the best of his knowledge and belief, the facts set forth in this letter are true.

This letter contains no new NRC commitments. If you have any questions, please advise.

Respectfully submitted,

SOUTHERN NUCLEAR OPERATING COMPANY

L. M. Stinson
Vice President – Fleet Operations Support

Sworn to and subscribed before me this 29th *day of* April *, 2008.*

Notary Public

My commission expires: July 5, 2010

LMS/DWD/phr

Enclosure: Farley Nuclear Plant Final Supplemental Response to GL 2004-02

cc: Southern Nuclear Operating Company
Mr. J. T. Gasser, Executive Vice President
Mr. J. R. Johnson, Vice President – Farley
Mr. D. H. Jones, Vice President – Engineering
RTYPE: CFA04.054; LC# 14746

U. S. Nuclear Regulatory Commission
Mr. V. M. McCree, Acting Regional Administrator
Mr. R. A. Jervey, NRR Project Manager – Farley
Mr. E. L. Crowe, Senior Resident Inspector – Farley

Alabama Department of Public Health
Dr. D. E. Williamson, State Health Officer

Joseph M. Farley Nuclear Plant
Final Supplemental Response to NRC Generic Letter 2004-02

Enclosure

Farley Nuclear Plant Final Supplemental Response to GL 2004-02

NOTE: Within this enclosure, Southern Nuclear Operating Company (SNC) provides information requested by GL 2004-02 which was not included in Enclosure 1, Section 3.0 of the SNC February 28, 2008 letter, pending completion of chemical effects testing and evaluation of the down stream effect on the fuel. The requisite testing and evaluation has been completed and the remaining requested information is provided below, in accordance with the guidance of NRC letter dated November 21, 2007, "Revised Content Guide for Generic Letter 2004-02 Supplemental Response," for Farley Nuclear Plant (FNP). The requested information corresponds to sections 3.n and 3.o of the Revised Content Guide.

3.n Downstream Effects - Fuel and Vessel

NRC Issue:

The objective of the downstream effects, fuel and vessel section is to evaluate the effects that debris carried downstream of the containment sump screen and into the reactor vessel has on core cooling.

1) Show that the in-vessel effects evaluation is consistent with, or bounded by, the industry generic guidance (WCAP-16793), as modified by NRC staff comments on that document. Briefly summarize the application of the methods. Indicate where the WCAP methods were not used or exceptions were taken, and summarize the evaluation of those areas.

SNC Response 3.n.1:

SNC partially responded to this item in the February 28, 2008 submittal, however at that time the plant specific core chemical impact had not been completed. This evaluation has now been performed.

An evaluation of the impact of chemical deposition on the fuel was performed in accordance with WCAP-16793-NP. This evaluation was performed using the LOCADM spreadsheet option 2 with bounding plant parameters. In accordance with the guidance, a LOCADM calculation was performed using the actual aluminum mass and surface area. This was done to determine the total mass of aluminum consumed during the 30-day mission time. The LOCADM calculation was re-run with double the aluminum surface area to ensure conservative aluminum dissolution rates. The results of the evaluation showed that the Farley post LOCA maximum fuel cladding temperature and deposit thickness are well below the acceptance criteria provided in Westinghouse letter OG-07-534 of 750 degrees F, and 889 microns. Maximum calculated post LOCA recirculation cladding temperature was 392 degrees F and occurs at the start of recirculation. The maximum post LOCA cladding deposition was 109 microns, with a corresponding temperature of 160 degrees F, and occurs at the end of the 30-day mission time. It can therefore be reasonably concluded that long term core cooling is demonstrated for Farley.

3.o Chemical Effects

The following items are in response to the content guidance for chemical effects provided in Enclosure 3 to a letter from the NRC to NEI dated September 27, 2007 (ADAMS Accession No. ML0726007425).

2) 1.d.i Sufficient 'Clean' Strainer Area: Those licensees performing a simplified chemical effects analysis should justify the use of this simplified approach by providing the amount of debris determined to reach the strainer, the amount of bare strainer area and how it was determined, and any additional information that is needed to show why a more detailed chemical effects analysis is not needed.

   SNC Response 1.d.i:

   Not applicable. FNP did not use a simplified chemical effects analysis.

3) 2.d.i Debris Bed Formation: Licensees should discuss why the debris from the break location selected for plant-specific head loss testing with chemical precipitate yields the maximum head loss. For example, plant X has break location 1 that would produce maximum head loss without consideration of chemical effects. However, break location 2, with chemical effects considered, produces greater head loss than break location 1. Therefore, the debris for head loss testing with chemical effects was based on break location 2.

   SNC Response 2.d.i:

   FNP utilized the break locations that yield maximum screen debris loading. The debris loading is primarily coatings and RMI insulation. A loading that corresponds to the highest RMI debris generation location was used in conjunction with a location that yields the highest Service Level 1 coating generation. A small amount of fiber is assumed to originate primarily from latent debris and is assumed to transport to the screen regardless of the assumed break location. Non design basis accident (DBA) qualified labels and coatings are also assumed to transport to the screen regardless of location of breaks.

   At FNP the maximum postulated screen debris loading is expected to produce the maximum head loss because with all fibrous debris assumed to transport to the screen, the amount of fiber in the FNP containments is too small for formation of a "deep bed" fibrous layer, a scenario which could reduce head

loss in conjunction with chemical effects compared to a thin bed of fiber. No chemical effects testing was done with a lesser loading of debris since previous test results demonstrated that reduced debris resulted in reduced head loss and there is no mechanism expected with FNP conditions whereby chemical effects could produce a higher head loss with reduced debris loading. With the small amount of fiber at FNP, reducing the fiber loading would likely result in "clean screen" conditions which would reduce head loss from both debris and chemical effects.

4) 3.d.i Plant Specific Materials and Buffers: Licensees should provide their assumptions (and basis for the assumptions) used to determine chemical effects loading: pH range, temperature profile, duration of containment spray, and materials expected to contribute to chemical effects.

SNC Response 3.d.i:

The pH range assumed was the maximum case calculated for the large break LOCA and is based upon parameters that yield the maximum pH. This pH value of 8.6 ensures a maximum aluminum dissolution rate. Containment spray is assumed to operate for 4 days. The sump temperature profile that corresponds to the design basis large break LOCA was used. The following materials are assumed to contribute to chemical effects along with the TSP buffer.

Submerged Materials		
Material Type	Quantity	Units
Metallic Aluminum	1,741	ft^2
Temp-Mat	1	ft^3
Concrete	523	ft^2
Unsubmerged Materials		
Metallic Aluminum	15,666.4	ft^2

All aluminum inventory regardless of submergence or exposure to containment spray was assumed to be active in precipitate formation.

5) 4.d.i Approach to Determine Chemical Source Term (Decision Point): Licensees should identify the vendor who performed plant-specific chemical effects testing.

SNC Response 4.d.i:

Testing was done at the CDI test facility under contract from GE. Alion performed Farley-specific chemical bench top testing. Farley-specific bench top tests and tests performed for other utilities at the Veuez facility were used to establish the upper temperature limit for formation of chemical precipitates.

6) 5.d.i Separate Effects Decision (Decision Point): State which method of addressing plant-specific chemical effects is used.

SNC Response 5.d.i:

The WCAP 16530 model was used to address Farley chemical effects.

7) 6.d.i AECL Model: Since the NRC USNRC is not currently aware of the testing approach, the NRC USNRC expects licensees using it to provide a detailed discussion of the chemical effects evaluation process along with head loss test results.

SNC Response 6.d.i:

Farley did not use the AECL model.

8) 6.d.ii AECL Model: Licensees should provide the chemical identities and amounts of predicted plant-specific precipitates.

SNC Response 6.d.ii:

Farley did not use the AECL model.

9) 7d.i WCAP Base Model: For licensees proceeding from block 7 to diamond 10 in the Figure 1 flow chart [in Enclosure 3 to a letter from the NRC to NEI dated September 27, 2007 (ADAMS Accession No. ML0726007425)], justify any deviations from the WCAP base model spreadsheet (i.e., any plant specific refinements) and describe how

any exceptions to the base model spreadsheet affected the amount of chemical precipitate predicted.

SNC Response 7.d.i:

Farley testing was done using the methodology of the WCAP base model. Bench top test results and other industry data was used to determine the temperature at which AlOOH precipitates were formed. This temperature was established at 140 °F.

10) 7.d.ii WCAP Base Model: List the type (e.g., AlOOH) and amount of predicted plant-specific precipitates.

SNC Response 7.d.ii:

$Ca_3(PO_4)_2$	$NaALSi_3O_8$	AlOOH
0.71 lbs	**7.23 lbs**	**988.31 lbs**

11) 8.d. WCAP Refinements: State whether refinements to WCAP-16530-NP were utilized in the chemical effects analysis.

SNC Response 8.d:

FNP did not utilize refinements to WCAP-16530-NP.

12) 9.d.i Solubility of Phosphates, Silicates and Al Alloys: Licensees should clearly identify any refinements (plant-specific inputs) to the base WCAP-16530 model and justify why the plant-specific refinement is valid.

SNC Response 9.d.i:

FNP did not utilize refinements to WCAP-16530-NP.

13) 9.d.ii Solubility of Phosphates, Silicates and Al Alloys: For crediting inhibition of aluminum that is not submerged, licensees should provide the substantiation for the following: (1) the threshold concentration of silica or phosphate needed to passivate aluminum, (2) the time needed to reach a phosphate or silicate level in the pool that would

result in aluminum passivation, and (3) the amount of containment spray time (following the achieved threshold of chemicals) before aluminum that is sprayed is assumed to be passivated.

SNC Response 9.d.ii:

Farley did not credit inhibition of aluminum.

14) 9.d.iii Solubility of Phosphates, Silicates and Al Alloys: For any attempts to credit solubility (including performing integrated testing), licensees should provide the technical basis that supports extrapolating solubility test data to plant-specific conditions. In addition, licensees should indicate why the overall chemical effects evaluation remains conservative when crediting solubility given that small amount of chemical precipitate can produce significant increases in head loss.

SNC Response 9.d.iii:

Farley did not credit solubility of Phosphates, Silicates and Al Alloys.

15) 9.d.iv Solubility of Phosphates, Silicates and Al Alloys: Licensees should list the type (e.g., AlOOH) and amount of predicted plant specific precipitates.

SNC Response 9.d.iv:

Not applicable.

16) 10. Precipitate Generation (Decision Point): State whether precipitates are formed by chemical injection into a flowing test loop or whether the precipitates are formed in a separate mixing tank.

SNC Response 10:

Precipitates were formed in a separate mixing tank per the method of WCAP-16530.

17) 11.d.i Chemical Injection into the Loop: Licensees should provide the one-hour settled volume (e.g., 80 ml of 100 ml solution remained

cloudy) for precipitate prepared with the same sequence as with the plant-specific, in-situ chemical injection.

SNC Response 11.d.i:

Not Applicable.

18) 11.d.ii Chemical Injection into the Loop: For plant-specific testing, the licensee should provide the amount of injected chemicals (e.g., aluminum), the percentage that precipitates, and the percentage that remains dissolved during testing.

SNC Response 11.d.ii:

Not Applicable.

19) 11.d.iii Chemical Injection into the Loop: Licensees should indicate the amount of precipitate that was added to the test for the head loss of record (i.e., 100 percent 140 percent).

SNC Response 11.d.iii:

Not Applicable.

20) 12.d.i Pre-Mix in Tank: Licensees should discuss any exceptions taken to the procedure recommended for surrogate precipitate formation in WCAP-16530.

SNC Response 12.d.i:

No exceptions were taken to surrogate precipitate formation method of WCAP-16530.

21) 13. Technical Approach to Debris Transport (Decision Point): State whether near-field settlement is credited or not.

SNC Response 13:

Near field settling was not credited.

22) 14.d.i Integrated Head Loss Test with Near-Field Settlement Credit:
Licensees should provide the one-hour or two-hour precipitate settlement values measured within 24 hours of head loss testing.

SNC Response 14.d.i:

Near field settling was not credited.

23) 14.d.ii Integrated Head Loss Test with Near-Field Settlement Credit:
Licensees should provide a best estimate of the amount of surrogate chemical debris that settles away from the strainer during the test.

SNC Response 14.d.ii:

Near field settling was not credited.

24) 15.d.i Head Loss Testing Without Near Field Settlement Credit:
Licensees should provide an estimate of the amount of debris and precipitate that remains on the tank/flume floor at the conclusion of the test and justify why the settlement is acceptable.

SNC Response 15.d.i:

The test arrangement for Farley was highly stirred using multiple mechanical mixers to lift the debris and chemical surrogates to the extent practicable so that this material would be deposited upon the screens. Some incidental settling occurred in isolated locations in the tanks and beneath the test article, where stirring was impractical. It is estimated that no more than 10% of the coating debris chips settled on the tank floor, while all fiber was deposited on the screens and all particulates were either on the screens or remained in suspension.

This incidental debris settlement during testing is acceptable since much more settlement would be expected under any postulated LOCA scenario. This is because the approach velocity to the test article was scaled to match that of the plant and the tank was highly stirred during testing, whereas the LOCA scenario would entail periods of quiescent sump conditions before the screens are placed in service and some isolated locations in the sump would have low velocities while the screens are in service.

25) 15.d.ii Head Loss Testing Without Near Field Settlement Credit: Licensees should provide the one-hour or two-hour precipitate settlement values measured and the timing of the measurement relative to the start of head loss testing (e.g., within 24 hours).

SNC Response 15.d.ii:

The sodium aluminum silicate one hour settled turbidity portion exceeded the criterion of 90%. The calcium phosphate turbidity was slightly low at 34% compared to the 40% criterion. However, as calcium phosphate is less than 0.1% of the total chemical precipitate the impact of the reduced turbidity on head loss is negligible.

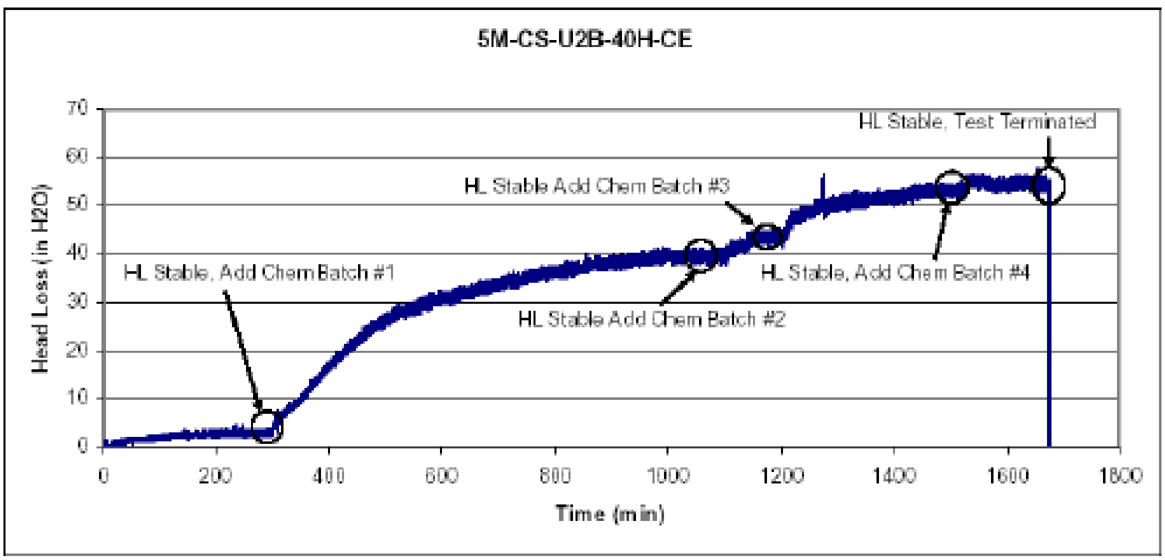
26) 16.d. Test Termination Criteria: Provide the test termination criteria.

SNC Response 16.d:

The test was continued until there was less than a 0.1 inch or 1% increase in measured head loss for at least 30 minutes or 5 turnovers, whichever was greater.

27) 17.d.i Data Analysis: Licensees should provide a copy of the pressure drop curve(s) as a function of time for the testing of record.

SNC Response 17.d.i:



28) 17.d.ii Data Analysis: Licensees should explain any extrapolation methods used for data analysis.

SNC Response 17.d.ii:

Extrapolation methods were used to a limited extent to establish the impact of chemical effects on head loss. Farley-specific bench top test results were utilized to determine that significant precipitation of AlOOH does not occur until the range of about 140 degrees F. These results were corroborated by tests done for a plant with similar chemicals.

29) 18.d. Integral Generation (Alion):

SNC Response 18.d:

Not applicable.

30) 19.c.i Tank Scaling / Bed Formation: Explain how scaling factors for the test facilities are representative or conservative relative to plant-specific values.

SNC Response 19.c.i:

Not applicable.

31) 19.c.ii Tank Scaling / Bed Formation: Explain how bed formation is representative of that expected for the size of materials and debris that is formed in the plant specific evaluation.

SNC Response 19.c.ii:

Not applicable.

32) 20.c.i Tank Transport: Explain how the transport of chemicals and debris in the testing facility is representative or conservative with regard to the expected flow and transport in the plant-specific conditions.

SNC Response 20.c.i:

Not applicable.

33) 21.d.i 30-Day Integrated Head Loss Test: Licensees should provide the plant-specific test conditions and the basis for why these test conditions and test results provide for a conservative chemical effects evaluation.

SNC Response 21.d.i:

Not applicable.

34) 22.d.i Data Analysis Bump Up Factor: Licensees should provide the details and the technical basis that show why the bump-up factor from the particular debris bed in the test is appropriate for application to other debris beds.

SNC Response 22.d.i:

Not applicable.