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SOUTHERN COMPANY
Energy to Serve Your World

March 30, 2010

Docket Nos.: 50-348
50-364

NL-10-0358

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

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

Ladies and Gentlemen:

In letters dated February 28, 2008, April 29, 2008 and July 27, 2009, Southern Nuclear Operating Company (SNC) submitted supplemental responses 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.

After a review of SNC's July 27, 2009 submittal, the NRC staff requested a teleconference to discuss some of the responses addressing the chemical effects testing. A teleconference was held on February 23, 2010 between the NRC staff and SNC personnel to discuss the information needed for closure for Joseph M. Farley Nuclear Plant. Enclosure 1 presents the questions raised by the NRC staff and SNC's responses.

Mr. M. J. Ajluni states he is Manager - Nuclear Licensing 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 NRC commitments. If you have any questions, please advise.

Respectfully submitted,

Mark J Ajluni

M. J. Ajluni
Manager - Nuclear Licensing

Sworn to and subscribed before me this 30th *day of* March, *2010.*

Patricia H. Raymond
Notary Public

My commission expires: 7-21-2012

MJA/DWM/phr

Enclosures:

1. Response to Request for Additional Information Regarding Generic Letter 2004-02

cc: Southern Nuclear Operating Company
Mr. J. T. Gasser, Executive Vice President
Mr. J. R. Johnson, Vice President – Farley
Ms. P. M. Marino, Vice President – Engineering
RTYPE: CFA04.054

U. S. Nuclear Regulatory Commission
Mr. L. A. Reyes, Regional Administrator
Mr. R. E. Martin, 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 – Units 1 and 2

Enclosure 1

Response to Request for Additional Information Regarding Generic Letter 2004-02

Joseph M. Farley Nuclear Plant – Units 1 and 2
Enclosure 1
Response to Request for Additional Information Regarding
Generic Letter 2004-02

NRC Question

Supply the Farley ECCS sump pH range expected following a LOCA and discuss the conservatisms used to determine that range.

SNC response

The post LOCA pH for the Farley Sump was calculated to range from 7.72 to 8.6. This included the minimum and maximum cases which were determined using assumptions that will bound the pH range in a post LOCA environment.

A conservatively calculated pH value of 8.6 was used in applying the WCAP methodology to determine the amount of Al precipitates used for chemical effects testing. Higher pH results in higher Al corrosion rates, and thus provides higher precipitate loading for purposes of testing.

Several conservative bounding assumptions were made to maximize the sump pH calculated values. These include minimizing the calculated water volume, minimizing the amount of boric acid in the sump, maximizing the quantity of TSP assumed to dissolve and maximizing the LiOH concentration of the RCS.

Further information on the specific assumptions made to maximize pH is provided below.

1. Refueling water storage tank (RWST) boron concentration is assumed to be at the minimum of the allowable range of 2300 to 2500 ppm. The contents of the RWST are injected into the RCS during a LOCA event.

2. Boron concentration of the RCS is assumed to be zero. Actual concentration varies from over a thousand ppm at the beginning of core life down to near zero at the end of core life.

3. Tri sodium phosphate (TSP) density is assumed to be at the maximum end of the bulk density range. The range is 0.866 to 0.961 g/cc.

4. TSP volume is assumed to be at the maximum end of the allowable range of 190 to 219 cf.

5. The amount of RWST water injected is minimized by assuming that the RWST is at the minimum Technical Specification value of 471,000 gallons and by further assuming that the maximum level instrument uncertainty is assumed such that volume is minimized. This results in 52,913 cf injected.

6. The Emergency Core Cooling System (ECCS) accumulators are assumed to not inject. In reality they would supply a minimum of 3030 cf of 2200 to 2500 ppm borated water to the containment sump.

The minimum pH value of 7.72 was determined using values designed to minimize TSP, and LiOH while maximizing boric acid injection into the Reactor Coolant System. Further information on the specific assumptions made to minimize pH is provided below.

1. Refueling water storage tank (RWST) boron concentration is assumed to be at the maximum of the allowable range of 2300 to 2500 ppm.

2. Boron concentration of the RCS is assumed to be 2500 ppm.

3. Tri sodium phosphate (TSP) density is assumed to be at the minimum end of the bulk density range. The range is 0.866 to 0.961 g/cc.

4. TSP volume is assumed to be at the minimum end of the allowable range of 190 to 219 cf.

5. The amount of RWST water injected is maximized with 67,173 cf.

6. The ECCS accumulators are assumed to inject 3120 cf of 2500 ppm borated water.

In summary the ECCS sump pH value used to generate the ECCS sump precipitate loading is a conservative value that would not be expected to occur in an actual LOCA event. A more realistic value would be more toward the middle of the pH range of 7.72 to 8.6.

NRC Question

Discuss the post LOCA ECCS sump Al sources, include discussion of conservatisms used in the quantification of the aluminum precipitates for chemical effects testing.

SNC answer:

The SNC containment inventory consists of the following sources of Aluminum:

Sources of Al at FNP

	Unit 1 lbm	Unit 1 Ft^2	Unit 2 lbm	Unit 2 Ft^2
Source, Intermediate, Power Range Detectors	244.0	83.0	244.0	83.0
Flux Map Drive System	171.0	75.0	171.0	75.0
Rod Position Indicator	74.0	40.9	69.0	39.5
Paint	125.0	14000	125.0	14000.0
RC Pump Motor	144.0	15.3	393.0	38.4
MOV Actuator	30.0	9.0	30.0	9.0
Misc Valves	230.0	86.0	230.0	86.0
RCP Motor Air Cooler	150.0	1728.0		
Barton Flow Indicator	3.7	1.4	3.7	1.4
AV 1120000 Valve Positioner	8.12	3.98		
CRDM Cooling Fan Rotors	402.0	41.15	402.0	41.15
CRDM Cooling Fan Connectors	46.6	7.0	46.6	7.0
PRZ Spray Valve Spring Adjuster	0.15	0.1	0.15	0.1
Antennae			3.1	0.8
Ex Vessel Neutron Dosimetry			1.3	0.72
TOTAL	1628.57	16090.83	1718.85	14382.07
Analyzed Values*	1800	17407.4	1800	17407.4

* Quantities and square footage of Al evaluated to develop precipitate loading in accordance with WCAP 16530

Calculated Al precipitation amounts are conservatively maximized by the following assumptions

The entire aluminum inventory was considered to be exposed to containment spray or submerged and thus contribute to the containment sump Al loading. In reality a large percentage of the inventory is shielded from spray. In addition, some of the Al inventory is located such that the spray that contacts it drains into an inactive sump area below the reactor vessel. Significant sources of inventory conservatisms are discussed below.

1) The Al contained in the control rod drive mechanism (CRDM) fans (402 lbm, 41.1 Ft^2) is assumed to contribute to the containment sump loading. These fans are not spray proof, however spray that falls on the CRDM fans will pass through them and travel down the side of the reactor vessel entering the reactor cavity. The reactor cavity is an inactive volume. Precipitates occurring in this area would not have a path to enter the ECCS sump screen area.

2) The Al contained in the RCP motors (144 lbm, 15.3 Ft^2) are assumed to react with the spray and contribute to the sump loading. These inventories are shielded from containment spray. RCP motor enclosures are drip proof.

3) The Aluminum in the core power instrumentation detectors (244 lbm, 83 Ft^2) is located above the inactive volume beneath the reactor vessel. This aluminum would not produce precipitates for the post accident sump inventory.

4) The flux map drive systems (171 lbm, 75 Ft^2) are located beneath the operating deck and also are enclosed. The operating deck provides shielding from containment spray. This inventory would not contribute to the ECCS sump loading.

5) 1800 pounds of Al with 17,407 Ft^2 was analyzed to produce the chemical concentrates used for head loss testing while the actual total inventory is less.

Taking credit for the items listed above being shielded from containment spray or draining to inactive volumes reduces the Al loading for Unit 1 to 667 lbm with a total of 15876.4 Ft^2 of surface area. The Unit 1 values bound the Unit 2 values.

Farley Al Inventory Crediting Reductions

U1 Aluminum	lbm	Ft^2
Total Submerged	271.82	100.38
Total Unsubmerged	395.75	15776

NRC Question

Discuss the length of time that containment spray (CS) was assumed to operate, the conservatisms associated with that assumption, and the procedural guidance for securing spray.

SNC answer

For the purposes of chemical precipitate quantification, containment spray was assumed to be in service for 4 days following the postulated LOCA. The actual time in service would be approximately 8 hours. The procedural criteria for securing CS is as follows:

> WHEN containment spray recirculation flow has been established for at least 8 hours, AND containment pressure is less than 16 psig, THEN stop both CS PUMPs.

Containment pressure under worst case scenarios will decrease to less than 16 psig in approximately 8 hours. Therefore, the 4 days of CS operation time assumed to occur for the purposes of Al corrosion is highly conservative.

NRC Question

Provide the maximum analyzed ECCS sump Al concentration and discuss conservatisms in the calculation. Provide the basis for the assumption that Al precipitates do not occur until sump temp is at 140 °F.

SNC Answer:

Using WCAP methodology, the conservatively analyzed ECCS sump Al concentration is 132 ppm. This value was used for the purposes of determining conservative precipitate values for the chemical effects head loss testing. This value was determined with the assumption that all Al in containment would be either submerged or subjected to containment spray. More realistic but still conservative values result in Al concentration of 51 ppm.

Using conservative references, solutions containing boron with 132 ppm Al concentration could result in some precipitation above 140 °F, however plant specific bench tests supports 140°F as a reasonable value for assuming full precipitate deposition. The full head losses from precipitates determined and tested from this Al concentration value have been applied to the range of RCS temperatures up to 200 °F to demonstrate adequate NPSH margin even in the event that precipitation were to occur at a higher temperature. This was discussed in the July 27, 2009 submittal in the response to question 18.

The actual Al sump concentration would be less than half the 132 ppm value tested due to 1) more than half the Al inventory not contributing to the sump inventory, 2) the CS duration is assumed to operate for 4 days while in reality operation would be expected to be approximately 8 hour, and 3) finally containment pH was conservatively calculated at a high level resulting in higher Al corrosion.

Parametric evaluations demonstrate that the Al sump concentrations are sensitive to aluminum inventories, containment temperatures and CS run time. Reducing inventory to more realistic values due to crediting shielding from CS and inactive volumes and also reducing CS operation time from 4 days to 12.9 hours results in sump Al concentrations of approximately 50 ppm. This value is conservative as any Al inventory with unspecified locations are considered to be submerged and CS is modeled to run longer than expected.

An Al concentration of 51 ppm corresponds to conservative Al solubility limits in the range of 125 to 130 °F. As the amount of precipitates used in testing chemical effects head losses were very conservatively determined, the head losses determined from the test was also conservatively high.