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SOUTHERN COMPANY

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NL-13-0954

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

Joseph M. Farley Nuclear Plant
Proposed Path to Closure of Generic Safety Issue-191,
"Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance"

References:

(1) Generic Letter (GL) 2004-02: Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors.

(2) December 23, 2010, Staff Requirements – SECY-10-0113 – Closure Options for Generic Safety Issue - 191, Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance.

(3) October 12, 2011, Pressurized Water Reactor Owners Group (PWROG), Topical Report (TR) WCAP-16793-NP, Revision 2, "Evaluation of Long-Term Core Cooling Considering Particulate Fibrous and Chemical Debris in the Recirculating Fluid".

(4) May 4, 2012, Nuclear Energy Institute (NEI) to the U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Reactor Regulation, Director, Division of Safety Systems – Subject: GSI-191 - Current Status and Recommended Actions for Closure.

(5) July 9, 2012, SECY-12-0093 – Closure Options for Generic Safety Issue - 191, Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance.

(6) November 15, 2012, Nuclear Energy Institute (NEI) to the U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Reactor Regulation, Director, Division of Safety Systems – Subject: GSI-191 – Revised Schedule for Licensee Submittal of Resolution Path.

(7) November 21, 2012, Nuclear Regulatory Commission Review of Generic Safety Issue-191 Nuclear Energy Institute revised Schedule for Licensee Submittal of Resolution Path.

(8) December 14, 2012, Staff Requirements – SECY-12-0093 – Closure Options for Generic Safety Issue - 191, Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance.

(9) April 8, 2013, Final Safety Evaluation for Pressurized Water reactor Owners Group Topical Report WCAP-16793-NP, Revision 2, "Evaluation of Long-Term Cooling Considering Particulate Fibrous and Chemical Debris in the Recirculating Fluid."

Ladies and Gentlemen:

In Reference (4), NEI highlighted the current industry status and recommended actions for closure of Generic Safety Issue (GSI)-191 based on licensees providing a docketed submittal to the NRC by December 31, 2012, outlining a GSI-191 resolution path and schedule pursuant to the Commission direction in Reference (2). By Reference (6), NEI recommended to NRC that licensees delay submittal of GSI-191 resolution path and schedule until January 31, 2013, or 30 days following placement of both the Commission response to Reference (5) and the NRC staff safety evaluation (SE) on Reference (3) into the public record. In Reference (8) the Commission approved the staff's recommendation in Reference (5) to allow licensees the flexibility to choose any of the three options discussed in the paper to resolve GSI-191. Further the Commission encouraged the staff to remain open to staggering licensee submittals and the associated NRC reviews to accommodate the availability of staff and licensee resources. The SE Reference (9) for Reference (3) was made publicly available by NRC on April 16, 2013.

An industry template was developed by NEI for the identification of a resolution path and schedule, and to describe defense-in-depth and mitigation measures to support the proposed resolution schedule. The NEI template was used for the development of Enclosure 1 for Joseph M. Farley Nuclear Plant (FNP) Units 1 and 2, and provides a resolution path forward and schedule for resolution, summary of actions completed for GL 2004-02, and defense-in-depth and mitigation measures which will be established and maintained throughout the resolution period.

The NRC commitments contained in this letter are provided as a table in Enclosure 2. If you have any questions, please contact Ken McElroy at (205) 992-7369.

Mr. C. R. Pierce states he is Regulatory Affairs Director 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.

Respectfully submitted,

C. R. Pierce
Regulatory Affairs Director

CRP/rmj/lac

Sworn to and subscribed before me this 16th *day of* May, *2013.*

Laura L. Crook
Notary Public

My commission expires: 11-2-13

Enclosures: 1. Path Forward and Schedule for Resolution of GSI-191
2. List of Regulatory Commitments

cc: Southern Nuclear Operating Company
Mr. S. E. Kuczynski, Chairman, President & CEO
Mr. D. G. Bost, Executive Vice President & Chief Nuclear Officer
Mr. T. A. Lynch, Vice President – Farley
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Ms. E. A. Brown, NRR Project Manager - Farley
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Joseph M. Farley Nuclear Plant
Proposed Path to Closure of Generic Safety Issue-191, "Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance"

Enclosure 1

Path Forward and Schedule for Resolution of GSI-191

Enclosure 1 to NL-13-0954
Path Forward and Schedule for Resolution of GSI-191

Introduction

Southern Nuclear Operating Company (SNC) has selected Option 2, Deterministic, for Farley Nuclear Plant (FNP), and intends to pursue refinements to evaluation methods and acceptance criteria. To support use of this path, and continued operation for the period required to complete the necessary analysis and testing, SNC has evaluated the design and procedural capabilities that exist to identify and mitigate sump strainer and in-vessel blockage. A description of these detection and mitigative measures are provided later in this document. Additionally, a summary of the existing margins and conservatisms that exist for FNP are also included in this document.

Characterization of Current Containment Fiber Status

Farley has essentially 100% reflective metal insulation in containment and has only a small amount of fiber in containment, consisting of the fiber content of latent debris, and a limited amount of Temp-Mat insulation. With the conservative assumptions on transport and bypass, FNP could exceed the 15 grams of fiber per fuel assembly limit specified in WCAP-16793-NP, Revision 2.

Characterization of Strainer Head Loss Status

SNC previously provided the results of strainer head loss testing, including the impact of chemical effects, in References 1 and 2. The results of this testing demonstrate acceptable results with regard to allowable head loss.

Characterization of In-Vessel Effects

SNC intends to follow the resolution strategy proposed by the Pressurized Water Reactor Owners Group (PWROG) for establishing in-vessel debris limits for the type of plant design that exists at FNP, Units 1 and 2.

Licensing Basis Commitments

SNC does not currently have open commitments within the FNP Units 1 and 2 commitment management system to provide additional updates or information to the NRC regarding GL 2004-02.

Resolution Schedule

SNC plans to achieve closure of GSI-191 and address GL 2004-02 per the following schedule. SNC is currently in the process of scheduling a meeting with the NRC to discuss this proposed resolution path.

The Proposed Modification and Testing Schedule, as currently expected, is given below:

- Fall 2013: U1 outage – confirm Temp-Mat location in U1 Zone of Influence (ZOI)
- 2013: Evaluate Modifications, develop plan for potential need to replace Temp-Mat
- 2014: PWROG WCAP Anticipated

  - 1Q14 – 3Q14: write spec, get bids, place order, get design drawings
  - 3Q14 – 2Q15: Design Window
  - 3Q14: Strainer Bypass Test if Required
  - 2Q15: Design Readiness Review
  - 2Q15 – 1Q16: Work Order Planning
  - Spring 2015: Safety Evaluation (SE) on PWROG WCAP anticipated
- Within six months of the NRC SE for the PWROG WCAP that will establish a final determination of the scope (if any) of insulation replacement or remediation, SNC will submit a final updated supplemental response to support closure of GL 2004-02 for FNP Unit 1 & 2.
- If SNC determines that proposed testing or analysis resolution path will not be viable, then an alternate resolution path will be discussed with the NRC to gain acceptance of the proposed path and to establish an acceptable completion schedule within 6 months of the NRC SE for the PWROG WCAP.
- SNC will update the current licensing basis (UFSAR) and complete the identified removal or modification of insulation debris sources in containment per plant modification procedures and processes (10 CFR 50.71(e)) within 18 months following NRC acceptance of the updated supplemental response for FNP, Units 1 and 2.

Summary of Actions Completed To Address GL 2004-02

To support closure of GSI-191 and to address GL 2004-02, SNC has completed the following actions for FNP, Units 1 and 2:

- The Temp Mat locations in the Unit 2 ZOI have been confirmed.
- FNP installed the largest sized strainers practicable for the space available within containment for each unit. The congested nature of the lower containment elevation resulted in the need for significant removal and relocation of structural steel and other equipment interferences. In addition the holes in the strainer surface were reduced to a nominally 3/32 inch from the 1/8 inch hole in the original strainers. Thus the potential for debris passing through the strainer and causing plugging of the down stream emergency core cooling system (ECCS) equipment is minimized.

  FNP contracted with General Electric Company (GE) to provide sump strainers that meet the requirements of GL 2004-02. GE provided FNP with seven horizontal stacked disk strainers (see Figure 4 of Enclosure 2 to Reference 2) and one vertical stacked disk strainer (see Figure 3 of Enclosure 2 to Reference 2). The strainers were installed in both Unit 1 and Unit 2. Unit 1 has the only vertical stacked strainer installed on the B-Train Containment Spray pump suction.

The strainers for FNP Unit 1 and Unit 2 are located outside the bio-wall between the bio-wall and containment outside wall (see Figures 1 and 2 of Enclosure 2 to Reference 2). This location protects the strainers from missile impacts.

For Unit 1, the passive strainer solution is shown in Figure 1 of Enclosure 2 to Reference 2. Each strainer assembly for both residual heat removal (RHR) strainers and containment spray system (CSS) A-Train strainer consists of two modular horizontal stacked disk strainer sub-units connected to the post loss of coolant accident (LOCA) pump suction through piping. The CSS B-Train strainer assembly consists of three modular vertical stacked disk strainer sub-units connected to a plenum that assists in directing flow to the post LOCA pump suction inlet located within the plenum boundary. The RHR strainer assembly, either A-Train or B-Train, is composed of two strainer sub-units per sump, each consisting of 22 stacked disks that are 40" X 40" and provide a total of approximately 878 ft^2 of perforated plate surface area. The CSS A-Train strainer assembly consists of one strainer sub-unit with (22) 40" X 40" stacked disks and the other with (10) 40" X 40" stacked disks, providing a total of approximately 638 ft^2 of perforated plate surface area. The CSS B-Train strainer assembly is composed of three strainer sub-units, each with (13) 30" X 30" vertical stacked disks, and provides a total of approximately 389 ft^2 of perforated plate surface area.

For Unit 2, the passive strainer solution is shown in Figure 2. Each strainer assembly for RHR and CSS consists of two modular horizontal stacked disk strainers connected to the sump through piping. The RHR strainer assemblies, both A-Train and B-Train, are composed of two strainers per sump, each consisting of 22 stacked disks that are 40" X 40" and provide a total of approximately 878 ft^2 of perforated plate surface area. The CSS A-Train strainer assembly consists of one strainer with (22) 40" X 40" stacked disks and the other with (10) 40" X 40 stacked disks, providing a total of approximately 638 ft^2 of perforated plate surface area. The CSS B-Train strainer assembly is composed of two strainers, one with (10) 40" X 40" stacked disks and the other with (22) 30" X 30" disks, and provides a total of approximately 433 ft^2 of perforated plate surface area.

- To prevent the potential for plugging and creating a hold-up volume, the refueling cavity drain covers are removed during modes requiring ECCS operability. This assures that water which is routed into the refueling cavity will drain into the ECCS sump thus increasing sump level.

- Debris interceptors are installed inside containment for both Units 1 and 2. No credit is taken in the analysis for the resulting reduced debris transport.

- ECCS high head branch flow line orifices were installed and the associated throttle valves were changed to ensure that adequate clearance in the valve will prevent debris from plugging.

- Completed latent debris sampling and characterization, including other debris sources, e.g., labels, etc.

- Completed debris generation and debris transport analyses.

- Completed ex-vessel downstream effects analysis.

- Completed net positive suction head (NPSH) analysis.

- Procedural and program controls are in place to ensure materials used in the containments will not result in an increase of the debris loading beyond the analyzed values. This includes controls for containment coatings, labels and insulation.

- Procedural changes have been made to ensure that the post LOCA ECCS sump levels are maximized.

Summary of Margins and Conservatisms for Completed Actions For GL 2004-02

The following provides a summary description of the margins and conservatisms associated with the resolution actions taken to date. These margins and conservatisms provide support for the extension of time required to address GL 2004-02 for FNP, Units 1 and 2.

- Detailed analyses of debris generation and transport ensure that a bounding quantity and a limiting mix of debris are assumed at the containment sump screen following a design basis accident (DBA). Using the results of the analyses, conservative evaluations were performed to determine worst-case screen head loss. Other conservatisms were applied to ensure that net positive suction head (NPSH) margins were conservatively calculated and conservative testing was done to demonstrate that vortexing and air ingestion would not occur.

The following is a list of significant conservatisms in FNP ECCS sump design, testing and analysis. It is provided to demonstrate that a conservative holistic approach for the resolution of GSI-191 is in effect at FNP.

- Debris interceptors are installed in both FNP Units 1 and 2 containments. No credit is taken in either the analysis or testing for debris captured by these interceptors. The interceptors are located in the debris flow path between the large-break loss-of-coolant accident (LBLOCA) zone of influence and the ECCS sump screens in the secondary shield wall access points. While the amount of debris intercepted by these interceptors is not quantified, they provide defense-in-depth.

- No credit was taken for near field debris settling. The test arrangement for FNP was highly stirred using multiple mechanical mixers along with test facility flow to lift the debris and chemical surrogates to the extent practicable so that the maximum amount practicable is deposited upon the screens. As the ECCS sump has many quiescent areas, it is reasonable to expect that significant settling of coating debris would occur following an LOCA scenario, and much less debris would transport and lift upon the screens than tested.

- FNP has separate ECCS sump screens for each RHR and containment spray (CS) pump. There are a total of four screens in each unit. Screen testing was done with the assumption that only one train of RHR and CS operate (2 of 4 screens), thus, doubling the amount of debris loading to each screen as compared to all four pumps operating.

Assuming only one of the four pumps failed to operate would reduce the amount of debris deposited on each screen to approximately 2/3 of the tested values.

- To generate the total debris loading for the screens, the debris quantity for the limiting break location that generated the most coatings debris is combined with the debris quantity from the one location that generates the most insulation debris. In reality, these are two separate break locations that cannot occur simultaneously. Thus, the tested debris loading for the screens is maximized.

- FNP assumed that all failures of acceptable coating in the ZOI were as chips. Since FNP is a very low fiber plant, this is more conservative than the assumption that the coating failed as particulates. FNP specific testing demonstrated that chips increase head loss more than particulates for the FNP (very low fiber) debris loading.

- Nonqualified containment coatings are all assumed to fail. Electric Power Research Institute (EPRI) report, "Design Basis Accident Testing of Pressurized Water Reactor Unqualified Original Equipment Manufacturer Coatings," for original equipment manufacturer (OEM) coating failures documented testing on various types of unqualified coatings, alkyds, epoxies and inorganic zinc. A 100% failure of all unqualified coatings is conservative, since the EPRI report indicated that only about 20% of unqualified OEM coatings actually detached as a result of autoclave DBA testing.

- The head loss associated with the Reflective Metal Insulation (RMI) transported to the sump was treated as separate from the head loss associated with the other debris. This is considered conservative, as a mixed debris bed containing RMI would be expected to have a lower head loss.

- All debris is assumed to be present at the sump screens immediately upon initiation of RHR recirculation. No credit was taken for time to transport while the sump continues to fill, due to continued addition of water to the sump resulting from containment spray operation.

- For testing purposes, twice the inventoried quantity of unqualified labels was assumed to detach and transport to the sump screens. In reality, many of the labels are tightly adhered and many are protected from direct containment spray and likely would remain in place. In the event of detachment, many of these labels would not be transported to the sump screens due to torturous paths between the labels and the screens.

- Two hundred pounds of latent debris was assumed for testing purposes while the surveyed value was 125 pounds. In addition, the debris was assumed to be 15% fiber per NEI guidance, although the source of fiber in the FNP containment is very limited as FNP is primarily a RMI insulation plant. Very limited amounts of fibrous insulation are installed on the steam generator instrument lines and around the reactor vessel nozzle penetrations. All latent fiber in containment and all other fiber within the break ZOI are assumed to transport to the sump screens.

- Measured tested screen head losses were increased by 43% to account for uncertainties. These conservatively increased head loss values were used to calculate NPSH margins.

- FNP does not credit containment pressure above pre-accident pressure for net positive suction head available (NPSHa) calculations. In reality, post LOCA pressures in containment would provide significant NPSH margin above calculated values. Analysis shows that this would add a minimum of 16 feet of NPSHa immediately upon initiation of ECCS recirculation and would increase during the event.

- A very detailed and conservative calculation is used to determine minimum ECCS sump level. The containment sump level calculations were performed using "stacked" conservatisms. For example, maximum reduction in Refueling Water Storage Tank (RWST) mass due to level instrument uncertainty was assumed even thought this would involve opposing instrument uncertainties; positive on the high end of the instrument range and negative on the low end of the range. In addition, minimum allowable initial water volumes were assumed for both the ECCS accumulators and the RWST. Also, the switch over to recirculation is assumed to occur instantaneously at the RWST low level set points. Operator action time is required for the operator to manually perform the swap over from injection to recirculation mode. During this time, additional inventory is added to the ECCS sump. A realistic value for containment sump level would be at least 6 inches higher than used for NPSH calculations.

- Testing for FNP's screens was conducted at lower than expected minimum sump levels. In addition, maximum ECCS pump flows were used for these tests. These tests clearly demonstrated that that FNP screens are not susceptible to air ingestion under worst case LBLOCA or small-break loss-of-coolant accident (SBLOCA) conditions.

- No credit for leak-before-break was taken in the FNP sump analysis scenario.

Summary of Defense-In-Depth (DID) Measures

The following describes the plant specific design features and procedural capabilities that exist for detecting and mitigating a strainer blockage or fuel blockage condition:

- Training on monitoring of indications of and responses to sump clogging; enhancement of ECCS logs to provide additional detail concerning the recognition and response to ECCS sump suction screen fouling; new training materials and job performance measures addressing the need for long-term monitoring of the recirculation phase; how to recognize that sump blockage is taking place; and actions to be taken if blockage is encountered.

- Guidance to reduce depletion of the RWST and initiate makeup to the RWST from normal and alternate sources during efforts to restore normal ECCS flowpaths.

- Containment exit inspections with logged material accounting procedures, and comparable controls for emergency entries into containment; and post-outage ECCS recirculation sump cleanliness and material control procedures to ensure the sumps are free of debris (trash, rags, protective clothing, etc).

- Post-refueling and heat-up procedures to inspect that reactor cavity drains are properly restored with their blind flanges and drain covers removed.

- Inspections to ensure ECCS subsystem inlets are not restricted by debris and sump components (trash racks, screens, etc.) show no evidence of abnormal corrosion or structural distress, and that the sump screens are correctly configured.

Additionally, the following actions have been implemented to provide further Defense in Depth strategies:

- SNC has completed the installation of the new sump strainers on Units 1 and 2. These strainers have increased the available surface area to deal with debris in the recirculation water.

Although these measures are not expected to be required based on the very low probability of an event that would challenge either the capability of the strainer to provide the necessary flow to the ECC and CS systems, or result in significant quantities of debris being transported to the reactor vessel that would inhibit the necessary cooling of the fuel, they do provide additional assurance that the health and safety of the public would be maintained. These measures provide support for the extension of time required to completely address GL 2004-02 for FNP, Units 1 and 2.

In addition to the defense in depth measures listed above, SNC is currently evaluating the recommendations made by Westinghouse in DW-12-013, and will also evaluate any other recommendations made for mitigative strategies. After these evaluations are complete, revisions to EOPs or Operations training will be made if necessary.

Conclusion

SNC expects that the GSI-191 resolution path for FNP, Units 1 and 2 is acceptable, based on the information provided in this document. The execution of the actions identified in this document will result in successful resolution of GSI-191 and closure of GL 2004-02.

References

1. SNC letter NL-08-0551 from L. M. Stinson to NRC, "Joseph M. Farley Nuclear Plant Final Supplemental Response to NRC Generic Letter 2004-02," April 29, 2008 (ADAMS Accession No. ML081210452)
2. SNC letter NL-08-2173 from D. H. Jones to NRC, "Joseph M. Farley Nuclear Plant Supplemental Response to NRC Generic Letter 2004-02," February 28, 2008 (ADAMS Accession No. ML080660657)
3. SNC letter NL-09-0982 from M. J. Ajluni to NRC, "Joseph M. Farley Nuclear Plant Response to Request for Additional Information Regarding NRC Generic Letter 2004-02," July 27, 2009 (ADAMS Accession No. ML092380647)
4. SNC letter NL-07-2245 from L. M. Stinson to NRC, "Joseph M. Farley Nuclear Plant – Units 1 and 2 Generic Letter 2004-02 Response to Extension Request – Chemical Effects," December 7, 2007.
5. SNC letter NL-07-0892 from L. M. Stinson to NRC, "Joseph M. Farley Nuclear Plant – Units 1 and 2 Extension Request for Completion of Corrective Actions Associated with Generic Letter 2004-02," July 3, 2007.

Joseph M. Farley Nuclear Plant
Proposed Path to Closure of Generic Safety Issue -191, "Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance"

Enclosure 2

List of Regulatory Commitments

List of Regulatory Commitments

The following table identifies the regulatory commitments in this document. Any other statements in this submittal represent intended or planned actions. Such statements are provided for information purposes and are not considered to be regulatory commitments.

Commitment	Expected Completion Date
SNC will submit a final updated supplemental response to support closure of GL 2004-02 for FNP Unit 1 & 2	Within six months of the NRC SE for the PWROG WCAP that establishes a final determination of the scope (if any) of insulation replacement or remediation
If SNC determines that proposed testing or analysis resolution path will not be viable, then an alternate resolution path will be discussed with the NRC to gain acceptance of the proposed path and to establish an acceptable completion schedule	Within six months of the NRC SE for the PWROG WCAP that establishes a final determination of the scope (if any) of insulation replacement or remediation
SNC will update the current licensing basis (UFSAR) and complete the identified removal or modification of insulation debris sources in containment per plant modification procedures and processes (10 CFR 50.71(e))	Within 18 months following NRC acceptance of the updated supplemental response for FNP, Units 1 and 2