August 29, 2007

Mr. J. Randy Johnson
Vice President - Farley
Joseph M. Farley Nuclear Plant
7388 North State Highway 95
Columbia, AL 36319

SUBJECT: GENERIC LETTER 2004-02 "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED WATER REACTORS," EXTENSION REQUEST APPROVAL FOR JOSEPH M. FARLEY NUCLEAR PLANT, UNIT 2 (TAC NO. MC4685)

Dear Mr. Johnson:

The NRC Staff has evaluated the information provided in Southern Nuclear Operating Company's (SNC's) July 3, 2007, request for an extension to the sump clogging corrective actions due date of December 31, 2007, in Generic Letter 2004-02 "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized Water Reactors," for Joseph M. Farley Nuclear Plant, Unit 2 (FNP 2). The NRC has determined that it is acceptable to extend the completion date for the throttle valve modifications for this unit until the completion of the FNP 2 fall 2008 refueling outage, scheduled to begin on October 11, 2008. Attached is the safety evaluation. Please note the suggested 30-day grace period on the FNP 2 fall 2008 outage commencement at the end of the attachment.

If you have any questions please contact Karen Cotton at 301-415-1438.

Sincerely,

EMarinos for **/RA/**

Karen Cotton, Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-364

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

JOSEPH M. FARLEY NUCLEAR PLANT, UNIT 2

EXTENSION REQUEST RELATED TO GENERIC LETTER 2004-02

In a July 3, 2007, letter Southern Nuclear Operating Company, Inc. (SNC) requested for the Joseph M. Farley Nuclear Plant, Unit 2 (FNP 2) an extension to the corrective action due date of December 31, 2007, stated in NRC Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized Water Reactors" (GL 2004-02).

SNC stated that it had installed new sump recirculation screens in FNP 2, which increased the available sump screen area from approximately 50 sq. ft. to 878 sq. ft. for each of the residual heat removal (RHR) screens, and from approximately 50 sq. ft. to 638 sq. ft. for the A-Train and 433 sq. ft. for the B-Train of the containment spray screens. However, SNC stated that it is facing challenges to the installation schedule for high head safety injection (HHSI) throttle valves, and has requested an extension to the GL 2004-02 completion schedule for downstream effects until the end of the fall 2008 FNP 2 refueling outage (designated U2R19), scheduled to begin on October 11, 2008.

Specifically, in the FNP 2 spring 2007 refueling outage, SNC designed and installed new flow restriction orifices in the HHSI lines to provide a greater drop in pressure, thereby allowing the HHSI throttle valves to be more fully open, thus, ensuring that the flow gap in the throttle valves would be at least 110 percent of the size of any openings in the new containment sump recirculation screens. Post-installation testing indicated that the orifices increased pressure drop as expected. However, the throttle valves were not opened as much as predicted. SNC stated that design review revealed that SNC had received incorrect valve flow performance data from the valve vendor that currently owns the throttle valve product line. To correct the design, SNC stated that it plans to install new throttle valves with more desirable flow characteristics.

In Enclosure 1 to SNC's July 3, 2007, extension request letter, SNC reiterated that it had installed larger sump recirculation screens, and provided a number of justifications for approval of the FNP 2 extension request, which SNC stated would remain valid during the requested extension period:

- The FNP 2 containment is compartmentalized, making the transport of debris to the sump difficult.

- FNP 2 does not require switchover to recirculation from the sump during a large break loss-of-coolant accident (LOCA) until 20 to 35 minutes after accident initiation, allowing time for much of the debris to settle in other places within the containment.

- The probability of the initiating event (i.e., intermediate break LOCAs) is extremely low.

- The current issue regarding primary water stress corrosion cracking associated with pressurizer Alloy 600182f182 dissimilar metal welds was addressed during the FNP 2 spring 2007 refueling outage by inspection and the use of weld overlay techniques on the pressurizer surge line nozzle. Additional inspections and mitigation by weld overlay techniques will be completed by the end of the FNP 2 spring refueling outage in 2010.

- SNC installed debris interceptors in the containment which will limit the amount of debris that reaches the screens.

SNC described its FNP downstream effects analysis, stating that it had been performed in accordance with WCAP [Westinghouse commercial atomic power] 16406-P, "Evaluation of Downstream Sump Debris Effects in Support of GSI-191" and Nuclear Energy Institute (NEI) document, NEI 04-07, Revision 0, dated December 2004, "Pressurized Water Reactor Sump Performance Evaluation Methodology." SNC stated that the following components had been evaluated for wear and plugging:

- RHR Pumps and Heat Exchangers
- Charging / HHSI Pumps
- Containment Spray System (CSS) Pumps and spray nozzles
- Flow Orifices
- Throttle Valves
- Instrumentation
- Check Valves
- Drain Lines
- Reactor Fuel and Vessel Internals

SNC stated that the emergency core cooling system (ECCS) throttle valves were the only components, other than the refueling cavity drain covers (now removed during Modes 1 through 4), which were identified as being susceptible to debris plugging.

SNC noted that SECY-06-0078, “Status of Resolution of GSI-191, Assessment of Debris Accumulation on PWR [pressurized water reactor] Sump Performance,” dated March 31, 2006, specified two criteria for short-duration GL 2004-02 extensions (limited to several months), and a third criterion for extensions beyond several months.

In regard to the first SECY-06-0078 criterion, that “the licensee has a plant-specific technical/experimental plan with milestones and schedule to address outstanding technical issues with enough margin to account for uncertainties,” SNC discussed a number of options considered (but not adopted) for resolving the post-orifice replacement throttle valve position problem, and then described the rationale for choosing to replace the existing throttle valves:

- The existing valves are obsolete. Replacement valves and valve parts are difficult to obtain. Valves of the same design would not meet the requirements;

- The existing valves lack the fine-tuning adjustment capability of currently available valves for this application; and

- Documentation related to the actual flow characteristics of the existing valves is unobtainable.

SNC stated that new throttle valves would be procured for the fall 2007, Joseph M. Farley Nuclear Plant, Unit 1 (FNP 1) fall outage, and that work on the design change for FNP 2 would begin after the FNP 1 outage. Therefore, the planned schedule for the FNP 2 design change and procurement would allow incorporation of any lessons learned FNP 1 throttle valve replacement.

In regard to the second SECY-06-0078 criterion, that "the licensee identifies mitigative measures to be put in place prior to December 31, 2007, and adequately describes how these mitigative measures will minimize the risk of degraded ECCS and CSS functions during the extension period," SNC stated that the following mitigative measures, compensatory measures, and/or favorable conditions are in effect at FNP 2 to minimize the risk of degraded ECCS and CSS functions during the extension period:

- SNC has completed installation of new FNP 2 sump recirculation screens and debris interceptors;

- Procedural guidance exists at FNP 2 regarding containment foreign material exclusion controls;

- Insulation inside containment that is affected during a LOCA event is mostly reflective metal insulation with very little fiber;

- The design basis net-positive suction head analysis for the CSS pumps and the RHR pumps does not credit containment overpressure;

- Latent debris quantities inside containment are very small;

- The qualified coatings in containment are in good condition. Periodic coatings condition asssessments are performed and as localized areas of degradation are identified, those areas are evaluated and scheduled for repair or replacement as necessary. These periodic condition assessments, and the resulting repair/replacement activities ensure that the amount of coatings that may be susceptible to detachment from the substrate during a LOCA event is minimized;

- Relatively heavy debris is impeded from reaching the sumps because the new sump recirculation screens are mounted approximately 4 inches above the containment floor. This design facilitates settling of debris on the floor prior to reaching the sump screen area; and

- Safety-related emergency containment coolers can supplement containment heat removal capability if spray flow is degraded.

SNC further discussed the following operator training, guidance and procedures targeted at minimizing the risk of degraded ECCS and CSS functions during the extension period:

- Operator training is conducted on monitoring of indications of and responses to sump clogging;

- Operator ECCS logs have been enhanced to provide additional detailed information for the recognition and response to ECCS sump suction screen fouling;

- New operator training materials and job performance measures addressing the need for long-term monitoring of the recirculation phase have been implemented;

- Operator training and procedural guidance is in place to expedite plant cooldown in response to a small break LOCA (and thereby completely avoid the sump recirculation mode of operation);

- Operator guidance is in place to reduce depletion of the refueling water storage tank (RWST), and to initiate makeup to the RWST from normal and alternative sources;

- Containment exit inspections are conducted with logged material accounting procedures, with comparable controls for emergency entries into containment;

- Post-outage ECCS recirculation sump cleanliness inspection procedures are followed to ensure the sumps are free of debris and in good material condition (show no evidence of abnormal corrosion or structural distress);

- Post-refueling and heat-up inspection procedures are followed to ensure that reactor cavity drains are properly restored with their blind flanges removed; and

- Inspections are conducted to ensure ECCS suction piping is not restricted by debris, and that the sump screens are correctly configured.

SNC stated that these measures would continue in effect until such time as all evaluations and all required plant modifications are complete.

In regard to the third SECY-06-0078 criterion, that “for proposed extensions beyond several months, a licensee's request will more likely be accepted if the proposed mitigative measures include temporary physical improvements to the ECCS sump or materials inside containment to better ensure a high level of ECCS sump performance,” SNC stated that:

- FNP 2 has new sump screens that increase the available screen area from approximately 50 sq. ft. to 878 sq. ft. for each of the RHR screens, and from approximately 50 sq. ft. to 638 sq. ft. for the A-Train and to 433 sq. ft. for the B-Train of the Containment Spray screens;

- The new screen mesh size is smaller than original (3/32 inch versus 1/8 inch originally).

- Four, approximately 30-inch high, perforated plate debris interceptors have been installed in doorways in the biological shield wall and between the biological shield wall and the containment wall;

- Orifices have been installed in two separate drain lines that drain to the reactor cavity containment sump to limit the loss of sump inventory to the reactor cavity during the early stages of a design basis LOCA;

- New orifices were installed in the HHSI lines to increase the pressure differential across the orifices to allow for the HHSI throttle valves to be more fully open (although not as far as predicted nor fully satisfactory).

SNC provided a discussion of the incremental risk associated with10 months of reactor operation with the existing ECCS throttle valves in place. SNC concluded that the incremental risk was small based on the following factors:

- All of the sump screen replacement modifications have been completed for FNP 2, enhancing recirculation capabilities (the larger screen sizes reducing the sump screen clogging potential);

- The new sump screens have a smaller mesh size (3/32 inch versus 1/8 inch originally) which limits the potential for plugging of the ECCS throttle valves; and

- The installation of new orifices in the HHSI lines increased the pressure differential across the orifices to allow for the throttle valves to be more fully open, although not as much as predicted.

Further, SNC provided an extensive analysis of small, medium and large LOCAs, noting in part that:

- Large LOCAs do not require successful operation of HHSI pumps (and their throttle valves) due to their early depressurization of the reactor coolant system (RCS);

- LOCAs smaller than large LOCAs deplete the RWST more slowly and therefore allow more time for debris to settle before the recirculation mode is initiated;

- Small LOCAs can provide enough time for operators to initiate RCS cooldown and depressurization for normal shutdown cooling, and, if successful, avoiding recirculation operation altogether. Also, Containment Spray initiation criteria may not be met during a small LOCA, reducing paint chip and other debris transport potential;

- Medium LOCAs, as defined for the FNP 2 probabilistic risk assessment (PRA), cover the range of two inches to six inches equivalent diameter. At the lower end of this break range, SNC stated that it could be expected that the operators could normally achieve shutdown cooling without recirculation, similar to a small LOCA. Breaks at the upper end of the medium LOCA range could behave similarly to a large LOCA, resulting in RCS depressurization. However, some medium LOCAs could result in the need for HHSI. SNC pointed out that two HHSI trains each inject into three separate RCS loops through flow orifices and throttle valves, providing some redundancy. Also, SNC requested Westinghouse to consider system behavior for breaks smaller than 6 inches in equivalent diameter using a NOTRUMP model. The results showed that the RCS will depressurize below RHR shutoff head, either on its own accord or through operator action, before the minimum deliverable volume of the RWST is exhausted and switchover to recirculation.

However, SNC stated that because there is some possibility that a medium LOCA could occur for which the RCS would not depressurize below the shutoff head of the low head injection system prior to the need for ECCS recirculation, it was assumed that there would be an increased risk associated with any medium LOCA for the extended period required to meet the requirements of GL 2004-02 (due to potential high pressure injection system throttle valve clogging). SNC stated that a quantitative PRA was performed that specifically assessed the impact of extending the time for meeting GL 2004-02 requirements for FNP 2 for 10 additional months of operation. SNC stated that no credit was taken for actions taken in response to NRC Bulletin 2003-01 that could mitigate sump blockage. SNC stated that the PRA estimated that the increase in core damage frequency (CDF) due to a medium LOCA during the 10-month extension of the time to meet the GL 2004-02 requirements is 1.5E-7 per year, which is less than the 1 E-6 per year acceptance limit in Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis." The large early release frequency (LERF) risk increase was stated by SNC to be 2.3E-10 per year, which is less than the 1 E-7 per year RG 1.174 acceptance limit. Therefore, SNC concluded that the calculated increases of CDF and LERF are very small, as defined by the RG 1.I74 acceptance limits.

The NRC has confidence that SNC has a plan that will result in the installation of final GSI-191 modifications that provide acceptable strainer function with adequate margin for uncertainties. Further, the NRC has concluded that SNC has put mitigation measures in place to adequately reduce risk for the requested approximately 10-month extension period, and it is, therefore, acceptable to extend the completion date for the corrective actions for certain issues discussed in Generic Letter 2004-02 (specifically HHSI throttle valve replacement) until the completion of the FNP 2 fall 2008 refueling outage, currently scheduled to begin on October 11, 2008. Should SNC elect to begin the outage more than 30 days after October 11, 2008, SNC will need to provide the NRC additional justification for further delay in completing corrective actions for GL 2004-02

Principal Contributors: Leon Whitney
Joseph Golla

Date: August 29, 2007

Joseph M. Farley Nuclear Plant, Units 1 & 2

cc:

Mr. J. Randy Johnson
Vice President - Farley
Joseph M. Farley Nuclear Plant
7388 North State Highway 95
Columbia, AL 36319

Mr. B. D. McKinney, Licensing Manager
Southern Nuclear Operating Company, Inc.
P.O. Box 1295
Birmingham, AL 35201-1295

Mr. M. Stanford Blanton
Balch and Bingham Law Firm
P.O. Box 306
1710 Sixth Avenue North
Birmingham, AL 35201

Mr. J. Gasser
Executive Vice President
Southern Nuclear Operating Company, Inc.
P.O. Box 1295
Birmingham, AL 35201

State Health Officer
Alabama Department of Public Health
434 Monroe St.
Montgomery, AL 36130-1701

Chairman
Houston County Commission
P.O. Box 6406
Dothan, AL 36302

Resident Inspector
U.S. Nuclear Regulatory Commission
7388 N. State Highway 95
Columbia, AL 36319

William D. Oldfield
SAER Supervisor
Southern Nuclear Operating Company, Inc.
P.O. Box 470
Ashford, AL 36312