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Regulatory Affairs Director

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SOUTHERN COMPANY

March 24, 2014

Docket Nos.: 50-348
50-364

NL-14-0295

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

Joseph M. Farley Nuclear Plant
Proposed Inservice Inspection Alternative FNP-ISI-ALT-15, Version 1.0

Ladies and Gentlemen:

In accordance with 10 CFR 50.55a(a)(3)(i), Southern Nuclear Operating Company (SNC) hereby requests Nuclear Regulatory Commission (NRC) approval of proposed inservice inspection (ISI) alternative FNP-ISI-ALT-15, Version 1.0. This Alternative would allow ASME Code Case N-770-1, Inspection Item B for Reactor Pressure Vessel (RPV) Cold Leg (CL) Dissimilar Metal (DM) welds to be examined once every six refueling outages based on a nominal cycle length of approximately 1.5 calendar years (approximately every 9.0 calendar years or 8.6 effective full power years (EFPYs)) for Farley Nuclear Plant (FNP) Units 1 and 2.

By letter dated August 8, 2013, the NRC approved FNP-ISI-ALT-13, Version 2.0, which allowed ASME Code Case N-770-1, Inspection Item B for RPV CL DM welds to be examined once every five refueling outages based on a nominal cycle length of approximately 1.5 calendar years (approximately every 7.5 calendar years or 7.1 EFPYs). SNC originally requested in FNP-ISI-ALT-13, Version 1.0 to examine these welds every seven refueling outages (approximately every 10.5 calendar years or 10.0 EFPYs) based on the technical basis given in ERPI document Materials Reliability Program (MRP)-349 and the FNP specific axial flaw evaluation that was performed in support of this request. In order to facilitate NRC approval of this Alternative in time for the Unit 1 fall 2013 refueling outage, SNC proposed in FNP-ISI-ALT-13 Version 2.0 to require ASME Code Case N-770-1, Inspection Item B for RPV CL DM welds to be inspected once every five refueling outages instead of once every seven refueling outages as originally requested. FNP-ISI-ALT-15 Version 1.0 provides additional justification over that provided in FNP-ISI-ALT-13 Version 2.0 to support a further examination extension to once every six refueling outages.

To allow SNC sufficient time to schedule appropriately, approval of this alternative is respectfully requested by December 31, 2014.

This letter contains no NRC commitments. If you have any questions, please contact Ken McElroy at (205) 992-7369.

Sincerely,

C. R. Pierce

C.R. Pierce
Regulatory Affairs Director

CRP/RMJ

Enclosure: Proposed Alternative FNP-ISI-ALT-15, Version 1.0
In Accordance with 10 CFR 50.55a(a)(3)(i)

cc: Southern Nuclear Operating Company
Mr. S. E. Kuczynski, Chairman, President & CEO
Mr. D. G. Bost, Executive Vice President & Chief Nuclear Officer
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U. S. Nuclear Regulatory Commission
Mr. V. M. McCree, Regional Administrator
Mr. S. A. Williams, NRR Project Manager – Farley
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Mr. J. R. Sowa, Resident Inspector – Farley

**Joseph M. Farley Nuclear Plant**
**Proposed Inservice Inspection Alternative FNP-ISI-ALT-15, Version 1.0**

**Enclosure**

**Proposed Alternative FNP-ISI-ALT-15, Version 1.0**
**In Accordance with 10 CFR 50.55a(a)(3)(i)**

Enclosure
Proposed Alternative FNP-ISI-ALT-15, Version 1.0
In Accordance with 10 CFR 50.55a(a)(3)(i)

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| **Plant Site-Unit:** | Joseph M. Farley Nuclear Plant (FNP) – Units 1 & 2. |
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| **Interval Dates:** | 4th Inservice Inspection (ISI) Interval – December 1, 2007 through November 30, 2017. |
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| **Requested Date for Approval :** | Approval is requested by December 31, 2014. |
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| **ASME Code Components Affected:** | The affected components are Examination Category ASME Code Case N-770-1, Inspection Item B. |
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| **Applicable Code Edition and Addenda:** | The applicable Code edition and addenda (for the 4th ISI interval) is ASME Section XI, "Rules for Inservice Inspection of Nuclear Power Plant components," 2001 Edition through the 2003 Addenda. Note that FNP will adopt a later applicable code edition for the 5th ISI Interval, and that this alternative applies to the frequency of the next Reactor Pressure Vessel (RPV) Cold Leg (CL) Exam. |
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| **Applicable Code Requirements:** | 10CFR50.55a(g)(6)(ii)(F) requires licensees of existing, operating pressurized-water reactors as of July 21, 2011 to implement the requirements of ASME Code Case N-770-1. Code Case N-770-1, Inspection Item B requires unmitigated butt welds at CL operating temperatures ≥ 525°F and < 580°F to be volumetrically examined every second inspection period not to exceed 7 years. |
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| **Reason for Request:** | EPRI document Materials Reliability Program (MRP)-349 (Enclosure 2 to Reference 1) and the FNP specific flaw growth evaluation (Reference 3) provides the overall basis for extension of the current volumetric inspection interval for the RPV CL Dissimilar Metal (DM) welds to a six refueling outage (approximately 9 calendar year) inspection interval based on a nominal cycle length of approximately 1.5 years. This technical basis demonstrates that the re-examination interval can be extended to the requested interval length while maintaining an acceptable level of quality and safety. Therefore, Southern Nuclear Operating Company (SNC) is requesting approval of this alternative to allow the use of the ISI interval extension for the affected FNP - Unit 1 and 2 components. |
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| **Proposed Alternative:** | SNC is requesting extension of the requirements of Code Case N-770-1, Inspection Item B for the RPV CL DM Welds from every second inspection period to once per six refueling outages based on a nominal cycle length of approximately 1.5 calendar years (approximately 9.0 calendar years or 8.6 effective full power years (EFPYs)). Reference 5 previously authorized the extension of Code Case N-770-1, Inspection Item B for the RPV CL DM Welds to once per five refueling outages based upon a nominal cycle length of approximately 1.5 calendar years.<br><br>Specifically, this proposed alternative would permit the deferral of the CL volumetric examinations currently scheduled for spring of 2015 for Unit 1 (baseline exams performed in fall of 2007) to be moved to the fall of 2016. For Unit 2, this would allow examinations currently scheduled for the fall of 2017 (baseline exams performed in the spring of 2010) to be moved to the spring of 2019. This request applies to the inspection frequencies and not the inspection techniques, as the inspections techniques may change with later editions of ASME Section XI and 10CFR50.55a.<br><br>In conjunction with the volumetric exams performed to the specifications of ASME Appendix VIII, a supplemental eddy current test will be performed to the specifications of ASME approved Code Case N-773. This matches the eddy current techniques that our vendor, Westinghouse, has previously used for qualification, coverage, and examination.<br><br>The inspection frequency of the proposed alternative is within the frequency requirements of ASME approved Code Case N-770-3, Inspection Item B-2. |
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| **Basis for Use:** | The overall basis used to demonstrate the acceptability of extending the inspection intervals for Code Case N-770-1, Inspection Item B components is contained in MRP-349 and the independent axial flaw evaluation performed in response to previous request for additional information (RAIs) submitted on May 24, 2013. In summary, the basis for extending the intervals to once every six refueling outages based on a nominal cycle length of approximately 1.5 calendar years (approximately 9.0 calendar years) is: (1) there has been no service experience with cracking found in any RPV CL DM welds, (2) crack growth rates in RPV CL DM welds are slow, (3) likelihood of cracking or through-wall leaks is very small in RPV CL DM welds, and (4) the FNP specific axial flaw evaluation showing the maximum through-wall flaw would not grow to a critical length in less than the requested inspection interval.<br><br><u>Service Experience</u><br><br>Each unit's baseline exams were performed using remote mechanized examinations from the Inside Diameter (ID) in accordance with Appendix VIII using performance demonstrated methods where 100% of the flaws were detected. The technique used in site specific exams included 100% coverage for axial and circumferential flaws. Data is obtained using encoded techniques; therefore, data may be reviewed by multiple qualified examiners. Site specific mock-ups were not used because of the flat, uniform surface |

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| **Basis for Use: (Continued)** | associated with performance of these examinations from the ID. These techniques provide a strong assurance that flaws will be detected during inspections.<br><br>All dissimilar metal welds in piping 4" Nominal Pipe Size (NPS) and greater, including those containing Alloy 82/182, in ASME Section XI Category B-F, have been volumetrically examined every 10-years in accordance with ASME Section XI. There have been multiple instances in the industry in which Primary Water Stress Corrosion Cracking (PWSCC) have occurred in Alloy 82/182 nozzle-to-safe-end weld region of the outlet nozzle where temperatures range typically from 608°F to 621°F; however, there are no known instances of PWSCC occurring in large bore (diameter greater than 14" NPS) that operate at or near FNP CL temperatures (approximately 538°F) noted within the nuclear industry. In summary, to date there has been no safety or structural integrity concern that has resulted from PWSCC in CL butt welds in the nuclear industry.<br><br>No unacceptable indications were detected in either the required volumetric examinations (UT) or the owner-elected surface examinations (ET) conducted during either 2007 Unit 1 exams or 2010 Unit 2 exams. The volumetric examinations were conducted using automated encoded ultrasonic techniques by an inspection vendor qualified to ASME Code Section XI Appendix VIII Supplement 10 criteria.<br><br><u>Crack Growth Rates (Flaw Tolerance)</u><br><br>All of the flaw tolerance analyses performed to date have shown that the critical crack sizes in large-diameter butt welds operating at CL temperatures are very large. Assuming that a flaw initiates, the time required to grow to through-wall is in excess of 20 years in most cases analyzed. The time to grow from a through-wall leak to a crack equal to the critical crack size can be in excess of 40 years.<br><br>More recent analyses have been performed for the RPV nozzles using through-wall residual stress distributions that were developed based on the most recent guidance. These analyses have shown that the flaw tolerance of these locations is high and postulated circumferential flaws will not reach the maximum ASME allowable depth in less than 10 years. Crack growth analysis is given for limiting plants part-circumferential through-wall flaws in Table 5-2 of MRP-349.<br><br><u>Probability of Cracking or Through-Wall Leaks</u><br><br>Analyses have been performed to calculate the probability of failure for Alloy 82/182 welds using both probabilistic fracture mechanics and statistical methods. Both approaches have shown that the likelihood of cracking or through-wall leaks, in large-diameter CL welds, is very small. Furthermore, |

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| **Basis for Use: (Continued)** | sensitivity studies performed using probabilistic fracture mechanics have shown that even for the more limiting high temperature locations, more frequent inspections than required by Section XI, such as that in MRP-139 or Code Case N-770, have only a small benefit in terms of risk.<br><br>Though past service experience may not be an absolute indicator of the likelihood of future cracking, the experience does give an indication of the relative likelihood of cracking in CL temperature locations versus hot leg temperature locations. While there is a significant amount of PWSCC service experience in hot leg locations, the number of indications in large-bore butt welds is still small relative to the number of potential locations. Also, all indications have been detected before they were a safety concern. Therefore, if hot leg PWSCC is a leading indicator for CL PWSCC, and the higher frequency of inspections will be maintained for the hot leg locations, it is reasonable to conclude that a moderately less rigorous inspection schedule would be capable of detecting any CL indications before they became large enough to be a concern.<br><br>Still to date, a flaw has never been detected in an inservice RPV CL DM weld that required repairs. In addition to the industry service experience listed above, a review of the fabrication data was performed to determine the potential for elevated weld residual stresses in localized areas of the ID due to repairs during fabrication of the DM welds. This review found no documented weld repairs that were performed from the ID that would increase the weld residual stresses on the inner diameter surface where a flaw would most likely initiate.<br><br><u>FNP Specific Axial Flaw Evaluation</u><br><br>SNC completed a site specific axial flaw evaluation. It is important to note, there is considerably less risk resulting from an axial flaw versus circumferential flaws. Inputs used in the analysis include a pipe ID of 27.47", a DM weld thickness of 3.27", a 4.7" safe end length, and a 541°F operating temperature .<br><br>The maximum end-of-evaluation period allowable flaw size was determined in accordance with the ASME Section XI IWB-3600 evaluation procedure and acceptance criteria. The FNP specific flaw evaluation was provided in Reference 3 which includes the bounding residual hoop stress profiles. For independence, the evaluation has been included in Figure 1 of this submittal. The site specific axial flaw growth evaluation provides assurance that through-wall leakage will be avoided. It supplements the generic, bounding CL circumferential flaw analysis provided in Figure 5-4 of MRP-349 that provides assurance of continued structural integrity in the more safety significant scenario for circumferential crack growth. Based on the PWSCC crack growth curve developed, an undetected flaw in a baseline inspection with a flaw depth of 0.24 inch, which is 7.5% of the original weld thickness, would not reach the maximum end-of-evaluation period allowable flaw depth of 75% of the original wall thickness in less than seven refueling outages (10.5 EFPY). |

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| | The analysis conservatively assumes a 50% weld repair; however, as indicated above, the review of the fabrication weld traveler records indicates that no repairs were performed from the ID surface of any of the six CL DM welds. Although SNC believes a longer inspection interval is justified, this alternative only request an inspection interval of 9 years (approximately 8.6 EFPYs).<br><br>An assumed 7.5% of weld thickness axial flaw depth is reasonable as an initiating flaw based on:<br><br>• the NDE demonstration of the UT data was determined to detect a 10% flaw, with no other NDE performed,<br>• the supplemental eddy current examination performed is a highly reliable means of detecting surface breaking indications on the ID of the DM weld. Any indication detected from the ID requires further evaluation in accordance with the vendor's eddy current procedure for characterizing and dispositioning perceived flaws. The eddy current examination, although not utilized for depth sizing, is reliable for detecting the initial stages of crack initiation (i.e. an initiating flaw of < 2.5%),<br>• a review of previous NDE UT data confirmed that inclusions as small as 6% were detected, evaluated, and appropriately assessed as fabrication related during the previous CL exams.<br><br><u>Conclusion</u><br><br>Extending the FNP Unit 1 and 2 RPV CL DM weld volumetric examination interval from two ISI periods to once per six refueling outages (based on a nominal cycle length of approximately 1.5 calendar years or approximately 9.0 calendar years) is justified given (1) that there has been no service experience with cracking found in RPV CL DM welds, (2) crack growth rates in RPV CL DM welds are approximately 3 times slower than hot leg crack growth rates, and (3) the FNP specific flaw evaluation demonstrates that a 9 year inspection interval provides reasonable assurance that in the unlikely event undetected indications are present, they will not propagate to an unacceptable depth during the proposed interval. Therefore, the use of this proposed alternative will provide an acceptable level of quality and safety. For these reasons, it is requested that the NRC authorize this proposed alternative in accordance with 10 CFR 50.55a(a)(3)(i). |
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| **Duration of Proposed Alternative:** | The 4$^{th}$ ISI Interval. |
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| **Precedents:** | There are no previous precedents to this alternative. |
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| **References:** | 1. SNC letter NL-12-2014 to NRC, "Joseph M. Farley Nuclear Plant – Units 1 & 2 Proposed Inservice Inspection Alternative FNP-ISI-ALT-13, Version 1.0," dated October 1, 2012.<br>2. SNC letter NL-13-0948 to NRC, "Joseph M. Farley Nuclear Plant Response to Request for Additional Information Concerning the Deferral of Inservice Inspection of Reactor Pressure Vessel Cold Leg Nozzle Dissimilar Metal Weld – Questions 1, 3, and 5," dated May 6, 2013.<br>3. SNC letter NL-13-1073 to NRC, "Joseph M. Farley Nuclear Plant Response to Request for Additional Information Concerning the Deferral of Inservice Inspection of Reactor Pressure Vessel Cold Leg Nozzle Dissimilar Metal Weld – Questions 2, 4, and 6," dated May 24, 2013.<br>4. SNC letter NL-13-1495 to NRC, "Joseph M. Farley Nuclear Plant, Proposed Inservice Inspection Alternative FNP-ISI-ALT-13, Version 2.0," dated July 19, 2013.<br>5. NRC letter to SNC, "Joseph M. Farley Nuclear Plant, Units 1 and 2 – Request for Alternative FNP-ISI-ALT-13 Regarding Deferral of Inservice Inspection of Reactor Pressure Vessel Cold Leg Nozzle Dissimilar Metal Welds (TAC Nos ME9739 and ME9740)," dated August 8, 2013. |
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| **Status:** | Under NRC Review |

Figure 1

PWSCC Crack Growth Curve for Farley Units 1 and 2 Reactor Vessel Inlet Nozzle Dissimilar Metal Weld