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SOUTHERN COMPANY
Energy to Serve Your World[SM]

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

Joseph M. Farley Nuclear Plant
30-Day Response to NRC Bulletin 2001-01
Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles

Ladies and Gentlemen:

By letter dated August 3, 2001 the NRC issued the subject Bulletin that requires a 30-day response in accordance with 10 CFR 50.54(f). The Bulletin requests that licensees provide information relevant to the vessel head cracking issue along with inspection plans.

Provided in the enclosed attachment is the Southern Nuclear Operating Company (SNC) 30-day response for the Farley Nuclear Plant (FNP). Should you have questions, please advise.

This submittal contains NRC commitments for future head inspection as specified in the response to question 4 and question 5 in the attachment.

Respectfully submitted,

Dave Morey

Sworn to and subscribed before me this 31st *day of* Aug. *2001*

Notary Public

My Commission Expires: 9/4-02

DWD/kaw: bul_0101.doc
Attachment

A088

cc: <u>Southern Nuclear Operating Company</u>
Mr. L. M. Stinson, General Manager – Farley

<u>U. S. Nuclear Regulatory Commission, Washington, D. C.</u>
Mr. F. Rinaldi, Licensing Project Manager – Farley

<u>U. S. Nuclear Regulatory Commission, Region II</u>
Mr. L. A. Reyes, Regional Administrator
Mr. T. P. Johnson, Senior Resident Inspector – Farley

Attachment

Joseph M. Farley Nuclear Plant
Response to Bulletin 2001-01
Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles

Joseph M. Farley Nuclear Plant
Response to Bulletin 2001-01
Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles

Joseph M. Farley Nuclear Plant (FNP) is participating in the EPRI Materials Reliability Program associated with the Reactor Pressure Vessel (RPV) nozzle cracking issue. The Materials Reliability Program response to NRC Bulletin 2001-01 (MRP-48) was submitted to the NRC by the Nuclear Energy Institute (NEI) on August 21, 2001. This submittal provides background information on all pressurized water reactor (PWR) plants, rankings of the plants relative to Oconee Nuclear Station Unit 3 (ONS3) based on the time-at-temperature model, previous inspections performed, a discussion of the regulatory requirements, and references to previous MRP submittals containing supporting information. Below is the FNP response to the requested information contained in NRC Bulletin 2001-01. The Bulletin's "Requested Information" is shown in bold.

<u>Requested Information</u>

1. **All addressees are requested to provide the following information:**

    a. **The plant-specific susceptibility ranking for your plant(s) (including all data used to determine each ranking) using the PWSCC [Primary Water Stress Corrosion Cracking] susceptibility model described in Appendix B to the MRP-44, Part 2, report;**

<u>Response</u>

FNP has been evaluated for relative susceptibility to outside diameter (OD) or weld initiated PWSCC of the RPV head penetration nozzles. The evaluation indicates it would take approximately 6.9 Effective Full Power Years (EFPYs) of additional operation for FNP Unit 1 and 8.3 EFPYs of additional operation for FNP Unit 2 to reach the same time-at-temperature as ONS3. The evaluation used the time-at-temperature model and plant-specific input data reported in MRP-48. Table 1 includes the plant-specific data used to determine the rankings. The susceptibility rankings are consistent with the information provided to the NRC by NEI in its submittal of MRP-48.

Using the criteria stated in NRC Bulletin 2001-01, the FNP units are in the category of plants greater than 5 EFPY and less than 30 EFPY relative to ONS3, which is considered as having a moderate susceptibility to circumferential cracking of the reactor pressure vessel head penetration nozzles.

<u>Requested Information</u>

1. **All addressees are requested to provide the following information:**

    b. **A description of the VHP [vessel head penetration] nozzles in your plant(s), including the number, type, inside and outside diameter, materials of construction, and the minimum distance between VHP nozzles;**

Response

FNP has 69 control rod drive mechanism (CRDM) nozzles plus 1 head vent nozzle. The 69 CRDM nozzles are the same size penetration through the head and are used for:

1) full length CRDM's
2) part length CRDM's
3) thermocouple column locations
4) head adapter plugs
5) cap latch housings
6) heated junction thermocouple locations.

Table 2 provides the inside and outside diameter, materials of construction and the minimum distance between VHP nozzles. The vessel head arrangement is shown in Figure A-2 (Figure c) of the PWR Materials Reliability Project, Interim Alloy 600 Safety Assessments for US PWR Plants (MRP-44) Part 2: Reactor Vessel Top Head Penetrations.

Requested Information

1. All addressees are requested to provide the following information:

c. A description of the RPV head insulation type and configuration;

Response

As reported in Table 2-1 of MRP-48, FNP has reflective (mirror) stepped vessel head insulation. The reactor vessel head insulation is constructed to be permanent, yet removable and reusable. The main portion of the insulation is installed horizontally above the RPV head with approximately a 1½" gap at the top. The main portion is square, with outer portions stepped down to accommodate the curved head configuration. The insulation is positioned below the head penetration connections to the CRDM housings. The insulation is provided in individual panels that fit together in a specific arrangement and are fastened by buckles.

Requested Information

1. All addressees are requested to provide the following information:

d. A description of the VHP nozzle and RPV head inspections (type, scope, qualification requirements, and acceptance criteria) that have been performed at your plant(s) in the past 4 years, and the findings. Include a description of any limitations (insulation or other impediments) to accessibility of the bare metal of the RPV head for visual examinations;

Response

FNP Unit 1 has not performed RPV head and nozzle inspections within the past four years; however, 32 of 69 penetrations on the outer rows were visually examined in 1995 and no leakage was detected.

A visual inspection was performed on the FNP Unit 2 RPV head during the February 2001 refueling outage. The objective of this inspection, which was conducted by Westinghouse Nuclear Services and

Brooks Associates, was to look for evidence of boric acid residue indicative of potential leakage from the CRDM penetrations. The inspection area focused on the annulus between the penetration stalk and the penetration hole for the CRDM penetrations. This inspection was performed without removing the insulation, using a length of conduit to guide a fiberscope to each CRDM penetration. No leakage was apparent from any of the CRDM penetrations at the interface between the vessel head and the penetration stalk based on the inspection experience of the personnel that performed the inspection. Although full 360° coverage inspection was not possible at every penetration, based on the absence of significant boron crystallization and the satisfactory condition of the bare metal of the RPV head and the general area around the penetrations it was concluded that no leakage existed.

Requested Information

1. **All addressees are requested to provide the following information:**

   e. **A description of the configuration of the missile shield, the CRDM housings and their support/restraint system, and all components, structures, and cabling from the top of the RPV head up to the missile shield. Include the elevations of these items relative to the bottom of the missile shield.**

Response

Table 3 provides elevations of various components relative to the missile shield. Figures 3.8-13 and 3.8-14 of the FNP Final Safety Analysis Report provide typical containment building plan and elevation views showing the general arrangement of the RPV and missile shield.

Missile Shield – The missile shield is a 12'-0" by 27'-0" reinforced concrete slab, 3'6" thick at the center, which is positioned above the RPV during power operations to intercept postulated CRDM missiles. It is supported by a steel structure bolted to the top of the refueling cavity floor. To enable refueling operations the missile shield supports are unbolted and the assembly is set aside using the polar crane to provide clear access to the RPV head. Two cooling fans are mounted on the missile shield, with ductwork directing airflow down to the CRDMs.

Seismic Support Platform – The seismic support platform is located below the missile shield. It rests on the RPV head and is attached to the refueling cavity walls with lateral struts. The seismic support platform extends above the top of the CRDMs and incorporates a grid of tensioned wire ropes (messenger cables) which support the electrical cables from the CRDM coils, core exit thermocouples, and rod position indication (RPI) coils as they are routed from the area above the RPV into their cable trays. The seismic support platform also provides lateral restraint to the upper ends of the CRDMs by means of the RPI top plates and seismic spacer plates. In addition, supports for the RPV head vent piping are mounted to the seismic support platform, as are the baffles and shrouds that channel cooling airflow around the CRDMs from the fans atop the missile shield.

CRDMs – The CRDMs are located atop the RPV head. A CRDM consists of a housing (pressure vessel) enclosing a drive rod, with an electromagnetic jack assembly to effect rod movement and an RPI coil stack to detect rod position mounted externally to the housing. Each CRDM housing is joined to a RPV head penetration nozzle by a threaded, seal-welded connection. Electrical cables for the CRDMs are contained in conduits from the coils to the RPI top plates.

Reactor Pressure Vessel Head Penetrations – The RPV head penetration nozzles form the pressure boundary from the RPV to the threaded, seal-welded connections of the CRDM housings. The penetrations are structured to provide a uniform height transition from the rounded reactor vessel head to the 48 full length CRDMs. Five penetrations are part length CRDMs (spares), four are thermocouple columns, four are head adapter plugs, six are cap latch housings and two are heated junction thermocouple (HJTC) locations. The six cap latch housings and two HJTCS in Unit 1 include retaining collars. The RPV head penetrations are surrounded by mirror insulation and associated support bracing.

Head Insulation – See response to 1.c

2. **If your plant has previously experienced either leakage from or cracking in VHP nozzles, addressees are requested to provide the following information:**

   a. **A description of the extent of VHP nozzle leakage and cracking detected at your plant, including the number, location, size, and nature of each crack detected;**

   b. **A description of the additional or supplemental inspections (type, scope, qualification requirements, and acceptance criteria), repairs, and other corrective actions you have taken in response to identified cracking to satisfy applicable regulatory requirements;**

   c. **Your plans for future inspections (type, scope, qualification requirements, and acceptance criteria) and the schedule;**

   d. **Your basis for concluding that the inspections identified in 2.c will assure that regulatory requirements are met (see Applicable Regulatory Requirements section). Include the following specific information in this discussion:**

      (1) If your future inspection plans do not include performing inspections before December 31, 2001, provide your basis for concluding that the regulatory requirements discussed in the Applicable Regulatory Requirements section will continue to be met until the inspections are performed.

      (2) If your future inspection plans do not include volumetric examination of all VHP nozzles, provide your basis for concluding that the regulatory requirements discussed in the Applicable Regulatory Requirements section will be satisfied.

<u>Response</u>

Neither FNP unit has experienced pressure boundary leakage or cracking in VHP nozzles. Therefore, it is SNC's belief that this section is not applicable. Minor RCS leakage has been found at mechanical joints for incore thermocouple electrical connections and through head vent isolation valves.

<u>Requested Information</u>

3. **If the susceptibility ranking for your plant is within 5 EFPY of ONS3, addressees are requested to provide the following information:**

   a. **Your plans for future inspections (type, scope, qualification requirements, and acceptance criteria) and the schedule;**

b. **Your basis for concluding that the inspections identified in 3.a. will assure that regulatory requirements are met (see Applicable Regulatory Requirements section). Include the following specific information in this discussion:**

(1) **If your future inspection plans do not include performing inspections before December 31, 2001, provide your basis for concluding that the regulatory requirements discussed in the Applicable Regulatory Requirements section will continue to be met until the inspections are performed.**

(2) **If your future inspection plans include only visual inspections, discuss the corrective actions that will be taken, including alternative inspection methods (for example, volumetric examination), if leakage is detected.**

Response

Neither FNP unit's susceptibility ranking is within 5 EFPY of ONS3. Therefore, this section is not applicable.

Requested Information

4. **If the susceptibility ranking for your plant is greater than 5 EFPY and less than 30 EFPY of ONS3, addressees are requested to provide the following information:**

   a. **Your plans for future inspections (type, scope, qualification requirements, and acceptance criteria) and the schedule;**

   b. **Your basis for concluding that the inspections identified in 4.a will assure that regulatory requirements are met (see Applicable Regulatory Requirements section). Include the following specific information in this discussion:**

   (1) **If your future inspection plans do not include a qualified visual examination at the next scheduled refueling outage, provide your basis for concluding that the regulatory requirements discussed in the Applicable Regulatory Requirements section will continue to be met until the inspections are performed.**

   (2) **The corrective actions that will be taken, including alternative inspection methods (for example, volumetric examination), if leakage is detected.**

Response

FNP Unit 1 plans to perform an effective remote visual inspection of the metal surface of the 69 CRDM nozzles and the head vent nozzle at the next scheduled refueling outage to begin in October 2001. Certified VT-2 visual examination personnel will oversee the inspection. The examiners will have additional training and be familiar with boron leakage by reviewing video tapes from other nuclear power plants where boron was detected. Evidence of boric acid deposit build up around the circumference of head penetrations will be investigated to determine the source. Boric acid deposits that can be attributed to sources other than a through wall leak of a penetration will be evaluated. Deposits evaluated as coming from a through wall leak of a penetration will be unacceptable, the source determined, and penetration repaired.

FNP Unit 2 plans to perform inspections of the RPV head and nozzles, including the head vent penetration, at the next refueling outage to begin in September 2002. FNP has committed to perform this inspection on Unit 2 as part of the industry program in response to Generic Letter 97-01. At the time of this commitment, the inspection plan was to use eddy current testing on the penetration ID for detection of ID-connected flaws and UT for sizing any such flaws, techniques that had already been qualified for these purposes. While effective for the type of ID flaws previously seen, such an inspection would not have detected some of the recent OD or weld initiated flaws seen in the industry. The industry is working to develop and qualify non-destructive examination techniques that will be effective for any of the flaws observed to date. Therefore, the details of the inspections that will be performed in September 2002 may change as the technology evolves and the Material Reliability Project inspection recommendations are updated.

FNP inspection plans provide assurance that FNP's regulatory basis will continue to be met. RPV head pressure boundary leakage will be detected by the proposed inspection plan. The FNP FSAR chapter 15 accident analysis describes the design basis of FNP to address and mitigate the effects of RCS leakage, including a CRDM housing rupture and control rod ejection, with acceptable regulatory consequences as approved by the NRC staff. In summary the combination of our inspection plans and FNP design basis analysis provide assurance that the regulatory requirements will continue to be met.

<u>Requested Information</u>

5. **Addressees are requested to provide the following information within 30 days after plant restart following the next refueling outage:**

    a. **A description of the extent of VHP nozzle leakage and cracking detected at your plant, including the number, location, size, and nature of each crack detected;**

    b. **If cracking is identified, a description of the inspections (type, scope, qualification requirements, and acceptance criteria) repairs, and other corrective actions you have taken to satisfy applicable regulatory requirements. This information is requested only if there are any changes from prior information submitted in accordance with this bulletin.**

<u>Response</u>

As requested, the NRC will be provided with additional information within 30 days after plant restart following the next refueling outage if any leaks or cracks are discovered.

Table 1

Joseph M. Farley Nuclear Plant

Input Data for Evaluation of Relative Susceptibility Ranking

Parameter	Unit 1 Value	Unit 2 Value
EFPYs thru February 2001	18.2	16.4
Head Temperature Range Over Life (°F)	597	597
Current Head Temperature (°F)	597	597
EFPYs Normalized to 600 °F	15.8	14.5
Remaining EFPYs to Reach ONS3 from March 01, 2001	6.9	8.3
Relative Susceptibility Ranking	15	17

Table 2

Joseph M. Farley Nuclear Plant

RPV Head Penetration Nozzle Data

Parameter	Data
NSSS Design	Westinghouse
Nozzle Material Supplier	B&W/Huntington
Nozzle Materials of Construction	Alloy 600
Head Fabricator	B&W/CE
Design Diametral Nozzle Interference Fit (mils)	0.0-3.0
Number of CRDM Nozzles	69
Outside Diameter of CRDM Nozzles (inches)	4.000
Inside Diameter of CRDM Nozzles (inches)	2.750
Number and Size of J-Groove Head Vent Nozzles	1 – ¾" Sch. 80 (OD machined to 1.014")
Minimum Horizontal Distance Between VHP Nozzles	11.973" c-c

Table 3

Joseph M. Farley Nuclear Plant

Relative Elevations of Reactor Head Components

Elevation	Distance from Missile Shield	Component
157'-11"	0'	Bottom of Missile Shield
153'-0"	4'-11"	Seismic Support Platform
137'-2"	20'-9"	Center of 34" Duct for CRDM Cooling Air
136'-6"	21'-5"	Head Insulation (Upper Horizontal Step)
136'-2"	21'-9"	Top of Vessel Head
129'-0"	28'-11"	Vessel Flange