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L-2011-043
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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

RE: Turkey Point Units 3
Docket Nos. 50-250
Response to Request for Additional Information
Relief Request No. 8, Transfer Canal Drain Line Piping Repair

By letter L-2010-243 dated October 21, 2010, Florida Power and Light Company (FPL) submitted to Nuclear Regulatory Commission (NRC) Relief Request No.8 requesting relief from the requirements of the ASME Code Section XI, IWA-4000 as it applies to the degradation in the spent fuel pool transfer canal drain line piping repairs.

During a teleconference on October 27, 2010, the NRC Staff granted a verbal authorization on the use of Relief Request No. 8, in accordance with 10 CFR 50.55a(g)(6)(i), and subsequently on November 5, issued the script for the verbal authorization.

On January 7, 2011, NRC requested additional information to complete the review of Relief Request No. 8. The attachment to this letter provides FPL's response to the requested information.

If there are any questions regarding this request, please contact Robert Tomonto at (305) 246-7327.

Sincerely,

Michael Kiley
Site Vice-President
Turkey Point Nuclear Plant

Attachment

A047
NRR

L-2011-043

Attachment

Response to Request for Additional Information
Relief Request No. 8, Transfer Canal Drain Line Piping Repair

NRC Request for Additional Information (RAI) for Relief Request #8, Spent Fuel Pool Transfer Canal

By letter dated October 21, 2010, Florida Power and Light Company (the licensee) submitted for the U. S. Nuclear Regulatory Commission (NRC) review and approval relief request number 8 related to the degradation in spent fuel pool (SFP) transfer canal drain line. The licensee requested relief from the requirements of the ASME Code, Section XI, IWA-4000 applies to flaws requiring repairs.

To complete its review, the NRC staff requests the following information:
(a) the flaw characterization

To characterize the flaw, a volumetric technique (Ultrasonic Testing) aided by dye penetrant surface exams were performed on the piping. The results were as follows:

3-12-028 piping

Dye penetrant shows leakage (from 1/4 in. pin hole) and surface pitting on the pipe.
UT provided the following information:

Pin hole size: 0.20 in. ID.
Axial and circumferential components were identified in the flawed area during scanning.
Facets were also observed as the transducer was skewed around the flawed area.
Examination of the identified surface pitting was performed with no axial or circumferential components identified.

3-12-029 piping

Dye penetrant shows leakage and surface pitting on the pipe.
UT provided the following information:

The two pin holes had no measurable length on the ID.
Examination of the identified surface pitting was performed with no axial or circumferential components identified.

Based on the above information, the pin hole flaws were characterized as surface non-planar. Those with no measurable geometry were also treated as surface non-planar.

(b) inspections performed and associated results

Initial Inspection by UT:

Examination on 08/19/10:

3-12-028 piping
UT confirmed the following:

One 0.20 in. ID pin hole.

Axial and circumferential components were identified in the flawed area during scanning.

Examination of the identified surface pitting was performed with no axial or circumferential components identified.

Facets were also observed as the transducer was skewed around the flawed area.

3-12-029 piping
UT confirmed the following:

Two pin holes with no measurable length on the ID.

Examination of the identified surface pitting was performed with no axial or circumferential components identified.

30 Day Reexaminations by UT:

The purpose of the 30 day reexamination was to determine if any changes had occurred to the flaw size since the last examination performed on 08/19/10 as required by ASME Section XI, Code Case N-513-2. A total of three 30 day reexaminations were performed on the following dates: 09/13/10, 10/13/10, and 11/12/10. The following were the results of the reexaminations:

Examination on 9/13/10:

3-12-028/29 piping
The flawed areas did not possess any measurable change from the dimension recorded during the ultrasonic examination performed on 08/19/10.

Examination on 10/13/10:

3-12-028 piping
UT confirmed the following:

One 0.50 in. ID pin hole.

Axial and circumferential components were identified in the flawed area during scanning.

Facets were also observed as the transducer was skewed around the flawed area.

3-12-029 piping

UT confirmed the following:

Two 0.40 in. ID (combined) pin holes.

Facets were also observed as the transducer was skewed around the flawed area.

The flawed areas possessed a slight measurable change from the dimension recorded during the ultrasonic examination performed on 09/13/10; however, they remained well within the allowable calculated size.

Examination on 11/12/10:

3-12-028/029 piping

The flawed areas do not possess any measurable change from the dimension recorded during the ultrasonic examination performed on 10/13/10.

Daily Monitoring for 3-12-028/029 piping:

Daily monitoring was performed as required by ASME Section XI, Code Case N-513-2 for through-wall leaking flaws. There were a few instances in which dry boric acid was noted, however there were no adverse changes to the condition of the piping and components that would invalidate any assumptions or conclusions of the flaw evaluation.

(c) flaw evaluations of the degraded pipe

Three pressure boundary leaks in similar areas (pinhole indications at the toe of a weld) were discovered on similar sections of 4" Schedule 10S SMLS A312 Type 304 stainless steel piping of the U3 Spent Fuel Pool Cooling System (Line 4"-AC-151R). The affected piping is located outside containment upstream of valve 3-12-028 drain valve for fuel transfer canal (one pinhole) and downstream of valve 3-12-029 SFP pump suction valve from fuel transfer canal (two pinholes). The leakage is characterized as minor with an estimated combined value of 1 drop every 2 to 3 minutes causing boric acid crystallization on the pipe. The affected piping is a part of the Spent Fuel Pool Cooling System and is classified as ASME Section XI Class 3 piping (Quality Group C).

The allowable flaw lengths for the degraded piping are determined below based on the methodology used for a previous analysis of flaws in 8" pipe with the same design and material conditions. The comparison basis is as follows:

1. The conditions involve the same pipe schedule and material (10S A312 Type 304) with the same code specified yield strength, code specified ultimate tensile strength, structural factor on primary membrane stress, Young's Modulus, and allowable design stress.

2. The design pressure and temperature of the piping is the same (150 psig, 200 F). The maximum operating pressure and temperature of the piping are 70 psig and 120 F respectively.

3. The system is the same, Spent Fuel Pool (SFP) Cooling System, thus the same design standards were applied for required pipe supports and analysis.

4. The lines are ASME Class 3, and subject to the same methodology for flaw analysis.

5. The three pinholes flaws are assumed to be a through-wall flaw depth.

6. The pinhole flaw identified near component 3-12-028 is a 0.25" on the OD and 0.20" on the ID at the time the initial inspection was performed. This flaw is conservatively assumed to be surface planar with a length of 0.25" in both the axial and circumferential directions.

7. The two pinhole flaws identified near component 3-12-029 had no measurable length at the time the initial inspection was performed. Discussions with ISI inspectors determined that the distance between the pinholes flaws was conservatively equal to or less than 1/8" (0.12"). Based on the proximity rules (Section XI paragraph IWA-3330), the flaws were considered discontinuous indications and treated as single surface planar flaws since the distance between the flaws is equal to or less than the dimension S ($S \leq 2d_1$ or $2d_2$, the pinholes are through wall which means that $2d_1$ and $2d_2$ are equal to the pipe wall thickness which is 0.12"). In order to add conservatism to this flaw evaluation, the pinhole flaws were assumed to be 1/16" diameter each which would yield a single planar flaw of 0.24" (1/16" + 1/16" + 0.12" = 0.24"). Additional conservatism was added by assuming that the single planar flaw is 0.25" in both the axial and circumferential directions. As allowed by section of Code Case N-513-2, the non-planar flaws are treated as independent planar flaws.

8. Service Level A safety factors were applied to the current condition (similar to the previous calculation performed for the 8 in. line).

9. The identified pinhole leaks are located on a 4" SFP pipe adjacent to valves 3-12-028 and 3-12-029. The area of concern consists of three pipes, receiving flow from the Fuel Transfer Canal and providing suction to the SFP Emergency Pump and drainage to the Waste Holdup Tank. All three lines are considered structurally anchored at the grouted wall penetrations of the Boric Acid Storage Tank Room. These pseudo anchors would permit no rotation and no lateral movement, and offer resistance to axial translation (pipes are well supported on each end). Since the piping configuration consists of small lengths of piping anchored at each end, three valves adjacent to these anchors, the expected deadweight and seismic stress

levels would be extremely small. It is also concluded that no loading/moments, thermal or dead weight conditions would adversely affect the pipes and the three flaws.

10. A previous flaw evaluation was performed on an 8" pipe with a through wall flaw evaluated as surface planar with a size of 0.25" in both the axial and circumferential directions. The current condition is on two 4" pipes with a total of three through wall flaws. However, based on assumption/design input 6 and 7, the flaws are evaluated as a total of two surface planar through wall flaws with the conservative size of 0.25" in the axial and circumferential directions. Since the previous analysis was performed for an 8" diameter schedule 10 pipe (allowable axial = 4.93" and allowable circumferential = 14.86"), the allowable axial and circumferential flaws for 4" diameter schedule 10 pipe can be approximated as follows.

In order to determine the allowable axial flaw for the 4 in. pipe, the ratio between the two allowable axial flaws is obtained by using equation (1) from Code Case N-513-2.

$$\frac{l_{all8}}{l_{all4}} = \frac{1.58\sqrt{R_8 t_8}\left[\left(\frac{\sigma_f}{(SF_m)\sigma_{h8}}\right)^2 - 1\right]^{1/2}}{1.58\sqrt{R_4 t_4}\left[\left(\frac{\sigma_f}{(SF_m)\sigma_{h4}}\right)^2 - 1\right]^{1/2}}$$

$$\frac{l_{all8}}{l_{all4}} = 0.976$$

This ratio resulted in an approx. allowable axial flaw size for the 4" Sch. 10 pipe to be 5.05 in. The 5.05 in. flaw size is for each pipe.

In order to determine the allowable circumferential flaw for the 4 in. pipe, a similar approach to the 8 in. pipe analysis was applied (the 8 in. pipe analysis applied ASME Section XI Appendix C (2001), Section C-5320). However, the ratio between the two circumferential flaws is obtained.

$$\frac{l_{all8}}{l_{all4}} = \frac{\theta D_{o,8}}{\theta D_{o,4}}$$

$$\frac{l_{all8}}{l_{all4}} = \frac{D_{o,8}}{D_{o,4}} = 1.917$$

This ratio resulted in an approx. allowable circumferential flaw size for the 4" Sch. 10 pipe to be 7.75 in. The 7.75 in. flaw size is for each pipe.

It is concluded that the identified flaws that were conservatively assumed to be 1/4" surface planar in the axial and circumferential direction are significantly below the allowable flaw sizes.

It is also concluded that the final 30 day reexamination results (0.5 in. and 0.4 in. flaw sizes for 3-12-028 and 3-12-029 respectively) were still within the allowable flaw sizes.

12. Resulting water volume weeping/leaking out of the through wall flaws is minimal (1 drop every 2 to 3 minutes). Additionally, the make up capacity for the SFP is 100 gpm from the demineralized water system (Ref. FSAR section 9.5) which is much greater than the reported leak and does not significantly impact the pool water level and inventory when there is direct communication between the SFP and Fuel Transfer Canal.

(d) the root cause of the degradation

Background:
Transgranular stress corrosion cracking (TGSCC) is a phenomenon that produces cracks that propagate through the grains of a material and usually occurs in the presence of halogens, sulfides or chlorides. In austenitic stainless steels, TGSCC is not usually associated with a specific metallurgical condition but is affected by high local residual stresses, such as caused by welding or local cold work, as well as by the environment. TGSCC in 300-series stainless steels is most commonly associated with chlorides.

Environment:
The nominal environment for the interior of the transfer canal piping would not be expected to contain sufficient chloride for TGSCC to occur due to controlled chemistry (borated clean water). The nominal external environment is ambient coastal air. For a line located in a pit where most part of the year have standing water a constant supply of moisture and salt can be present.

Apparent Cause:
The apparent cause of the U3 transfer canal through wall leakage is chloride induced Transgranular Stress Corrosion Cracking (TGSCC) initiated in the outside diameter of the pipes. The leaks are located in the heat affected zone of the pipes to valves weld. Residual stresses from these welds are a likely source of the flaw initiation. A minor amount of SCC, could have readily produced the final through-thickness flaws and the leaks. The TGSCC is the most likely cause due to accumulation of chlorides on the OD, in the region of the base metal.

(e) how the requirements of Code Case N-513-2 are satisfied

The flaws identified on the pipes, evaluations, and actions satisfy the requirements of Code Case N-513-2 as follows:

1. The affected piping is Class 3 under ASME Section XI program.

2. Piping maximum operating temperature and pressure are 120 F and 70 psig respectively. This is below the code case requirements of 200 F and 275 psig.

3. The flaw evaluation was applied to pipes designed to ANSI B31.1.

4. The system operability considering effects of leakage was demonstrated by the daily inspections and 30 day volumetric inspections with no adverse changes to the conditions. Also, the resulting water volume weeping/leaking out of the through wall flaws was minimal (1 drop every 2 to 3 minutes). Additionally, the make up capacity for the SFP is 100 gpm from the demineralized water system (Ref. FSAR section 9.5) which is much greater than the reported leaks and did not impact the pool water level and inventory when there was direct communication between the SFP and Fuel Transfer Canal.

5. The flaw geometry was characterized by through wall sizing techniques (Ultrasonic Testing) and aided physical measurements (Dye Penetrant Testing). Also, the full pipe circumference at the flaws locations were inspected in order to characterize the length and depth of the flaws in the pipe section.

6. The flaws were characterized as surface non-planar however they were conservatively assumed to be surface planar and 1/4" in the axial and circumferential directions as allowed by 3(f) of Code Case N-513-2. The final 30 day reexamination report shows that the flaws increased in size (3-12-028 → 0.5 in; 3-12-029 → 0.4 in.) however, the flaw sizes were still within the allowable sizes.

7. The flaws detected near component 3-12-029 were two pinholes. Since this condition classifies as multiple flaws, the proximity rules for flaws (Section XI paragraph IWA-3330) were applied in this condition.

8. A flaw evaluation was performed to determine the conditions for flaw acceptance per Section 3 of N-513-2 as discussed above.

9. Frequent periodic inspection of no more than 30 day intervals were performed to determine if flaws were growing and to establish the time at which the detected flaw will reach the allowable size. The following were the results:

	3-12-028 (in.on ID)	3-12-029 (in. on ID)
8/19/2010	0.2	0
9/13/2010	0.2	0
10/13/2010	0.5	0.4
11/12/2010	0.5	0.4

Based on the flaw evaluation performed the most limiting allowable flaw is in the axial direction (5.05 in.). Of the observed flaw propagation in the table above, the most limiting rate is demonstrated by the flaw near 3-12-029 (0.4 in. / 30 day = 0.013 in./day growth). Assuming the entire flaw length is in the axial direction and propagating at a continuous linear rate, significant margin exists [(5.05-0.4) in. / 0.013 in. / day = 357 days] to reach the allowable flaw size (repair occurred within that window). Therefore, although the flawed areas exhibited a measurable change from the dimension recorded during the ultrasonic examination performed on 09/13/10, they remained well within the allowable calculated size with an acceptable growth rate.

The SFP transfer canal piping was completely drained and tagged out of service on 11/30/10 by which at that time no additional 30 day reexamination was required. PMT (Post Modification Testing) including ASME Section XI Pressure Test was performed on the affected piping and components with SAT results on 12/30/10. Therefore, Relief Request No. 8 commitment was met.

10. The identified flaws were through-wall leaking flaws. The leakage was observed by daily walk downs with no adverse changes. Therefore, the analysis conditions used in the evaluation remained valid.

11. A relief request from ASME Section XI Code Case N-513-2 requirement to perform repair or replacement of the transfer canal drain line no later than the next scheduled outage, which was PT3-25 RFO, and to implement design modifications after Unit 3 returns to 100% power but no later than 12/31/10 was submitted to the NRC and verbally approved by the NRC on 10/27/10. The repair and replacements of the affected piping and components were performed in accordance with Code Case N-513-2 and by meeting Relief Request No. 8.

12. The evaluations and examinations are documented in the Owner's Activity Report (OAR) in accordance with IWA-6300.

13. An augmented inspection to assess degradation of the affected system was performed. A sample size of 5 of the most susceptible and accessible locations were examined within 30 days of detecting the flaw. No significant flaws were detected.

(f) a demonstration to show that the structural integrity of the degraded pipe is maintained during the period of the deferred Code repair

1. Further pipe wall degradation due to boric acid corrosion (BAC) is not a major concern since pipe is made of austenitic stainless steel (SCH.10S SMLS A312 Type 304) that is highly resistant to this failure mode.

2. Further flow-induced wall degradation is not a major concern since hydraulic shear load near the pipe wall is at its minimal value (i.e., lower fluid velocity).

3. Based on the review of the pipe configuration, the piping region where the flaws are located are not subjected to fatigue-type or vibratory loading as it is located away from pump nozzles and isolated from impact of pump vibration by multiple supports. Additionally, the flaws are located in close proximity to a wall penetration analyzed as an anchor point having minimal movements/deflections.

4. Normal pipe stresses due to mechanical loading are minimal at the flaw locations due to the location of the pipe and the way it is supported.

5. The following is a table that shows the growth:

	3-12-028 (in.on ID)	3-12-029 (in. on ID)
8/19/2010	0.2	0
9/13/2010	0.2	0
10/13/2010	0.5	0.4
11/12/2010	0.5	0.4

Although the flawed areas exhibited a change from the dimension recorded during the ultrasonic examination performed on 09/13/10, they remained well within the allowable calculated size with an acceptable growth rate. The SFP transfer canal piping was completely drained (out of service) on 11/30/10 and pipe repairs started on 12/06/10 by which time no additional 30 day reexamination was required. Furthermore, the daily inspection reports show no adverse changes to the conditions of the flaws and structural integrity of the degraded pipes.

PMT (Post Modification Testing) including ASME Section XI Pressure Test was performed on the affected piping and components with SAT results on 12/30/10. Therefore, Relief Request No. 8 commitment was met.