Florida Power & Light Company, 6501 S. Ocean Drive, Jensen Beach, FL 34957

May 25, 2004

L-2004-109
10 CFR 50.4

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

RE: St. Lucie Units 1 and 2
Docket Nos. 50-335 and 50-389
Supplemental Response Following SL1-19 Refueling Outage
Generic Letter 96-06 Waterhammer Issues

Florida Power & Light Company (FPL) committed in FPL Letter L-2003-244 on September 29, 2003, to update Question 6 and 7 responses to address final design information within 30 days after return to power following the Unit 1 spring 2004 refueling outage (SL1-19). This supplement updates the above referenced responses and response 9.

Generic Letter (GL) 96-06 concerns whether the cooling water system for containment air coolers is susceptible to waterhammer or two phase flow conditions during postulated design basis accidents and whether piping systems that penetrate the containment are susceptible to overpressurization from thermal expansion of entrapped fluid. Under previous correspondence:

- NRC accepted FPL's responses and actions concerning two-phase flow and thermal pressurization issues and has closed these issues.

- NRC letter dated April 3, 2002 documented acceptance of EPRI Report TR-113594 for use in evaluating GL 96-06 waterhammer issues and requested FPL respond to the remaining waterhammer issues.

FPL Letter L-2002-149 dated July 29, 2002, provided a schedule for completing GL 96-06 analysis and modifications and indicated that FPL intended to preclude containment fan cooler (CFC) voiding by moving the component cooling water (CCW) pumps to an earlier emergency diesel generator (EDG) load block. To reduce modeling uncertainty for the time-to-boil and void size calculations, FPL subsequently performed benchmark testing of the CCW pump stop and start transients. These tests indicated that CFC voiding could be expected within Unit 1 Train B for the design bases accident with loss of offsite power (DBA/LOOP) scenario.

FPL Letter L-2003-069 dated March 13, 2003 responded to the NRC using an analysis based on the method of characteristic (MOC) methodology to determine waterhammer occurrence and magnitude as described in the EPRI Report. On August 1, 2003, the

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NRC issued a request for additional information (RAI) with respect to this response requesting clarification of specific issues and additional analysis information. FPL Letter L-2003-244 dated September 29, 2003, provided the initial response to this August 1, 2003 RAI.

On March 11, 2004, the NRC issued a closeout letter for the St. Lucie Units 1 and 2 response to GL 96-06 concerning waterhammer and two-phase flow. Based on the NRC review of the information provided by FPL, the NRC was satisfied with FPL's evaluation of the GL 96-06 waterhammer issue. The NRC acknowledged the FPL commitment to submit the results of the final CCW piping and support design analysis (i.e., updated response to Questions 6 and 7 of the September 29, 2003 FPL letter L-2003-244) within 30 days after Unit 1 was returned to power following the spring 2004 refueling outage SL1-19. In addition, FPL was requested to confirm that all remaining GL 96-06 modifications have been completed, along with a summary description of the modifications, within 30 days after Units 1 and 2 return to power following the SL1-19 and SL2-15 refueling outages, respectively.

Please contact George Madden at 772-467-7155 if there are any questions about this submittal.

Very truly yours,

William Jefferson, Jr.
Vice President
St. Lucie Plant

WJ/GRM

Attachment

Attachment
St. Lucie Units 1 and 2 Response
NRC Request for Additional Information Dated August 1, 2003
Regarding GL 96-06 Waterhammer Issues

As documented in NRC's Generic Letter (GL) 96-06 closeout letter dated March 11, 2004, FPL committed to provide results of the final component cooling water (CCW) piping and support design analyses and summary descriptions of the modifications within 30 days of return to power following the Unit 1 spring 2004 SL1-19 refueling outage. Accordingly, updates are provided for RAI Questions 6, 7, and 9.

NRC Question 6 - Provide the maximum loads calculated for the CCW piping, supports, orifices, bends, and penetrations for the worst case column closure waterhammer. Also, provide the ratios of the maximum loads within the service water system to the loads required for failure.

FPL Response

The load combinations utilized for the CCW piping and supports under GL 96-06 are as defined in the St. Lucie Unit 1 and Unit 2 Updated Final Safety Analysis Reports (UFSAR) in Section 3.9. Specifically, the piping and components are evaluated for pressure, dead weight, thermal, and the square root sum of the squares (SRSS) of seismic design basis earthquake (DBE) and waterhammer. Pipe supports, nozzles, and containment penetrations are evaluated for dead weight, thermal, and the SRSS of seismic DBE and waterhammer.

GL 96-06 waterhammer loads were developed from the HYTRAN generated pressure time histories of each pipe leg and input into a dynamic piping analysis program to calculate pipe stress and support loads. The HYTRAN analysis credited air release in accordance with the EPRI methodology. These dynamic loads were appropriately combined with other piping analysis of record loads to evaluate the integrity of the piping. The results of these analyses indicate the piping and in-line components comply with ASME Section III Code requirements.

The September 29, 2003 FPL response to NRC RAI Question 6 included the maximum pipe stress ratio for the design load combination (including GL 96-06 waterhammer loads) and the applicable design margins for the pipe supports. The response also identified those pipe supports that required modification for the revised loads. As previously committed to by FPL, these pipe support modifications were completed prior to exiting the SL1-19 refueling outage.

As discussed with the NRC staff on July 30, 2003, FPL identified several analytical discrepancies within the stress analyses of record for the affected CCW piping that are unrelated to GL 96-06. These discrepancies included incorrect seismic response spectra and omission of or incorrect seismic anchor and thermal accident movements. FPL completed the revisions to the affected Unit 1 CCW supply and return piping stress

analyses just prior to the SL1-19 refueling outage. The analysis results confirmed compliance to the ASME Section III B&PV Code with a maximum piping stress ratio of 0.54. An updated table of the bounding B train return pipe supports, loads, and their design margins is provided in Table 1. The bounding B train return penetration loads and their design margins is provided in Table 2. Additional support modifications, independent of those implemented in SL1-19 to address GL 96-06 waterhammer loads, are required as a result of this reanalysis. However, there was insufficient time for planning and material procurement for implementation of these additional support modifications in the SL1-19 refueling outage. Operability has been demonstrated for the existing condition under the St Lucie corrective action program. The necessary corrective actions are scheduled for implementation at the next available opportunity (SL1-20 refueling outage), which is considered to be within the guidelines of GL 91-18 with respect to timeliness of corrective actions. As stated in the previous RAI response, Unit 2 CCW system stress analyses are not affected by this issue.

Table 1
Calculated Loads for Pipe Supports - 1C & 1D CFC Coolers
Return Piping Inside/Outside Containment to RAB CCW 'B' Return Header

Stress Calc	Pipe Support Mark No.	Support Type	Dynamic Loads Water Hammer (lbs)			New Combined Design Loads Faulted (lbs)			Margin		Remarks
			X Horizontal	Y Vertical	Z Transverse	X Horizontal	Y Vertical	Z Transverse	Catalog Items Capacity (lbs)	Limiting Stress Ratio Frames/Welds	
1D Containment Cooler to Penetration P-17 (Inside Containment)	CCH-212	Strut		±184			+3448		4000	0.14	
	CC-1899-6210	Frame		±305	±578		-1808	±758	N/A	0.24	
	CC-1899-2208	Snubber	±4655			±4670			15000	0.14	
	CC-1899-6208	Frame		±416	±2269		-1588	±3022	N/A	0.22	
	CC-1899-6206	Frame		±1244	±783		-2491	±842	N/A	0.45	
	CC-1899-6204	Frame		±388	±1973		-1274	±2786	N/A	0.15	
	CC-1899-6202	Strut		±314			-1439		3000	0.37	
	CC-1899-29	Strut			±524			±941	3000	0.04	
	CC-1899-2200	Snubber			±827			±896	6000	0.61	
	CCH-169	Frame		±921	±403		-2317	±930	N/A	0.98	
	CC-1899-6173	Frame	±736	±400	±657	±2320	-2630	±1187	N/A	0.98	
	CCH-184	Frame		±948			+3330		N/A	0.69	
	CC-1899-2184	Strut			±221			±675	3000	0.05	
	CC-1899-48	Snubber			±416			±1403	6000	0.04	
	CC-1899-1187	Strut		±846			-5524		7000	0.21	Modification – Increase Strut Size
	CC-1899-6187	Strut			±1104			±4405	6000	0.17	

Table 1
Calculated Loads for Pipe Supports - 1C & 1D CFC Coolers
Return Piping Inside/Outside Containment to RAB CCW 'B' Return Header

Stress Calc	Pipe Support Mark No.	Support Type	Dynamic Loads Water Hammer (lbs)			New Combined Design Loads Faulted (lbs)			Margin		Remarks
			X Horizontal	Y Vertical	Z Transverse	X Horizontal	Y Vertical	Z Transverse	Catalog Items Capacity (lbs)	Limiting Stress Ratio Frames/Welds	
1C Containment Cooler to Penetration P-15 (Inside Ctmt)	CC-1883-6198	Rigid Bar		±2610			-4436		6000	0.20	
	CC-1883-1198	Strut			±2959			±3495	6000	0.20	
	CCH-196	Strut		±1231			+1739		4000	0.12	
	CC-1883-6196	Strut			±1958			±2075	3000	0.08	
	CC-1883-6194	Frame		±680	±960		-2050	±1045	N/A	0.26	
	CC-1883-6192	Strut			±1298			±1724	3000	0.51	
	CCH-192	Strut		±428			+3419		4000	0.50	
	CC-1883-6190	Frame	±810	±2731	±574	±2504	-7831	±1616	N/A	0.94	
Penetration P-15 & P-17 to Common Header (RAB)	CCH-47	Strut									To Be Deleted
	CCH-51	Strut		±502			-5240		25000	0.14	
	CC-23-1	Strut			±1326			±11,917	15000	0.30	Modification – Add Angle Brace
	CC-23-3	Frame		±496	±945		-5157	±7950	N/A	0.96	
	CC-23-4	Frame		±218	±749		-4999	±6083	N/A	0.28	
	CCH-46	Spring Can	Dead load support only – evaluation not required								
	CCH-50	Spring Can	Dead load support only – evaluation not required								

Table 2
Calculated Loads for Penetrations P-15 and P-17

Penetration ID	Type	Dynamic Loads Water Hammer (lbs/ft-lbs)			New Combined Design Loads Faulted (lbs/ft-lbs)			MARGIN Limiting Stress Ratio
		Fx/Mx	Fy/My	Fz/Mz	Fx/Mx	Fy/My	Fz/Mz	
P-15 & P-17	Ctmt Pen Type II	3058/455	485/3126	651/2008	3097/533	558/4169	787/2496	0.87

NRC Question 7 - Page 11 of the submittal states that the piping, pipe support, and cooler structural analysis for the design basis case was ongoing. Provide the results of the structural analysis and include a summary of the licensing basis load combination along with the results of the stress analysis.

FPL Response

A summary of the licensing basis stress combinations, piping, and pipe support analysis was addressed in the response to Question 6. This response to Question 7 will summarize the containment fan cooler (CFC) structural analysis. The piping stress analysis discrepancies discussed within the Question 6 response affect piping segments that are remote from the cooler location and thus do not significantly affect the CFC structural analysis.

The CFC analysis develops the waterhammer loads and combines the dynamic stress with pressure, deadweight, thermal, and seismic stresses to support the UFSAR design basis load combination.

The CFC analysis addresses the copper cooling coils, cooler manifold piping up to the 10-inch diameter flanges on both the supply and return lines, and the cooling coil and manifold supports. The 10-inch piping flanges are the interface point between the cooler analysis and the CCW piping analysis.

CFC Design

The containment fan cooler is a 12 x 11 x 24-foot assembly constructed of structural steel members and sheet metal to support a fan, motor, ducting, cooling coils, and supply/return manifold piping which is connected to the CCW system. The steel manifold piping serving the 6 cooling coils consists of 6-inch x 10-inch tee in a horizontal run serving two 6-inch vertical risers which supply flow to three coils each via three nominal 3-inch flanged branch connections. The supply manifold and return manifold have a nearly identical layout and are supported by two supports on the horizontal run and two supports on each vertical leg. The 5/8-inch copper cooling coils are of a serpentine construction supported by a radiator type fins in a steel frame. Each coil has 44 copper tubes, which make four passes and each of the tube passes is approximately 80 inches in length. The outside diameter of each copper tube is 0.64 inches, and the tube thickness is approximately 0.049 inches, leaving the copper tube inside diameter at approximately 0.542 inches. Three-inch nominal diameter copper pipe headers are drilled to accept the 5/8-inch copper tubing. The copper pipe headers have a brazed joint for steel or 90/10 copper/nickel stub and flange for connection to the steel manifold piping.

Cooling Coil Nozzle Loads

The limiting condition for the cooling coils is governed by the piping nozzle allowable, which is expressed in a six-factor interaction equation by the coil manufacturer. Fluid

transient piping loads acting on the 3-inch flanges are compared to the faulted nozzle allowable values provided in vendor documentation with adjustment for actual tube wall thickness and for a faulted stress allowable of 2.4 S_h per ASME Section III, Class 2, 1980 Edition with addenda through and including Summer 1982 (Code used by the coil manufacturer for the coil construction). The nozzle allowable criterion, for the combined loading condition, is met for each of the six coils connecting to the manifold on the return line piping.

Manifold Piping Stresses

Carbon steel and copper piping stresses, for the combined loading condition, are compared to a faulted condition allowable of 2.4 S_h. Stress allowable criteria is met for the manifold piping.

Manifold Support Evaluation

Piping supports, for the combined loading condition, are qualified using the acceptance criteria based on AISC Manual of Steel Construction, 9th Edition. The location with the maximum faulted stress interaction is in the 3x3x1/4-inch tube steel member; consistent with the critical member identified in the vendor seismic stress analysis. Stress allowable criteria is met.

Summary – Cooler Analysis for Waterhammer Loading

- Piping nozzle allowable values adjusted for the actual tube wall thickness and faulted stress allowable, for the combined loading condition, are met for each of the six coils connected to the return piping. As the tubing connected to the copper header is the weakest location of the CFC and the nozzle loads are controlled based on this criterion, the CFC coil design is adequate to withstand the combined loading (including the additional GL 96-06 waterhammer dynamic loading).

- Return side manifold piping is shown to meet analysis allowable values for the combined loading (including the additional GL 96-06 dynamic loading). Due to the location of the column closure, the supply side piping is expected to have similar or lower GL 96-06 dynamic loads than the return side piping. Since the supply side piping routing is nearly identical to the return side piping, the supply side piping is also acceptable. Manifold pipe supports meet their stress allowable values and manifold support modifications are not required.

Unit 1 Train B CFC C return manifold stresses and support/nozzle loads are within acceptance criteria for faulted condition loading during the LOCA event. By meeting the faulted allowable nozzle loads and accounting for supply/return nozzle manifold configuration similarity, CFC C and the cooling coil tubes are qualified for the GL 96-06 waterhammer loading. Because of the similarities between the Unit 1 and 2 CFCs, cooling coil tube geometry, and return and supply manifold/supports, it is reasonable to conclude the CFC C analysis is representative of the remaining Unit 1 and Unit 2 CFCs and their supply and return manifolds.

NRC Question 9 - Page 13 of the submittal establishes commitments for completing modifications that are necessary for resolving the waterhammer issue. Provide a status update for these items.

FPL Response

- Modifications to implement Unit 1 EDG load block changes were completed during SL1-18 as committed.
- Modifications to implement Unit 2 EDG load block changes were completed during SL2-14 as committed.
- Support modifications for Unit 1 to address GL 96-06 waterhammer loading were implemented during the SL1-19 refueling outage as committed.
- Update of RAI Questions 6 and 7 responses to address final design information post SL1-19 is provided in this response.
- As previously committed, support modifications for Unit 2 to address GL 96-06 waterhammer loading will be implemented during the SL2-15 refueling outage. Design package development is underway to support this commitment. FPL will submit confirmation that all the Unit 2 GL 96-06 modifications have been completed, along with a summary description of the modifications within 30 days after the SL2-15 refueling outage.