TurkeyPointLANPEm Resource

From: Czaya, Paul [Paul.Czaya@fpl.com]
Sent: Tuesday, July 29, 2014 8:01 AM
To: Klett, Audrey
Subject: Turkey Point UHS FTP Site is Updated
Attachments: L-2014-253, Response to BOP & SCVB RAIs from 7282014 Final.pdf

Audrey:

The RAI response (attached) Bob sent to you last night is also available now on the FTP site. It's a better copy as well.

Paul Czaya
Turkey Point Nuclear Plant Licensing
305-246-7150

Hearing Identifier: TurkeyPoint_LA_NonPublic
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From: Czaya, Paul

Created By: Paul.Czaya@fpl.com

Recipients:
"Klett, Audrey" <Audrey.Klett@nrc.gov>
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L-2014-253
July 28, 2014

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

Turkey Point Units 3 and 4
Docket Nos. 50-250 and 50-251
Renewed Facility Operating License Nos. DPR-31 and DPR-41

Subject: Response to Request for Additional Information Regarding License Amendment Request No. 231, Application to Revise Ultimate Heat Sink Temperature Limit

References:

1. Florida Power & Light Company Letter L-2014-216, "License Amendment Request No. 231, Application to Revise Technical Specifications to Revise Ultimate Heat Sink Temperature Limit," July 10, 2014.
2. Florida Power & Light Company Letter L-2014-226, "License Amendment Request No. 231, Application to Revise Ultimate Heat Sink Temperature Limit – Request for Emergency Approval," July 17, 2014.
3. Florida Power & Light Company Letter L-2014-235, "License Amendment Request No. 231, Application to Revise Ultimate Heat Sink Temperature Limit – Supplement 1, and Response to Request for Additional Information" July 22, 2014.
4. Email from A. Klett (NRC) to R. Tomonto, et al. (FPL), "Turkey Point 3 and 4 Request for Additional Information – LAR 231 (TACs MF4392 and MF4393)," July 28, 2014 (SCVB RAI-4, BOP RAI-7,8).

In Reference 1, Florida Power & Light Company (FPL) requested an amendment to the Technical Specifications (TS) for the Turkey Point Nuclear Plant (Turkey Point), Units 3 and 4. The proposed amendment would revise the ultimate heat sink (UHS) water temperature limit from 100ºF to 104ºF. In Reference 2, FPL requested the U.S. Nuclear Regulatory Commission (NRC) to review and approve the application on an emergency basis.

FPL supplemented the Reference 1 application and provided responses to a related request for additional information (RAI) in Reference 3.

Florida Power & Light Company
9760 SW 344th St., Florida City, FL 33035

The enclosures to this letter provide the FPL response to Balance of Plant RAIs 7 and 8 (Enclosure 1) and Containment and Ventilation Branch RAI-4 (Enclosure 2) contained in Reference 4.

The additional information provided in the enclosure to this letter does not impact the no significant hazards determination and environmental considerations previously provided in Reference 1.

There are no new commitments made in this submission.

If you have any questions or require additional information, please contact Mr. Robert Tomonto at 305-246-7327.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on: July 28, 2014.

Very truly yours,

Michael Kiley
Vice President
Turkey Point Nuclear Plant

Enclosures 1) Response to Balance of Plant RAIs 7 and 8
2) Response to Containment and Ventilation Branch RAI-4

cc: USNRC Regional Administrator, Region II
USNRC Project Manager, Turkey Point Nuclear Plant
USNRC Senior Resident Inspector, Turkey Point Nuclear Plant
Ms. Cindy Becker, Florida Department of Health

Response to Request for Additional Information (RAI)

Balance of Plant RAIs 7 and 8

Turkey Point Units 3 and 4

License Amendment Request No. 231

Application to Revise Ultimate Heat Sink Temperature Limit

Enclosure 1

Background

By letter dated July 10, 2014, as supplemented by letters dated July 17, July 22, July 24, and July 26, 2014, Florida Power & Light Company (FPL) submitted a license amendment request for the Turkey Point Nuclear Generating Unit Nos. 3 and 4 (Turkey Point). FPL requested revisions to the Turkey Point Technical Specifications (TSs), Section 3/4.7.4, Ultimate Heat Sink."

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the information provided and determined that it needs additional information to complete the review. The NRC staff's request for additional information (RAI) is contained in Reference 1. The FPL response to Balance of Plant (BOP) RAIs 7 and 8 follows.

BOP RAI-7

The licensee's response to BOP RAI-1 states that the input to HX3/HX4 is $T_{ICW\ in}$, $T_{ICW\ out}$, $T_{CCW\ in}$, $T_{CCW\ out}$, and intake cooling water (ICW) Flow Rate.

The licensee's response also states that "The HX3/HX4 program equates the heat gain by the ICW system, the heat loss from CCW [component cooling water] and then determines the overall heat transfer coefficient, 'U', based on the surveillance heat transfer rate and logarithmic mean temperature difference. The HX3/HX4 program determines the TR [tube resistance] based on the surveillance overall heat transfer coefficient 'U', first principle equations and appropriate film coefficients."

When doing the surveillances, Q is unknown.

Equations:

1. $Q_{ICW} = (M_{ICW})\ (C_{P\ ICW})\ (T_{ICW\ out} - T_{ICW\ in})$
2. $Q_{CCW} = (M_{CCW})\ (C_{P\ CCW})\ (T_{CCW\ in} - T_{CCW\ out})$
3. $Q = U_0\ (A)\ LMTD$
4. $Q = Q_{ICW} = Q_{CCW}$

Where:
Q_{ICW} **= Heat Gain to ICW from CCW**
$C_{P\ ICW}$ **= ICW Specific Heat**
$\underline{M_{ICW}}$ **= ICW Mass Flow Rate**
$\underline{T_{ICW\ out}}$ **= ICW Outlet Temperature**
$\underline{T_{ICW\ in}}$ **= ICW Inlet Temperature**
Q_{CCW} **= Heat Loss from CCW to ICW**
M_{CCW} **= CCW Mass Flow Rate**
$\underline{C_{P\ CCW}}$ **= CCW Specific Heat**

$\underline{T_{CCW\ in}}$ = CCW Inlet Temperature
$\underline{T_{CCW\ out}}$ = CCW Outlet Temperature
U_0 = Overall Heat Transfer Coefficient
<u>A</u> = Total Tube Exterior Surface Area
<u>LMTD</u> = log mean temperature differential

Variables that are underlined are known.

Q is needed to get U_0, which is needed to get TR (tube resistance), so that one can accurately enter Figure 3.5-1 of the licensee's letter dated July 10, 2014, or the graphs of HX3/HX4. The unknowns are Q, $C_{P\ ICW}$, M_{CCW}, and U_0. Considering equations 1, 2, and 3, there are 3 equations and 4 unknowns.

A. **How does the licensee know the value of U_0?**

B. **When the licensee knows the value of U_0, how does it find TR knowing that the tube side film coefficient is affected by the algae**?

C. **How does the licensee know it has the correct TR when doing surveillances and thus is able to know that there is sufficient heat transfer capability for a design basis accident?**

Response:

The determination of the heat exchanger performance is based on the conservation of energy equations for heat transfer between the ICW and CCW systems and the performance equation for the heat exchanger. The heat gain (to the ICW System) is equal to the heat lost (from the CCW System) and is also equal to the heat transferred within the heat exchanger as described by the total surface area, A_{os}, the heat exchanger heat transfer coefficient, U_o, and the logarithmic mean temperature difference, LMTD.

QG = Heat Gain to the Tube Side from the Shell Side, BTU/hr

$$QG = W_i \cdot C_{pi} \cdot (T_{i2} - T_{i1})$$

QL = Heat Loss from the Shell Side to the Tube Side, BTU/hr

$$QL = W_o \cdot C_{po} \cdot (T_{o1} - T_{o2})$$

QO = Total Overall Heat Transfer, BTU/hr

$$QO = U_o \cdot A_{os} \cdot LMTD$$

$$QL = QG$$

$$QL = QG = QO$$

The logarithmic mean temperature difference is defined as:

$$\text{LMTD} = \frac{(T_{o1} - T_{i2}) - (T_{o2} - T_{i1})}{ln\left(\frac{T_{o1} - T_{i2}}{T_{o2} - T_{i1}}\right)} \cdot F_3$$

Therefore, there are six equations and six unknowns. If we add the tube side fouling resistance as an unknown and its associated equation for U_o, we have seven equations and seven unknowns. These parameters are T_{o1}, T_{o2}, T_{i1}, T_{i2}, W_o, W_i, and r_i. Therefore, there will be a unique solution to this system of equations for a given heat exchanger.

The ICW specific heat coefficient (C_{pi}) is found by using equations formulated from a study performed as part of the Extended Power Uprate efforts. These equations take actual salinity and bulk temperature as inputs to obtain a specific heat coefficient value by interpolation. Specific heats of freshwater (0% salinity), salt water with normal seawater salinity (3.44%), salt water with double normal salinity (6.88%), and salt water with triple normal salinity (10.32%) are used as interpolation points. Equations for the aforementioned specific heats are as follows:

Fresh Water (0% salinity)

C_{pi} = 1.362E-10$\cdot T_i^4$ - 6.797E-08$\cdot T_i^3$ + 1.272E-05$\cdot T_i^2$ - 1.023E-03$\cdot T_i$ + 1.028

Salt water with normal salinity (3.44% salinity)

C_{pi} = -2.352E-11$\cdot T_i^4$ + 7.445E-09$\cdot T_i^3$ - 7.772E-07$\cdot T_i^2$ + 7.993E-05$\cdot T_i$ + 9.522E-01

Salt water with double normal salinity (6.88% salinity)

C_{pi} = -5.654E-11$\cdot T_i^4$ + 2.160E-08$\cdot T_i^3$ - 3.393E-06$\cdot T_i^2$ + 3.636E-04$\cdot T_i$ + 9.015E-01

Salt water with triple normal salinity (10.32% salinity)

C_{pi} = -2.669E-11$\cdot T_i^4$ + 1.210E-08$\cdot T_i^3$ - 2.269E-06$\cdot T_i^2$ + 3.127E-04$\cdot T_i$ + 8.678E-01

where, T_i is the tube side ICW bulk temperature, °F.

When five of the parameters are specified, the remaining two parameters can be determined by iteration. All other parameters which describe the physical aspects of the heat exchanger and the fouling on the shell side of the heat exchanger tubes are taken as specified constants.

The five "known" parameters are the four temperatures (inlet and outlet on both sides of the heat exchanger) and the ICW mass flow rate through the tubes (recorded as a volumetric flow rate): T_{o1}, T_{o2}, T_{i1}, T_{i2}, and W_i. They are surveillance data inputs for the CCW heat exchanger fouling evaluation. Given the five specified parameters, the computer code determines the CCW flow rate on the shell side (W_o) from the heat balance, U_o from the heat transfer equation and calculates the tube internal fouling (r_i) based on the surveillance data inputs (See formulas below). In order to determine r_i, the terms r_o and r_w are constants and the other parameters are calculated using the equations below with the surveillance data.

r_i = Tube side (ICW) fouling, (hr-ft2-°F)/BTU

$$\frac{1}{U_o} = \frac{1}{h_o} + r_o + r_w + r_i \cdot \left(\frac{A_{os}}{A_{is}}\right) + \left(\frac{1}{h_i}\right) \cdot \left(\frac{A_{os}}{A_{is}}\right)$$

$$r_i = \left(\frac{1}{U_o} - \frac{1}{h_o} - r_o - r_w\right) \cdot \left(\frac{A_{is}}{A_{os}}\right) - \left(\frac{1}{h_i}\right)$$

h_o = Shell Side Film Coefficient, BTU/(hr-ft2-°F)

$$h_o = (1.01) \cdot [1 + (0.0067 \cdot T_o)] \cdot \left(\frac{{V_{max}}^{0.6}}{{D_o}^{0.4}}\right) \cdot F_1 \cdot F_2$$

h_i = Tube Side Heat Transfer Coefficient, (BTU)/(hr-ft2-°F)

$$h_i = 0.023 \frac{(V \cdot \rho_i)^{0.8} \cdot k_i^{0.6} \cdot C_{pi}^{0.4}}{D_i^{0.2} \cdot \mu_i^{0.4}}$$

Once r_i is calculated, using the formula below the TR is calculated.

TR= Tube resistance, (hr-ft2-°F)/BTU

$$TR = r_o + r_w + r_i \cdot \left(\frac{A_{os}}{A_{is}}\right)$$

During the discovery of the algae, several samples of the cooling canals were performed to determine the effect on the water properties. The only parameter that was not bounded by the current analysis was the viscosity. The viscosity affects the tube side film coefficient calculation. To compensate for the effect of the viscosity, internal tube fouling "r_i" will captured this effect based on the calculated overall heat transfer coefficient "U_o".

To assess the performance of the heat exchangers for a design condition, the design basis heat load, shell side (CCW) inlet/outlet temperatures, and the assured tube side (ICW) flow rate are assumed with the previously calculated internal tube fouling. The other parameters are Design Basis parameters consistent with and varying only slightly from the Heat Exchanger Specification Sheets for the Unit 3 and 4 heat exchangers. The tube side temperatures are calculated, specifically the maximum allowable ICW inlet temperature. This process is illustrated in Figure 1 of RAI1-B.

BOP-8:

In its response to BOP RAI-6 by letter dated July 26, 2014, the licensee stated, "The RHR [residual heat removal] Pump mechanical seals are cooled by CCW [component cooling water] through mechanical seal coolers with process fluid on the tube side and CCW water on the shell side. Per Drawing 5610-M-450-96, Sheet 1, CCW is to be available at 145ºF [degrees Fahrenheit] initially, decreasing to 125ºF in 16 hours."

The licensee also stated, "The CS [containment spray] Pump mechanical seal is cooled by CCW through a mechanical seal cooler. The maximum operating temperature for the Containment Spray Pump mechanical seal is 205ºF. Per the vendor data sheets for the mechanical seals on the Unit 4 CS pumps, 3 gpm [gallons per minute] of flow at 150ºF is needed for the CS pump seal coolers."

However, the peak CCW supply temperature to the RHR and CS pumps during a loss-of-coolant accident, double-ended pump suction (LOCA-DEPS) break approaches 160°F and stays above 150°F for several hours after the accident, according to the licensee's letter dated July 24, 2014. The CCW supply temperature appears to be too high to meet the vendor-specified cooling requirements for these pumps. Discuss how the RHR and CS pumps will have adequate cooling to run continuously in order to perform their design basis function during a design basis accident.

Response:

The Turkey Point Containment Spray Pump (CSP) mechanical seal is cooled by a seal cooler which in turn is cooled by Component Cooling Water (CCW). Per WCAP 12263, Section 4.1.2, an evaluation was performed by the seal manufacturer (John Crane) with 300◦F seal cavity temperature and no seal cooling. The tests resulted in insignificant wear to the seals and demonstrated that the seals could perform their required post-accident safety function with 300◦F seal cavity temperature. It was determined that the Containment Spray Pump post-accident conditions would have negligible effect on the Containment Spray Pump mechanical Seal Life. The peak containment sump temperatures to the RHR heat exchangers, which is CSP process fluid, was calculated for EPU to be 237.8◦F. The actual CSP process fluid is expected to be closer to 200◦F, assuming cooling from the RHR heat exchangers but the 237.8◦F assumes no cooling from these exchangers and is therefore conservative.

For the Residual Heat Removal (RHR) Seal coolers, the OEM vendor (Flowserve) provided analysis in Evaluation SR-1300 for post-accident recirculation operation of the RHR seal. The temperatures for the evaluation were: process temperature 260◦F, CCW minimum flow 5.6 gpm, CCW temperature 165 F. The evaluation result showed a maximum RHR seal chamber temperature of 189.8 F, which is noted as below the operating limit (200F, 24 hours) and at post 24 hour CCW flow at 135F, the mechanical seal will not experience problems. Note that per operating procedures ¾-NOP-030, the minimum CCW flow to the RHR seal coolers is 8.5 gpm.

References

1. Email from A. Klett (NRC) to R. Tomonto, et al. (FPL), "Turkey Point 3 and 4 Request for Additional Information – LAR 231 (TACs MF4392 and MF4393)," July 28, 2014 (SCVB RAI-4, BOP-7 and 8).

Response to Request for Additional Information (RAI)

Containment and Ventilation Branch RAI-4

Turkey Point Units 3 and 4

License Amendment Request No. 231

Application to Revise Ultimate Heat Sink Temperature Limit

Enclosure 2

Background

By letter dated July 10, 2014, as supplemented by letters dated July 17, July 22, July 24, and July 26, 2014, Florida Power & Light Company (FPL) submitted a license amendment request for the Turkey Point Nuclear Generating Unit Nos. 3 and 4 (Turkey Point). FPL requested revisions to the Turkey Point Technical Specifications (TSs), Section 3/4.7.4, Ultimate Heat Sink."

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the information provided and determined that it needs additional information to complete the review. The NRC staff's request for additional information (RAI) is contained in Reference 1. The FPL response to Containment and Ventilation Branch (SCVB) RAI-4 follows.

SCVB RAI-4

Please describe the changes that will be included in the UFSAR related to the license amendment request (e.g., regarding maintaining the component cooling water heat exchangers so that they are ready and capable of functioning as intended during normal and accident conditions).

Response

A note will be added to UFSAR Table 14.3.4.3-1, "Containments Analysis Parameters" to clarify the continued applicability of the containment integrity accident analysis for ICW temperatures higher than 100 ^{0}F. The following note is proposed to be added to UFSAR Table 14.3.4.3-1.

> "Note: The ICW temperature of 100 ^{0}F assumed in the containment integrity accident analysis can be exceeded up to the Technical Specification limit of 104 ^{0}F if heat exchanger performance monitoring demonstrates the ability to remove postulated post-accident heat loads at the elevated ICW temperature. Maintaining the same heat removal capability with a higher ICW temperature assures that the containment integrity accident analysis described in the UFSAR remains valid."

UFSAR Sections 9.3 and 9.6 discuss maintaining the heat removal capability of the CCW system during normal and accident conditions. Furthermore, the surveillance requirements of Technical Specification 4.7.2 assure that the heat removal capability of the CCW system is maintained such that it remains ready and capable of functioning as intended to remove the design basis heat loads during normal and accident conditions.

Reference: 1. Email from A. Klett (NRC) to R. Tomonto, et al. (FPL), "Turkey Point 3 and 4 Request for Additional Information – LAR 231 (TACs MF4392 and MF4393)," July 28, 2014 (SCVB RAI-4 and BOP RAI-7 and 8).