Dear FOIA Requester:

The FOIA Improvement Act of 2016, which was enacted on June 30, 2016, made several changes to the Freedom of Information Act (FOIA). Federal agencies must revise their FOIA regulations to reflect those changes by December 27, 2016. In addition to revising our regulations, we intend to update the Form 464, which we use to respond to FOIA requests.

In the interim, please see the comment box in Part I.C of the attached Form 464. The comment box includes information related to the recent changes to FOIA that is applicable to your FOIA request, including an updated time period for filing an administrative appeal with the NRC.

Sincerely yours,

Stephanie Blaney /S/

Stephanie Blaney
FOIA Officer (Acting)

NRC FORM 464 Part I (12-2015)

U.S. NUCLEAR REGULATORY COMMISSION

RESPONSE TO FREEDOM OF INFORMATION ACT (FOIA) REQUEST

FOIA	RESPONSE NUMBER
2016-0623	1

RESPONSE TYPE: ☐ INTERIM ☑ FINAL

REQUESTER: Andrew DeSalvo

DATE: 09/15/2016

DESCRIPTION OF REQUESTED RECORDS:

Design control measures Intake Cooling Water (ICW), Component Cooling Water (CCW), the Cooling Canal System (CCS) Turkey Point Units 3 and 4; Allegation Report RII-2016-A-0014

PART I. -- INFORMATION RELEASED

- ☑ Agency records subject to the request are already available in public ADAMS or on microfiche in the NRC Public Document Room.
- ☑ Agency records subject to the request are enclosed.
- ☐ Records subject to the request that contain information originated by or of interest to another Federal agency have been referred to that agency (see comments section) for a disclosure determination and direct response to you.
- ☐ We are continuing to process your request.
- ☑ See Comments.

PART I.A -- FEES

AMOUNT* $

*See Comments for details

- ☐ You will be billed by NRC for the amount listed.
- ☐ You will receive a refund for the amount listed.
- ☑ None. Minimum fee threshold not met.
- ☐ Fees waived.

PART I.B -- INFORMATION NOT LOCATED OR WITHHELD FROM DISCLOSURE

- ☐ We did not locate any agency records responsive to your request. *Note*: Agencies may treat three discrete categories of law enforcement and national security records as not subject to the FOIA ("exclusions"). 5 U.S.C. 552(c). This is a standard notification given to all requesters; it should not be taken to mean that any excluded records do, or do not, exist.
- ☐ We have withheld certain information pursuant to the FOIA exemptions described, and for the reasons stated, in Part II.
- ☐ Because this is an interim response to your request, you may not appeal at this time. We will notify you of your right to appeal any of the responses we have issued in response to your request when we issue our final determination.
- ☐ You may appeal this final determination within 30 calendar days of the date of this response by sending a letter or email to the FOIA Officer, at U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or FOIA.Resource@nrc.gov. Please be sure to include on your letter or email that it is a "FOIA Appeal."

PART I.C COMMENTS (Use attached Comments continuation page if required)

In conformance with the FOIA Improvement Act of 2016, the NRC is informing you that you have the right to seek assistance from the NRC's FOIA Public Liaison.

One responsive record to your request is attached. An additional record is already publicly available (ADAMS accession number: ML12279A246).

(continued on next page)

SIGNATURE - FREEDOM OF INFORMATION ACT OFFICER

for Stephanie Blaney, Acting [signature]

U.S. NUCLEAR REGULATORY COMMISSION

RESPONSE TO FREEDOM OF INFORMATION ACT (FOIA) REQUEST Continued

FOIA	RESPONSE NUMBER
2016-0623	1

RESPONSE TYPE: ☐ INTERIM ☑ FINAL

REQUESTER:	DATE:
Andrew DeSalvo	09/15/2016

PART I.C COMMENTS (Continued)

The incoming FOIA request will be available in ADAMS at ML16208A010. Records with an ML accession number are available in the NRC Library at www.nrc.gov/reading-rm/adams.html. For assistance in obtaining any public records, please contact the NRC's Public Document Room (PDR) at 1-800-397-4209 or by email at PDR.Resource@nrc.gov.

CR Title: 2012 NRC PI&R : CCW HX PERFORMANCE MONITORING PROGRAM INPUT

NOTE: To ensure a complete POD, each of the following items shall be addressed to a level of detail commensurate with the affected SSC safety significance.

1. Describe affected SSC (System #/ Comp #, etc.):

Component Cooling Water (CCW) System and Ultimate Heat Sink (Cooling Canal System (CCS)).

2. Describe degraded or nonconforming condition:

During 2012 NRC PI&R, several discrepancies have been identified in the current usage of the CCW HX performance monitoring program HX3R1/HX4R1. The discrepancies have been resolved for post-EPU conditions via HX3R2/HX4R2 and therefore are not applicable any more to Unit 3. The identified discrepancies include:

1. Procedure 4-OSP-030.4 instructs the user to input a minimum assured Intake Cooling Water (ICW) flow rate of 7,700 gpm, which correlates to 15,400 gpm total to two CCW heat exchangers. Per calculation PTN-4FSM-04-003 Rev 2 (pre-EPU), the worst-case total post-accident ICW flow rate delivered to CCW heat exchangers is 15,211 gpm (7,600 gpm per heat exchanger). The effect of this discrepancy is to reduce maximum allowed canal temperature by ~0.1% per HX4R1 data runs.

2. HX4R1 uses nominal seawater salinity of 3.44% (calculation PTN-BFJM-96-004 Rev 2), but the actual intake canal water salinity varies seasonally, but up to as high as 7.11%. The effect of this discrepancy is to reduce maximum allowed canal temperature by ~1.4% based on sensitivity runs in PTN-BFJM-96-004 Rev 2.

3. HX4R1 utilizes a tube-side heat transfer film coefficient correlation that is applicable to fresh water, instead of saline ICW water. This difference has no effect on the results of the program because any differences will be accounted for in the calculation of the tube side fouling factor, which is determined from real test data.

CCW Heat Exchanger Monitoring Program Background

HX3 and HX4

The CCW Heat Exchanger Monitoring program HX3 and HX4 were issued under calculation M12-183-010 Revision 0, "HX3 and HX4 Computer Code Verification" and calculation PTN-BFJM-96-004 Revision 0, "HX3 and HX4 Computer Code Verification". The HX3R1 and HX4R1 computer programs were developed to permit onsite testing and evaluation of the Turkey Point Unit 3 and 4 CCW Heat Exchangers. The performance parameters of flow rate and fluid inlet and outlet temperatures are evaluated to determine if the CCW heat exchangers can remove the design basis accident heat load.

HX3R1 and HX4R1

During the Thermal Power Uprate Project, which increased the net thermal and electrical power output for each Unit (Turkey Point Unit 3 and Unit 4), Westinghouse performed a reanalysis of the

FSAR Accident analyses and revised the heat transfer design requirements for the Turkey Point CCW Heat Exchangers (SE/SS-FPL-2144, Turkey Point Units 3 and 4 Revised CCWS Hx Operating Conditions, Rev. 1). The design heat transfer as noted in HX3 and HX4 as 60,031,888.86 BTU/hr and 60,432,236.25 BTU/hr, respectively, was reduced to approximately 47,644,620 BTU/hr in accordance with Westinghouse's calculation. Additionally, the default shell side outlet temperature of 124.92874 °F in HX3 and 124.694816 °F in HX4 were increased to approximately 132.1335 °F. Revision 1 of the HX3 and HX4 (HX3R1 and HX4R1) CCW Heat Exchanger Monitoring Program was issued to incorporate the above described changes among the following:

1. ICW Outlet Temperature reduced from 110.429189 °F to 106.9605 °F.
2. Orifice Pressure Drop increased from 101.6073 inches H2O to 106.453 inches H2O.
3. Assured ICW Flow Rate increased from 7863.0029 gpm to 8048.3 gpm.

HX3R1/HX4R1 Theory

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 CCW system) and is also equal to the heat transferred within the heart 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.

$$QG = W_i \cdot C_{pi} \cdot (T_{i2} - T_{i1}), \text{ (BTU/hr)}$$
$$QL = W_o \cdot C_{po} \cdot (T_{o2} - T_{o1}), \text{ (BTU/hr)}$$
$$QO = U_o \cdot A_{os} \cdot LMTD, \text{ (BTU/hr)}$$
$$QG = QL = QO$$

$$LMTD = \frac{(T_{o1} - T_{i2}) - (T_{o2} - T_{i1})}{\ln\left(\frac{T_{o1} - T_{i2}}{T_{o2} - T_{i1}}\right)}, \text{ (°F)}$$

Where:

- QG = Heat Gain to the tube (ICW) Side from the Shell (CCW) Side, BTU/hr
- QL = Heat Loss from the Shell (CCW) Side to the Tube Side (ICW), BTU/hr
- QO = Total Overall Heat Transfer, BTU/hr
- $LMTD$ = Logarithmic Mean Temperature Difference, °F
- T_{i1} = ICW Inlet Temperature, °F
- T_{i2} = ICW Outlet Temperature, °F
- W_i = ICW/Tube Flow Rate, gpm
- W_o = CCW/Shell Flow Rate, gpm
- T_{o1} = CCW Inlet Temperature, °F
- T_{o2} = CCW Outlet Temperature, °F

- C_{pi} = ICW Fluid Specific Heat , BTU/lbm-°F
- C_{po} = CCW Fluid Specific Heat , BTU/lbm-°F
- U_o = Overall Heat Transfer Coefficient, BTU/ft^2-°F-hr
- A_{os} = Total Surface Area, ft^2

Therefore, there are six equations in six unknowns. When the internal tube resistance is added as an unknown and its associated equation U_o, there results seven equations in seven unknowns. These parameters 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.

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

Where:

- h_o = Shell Side Film Coefficient, BTU/ hr-ft^2-°F

  $$h_o = 1.01 \cdot (1 + 0.0067 \cdot T_o) \cdot \left(\frac{V_{\max}^{0.6}}{D_o^{0.4}}\right) \cdot F_1 \cdot F_2$$
- r_o = Shell Side Fouling Resistance, ft^2-°F-hr/BTU

  r_o = Design Specification
- r_w = Outside Tube Wall Resistance, ft^2-°F-hr/BTU

  $$r_w = \left(\frac{d_o}{24 \cdot k}\right) \cdot \ln\left(\frac{d_o}{d_o - 2 \cdot t}\right)$$
  - d_o =
  - k = Tube Wall Thermal Conductivity. BTU-ft/hr-ft^2-°F
  - t = Tube Wall Thickness, in
- r_i = Tube Side Fouling Resistance, ft^2-°F-hr/BTU (Iterated Value)
- h_I = Tube Side Film Coefficient, BTU/ hr-ft^2-°F

  $$h_I = 0.13 \cdot (1 + 0.11 \cdot T_i) \cdot \left(\frac{V^{0.8}}{D_i^{0.2}}\right)$$
- A_{os} = Total Tube Exterior Surface Area, ft^2
- A_{is} = Total Tube Interior Surface Area, ft^2

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 flow rate through the tubes (recorded as a pressure drop across a flow orifice): T_{o1}, T_{o2}, T_{I1}, T_{I2}, and W_I. Given the five specified parameters, the computer code determines the CCW flow rate on the shell side (W_o) from the heat balance and iterates until a value for the tube internal fouling (r_i) results in a converging solution.

Since the internal fouling (r_i) is calculated from actual performance data this value not only represents the internal fouling its also compensate for any other term not accounted (or partially accounted) for in the overall heat transfer coefficient or (i.e. difference between tube-side heat transfer film coefficient correlations).

To assess the performance of the heat exchangers for a design basis accident, the design basis heat load (47,644,620 BTU/hr), shell side (CCW) temperatures (T_{01}=160°F and T_{02}=132.1335 °F), and the shell side (CCW) flow rate (1,710,000 lbm/hr) are assumed with the previously calculated internal tube fouling. The tube side (ICW) flow rate through the heat exchangers is a user specified parameter. The other parameters are design basis parameters consistent with and varying only slightly from the Heat Exchanger Specification Sheets for the Unit 3 heat exchangers. The tube side (ICW side) temperatures are calculated and specifically, the maximum allowable ICW inlet temperature. The only physical parameter of the heat exchangers which can be modified in the computer analysis is the number of tubes plugged, which will affect both the flow velocity through the tubes and the total available heat transfer surface area.

Since the design basis heat load used is a fixed parameter the temperatures inside containment will not change, only the intake temperatures will change in order to accommodate the fixed heat load from the containment.

HX3R1A and HX4R1A

AR 484935 addressed that Westinghouse discovered significant errors in the Containment Integrity Analysis, which ended up increasing the total heat load in containment during accident conditions. A Prompt Operability Determination (POD) was issued to address the input error in the LOCA containment AOR as it relates to continued compliance with containment design pressure and P_a, maximum CCW temperature, and the EQ containment temperature profile. As a compensatory action to maintain the operability of the CCW system, the requirement for ICW temperature of 95 °F concurrent with a CCW heat exchanger tube resistance value of 0.0025 hr-ft^2-°F/BTU for the best pair of CCW heat exchanger during plant operation in Mode 1 was established.

Along with Revision 1 of the POD associated with AR 484935, a new version of the HX3R1 and HX4R1 software were issued, which were called HX3R1A and HX4R1A. The purpose of the software revision was to allow the containment heat load be a user input in order to account for the errors found by Westinghouse.

HX3R1A/HX4R1A were used to calculate the maximum allowable ICW temperatures. However, Westinghouse subsequently issued Westinghouse Letter FPL-09-174 (Turkey Point Units 3 and 4 – Containment Integrity Current Analysis of Record JPO/JCO Regarding Containment Heat Sink Errors in the COCO Model, dated May 26, 2009) supplement to Westinghouse Letter FPL-08-96 (Revision, dated November 23, 2008, Error In Current Analysis of Record for Containment Integrity – Justification for Past/Continued Operation) report which re-evaluated the CCW temperatures using additional credits obtained from the re-calculation of the containment heat sinks and inclusion of the injected Refueling Water Storage Tank (RWST) water volume during a LOCA. The added benefits from these credits provided the margin necessary to allow for the relaxation of the CCW heat exchanger performance requirement. Therefore, HX3R1A and HX4R1A were used during the period between 10/29/2008 and 6/11/2009 (approximately 8 months). The table below has the data from the performance test performed for Unit 4 using the HX3R1A and HX4R1A software.

Date	A/B (°F)	B/C (°F)	A/C (°F)	Best Pair (°F)	Worst Pair (°F)	Intake Temp (°F)	Margin (°F)	Comments
10/31/2008	105.21	107.69	104.95	107.69	104.95	72.98	31.97	Margin higher than the administrative required (3 °F)
3/17/2009	108.15	102.29	109.99	109.99	102.29	83.25	19.04	Margin higher than the administrative required (3 °F)
4/7/2009	112.51	106.49	105.87	112.51	105.87	81.62	24.25	Margin higher than the administrative required (3 °F)
4/29/2009	111.22	99.90	103.35	111.22	99.90	80.02	19.88	Margin higher than the administrative required (3 °F)
5/10/2009	107.10	88.30	96.40	107.10	88.30	89.75	-1.45	C' heat exchanger declared out of service actual margin was 17.35 °F (107.1 °F-89.75 °F), which is higher than the administrative margin (3°F). See Attachment 3.
5/11/2009	108.10	103.80	111.50	111.50	103.80	89.81	13.99	Margin higher than the administrative required (3 °F)
5/26/2009	112.40	109.20	109.10	112.40	109.10	85.93	23.17	Margin higher than the administrative required (3 °F)
6/11/2009	111.79	102.27	108.71	111.79	102.27	93.73	8.54	Margin higher than the administrative required (3 °F)

HX3R2 and HX4R2

As part of the Extended Power Uprate (EPU) calculations M12-183-010, "HX3 and HX4 Computer Code Verification" and PTN-BFJM-96-004, "HX3 and HX4 Computer Code Verification" need to be revised to account for post-EPU conditions. Unit 3 has undergone EPU and as part of the EPU effort all the documents associated with the heat exchanger performance software has been updated. All the discrepancies identified under AR 1789995 have been addressed and a new version of the heat exchanger performance software has been issued. Therefore, this issue does not affect Unit 3.

3. Identify Current Licensing Basis function(s) and performance requirements, including Technical Specifications, FSAR, EOPs, NRC Commitments, or other appropriate information:

Technical Specifications (TS)

- 3/4.7.2 COMPONENT COOLING WATER SYSTEM

3.7.2 The Component Cooling Water System (CCW) shall be OPERABLE with:

a. Three CCW pumps, and
b. Two CCW heat exchangers.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTION:

a. With only two CCW pumps with independent power supplies OPERABLE, restore the inoperable CCW pump to OPERABLE status within 30 days or be in HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours. The provisions of Specification 3.0.4 are not applicable.

b. With only one CCW pump OPERABLE or with two CCW pumps OPERABLE but not from independent power supplies, restore two pumps from independent power supplies to OPERABLE status within 72 hours or be in HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

c. With less than two CCW heat exchangers OPERABLE, restore two heat exchangers to OPERABLE status within 1 hour or be in HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

- 3/4.7.3 INTAKE COOLING WATER SYSTEM

3.7.3 The Intake Cooling Water System (ICW) shall be OPERABLE with:

a. Three ICW pumps, and
b. Two ICW headers.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTION:

a. With only two ICW pumps with independent power supplies OPERABLE, restore the inoperable ICW pump to OPERABLE status within 14 days or be in HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours. The provisions of Specification 3.0.4 are not applicable.

b. With only one ICW pump OPERABLE or with two ICW pumps OPERABLE but not from independent power supplies, restore two pumps from independent power supplies to OPERABLE status within 72 hours or be in HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

c. With only one ICW header OPERABLE, restore two headers to OPERABLE status within 72 hours or be in HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

- 3/4.7.4 ULTIMATE HEAT SINK

3.7.4 The ultimate heat sink shall be OPERABLE with an average supply water temperature less than or equal to 100 °F.

APPLICABILITY: MODES 1. 2, 3. and 4.

ACTION:

With the requirements of the above specification not satisfied, be in at least HOT STANDBY within 12 hours and In COLD SHUTDOWN within the following 30 hours. This ACTION shall be applicable to both units simultaneously.

Note:

Per 4-ADM-536, Technical Specification Bases Control Program

The limit on Ultimate Heat Sink (UHS) temperature in conjunction with the SURVEILLANCE REQUIREMENTS of Technical Specification 3/4.7.2 will ensure that sufficient cooling capacity is available either:

(1) To provide normal cooldown of the facility, or
(2) To mitigate the effects of accident conditions within acceptable limits.

FPL has the option of monitoring the UHS temperature by monitoring the temperature in the ICW system piping going to the inlet of the CCW Heat Exchangers. Monitoring the UHS temperature after the ICW Pumps but prior to CCW Heat Exchangers is considered to be equivalent to temperature monitoring before the ICW Pumps. The supply water leaving the ICW Pumps will be mixed and therefore, it will be representative of the bulk UHS temperature to the CCW Heat Exchanger inlet. The effects of the pump heating on the supply water are negligible due to low ICW head and high water volume. Accordingly, monitoring the UHS temperature after the ICW Pumps but prior to the CCW Heat Exchangers provides an equivalent location for monitoring the UHS temperature. With the implementation of the CCW Heat Exchanger Performance Monitoring Program, the limiting UHS temperature can be treated as a variable with an absolute upper limit of 100°F without compromising any margin of safety. Demonstration of actual heat exchanger performance capability supports system operation with postulated canal temperatures greater than 100°F. Therefore, an upper Technical Specification limit of 100°F is conservative.

Updated Final Safety Analysis Report(UFSAR)

CHAPTER 9

- 9.3.2 SYSTEM DESIGN AND OPERATION

  Component Cooling Loop provides cooling for the following heat sources:

  a. Residual heat exchangers (Auxiliary Coolant System, ACS)
  b. Reactor coolant pumps (Reactor Coolant System)
  c. Non regenerative heat exchanger (Chemical and Volume Control System, CVCS)
  d. Excess letdown heat exchanger (CVCS)
  e. Seal water heat exchanger (CVCS)
  f. Sample heat exchangers (Sampling System)
  g. Waste gas compressors (Waste Disposal System)
  h. Residual heat removal pumps (ACS)
  i. Safety injection pumps (Safety Injection System, SIS)
  j. Containment spray pumps
  k. Spent fuel pit heater exchanger (ACS)
  l. Charging pump (CVCS)
  m. Normal containment coolers
  n. Control rod drive coolers
  o. Emergency containment coolers

p. Post Accident Sampling System (PASS)

Design Bases

The design basis of the Component Cooling Water System is to provide sufficient heat removal from the Engineered Safety Features to the ultimate heat sink (ICW System), post accident. The system, which is normally operated in an open configuration, is designed with sufficient capability to accommodate the failure of any single, active component without resulting in undue risk to the health and safety of the public following a Maximum Hypothetical Accident (MHA). The most limiting single active failure considered was the loss of one diesel, which results in only one CCW pump starting automatically to mitigate the consequences of the MHA. This assumed single failure also results in the loss of a complete train of engineered safety features, including the inability to open the CCW isolation valve associated with one RHR heat exchanger and one Emergency Containment Cooler (ECC). Although a complete train of engineered safety feature components will be inoperable on loss of a diesel, CCW flow to these components will continue, except as noted above in the case of an RHR heat exchanger and one ECC. In support of the Thermal Uprate Project, detailed CCW System thermal analyses

CHAPTER 14

- 14.3.4.3.2 INPUT PARAMETERS AND ASSUMPTIONS

An analysis of containment response to the rupture of the RCS or main steamline must start with knowledge of the initial conditions in the containment. The pressure, temperature, and humidity of the containment atmosphere prior to the postulated accident are specified in the analysis. Also, values for the initial temperature of the component cooling water (CCW) and temperature of the intake cooling water (ICW) and refueling water storage tank (RWST) solution are assumed, along with the initial water inventory of the RWST. All of these values are chosen conservatively, as shown in Table 14.3.4.3-1.

TABLE 14.3.4.3-1
CONTAINMENT ANALYSIS PARAMETERS
ICW temperature (°F)[Containment Integrity] 100
Refueling water temperature (°F) 105
RWST minimum water deliverable volume (gal) 2.399×10^5
Initial containment temperature (°F) 130
Initial containment pressure (psia) 15.0
Initial relative humidity (%) 20
Net free volume (ft^3) 1.55×10^6

- 14.3.4.3.2.2 ACTIVE HEAT REMOVAL

The emergency containment coolers (ECCs) are a final means of heat removal. The ECCs consist of the fan and the banks of cooling coils. The fans draw the dense post-accident atmosphere through banks of cooling coils and mix the cooled steam/air mixture with the rest of the containment atmosphere. The coils are kept at a low temperature by a constant flow of component cooling water (CCW). Since this system does not use water from the RWST, the mode of operation remains the same both before and after the spray system and emergency core cooling system change to the recirculation mode. However, CCW is also used to cool the RHR heat exchanger(s) during recirculation. This will adversely affect fan cooler performance due to increased CCW temperatures and lower CCW flowrates to the fan coolers. See Table 14.3.4.3-5 for ECC heat removal capability for the design basis containment integrity analyses.

4. Identify the established minimum design basis values necessary to satisfy the SSC design basis safety and quality function(s):

DBD 5610-030-DB-002, Component Cooling Water (CCW) System Design Basis Document

CCW Heat Exchanger

Safety-Related Functions

1. Shall transfer the total CCW System heat load to the ICW System during both the injection and recirculation phases of a LOCA to support containment and reactor heat removal requirements.

2. Shall transfer the total CCW System heat load to the ICW System to support safe shutdown (hot standby with RCS > 540F).

3. Shall passively maintain CCW System pressure boundary integrity.

Quality-Related Functions

1. Shall transfer the heat load imposed by the Spent Fuel Pit Cooling System and equipment required to operate during refueling operations to support core decay heat removal requirements.

2. Shall transfer the heat load imposed by the Normal Containment Coolers to maintain the containment temperature below the Technical Specification limit of 120 F.

3. Shall transfer the total CCW System heat load to the ICW System at a rate to ensure that the maximum allowable CCW supply temperature shall not be exceeded.

4. Shall maintain a barrier to prevent leakage of potentially radioactive CCW fluid into the ICW system.

5. Shall maintain a barrier to prevent leakage of potentially corrosive ICW fluid into the CCW System.

KEY ATTRIBUTE VALUE

1. Design Heat Transfer Load	60 MBtu/hr (nom)
2. ICW Inlet Temperature	Variable
3. ICW Flow	Variable
4. Tube Thermal Resistance (Fouling)	Variable
5. Heat Transfer Area (A)	Variable
6. CCW Flow	1.7 Mpph (nom)
7. CCW Outlet Temperature	125 °F (nom)
8. Design Pressure	150 psig (nom)
9. Design Temperature	200 °F (nom)

10. CCW Flow - Maximum acceptable to limit tube vibration and erosion

Unit 3
4,063 gpm (continuous)
6,840 gpm (normal evol)
7,200 gpm (31 day)
7,500 gpm (initial SI)

Unit 4
6,756 gpm (continuous)
8,000 gpm (normal evol)
11,900 gpm (31 day)

11. Design Code ASME VIII Class C 1965, Winter 66 Ad. TEMA Class R

DBD 5610-019-DB-002, Intake Cooling Water (ICW) System Design Basis Document

CCW Heat Exchanger

Safety-Related Functions

1. Shall transfer the total CCW system heat load to the ICW system during both the injection and recirculation phases of a LOCA to support containment and reactor heat removal requirements.

2. Shall transfer the total CCW system heat load to the ICW system at a rate to ensure that the maximum allowable CCW supply temperature shall not be exceeded.

3. Shall transfer the total CCW system heat load to the ICW system to support safe shutdown.

4. Shall passively maintain the CCW system pressure boundary integrity.

Quality-Related Functions

1. Shall transfer heat from the spent fuel pit cooling system and equipment required to operate during refueling operations to support core decay heat removal requirements.

2. Shall transfer the heat load imposed by the normal containment coolers to maintain the containment temperature below the Technical Specification limit of 120 °F.

3. Shall maintain a barrier to prevent leakage of potentially radioactive CCW fluid into the ICW system.

4. Shall maintain a barrier to prevent leakage of potentially corrosive ICW fluid into the CCW system.

KEY ATTRIBUTE VALUE

1. Type Shell and Straight Tube

2. Code	ASME Section VIII 5.3.1 TEMA R
3. Design Pressure (tube side)	75 psig
4. Design Temperature (tube side)	150 °F
5. Maximum Recommended Tube Velocity	7 feet/sec
6. Design Parameters	
Heat transfer required	60 x 106 Btu/hr(1)
CCW Outlet Temperature	125 °F (maximum)
CCW flow (Shell side)	
Unit 3	6,840 gpm
Unit 4	8,000 gpm
ICW Inlet Temperature	100 °F (maximum)
ICW Flow (Tube side)	8,000 gpm (nominal)
Heat Transfer Area	5,100 ft2
Number of heat exchangers required :	
Normal Operation	2
Post Accident Operation	2
Shutdown Cooling	3

5. Evaluate effects of condition, including potential failure modes, on the ability of the SSC to perform its specified TS, or safety support, function(s). The following items shall be covered in the Evaluation:

   A. Identify the Mode or other specified conditions of Operability when the specified TS function(s) for the affected SSCs are required;

      The affected LCOs are applicable in Mode 1 – 4. Therefore, plant operation in Modes 1, 2, 3 and 4 is affected by the identified discrepancies in HX4R1.

   B. Identify assumptions used;

      1. Maximum canal salinity throughout the year is 7.11%.

         As part of the 5th Supplemental Agreement between FPL, South Florida Water Management District (SFWMD), Dade County's Department of Regulatory and Economic Resources (RER; formerly Department of Environmental Resources Management (DERM)), and Florida Department of Environmental Protection (FDEP) the FPL Environmental Monitoring Plan collects data from the Cooling Canal System (CCS) groundwater and surface water (See Attachment 1 – FPL Correspondence, Salinity Data and Excerpt form Environmental Monitoring Plan).

         The FPL Environmental Monitoring Plan is conducted in order to satisfy the objectives of the 1983 Agreement and the 5th supplemental. The Monitoring Plan shall provide information to determine the vertical and horizontal effects and extent of the cooling canal system (CCS) water on existing and projected surface and groundwater, and ecological conditions surrounding Turkey Point.

         There are three sources for Cooling Canal System (CCS) salinity data, these are:

- FPL Environmental Monitoring Plan – Cooling Canal System automated real-time data (from 09/2010 to 01/2012) collection from groundwater and surface water stations. Summary of results (from the attached graphs in Attachment 1):

	Cooling Canal Salinity	
Sample Station	Min (%)	Max (%)
TPSWCCS-1	3.8	6.5
TPSWCCS-2	4.5	6.2
TPSWCCS-3	3.6	6.6
TPSWCCS-4	3.6	6.8
TPSWCCS-5	3.9	6.5
TPSWCCS-6*	3.9*	6.4*
TPSWCCS-7	3.0	6.1

*Cooling Canal System (CCS) sample location closest to the Intake Cooling Water (ICW) System suction.

- Site Certification Application Turkey Point Uprate Project – Cooling Canal System data (from 09/2000 to 09/2002, one data point per month) downloaded from the United States Environmental Protection Agency (EPA).

Cooling Canal Salinity	
Min (%)	Max (%)
4.2	5.9

- AREVA Cooling Canal System Sample Analyses – Cooling Canal System samples (two (2) sample were taken, 4/2009 & 08/2009) analysis.

Cooling Canal Salinity	
4/09 Sample (%)	8/09 Sample (%)
7.11	6.02

After a review and comparison of the available data, there is only one occasion when the CCS salinity was documented at 7.11%. The automated real-time data collected under the FPL Environmental Monitoring Plan and the data provided in the CCS Modeling Report, which have salinity data for the periods between 09/00 to 09/02 and 09/10 to 01/12, show that the maximum salinity documented was approximately 6.8%. However, for conservatism, the maximum CCS salinity that will be used to determine operability, past operability and for post-EPU conditions will be 7.11%, which was an isolated sample taken during 2009 and analyzed by AREVA. This value is determined to be conservative since salinity data taken after and before the 04/09 sample show that the CCS salinity ranges approximately from 4%-6.5%.

C. Discuss why the degraded or nonconforming condition does or does not prevent the SSC from performing its specified TS function(s). (Include known information that supports the specific evaluation, any adverse impact about the condition, or related analysis);

Identified discrepancies in HX4R1:

- Tube-side heat transfer film coefficient Correlation – The film coefficient for the tube (ICW) side calculated in HX4R1 used a correlation which is for pure water and does not take into account the fluid properties of sea water. However, this discrepancy is accounted for in the calculation of fouling factor, which is then used in the determination of maximum allowable canal temperature. Therefore, this discrepancy does not affect the results of HX4R1.
- Salinity – The properties of the ICW side fluid used in HX4R1 are based on seawater with a salinity of 3.44%. However, analyzed samples of the Turkey Point cooling canal show that the salinity of the canal/ICW water is up to 7.1% (See AREVA letter #AREVA-09-01876).
- ICW flow – The ICW assured flow used in HX4R1 is 7,700 gpm (per heat exchanger, for a total of 15,400 gpm for 2 heat exchangers). However, calculation PTN-4FSM-04-003 Rev 2 (pre-EPU) results show that the minimum value during accident conditions could be as low as 15,211 gpm.

These discrepancies could potentially affect the current guidelines used to track the cleaning frequency of the CCW heat exchangers. These discrepancies are only applicable to Unit 4 since as part of the EPU efforts the HX3R1 has been revised for post-EPU conditions and all the above identified discrepancies have been addressed. The heat exchanger performance programs HX3R1 and HX4R1 have been revised and merged together for post-EPU conditions. The revised software, which is now named HX3R2/HX4R2, could be used for Unit 4 to determine impact of this salinity since it has all the discrepancies resolved. However, since the software was revised for post EPU conditions, it considers higher post accident heat loads, which are not yet applicable to Unit 4 and can not be used for heat exchanger performance monitoring.

The minimum ICW assured flow discrepancy can be evaluated using the HX4R1 software, since the minimum assured flow is a user input. A set of data from a previously performed performance test can be used to compare the results (maximum ICW allowable temperatures) and estimate the percentage difference due to the assured ICW flow discrepancy. Using the performance test data of 2/6/2012 and running HX4R1 at 2 different ICW assured flow rates (7,700 gpm Vs. 7,600 gpm) the estimated temperature percentage difference was obtained (see table below).

ICW Temperature Percentage Difference	
ICW Assured Flow (gpm)	Max Temp (°F)
7700	115.122
7600	114.969
% Difference	0.13%

The maximum ICW inlet temperature percentage difference for an assured ICW flow rate of 7,600 gpm would be approximately 0.13% difference.

The salinity discrepancy effect can be estimated using the revised calculation (PTN-BFJM-96-004 Rev 2) which uses HX3/HX4 R2 to develop the newer CCW Heat Exchanger Operability Curves. The curves provide the limiting ICW inlet temperatures for different salinity percentages depending on the assured ICW accident flow rate and tube resistance.

The following table define the limiting ICW inlet temperature for seawater salinity (3.44%), various assured accident flows and various tube resistances.

3.44% ICW Salinity						
Tube Resistance (hr-ft2-°F/Btu)	Assured Accident ICW Flow Rate (gpm)					
	4000	5000	6000	7000	8000	9000
0.0008	106.48	113.64	118.36	121.69	124.18	126.11
0.0012	100.89	108.09	112.84	116.21	118.72	120.67
0.0016	95.24	102.51	107.3	110.7	113.25	115.23
0.002	89.53	96.88	101.73	105.18	107.76	109.77
0.0024	83.77	91.22	96.14	99.63	102.25	104.29
0.0028	77.94	85.5	90.5	94.05	96.71	98.78
0.0032	72.06	79.76	84.84	88.45	91.15	93.26
0.0036	66.12	73.96	79.13	82.81	85.56	87.71
0.004	60.13	68.14	73.41	77.16	79.96	82.15
0.0044	54.07	62.25	67.63	71.46	74.32	76.55
0.0048	47.94	56.32	61.82	65.73	68.65	70.93
0.0052	41.77	50.36	55.99	59.98	62.97	65.3
0.0056	35.53	44.34	50.11	54.2	57.26	59.63
0.006	29.22	38.27	44.19	48.38	51.51	53.94
	Limiting ICW Inlet Temperature (°F)					

The following table define the limiting ICW inlet temperature for the maximum assumed salinity (7.11%), various assured accident flows and various tube resistances.

7.11% ICW Salinity						
Tube Resistance (hr-ft2-°F/Btu)	Assured Accident ICW Flow Rate (gpm)					
	4000	5000	6000	7000	8000	9000
0.0008	105.39	112.77	117.63	121.07	123.63	125.62
0.0012	99.76	107.2	112.09	115.57	118.16	120.17
0.0016	94.08	101.59	106.53	110.05	112.67	114.71
0.002	88.35	95.94	100.95	104.51	107.17	109.24
0.0024	82.53	90.24	95.31	98.93	101.63	103.73
0.0028	76.68	84.5	89.66	93.33	96.07	98.21
0.0032	70.77	78.73	83.97	87.7	90.5	92.67
0.0036	64.81	72.92	78.26	82.06	84.9	87.12
0.004	58.79	67.06	72.51	76.38	79.28	81.53
0.0044	52.72	61.17	66.73	70.67	73.63	75.93
0.0048	46.59	55.24	60.91	64.95	67.96	70.31
0.0052	40.42	49.27	55.07	59.19	62.27	64.67
0.0056	34.19	43.25	49.19	53.41	56.56	59.01
0.006	27.89	37.19	43.28	47.59	50.81	53.32
	Limiting ICW Inlet Temperature (°F)					

Since minimum assured accident ICW flow is 7,600, the percentage difference between the limiting ICW inlet temperature at 3.44% and 7.1% salinity was estimated as shown in the table below. Only the columns for 7,000 gpm and 8,000 gpm were compared since the assured ICW flow is 7,600 gpm.

% Difference Between 3.44% and 7.1% Salinity		
Tube Resistance (hr-ft2-°F/Btu)	Assured Accident ICW Flow Rate (gpm)	
	7000	8000
0.0008	0.512	0.445
0.0012	0.554	0.474
0.0016	0.591	0.515
0.002	0.641	0.551
0.0024	0.708	0.610
0.0028	0.771	0.666
0.0032	0.855	0.718
0.0036	0.914	0.777
0.004	1.021	0.858
0.0044	1.118	0.937
0.0048	1.201	1.015
0.0052	1.335	1.124
0.0056	1.479	1.238
0.006	1.660	1.378
Average	**0.881**	

The average effect due to the salinity discrepancy at 7,600 gpm is 0.88%. And the vast majority of fouling factors would be less than a 1.4% decrease in maximum allowable ICW temperature.

Adding the temperature percentage differences of the two discrepancies (i.e. salinity and assured ICW flow rate), the total effect of the discrepancies is reduction of approximately 1.5% decrease in maximum allowable canal temperature. At typical maximum canal temperatures around 100°F, this corresponds to nominally a 1.5°F reduction in the maximum allowable canal temperature for the "worst" and "best" heat exchangers pair. However, due to the fact that the maximum ICW allowable temperatures for the "worst" and "best" heat exchanger pairs are above 100 °F, the Technical Specification for maximum UHS temperature (100 °F) is the more bounding requirement not the heat exchanger performance. Per Attachment 4 the maximum recorded UHS temperature is approximately 97.5 °F.

CCW HX Performance is monitored by the Shift Technical Advisor per procedure 4-OSP-019.4. Presently, the maximum allowable canal temperature for the worst pair of CCW heat exchangers is approximately 105.5°F (which represent the ICW temperature limit that would allow design basis heat removal capability), as compared to 91 °F actual canal temperature. The present 14.5°F margin is sufficient to accommodate the 1.5°F reduction identified herein.

Past and future operability is provided by the Heat Exchanger Monitoring Program, 4-OSP-019.4. By procedure, whenever the actual canal temperature comes within 3°F of the maximum allowable canal temperature for the worst pair of heat exchangers, the most fouled heat exchanger is declared out of service for cleaning. Additional margin is then realized by relying on the two cleaner heat exchangers to comply with Technical Specification requirements. Since the identified discrepancies are bounded by the 3°F margin line, continued operability is assured.

The performance test results from for the period of time from 1/5/2010 to 8/9/2012 (See Attachment 4) have been reviewed and the administrative margin of 3 °F has been crossed once, in 4/28/2011. The actual available margin between the UHS temperature and the maximum allowable ICW temperature for the "worst" pair of heat exchangers was 1.31 °F. However, on 4/28/11 the 4C heat exchanger was declared Out Of Service (OOS) and the available margin between the UHS temperature and the maximum allowable ICW temperature for the "best" pair of heat exchangers was 28.8 °F. Therefore, due to the 3 °F administrative margin and the nature of the CCW heat exchanger monitoring program, the heat removal capability of the CCW heat exchanger has not been challenge even while in the "worst" pair configuration.

D. Describe (for SSC not fully capable of performing its specified TS function(s)) compensatory actions (e.g., procedure changes, facility changes, or substitution of manual actions for automatic functions) taken to address the condition (compensatory actions must be reviewed under 10 CFR 50.59):

No compensatory action is required. However, an assignment will be issue to the appropriate system engineer to closely track the performance of the CCW heat exchangers until the Unit 4 EPU Outage and the CCW Heat Exchanger Monitoring Program is revised to account for the discrepancies identified under AR 1789995.

E. Evaluate continued operation should the degraded condition degrade further and describe the method used to monitor the degraded condition until corrected (e.g., operator rounds, system health trending/walkdowns, CAP monitoring action) or provide justification why monitoring is not required. (The POD must be forward looking to assess conditions that may impact the SSC during the period of operation until the condition is corrected, especially for PODs that rely on equipment performance information):

CCW HX Performance is monitored by the Shift Technical Advisor per procedure 4-OSP-019.4. Presently, the maximum allowable canal temperature for the worst pair of CCW heat exchangers is approximately 105.5°F, as compared to 91 °F actual canal temperature. The present 14.5°F margin is sufficient to accommodate the 1.5°F reduction identified herein.

Past and future operability is provided by the Heat Exchanger Monitoring Program, 4-OSP-019.4. By procedure, whenever the actual canal temperature comes within 3°F of the maximum allowable canal temperature for the worst pair of heat exchangers, the most fouled heat exchanger is declared out of service for cleaning. Additional margin is then realized by relying on the two cleaner heat exchangers to comply with Technical Specification requirements. Since the identified discrepancies are bounded by the 3°F margin line, continued operability is assured.

The performance test results from for the period of time from 1/5/2010 to 8/9/2012 (See Attachment 4) have been reviewed and the administrative margin of 3 °F has been crossed once, in 4/28/2011. The actual available margin (after subtracting the reduction in margin) between the UHS temperature and the maximum allowable ICW temperature for the "worst" pair of heat exchangers was 1.31°F (2.65°F-89.05*.985). However, on 4/28/11 the 4C heat exchanger was declared Out Of Service (OOS) and the available margin between the UHS temperature and the maximum allowable ICW temperature for the "best" pair of heat exchangers was 28.8 °F. Therefore, due to the 3 °F administrative margin and the nature of the CCW heat exchanger monitoring program, the heat removal capability of the CCW heat exchanger has not been challenge even while in the "worst" pair configuration.

Additionally, the discrepancies identified, which reduce the available margin by approximately 1.5 °F, will be addressed during the upcoming Unit 4 Ouatge. As stated above the upcoming temperatures for the remaining of the year should be lower than the current temperatures. However, in the hypothetical case that the canal temperatures continue to increase the cleaning frequency of the heat exchangers will increase in order to ensure the required heat removal capabilities and if the temperatures reach up to 100 °F; Technical Specification 3/4.7.4 provide the required actions to take.

F. Assess (for SSC not fully capable of performing its specified TS function(s)) the impact of Engineering Changes (e.g., modifications) scheduled for implementation over the duration of the POD and applicable open PODs and their cumulative impact on this POD (including a review of any related compensatory actions in place as a result of an open POD(s)):

A review of open and upcoming design modifications was performed and no modification was found that could affect the assumptions and analyses provided under this POD (from the present to the upcoming Unit 4 EPU Outage which will resolve the discrepancies identified herein).

There is an open "Operable But Degraded" condition associated with the CCW system that was documented under AR 484935. AR 484935 addressed that Westinghouse discovered significant errors in the Containment Integrity Analysis, which ended up increasing the total heat load in containment during accident conditions. However, Westinghouse subsequently issued Westinghouse Letter FPL-09-174 (Turkey Point Units 3 and 4 – Containment Integrity Current Analysis of Record JPO/JCO Regarding Containment Heat Sink Errors in the COCO Model, dated May 26, 2009) supplement to Westinghouse Letter FPL-08-96 (Revision, dated November 23, 2008, Error In Current Analysis of Record for Containment Integrity – Justification for Past/Continued Operation) report which re-evaluated the CCW temperatures using additional credits obtained from the re-calculation of the containment heat sinks and inclusion of the deliverables Refueling Water Storage Tank (RWST) water volume during a LOCA. The added benefits from these credits provided the margin necessary to allow for the relaxation of the CCW heat exchanger performance requirement. Therefore, the open "Operable But Degraded" condition does not pose a cumulative effect.

G. Conclusion:

The identified discrepancies have a net effect of reducing the maximum allowable ICW temperature by less than 1.5%, or nominally less than 1.5 degrees. CCW Heat Exchanger Performance is monitored by the Shift Technical Advisor per procedure 4-OSP-019.4. Presently, the maximum allowable canal temperature for the "worst" pair of CCW heat exchangers is approximately 105.5°F, as compared to 91 °F actual canal temperature. The present 14.5°F margin is sufficient to accommodate the 1.5°F reduction identified herein.

Past and future operability is provided by the Heat Exchanger Monitoring Program, 4-OSP-019.4. By procedure, whenever the actual canal temperature comes within 3°F of the maximum allowable canal temperature for the "worst" pair of heat exchangers, the most fouled heat exchanger is declared out of service for cleaning. Additional margin is then realized by relying on the two cleaner heat exchangers to comply with Technical Specification requirements. Since the identified discrepancies are bounded by the 3°F margin line and an available better performing pair of heat exchangers, continued operability is assured. Due to the 3 °F administrative margin and the nature of the CCW heat exchanger monitoring program, the heat removal capability of the CCW heat exchangers has not been challenge even while in the "worst" pair configuration.

FPL requires that the CCW Heat Exchangers Monitoring program provides a 3 °F margin between the Cooling Canal System (CCS or UHS) temperature and the "worst" pair of heat exchangers maximum allowable ICW temperature. Therefore, Unit 4 Heat Exchangers are Operable and above Full Qualification but with reduced margin below some FPL requirement.

6 References:

1. 4-OSP-030.4, Component Cooling Water Heat Exchanger Performance
2. EN-AA-203-1001, Operability Determinations / Functionality Assessments
3. Turkey Point 3 and 4 Open RIS 2005-20, Operable But Degraded' Condition Repots
4. Calculation M12-183-010, CCW Heat Exchanger Nozzle Loads Allowable
5. Calculation PTN-BFJM-96-004, Revised CCW HX Operability Curves for Thermal Uprate

7. Attachments:

1. FPL Correspondence, Surface Water and Groundwater Monitoring Stations Map, FPL Environmental Monitoring Plan Data, FPL Turkey Point Annual Monitoring Report and Excerpt from the Quality Assurance Project Plan.
2. Site Certification Application Turkey Point Uprate Project, and AREVA Letters 09-01876 and 09-03763.
3. AR 466167: 2009-14191 – 4C CCW Hx failed performance test, 4-OSP-030.4.
4. CCW Heat Exchanger Performance Tests (1/5/2011 to 8/9/2012).

8. MODE Restrictions (APPLICABILITY Restrictions for ISFSI Conditions):

None.

CR: 1789995 **Revision: 0**

CHECK ONE	PROMPT OPERABILITY DETERMINATION
	Affected SSC should be considered Operable since it is fully qualified, meeting As-Built condition.
X	Affected SSC should be considered Operable and above Full Qualification but with reduced margin below some FPL requirement. There is a high degree of confidence that the degraded SSC meets Full Qualification as described in the Current Licensing Basis. Action item AR 1789995-03 was initiated to notify the System Engineer of this item for potential System Health Report discussion.
	Affected SSC should be considered Operable but degraded, and below Full Qualification. Continued Operability is based on the provisions of RIS 2005-20. Action item ____________ was initiated to administratively track resolution of this item.
	Affected SSC should be considered inoperable.

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SM Approval: M. Coon [signature] Date/Time 8/10/12
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Distribution:

Responsible Supervisor
Responsible System Engineer

FPL Nuclear Station OPERABILITY Condition Model