Entergy Operations, Inc.
17265 River Road
Killona, LA 70057-3093
Tel 504 739 6660
Fax 504 739 6678
jdinelli@entergy.com

John C. Dinelli
Site Vice President
Waterford 3

W3F1-2017-0050

10 CFR 50.90

March 26, 2018

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

SUBJECT: License Amendment Request
Proposed Change to Technical Specification 3/4.7.4 for Ultimate Heat Sink Design Basis Update
Waterford Steam Electric Station, Unit 3
Docket No. 50-382
License No. NPF-38

REFERENCES:

1. NRC Notice, Pre-submittal Meeting with Entergy Operations, Inc Regarding a License Amendment Request to Revise Technical Specification Table 3.7-3 for Waterford Steam Electric Station, Unit 3, May 15, 2017 [NRC ADAMS Accession Number ML17151A314].

2. Waterford 3 Slides for Presentation to the NRC on the Ultimate Heat Sink Amendment Request, June 1, 2017 [NRC ADAMS Accession Number ML17151A295].

3. NRC Letter, Summary of June 1, 2017, Public Meeting With Entergy Operations, Inc., regarding Planned License Amendment Request to Revise Technical Specification (TS) Table 3.7-3 and TS 3/4.7.4, “Ultimate Heat Sink” For Waterford Steam Electric Station, Unit 3, June 28, 2017 [NRC ADAMS Accession Number ML17174B226].

Dear Sir or Madam:

On June 1, 2017, a Category 1 public meeting was held between the U.S. Nuclear Regulatory Commission (NRC) staff and representatives of Entergy Operations, Inc. (Entergy) at the NRC Headquarters. The purpose of the meeting was to discuss Entergy’s plan for a license amendment request regarding changes to Technical Specification 3/4.7.4 for the ultimate heat sink. Reference 1 provides the meeting announcement, Reference 2 provides the meeting presentation information, and Reference 3 provides the meeting summary information.

As discussed in the public meeting and pursuant to 10 CFR 50.90, Entergy hereby requests an amendment to revise Technical Specification 3/4.7.4 associated with the ultimate heat sink for Waterford Steam Electric Station Unit 3 (Waterford 3).

The proposed change has been evaluated in accordance with 10 CFR 50.91(a)(1) using the criteria in 10 CFR 50.92(c), and it has been determined that the changes involve no significant hazards consideration. The bases for these determinations are included in the enclosure.

Enclosure Attachment 3 contains the new commitments associated with this change.

Entergy requests approval of the proposed amendment by March 26, 2019. Once approved, the amendment shall be implemented within 60 days.

Please contact John Jarrell, Regulatory Assurance Manager, at 504-739-6685 if there are any questions regarding this submittal.

I declare under penalty of perjury that the foregoing is true and correct. Executed on March 26, 2018.

Sincerely,

JCD/JPJ/WJS

Enclosure: Analysis of Proposed Technical Specification Change

cc: Mr. Kriss Kennedy, Regional Administrator
U.S. NRC, Region IV
RidsRgn4MailCenter@nrc.gov

U.S. NRC Project Manager for Waterford 3
April.Pulvirenti@nrc.gov

U.S. NRC Senior Resident Inspector for Waterford 3
Frances.Ramirez@nrc.gov
Chris.Speer@nrc.gov

Louisiana Department of Environmental Quality
Office of Environmental Compliance
Surveillance Division
Ji.Wiley@LA.gov

Enclosure to

W3F1-2017-0050

Analysis of Proposed Technical Specification Change

(40 pages)

Enclosure
Analysis of Proposed Technical Specification Change

Subject: Proposed Change to Technical Specification 3/4.7.4 for Ultimate Heat Sink Design Basis Update

ATTACHMENTS:

1.0 SUMMARY DESCRIPTION

On June 1, 2017, a Category 1 public meeting was held between the U.S. Nuclear Regulatory Commission (NRC) staff and representatives of Entergy Operations, Inc. (Entergy) at the NRC Headquarters. The purpose of the meeting was to discuss Entergy's plan for a license amendment request regarding changes to Technical Specification 3/4.7.4 for the ultimate heat sink. Reference 7.5 provides the meeting announcement, Reference 7.6 provides the meeting presentation information, and Reference 7.7 provides the meeting summary information.

The license amendment request revises Technical Specification 3.7.4 (Ultimate Heat Sink) to address several non-conforming conditions. The issues addressed by this change are as follows:

- Wet cooling tower basin level discrepancy.
- Dry cooling tower and wet cooling tower recirculation impacts.
- Wet cooling tower methodology for determining fan requirements.

1.1 Wet Cooling Tower Basin Level Discrepancy

Technical Specification 3.7.4.a gives the wet cooling tower basin level requirement as 97% (-9.86 ft MSL). The Technical Specification 3.7.4.a wet cooling tower basin level requirement of 97% is correct but the associated level of -9.86 feet mean sea level was found to be not correct. The corrected level is -9.77 feet mean sea level. The Technical Specification 3.7.4.a basin level requirement of 97% is supported by the design basis calculations which require a minimum water inventory capacity of 174,000 gallons. Since -9.86 feet mean sea level maintains the 174,000 gallon requirement, the plant remained within the design and licensing requirements and no compensatory measures were required.

1.2 Dry Cooling Tower and Wet Cooling Tower Recirculation Impacts

Updated Final Safety Analysis Report (UFSAR) Section 9.2.5.3.2 states that the dry and wet cooling tower design heat removal is based on the worst combination meteorological condition of 102 ºF dry bulb temperature and associated 78 ºF wet bulb temperature. In addition, 1.9 ºF has been added to the design dry bulb temperature and 1.0 ºF to the design wet bulb temperature to account for possible recirculation. Waterford 3 identified that the recirculation impacts were non-conservative and entered the condition into the corrective action program [Reference 7.26]. Waterford 3 has implemented administrative controls, in accordance with NRC Administrative Letter 98-10 [Reference 7.4] to require dry cooling tower fan operation with more restrictive temperature requirements.

1.3 Wet Cooling Tower Methodology for Determining Fan Requirements

During the review for Waterford 3 license amendment 237 [Reference 7.8], the NRC identified in their request for additional information [Reference 7.9] that the methodology being used for analyzing the impact of taking wet cooling tower fans out of service was not appropriate. Waterford 3 letter W3F1-2012-0019 [Reference 7.10] acknowledged that the methodology was not appropriate for the application. Waterford 3 letter W3F1-2012-0028 [Reference 7.11] changed the Technical Specification request to require all wet cooling tower fans to be operable regardless of ambient temperature due to this condition. Waterford 3 license amendment 237 required all wet cooling tower fans for the system to be operable.

2.0 PROPOSED CHANGE

Technical Specification 3/4.7.4 is requested to be updated to reflect the updated design analyses.

2.1 Technical Specification 3.7.4 Item a

Technical Specification 3.7.4 item a currently states:

> A minimum water level in each wet tower basin of 97% (-9.86 ft MSL)

Technical Specification 3.7.4 item a will be revised to:

> A minimum water level in each wet tower basin of 97% (-9.77 ft MSL)

The existing Technical Specification associates -9.86 ft MSL with 97% full wet cooling tower basins. The proposed change revises the wet cooling tower basin inventory calculation and concludes that -9.77 ft MSL is the correct basin level for 97% full. The revised analyses credit the same 174,000 gallons of wet cooling tower basin water inventory as was previously credited for a 97% full wet cooling tower basin.

2.2 Technical Specification 3.7.4 Action c

Technical Specification 3.7.4 Action c currently states:

> With a Tornado Watch in effect, all 9 DCT fans under the missile protected portion of the DCT shall be OPERABLE. If the number of fans OPERABLE is less than required, restore the inoperable fan(s) to OPERABLE status within 1 hour, or be in at least HOT STANDBY within 6 hours and in HOT SHUTDOWN within the following 6 hours.

Technical Specification 3.7.4 Action c will be revised to:

> This action applies only when UHS tornado required equipment is inoperable. With a Tornado Watch or Warning in effect with the forecast 7 day average ambient dry bulb temperature greater than 74ºF, all 6 DCT tube bundles and all 9 DCT fans associated with the missile protected portion of both trains of the DCT shall be OPERABLE. With a Tornado Watch or Warning in effect with the forecast 7 day average ambient dry bulb temperature less than or equal to 74ºF, all 6 DCT tube bundles and at least 8 DCT fans associated with the missile protected portion of both trains of the DCT shall be OPERABLE. If the number of tube bundles or fans OPERABLE is less than required, restore the inoperable tube bundle(s) or fan(s) to OPERABLE status within 1 hour, or be in at least HOT STANDBY within the following 6 hours and in HOT SHUTDOWN within the following 6 hours.

The existing Technical Specification 3.7.4 Action c requires all 9 dry cooling tower fans associated with the tube bundles under the missile shield to be operable during a tornado watch. The analysis in the proposed change accounts for bounding combinations of meteorological parameters, including recirculation, as well as potential dry cooling tower tube plugging and sleeving, and the need to occasionally isolate dry cooling tower tube bundles for maintenance, and establishes dry cooling tower fan and tube bundle requirements during a tornado watch or warning based on ambient temperature limits. The proposed change allows for reduced dry cooling tower fan requirements for the missile protected portion when the established ambient temperature limits are not exceeded.

2.3 Technical Specification 3.7.4 Action d

Technical Specification 3.7.4 Action d currently states:

> With any UHS fan inoperable, determine the outside ambient temperature at least once every 2 hours and verify that the minimum fan requirements of Table 3.7-3 are satisfied (required only if the associated UHS is OPERABLE).

Technical Specification 3.7.4 Action d will be revised to:

> When Table 3.7-3 dry bulb temperature restrictions apply with UHS fan(s) inoperable, determine the forecast ambient temperatures and verify that the minimum fan requirements of Table 3.7-3 are satisfied (required only if the associated UHS is OPERABLE). The more restrictive fan requirement shall apply when 1 hour and 3 day average temperatures allow different configurations.

The analyses in the proposed change establish dry cooling tower fan and tube bundle requirements based on one hour and three day average ambient temperature limits that maintain total ultimate heat sink heat transfer capacity (dry cooling tower and wet cooling tower combined) and water inventory margin. Thus, the proposed change provides conservative dry cooling tower fan requirements, addresses dry cooling tower tube bundle requirements, and introduces combination dry cooling tower and wet cooling tower fan requirements based on both one hour and three day average temperature forecasts for achieving total ultimate heat sink design basis heat transfer capacity and water inventory margin.

2.4 New Technical Specification 3.7.4 Action e and New Surveillance 4.7.4.c

New Technical Specification 3.7.4 Action e is added to address the wet cooling tower basin cross-connect valves. The new action is as follows:

> With either or both wet cooling tower basin cross-connect valves not OPERABLE for makeup, restore the valve(s) to OPERABLE status within 7 days or be in at least HOT STANDBY within the next 6 hours or COLD SHUTDOWN within the following 30 hours.

New Technical Specification Surveillance 4.7.4.c is added to address the wet cooling tower basin cross-connect valves. The new surveillance is as follows:

> Verify that each wet tower basin cross-connect valve is OPERABLE in accordance with the INSERVICE TESTING PROGRAM.

The existing and revised analysis credits the wet cooling tower basin cross-connect line for additional water inventory margin. The proposed changes are enhancements to clarify the credit taken for the wet cooling tower basin cross-connect line for additional water inventory margin. A separate action for the wet cooling tower basin cross-connect function clarifies that both ultimate heat sink trains do not have to be considered inoperable when the wet cooling tower basin cross-connect line is inoperable. The existing in-service testing requirements for testing the open safety function of the wet cooling tower basin cross-connect isolation valves satisfy the new Technical Specification surveillance requirement.

2.5 Technical Specification 3.7.4 Table 3.7-3

Technical Specification 3.7.4 Table 3.7-3 currently states:

TABLE 3.7-3

ULTIMATE HEAT SINK MINIMUM FAN REQUIREMENTS PER TRAIN

DRY COOLING TOWER

AMBIENT CONDITION	DRY BULB ≥ 97°F	< 97°F DRY BULB ≥ 91°F	< 91°F DRY BULB
Fan Requirements[1]	15	14*	12*

WET COOLING TOWER

Fan Requirements - 8

[1] With any of the above required DCT Fans inoperable comply with ACTION d.

* With a tornado watch in effect, all 9 DCT fans under the missile protected portion of the DCT shall be OPERABLE.

Technical Specification 3.7.4 Table 3.7-3 will be revised to:

TABLE 3.7-3

ULTIMATE HEAT SINK MINIMUM FAN REQUIREMENTS PER TRAIN [1]

ALLOWABLE FAN COMBINATIONS WITHOUT BACKFLOW PREVENTED THROUGH INOPERABLE DCT FAN(S)
1 hour / 3 day average dry bulb temperature restrictions

OPERABLE WCT Fans[2]	OPERABLE DCT Fans (Inoperable Fan Backflow NOT Prevented)							
	15		14		13		12	
	1 hour	3 day	1 hour	3 day	1 hour	3 day	1 hour	3 day
8	No Temperature Restrictions				≤88 °F	≤77 °F	Not Allowed	
7					≤87 °F	≤77 °F	Not Allowed	

ALLOWABLE FAN COMBINATIONS WITH BACKFLOW PREVENTED THROUGH INOPERABLE DCT FAN(S)
1 hour / 3 day average dry bulb temperature restrictions

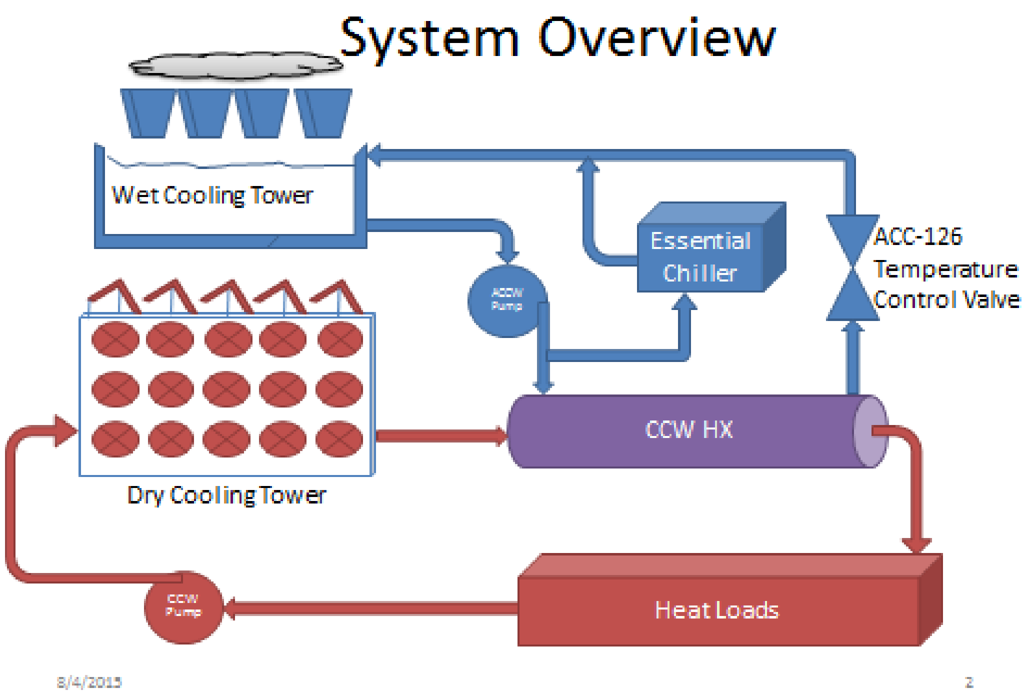
OPERABLE WCT Fans[2]	OPERABLE DCT Fans (Inoperable Fan Backflow Prevented)							
	15		14		13		12	
	1 hour	3 day	1 hour	3 day	1 hour	3 day	1 hour	3 day
8	No Temperature Restrictions						≤89 °F	≤79 °F
7							≤88 °F	≤79 °F

[1] With any DCT tube bundle isolated, at least 14 DCT fans and 7 WCT fans shall be OPERABLE.
[2] Inoperable WCT fans shall be covered or the entire WCT shall be considered inoperable.

Technical Specification 3.7.4 Table 3.7-3 is part of Technical Specification 3.7.4 Item c and Technical Specification Action d which provides restrictions on ultimate heat sink operability for dry cooling tower and wet cooling tower fan requirements. The current design basis analysis for the ultimate heat sink establishes the design basis dry cooling tower heat transfer capacity for the bounding dry bulb temperature (102°F) with 15 operable dry cooling tower fans. The design basis wet cooling tower heat transfer capacity is with a design basis wet bulb temperature (78°F) with 8 operable wet cooling tower fans. The current Technical Specification Table 3.7-3 dry cooling tower fan requirements are based on ambient temperature limits that maintain the design basis dry cooling tower heat transfer capacity with fewer operable dry cooling tower fans. The existing dry cooling tower fan requirements were based on non-conservative assumptions regarding hot air recirculation. The bounding hot air recirculation is higher at lower ambient temperatures, when bounding ambient wind speeds are higher, causing a non-linear relationship between dry cooling tower heat transfer capacity and ambient temperature. In addition, the existing Technical Specifications do not address the potential for isolating dry cooling tower tube bundles for maintenance. The analyses in the proposed change account for bounding combinations of meteorological parameters, dry and wet cooling tower hot air recirculation, as well as potential dry cooling tower tube plugging and sleeving, and the need to occasionally isolate dry cooling tower tube bundles for maintenance. The analyses in the proposed change establish dry cooling tower fan, wet cooling tower fan, and tube bundle requirements based on one hour and three day average ambient temperature limits that maintain total ultimate heat sink heat transfer capacity and water inventory margin. Thus, the proposed change provides conservative Technical Specification fan requirements, addresses dry cooling tower tube bundle requirements, and introduces combination dry cooling tower and wet cooling tower fan requirements based on both one hour and three day average temperature forecasts for achieving total ultimate heat sink design basis heat transfer capacity and water inventory margin.

3.0 BACKGROUND

The UFSAR Section 9.2.5 describes the ultimate heat sink. The function of the ultimate heat sink is to dissipate the heat removed from the reactor and its auxiliaries during normal operation, during refueling, or after a design basis accident or event. The ultimate heat sink consists of dry and wet cooling towers, and the water stored in the wet cooling tower basins. Two 100% capacity trains employ one dry cooling tower and one wet cooling tower each. A simplified diagram of the ultimate heat sink is provided below.

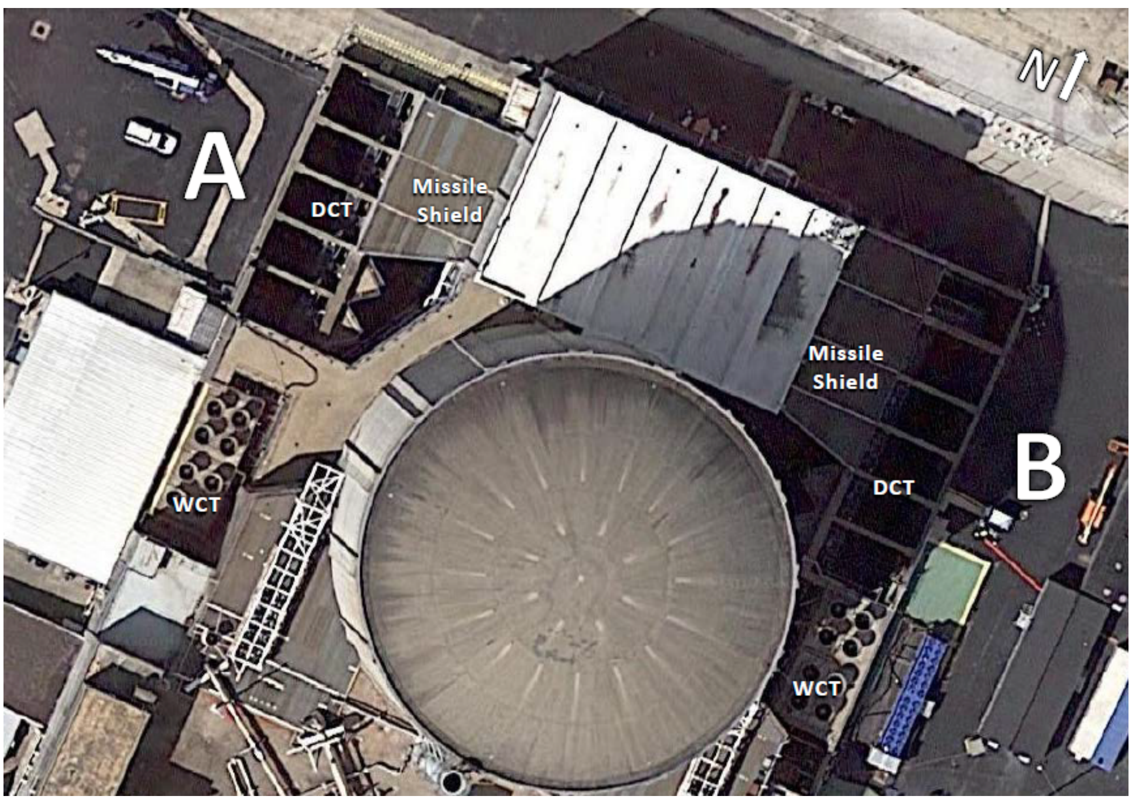


The UFSAR Section 9.2.2 describes the component cooling water and auxiliary component cooling water systems. The dry cooling towers remove heat from the component cooling water system, which is a closed cooling system that serves reactor auxiliaries. The auxiliary component cooling water system is a separate system that provides cooling water to the component cooling water heat exchangers and utilizes the wet cooling towers for heat dissipation to the atmosphere.

Each dry cooling tower is sized to dissipate approximately 60% of heat removed by the component cooling water system after a design basis accident. The heat removal capacity of the dry cooling towers varies significantly depending on the component cooling water temperature and ambient conditions. The dry cooling tower on each train consists of five separate cells, each cell containing two vertical cooling coils (tube bundles). Three of the five cells feature a missile shield covering the tube bundles to protect against tornado missiles. Cooling for each cell is provided by three fans. Dry cooling tower fans are started and shut-off automatically to maintain the component cooling water supply temperature at a predetermined setpoint. When the water outlet temperature of the component cooling water heat exchanger exceeds a separate predetermined setpoint, the component cooling water temperature control valve (ACC-126A(B)) opens and the associated auxiliary component cooling water pump automatically starts, which initiates heat removal via the component cooling water heat exchanger and the wet cooling towers. The wet cooling towers are designed to operate whenever the heat rejection capacity of the dry cooling tower is exceeded with the desired component cooling water supply temperature. The wet cooling towers can also be used to maintain the component cooling water system temperature below the range maintained by the dry cooling tower during normal operation.

Each wet cooling tower is sized to dissipate approximately 40% of the heat removed by the component cooling water system after a design basis accident to the atmosphere. The capacity of the wet cooling tower varies significantly, depending on the component cooling water temperature to be maintained and the atmosphere wet bulb temperature. Each wet cooling tower consists of two cells separated by a concrete barrier which is intended to promote more evenly distributed air flow though the fill of each cell. The wet cooling tower fans are started automatically whenever the water temperature in the wet cooling tower basin exceeds a predetermined setpoint.

An aerial view of the Waterford 3 facility is provided to show the location of the dry cooling towers, wet cooling towers, and missile shield locations.



4.0 TECHNICAL EVALUATION

The license amendment request revises Technical Specification 3.7.4 (Ultimate Heat Sink) to address several non-conforming conditions. The issues addressed by this change are as follows:

- Wet cooling tower basin level discrepancy.
- Dry cooling tower and wet cooling tower recirculation impacts.
- Wet cooling tower methodology for determining fan requirements.

The material referenced in the submittal will be provided via electronic file sharing at the NRC's request.

The technical analysis will address each specific Technical Specification change. This is broken into the individual parts because the ultimate heat sink analysis is a complex multipart set of calculations and will provide a more user friendly format for the information.

As part of the Waterford 3 license amendment 237 review, Waterford 3 letter W3F1-2012-0004 [Reference 7.12] had submitted calculation ECM95-008 [Reference 7.13] and ECM95-009 [Reference 7.14] to the NRC. As part of this change, calculations ECM95-008, ECM95-009, and other calculations have been consolidated into one calculation ECM95-008 [Reference 7.20]. The major changes associated with ECM95-008 and the input documents and corresponding impacts will be presented.

4.1 Technical Specification 3.7.4 Item a

The Technical Specification 3/4.7.4 bases states the following:

> Each WCT has a basin which is capable of storing sufficient water to bring the plant to safe shutdown under all design basis accident conditions. Item a of LCO 3/4.7.4 requires a minimum water level in each WCT basin of 97% (-9.86 ft MSL). When the WCT basin water level is maintained at -9.86 ft MSL, each basin has a minimum capacity of 174,000 gallons.

The existing Technical Specification associates -9.86 ft MSL with 97% full wet cooling tower basins. Calculation MNQ9-38 [Reference 7.27] revises the wet cooling tower basin inventory calculation and concludes that -9.77 ft MSL is the correct basin level for 97% full. The revised analyses credit the same 174,000 gallons of wet cooling tower basin water inventory as was previously credited for a 97% full wet cooling tower basin. For the ultimate heat sink analysis, the parameter of interest is the wet cooling tower basin inventory of 174,000 gallons, since this remains the same, this change is administrative in nature.

4.2 Technical Specification 3.7.4 Action c

UFSAR Sections 9.2.5.3.2, 9.2.5.3.3, and Table 9.2-9 describes the tornado event.

4.2.1 Tornado Technical Specification Change

The existing Technical Specification 3.7.4 Action c requires all 9 dry cooling tower fans associated with the tube bundles under the missile shield to be operable during a tornado watch. Calculation ECM95-008 determines that the dry cooling tower can meet its safety function with only eight dry cooling tower fans associated with tube bundles under the missile shield operable during a tornado watch when the 7 day average ambient temperature is ≤74°F which is less restrictive than the existing Technical Specification fan requirements. Calculation ECM95-008 accounts for bounding combinations of meteorological parameters, including recirculation, as well as potential dry cooling tower tube plugging and sleeving, and the need to occasionally isolate dry cooling tower tube bundles for maintenance, and establishes dry cooling tower fan and tube bundle requirements during a tornado watch or warning based on ambient temperature limits. The proposed change allows for reduced dry cooling tower fan requirements for the missile protected portion when the established ambient temperature limits are not exceeded.

Regulatory Guide 1.27 requires determining critical time periods. The use of 7 day average temperature forecast provides a conservative critical time period for the design basis tornado event and meets the Regulatory Guide 1.27 requirements. The forecast temperature readings will use data from the national weather service or other reputable weather forecaster (e.g. National Oceanic and Atmospheric Administration, AccuWeather) to obtain the information required to predict the future temperature trends. Internet outages, website problems, or other issues may prohibit being able to obtain this information. Section 4.5.4.2 gives the maximum average dry bulb temperature as a function of the time of year by month. This information will be added to the UFSAR (Enclosure Attachment 3 – Commitment). This new UFSAR table may be used to evaluate the 7 day average restrictions when forecast data is not available. It may also be conservatively used when the time of year is such that forecast data is not needed to demonstrate the temperature requirements will be met.

The use of forecast data is beneficial because it more accurately reflects the analysis requirements by ensuring that the starting and future ambient temperatures remain within the required limits. The 7 day average will typically be evaluated by using the national weather service or other reputable weather forecaster hourly temperatures (or maximum temperature for time period available) for the next 7 days and averaged. The forecast data will be updated every 12 hours to ensure temperature changes are incorporated. The 12 hour update time is a reasonable time to ensure the prediction remains valid for changes in temperature. This will ensure that daily temperature variations and weather changes will not cause an unpredicted Technical Specification action entry. When the online forecast data is not available or when desired by operations the new UFSAR Table (Section 4.5.4.2) may be used to conservatively perform the same forecast function.

Calculation ECM95-008 accounts for potential leakage past the isolation valves for the unprotected dry cooling tower tube bundles and establishes appropriate timing for operator actions after a design basis tornado for implementing water inventory replenishment and initiating shutdown cooling. NUREG-0787 [Reference 7.29] Section 9.2.5 states the following:

> Makeup to the wet tower basins is normally provided by the nonessential demineralized water system. In addition, makeup water can be supplied to the wet tower basins by gravity from the circulating water system for continuous once-through cooling of the component cooling water system.

Thus, crediting replenishment of water from the circulating water system in the tornado analysis is consistent with NUREG-0787 NRC approved water sources. The revised ECM95-008 operator action times for water replenishment are increased meaning that more time is available to perform the actions. Procedures will be updated to implement administrative controls and operator actions credited in the analyses. The analyses demonstrate that the ultimate heat sink meets the requirements of Regulatory Guide 1.27.

This change also adds a tornado warning to the requirements for this action. It was apparent that this action applied to both a tornado watch and warning, but was not specifically listed in the Technical Specification. This is considered an editorial improvement.

Section 4.5 provides a more detailed explanation of the ECM95-008 analysis inputs and methods.

4.2.2 Clarification of Tornado Requirements

The Technical Specification 3.7.4 Action c adds the following information:

> This action applies only when UHS tornado required equipment is inoperable.

This information is added to clarify the ultimate heat sink design basis requirements during a tornado and the associated Technical Specification impacts. This clarification is needed to address analysis and Technical Specification interpretation issues. The information presented will start by describing the wet cooling tower design basis fan requirements.

UFSAR Sections 9.2.5.3.2, 9.2.5.3.3, and Table 9.2-9 describes the tornado event. The wet cooling tower will operate in natural draft mode following a tornado missile strike. Calculation ECM95-008 evaluates the tornado event and assumes the unprotected wet cooling tower fans are lost in the tornado strike, as well as the unprotected 40% of the dry cooling tower bundles. Calculation ECM95-008 also considers the most limiting failure as being that of an emergency diesel generator which results in the loss of a complete train of the ultimate heat sink. The wet cooling tower is evaluated as operating in natural draft mode, in which the wet cooling tower fans are not in operation, to dissipate part of the auxiliary and decay heat load. Therefore, the wet cooling tower fans do not have a design basis function following an event involving tornado missile strikes. Other ultimate heat sink components such as (but not limited to) the component cooling water heat exchanger, component cooling water/auxiliary component cooling water pumps, wet cooling tower basins, auxiliary component cooling water to emergency feedwater cross-connects, and dry cooling tower fans associated with tube bundles under the missile shielding are required to operate post-tornado in order to meet the credited design function of the ultimate heat sink.

Next, an example will be provided to illustrate the potential interpretation issue that is being addressed by clarifying the Technical Specification. Technical Specification 3.7.4.c refers to Table 3.7-3. Technical Specification Table 3.7-3 lists the dry and wet cooling tower fan requirements. If one train of wet cooling tower fans are removed from service for maintenance (inoperable), then Technical Specification 3.7.3 Action a is entered and 72 hours exists before a shutdown is required. For this condition, the ultimate heat sink is considered inoperable. This means that the ultimate heat sink system may be inoperable due to the wet cooling tower fans being inoperable but all the dry cooling tower fans and other ultimate heat sink components remain capable of performing their safety function. For this configuration, (only one train of wet cooling tower fans are not OPERABLE), if a tornado watch were to occur, then the station would ensure that all dry cooling tower tube bundles under the missile shield and their associated fans are OPERABLE under Technical Specification Action c. 10 CFR 50.36 (Technical Specifications) defines limiting conditions for operation as the lowest functional capability or performance levels of equipment required for safe operation of the facility. When a limiting condition for operation of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met. For this configuration with a tornado watch, the dry cooling tower tube bundles under the missile shield and their associated fans (and other support equipment) meet the lowest functional capability requirements. This would also mean for this configuration, that the Technical Specification Action c shutdown requirement (1 hour) would not be applied because the equipment required for safe operation of the facility are OPERABLE for tornado mitigation.

If the missile protected dry cooling tower tube bundles or their associated fans are inoperable for any other reason including component cooling water and/or auxiliary component cooling water pumps/systems, component cooling water heat exchanger, wet cooling tower basin, then the Technical Specification 3.7.4 Action c statement to restore the dry cooling tower fans or tube bundles to OPERABLE status within 1 hour must be adhered to with a tornado watch or warning in effect.

This clarification is to ensure that the appropriate Technical Specification actions are taken and that the plant is not shutdown when the required equipment is still capable of meeting the safety function.

4.3 Technical Specification 3.7.4 Action d

Calculation ECM95-008 establishes dry cooling tower fan and tube bundle requirements and wet cooling tower fan requirements based on one hour and three day average ambient temperature limits that maintain total ultimate heat sink heat transfer capacity (dry cooling tower and wet cooling tower combined) and water inventory margin. Thus, the proposed change provides conservative dry cooling tower fan requirements, addresses dry cooling tower tube bundle requirements, and introduces combination dry cooling tower and wet cooling tower fan requirements based on both one hour and three day average temperature forecasts for achieving total ultimate heat sink design basis heat transfer capacity and water inventory margin. Section 4.5 provides the technical basis for Table 3.7-3 requirements.

Regulatory Guide 1.27 requires determining critical time periods. The use of one hour and three day average temperature forecasts provides conservative critical time periods and meets the Regulatory Guide 1.27 requirements. The forecast temperature readings will use data from the national weather service or other reputable weather forecaster (e.g. National Oceanic and Atmospheric Administration, AccuWeather) to obtain the information required to predict the future temperature trends. Internet outages, website problems, or other issues may prohibit being able to obtain this information. Section 4.5.4.2 gives the maximum average dry bulb temperature as a function of the time of year by month. This information will be added to the UFSAR (Enclosure Attachment 3 – Commitment). This new UFSAR table may be used to evaluate Technical Specification Table 3.7-3 restrictions when either forecast data is not available or when the time of year is such that online forecast data is not needed to demonstrate the temperature requirements will be met.

The use of forecast data is beneficial because it more accurately reflects the analysis requirements by ensuring that the starting and future ambient temperatures remain within the required limits. The 1 hour average temperatures will typically be evaluated by using the national weather service or other reputable weather forecaster for hourly temperatures on a 12 hour look-ahead. This will be performed by looking at the hourly temperatures for the next 12 hours to ensure the temperatures remain within the limits. If any of the forecast temperatures are above the limit, then a more detailed hourly average may be performed to validate that the hourly average temperatures remain within the limits. The forecast data will be updated every 2 hours to ensure temperature changes are incorporated. The 2 hour update time is a reasonable time to ensure the prediction remains valid for changes in temperature. This protects the ultimate heat sink peak heat load by ensuring the analysis temperature requirements remain bounded. This will ensure that daily temperature variations and weather changes will not cause an unpredicted Technical Specification action entry. The 3 day average will typically be evaluated by using the national weather service hourly temperatures for the next 72 hours and averaged. The forecast data will be updated every 12 hours to ensure temperature changes are incorporated. The 12 hour update time is a reasonable time to ensure the prediction remains valid for changes in temperature. The 3 day average temperature protects the ultimate heat sink heat loads and inventory requirements. The Section 4.5.4.2 new UFSAR table will be used to evaluate the average restrictions when forecast data is not available. It may also be conservatively used when the time of year is such that online forecast data is not needed to demonstrate the temperature requirements will be met.

In addition, the Technical Specification Action d specifies that the temperature readings are only required when the Technical Specification Table 3.7-3 limitations apply. The ultimate heat sink configurations with no temperature limitations means that the ultimate heat sink can meet the design basis heat removal with the maximum design basis ambient temperatures.

4.4 New Technical Specification 3.7.4 Action e and New Surveillance 4.7.4.c

The calculation ECM95-008 existing and revised analysis credits the wet cooling tower basin cross-connect line for additional water inventory margin. A new Technical Specification action and surveillance for the wet cooling tower basin cross-connect function were added. The proposed enhancement clarifies how an inoperable wet cooling tower basin cross-connect line impacts the operability of the ultimate heat sink. The Technical Specification action for the basin cross-connect function clarifies that both ultimate heat sink trains do not have to be considered inoperable when the basin cross-connect is not operable. The existing inservice testing requirements for testing the open safety function of the wet cooling tower basin cross-connect isolation valves satisfy the new Technical Specification surveillance requirement.

Crediting the second wet cooling tower basin after an accident has already been approved by the NRC.

NUREG-0787 Section 9.2.5 states:

> The wet cooling tower basins can be manually interconnected through a seismic Category I line in order to take advantage of the full storage volume in the event of a single active failure to one tower.

In addition, Waterford 3 license amendment 139 [Reference 7.28] safety evaluation states:

> In the Safety Evaluation Report (SER) for Waterford 3, NUREG-0787, the staff gave credit for the Category I cross-connect between basins and concluded that the UHS provided sufficient cooling for at least 30 days under all design basis conditions in accordance with the guidance of RG 1.27 "Ultimate Heat Sink." Because of the seismic Category I cross-connect, it was not necessary to demonstrate that the volume of one wet cooling tower basin was sufficient to last 30 days following a

design basis LOCA. The staff further concluded that the UHS met the requirements of General Design Criterion 44, "Cooling Water," with respect to decay heat removal capability.

The wet cooling tower basin cross-connect isolation valves are already tested for an open safety function in accordance with procedure OP-903-118 [Reference 7.30]. Procedure EP-002-100 [Reference 7.31] already addresses opening the wet cooling tower basin cross-connect isolation valves after a design basis accident or tornado. This means that the analyses crediting transferring water between wet cooling tower basins via the seismic category I cross-connect line for additional inventory margin after design basis accidents has previously been approved by the NRC and the revision to calculation ECM95-008 continues to credit the wet cooling tower basin cross-connect safety function.

The Technical Specification 3.7.4 Action e times are reasonable times considering the need to provide makeup water sources are not an immediate operator action (approximately 22 hours after a tornado and approximately 55 hours after a loss of coolant accident) and other non-safety water sources would most likely be available.

4.5 Technical Specification 3.7.4 Table 3.7-3

Technical Specification 3.7.4 Table 3.7-3 is part of Technical Specification 3.7.4 Item c and Technical Specification Action d which provides restrictions on ultimate heat sink operability for dry cooling tower and wet cooling tower fan requirements. Calculation ECM95-008 establishes the ultimate heat sink design basis which provides the parameters contained in Technical Specification 3.7.4 Table 3.7-3. This section describes the major changes to calculation ECM95-008 and inputs since the NRC performed a detailed review in Waterford 3 license amendment 237. From an overview perspective, the changes associated with Technical Specification Table 3.7-3 are mainly due to the recirculation impacts and the changes to recover that margin. Engineering Change (EC) 52043 [Reference 7.19] revises the design basis and authorizes installation of modifications to the ultimate heat sink to restore margin to compensate for non-conservative recirculation impacts and inappropriate wet cooling tower capacity calculations. The main modification is the dry cooling tower recirculation barrier which limits the recirculation effect to maintain dry cooling tower air inlet temperatures to less than the original value listed in the UFSAR and ECM95-008 for the fan inlet temperature design point (103.9°F).

Calculation ECM95-008 establishes the design basis dry cooling tower heat transfer capacity for the bounding dry bulb temperature with 15 operable dry cooling tower fans. The design basis wet cooling tower heat transfer capacity is with a design basis wet bulb temperature with 8 operable wet cooling tower fans. The Technical Specification Table 3.7-3 dry cooling tower fan requirements are based on ambient temperature limits that maintain the design basis dry cooling tower heat transfer capacity with fewer operable dry cooling tower fans. The existing dry cooling tower fan requirements were based on non-conservative assumptions regarding hot air recirculation. The bounding hot air recirculation is higher at lower ambient temperatures, when bounding ambient wind speeds are higher, causing a non-linear relationship between dry cooling tower heat transfer capacity and ambient temperature. In addition, the existing Technical Specifications do not address the potential for isolating dry cooling tower tube bundles for maintenance. The analyses in the proposed change account for bounding combinations of meteorological parameters, dry and wet cooling tower hot air recirculation, as well as potential dry cooling tower tube plugging and sleeving, and the need to occasionally isolate dry cooling tower tube bundles for maintenance. The analysis establishes dry cooling tower fan, wet cooling tower fan, and tube bundle requirements based on one hour and three day average ambient temperature limits that maintain total ultimate heat sink heat transfer capacity and water inventory margin. Thus, the proposed change provides conservative Technical Specification fan requirements, addresses dry cooling tower tube bundle requirements, and introduces combination dry cooling tower and wet cooling tower fan requirements based on both one hour and three day average temperature forecasts for achieving total ultimate heat sink design basis heat transfer capacity and water inventory margin.

The major changes to the ultimate heat sink design basis calculation ECM95-008 and associated inputs are summarized below and described in the associated subsections.

- Dry Cooling Tower Recirculation Barriers (Subsection 4.5.1)
  The dry cooling tower recirculation barriers are a passive structure that limits the dry cooling tower recirculation effects. This modification provides real ultimate heat sink performance improvements.

- Computational Fluid Dynamics Model (Subsection 4.5.2)
  The computational fluid dynamic models predict the dry cooling tower recirculation barrier impact and calculate bounding cooling tower recirculation effects for varying meteorological conditions.

- Wet Cooling Tower Performance Curves (Subsection 4.5.3)
  The wet cooling tower performance curves were created based upon the manufacturer's information and validated during testing. These performance curves allow one wet cooling tower fan to be taken out of service.

- Meteorological Parameters (Subsection 4.5.4)
  This section describes the bounding meteorological parameters and relationships that were used in the computational fluid dynamic models and the ultimate heat sink analyses.

- Component Cooling Water Safety Injection Actuation Signal Temperature (Subsection 4.5.5)
  The safety injection actuation signal automatically raises the component cooling water supply temperature. The temperature setpoint is increased to improve dry cooling tower heat transfer performance.

- Dry Cooling Tower Fan Backflow Preventers (Subsection 4.5.6)
  The dry cooling tower fan backflow preventers are utilized to prevent backflow through out of service dry cooling tower fans. The backflow prevention improves dry cooling tower performance and enables more flexible Technical Specification Table 3.7-3 temperature limits.

- Manual Actions (Subsection 4.5.7)
  Manual operator actions were evaluated with respect to the regulatory requirements. The actions are procedurally driven, access to equipment is available, and significant time exists to complete the actions.

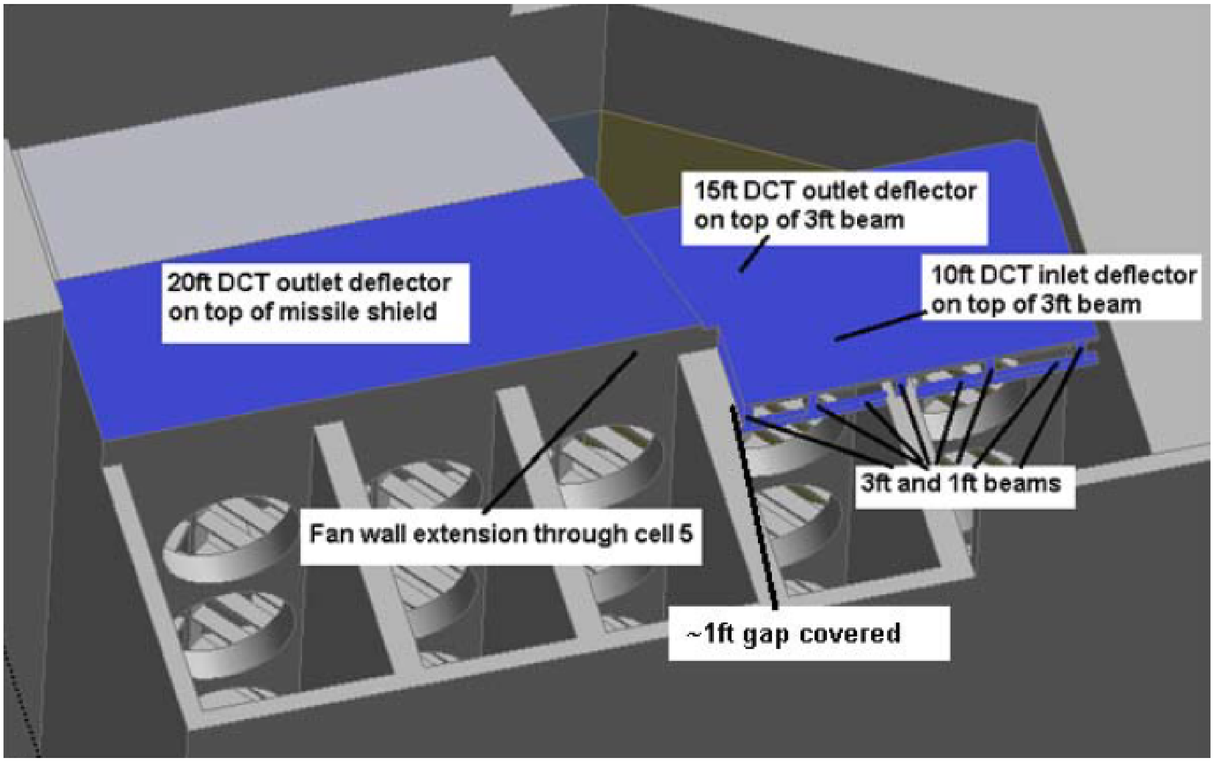
- Ultimate Heat Sink Design Basis Reconstitution (Subsection 4.5.8)
  Engineering change EC 52043 resolved multiple issues and updated analyses items within the 10 CFR 50.59 process. Even though these are covered by a separate process, many would still be pertinent to the NRC review of this change. A summary list is provided to support the NRC review.

- Ultimate Heat Sink Design Bases Summary (Subsection 4.5.9)
  The ultimate heat sink design meets Regulatory Guide 1.27 requirements.

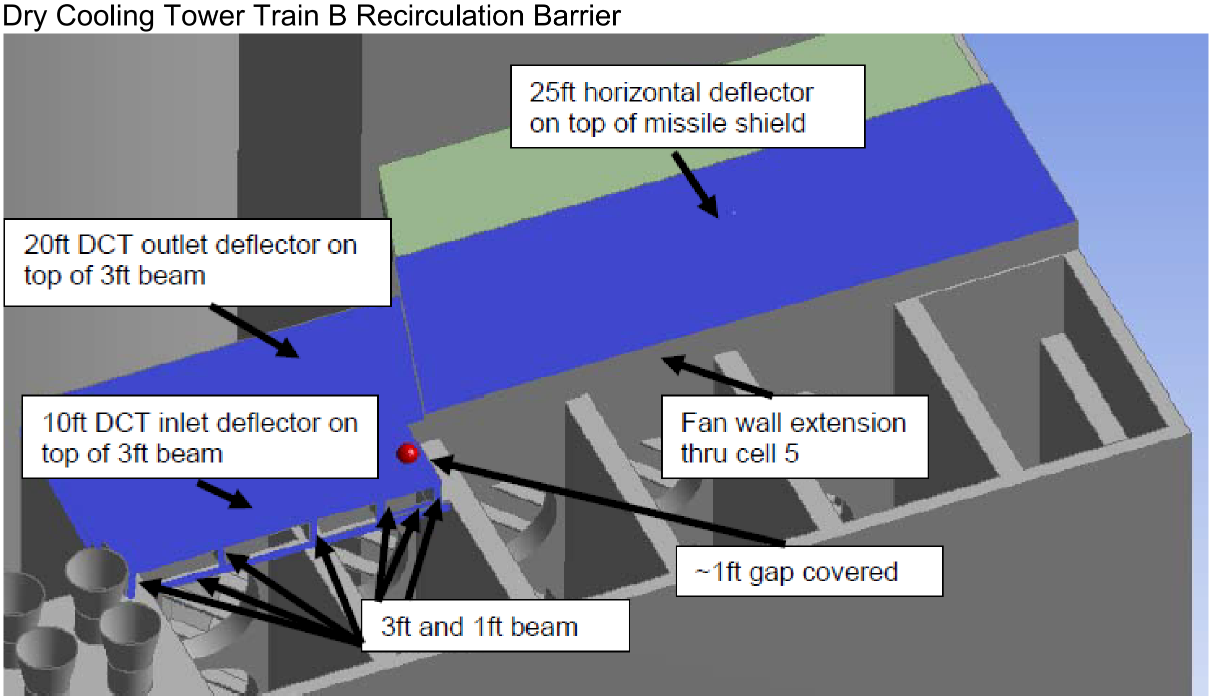
4.5.1 Dry Cooling Tower Recirculation Barriers

The recirculation effect is the difference between remote ambient temperature and the temperature of the air entering the cooling tower heat exchanger surfaces. Waterford 3 identified that the recirculation impacts were non-conservative with respect to UFSAR Section 9.2.5.3.2 and calculation ECM95-008. The EC 52043 change authorizes installation of the dry cooling tower recirculation barriers (DCTRB) above all ten dry cooling tower tube bundles on both trains. The dry cooling tower recirculation barrier limits the recirculation effect to maintain dry cooling tower air inlet temperatures to less than the original design point value listed in the UFSAR and ECM95-008 which was 103.9°F (102°F ambient + 1.9°F recirculation). As a structure, the dry cooling tower recirculation barriers meets the 10 CFR 50.59 requirements to be installed but due to Technical Specification 3.7.4 changes, the thermal hydraulic benefits cannot be realized until after NRC approval of this change. The dry cooling tower recirculation barriers are designed to maintain existing structural qualifications, including seismic, wind, and tornado loading. As an added benefit, a rain collection gutter is added to the dry cooling tower recirculation barriers to direct precipitation that falls onto the new dry cooling tower recirculation barriers out of the cooling tower area, thereby improving ponding margin for the design basis precipitation events. The dry cooling tower recirculation barrier increases separation between inlet and exhaust and provides a real ultimate heat sink performance improvement. The modifications are illustrated below to provide a visual of the location on the dry cooling towers.

Dry Cooling Tower Train A Recirculation Barrier

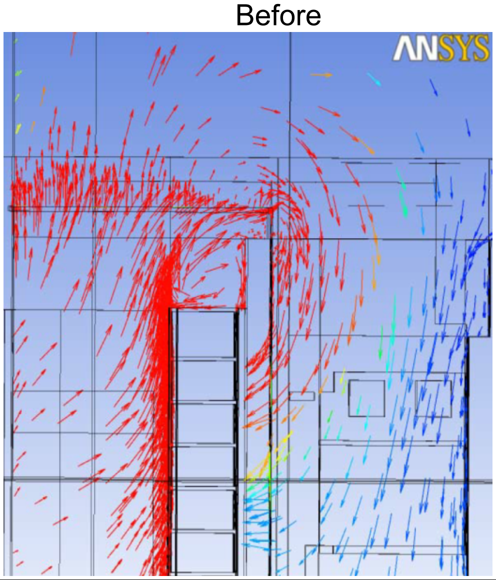
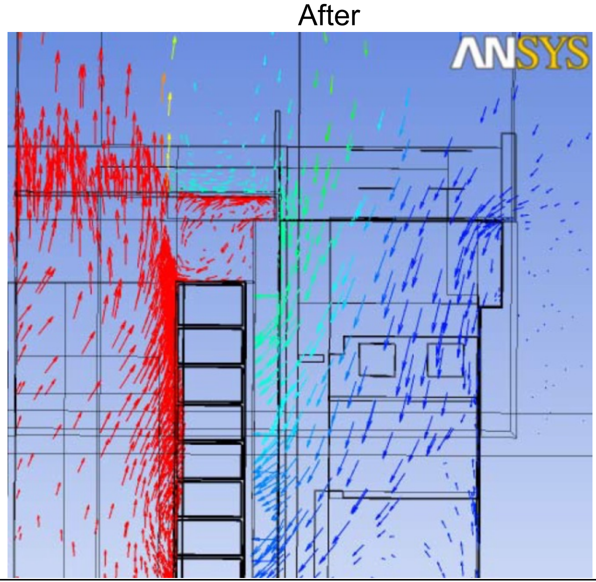


Dry Cooling Tower Train B Recirculation Barrier



Engineering Report WF3-ME-15-00014 [Reference 7.21] provides the computational fluid dynamic model of the dry cooling tower recirculation barrier impact. The WF3-ME-15-00014 results demonstrate that the dry cooling tower recirculation barrier limits the recirculation effect to maintain dry cooling tower air inlet temperatures to less than the original design point value listed in the UFSAR, which was 103.9°F (102°F + 1.9°F recirculation). In addition, the results demonstrate that the dry cooling tower recirculation barrier limits the recirculation effect to maintain fan inlet temperatures less than 103.9°F for other potential combinations of ambient temperature and wind. The WF3-ME-15-00014 results demonstrate that the dry cooling tower fan flows after installation of the dry cooling tower recirculation barrier all remain above the stall limit and that dry cooling tower fan flowrate is influenced more by ambient wind speed and direction than by the resistance caused by the dry cooling tower recirculation barrier. The ultimate heat sink thermal performance evaluations in ECM95-008 account for limiting dry cooling tower fan flow rate in demonstrating that the ultimate heat sink is capable of cooling safety related equipment for the design basis mission time with margin. The addition of the dry cooling tower recirculation barriers improves thermal performance and meets the structural requirements of the ultimate heat sink.

Below is an elevation view of air flows around the middle cell illustrating the before (before installation of the dry cooling tower recirculation barriers) and after (after installation of the dry cooling tower recirculation barrier). The red arrows indicate hot air that is being discharged from the dry cooling tower and the blue arrows show cooler, ambient air. A significant improvement can be seen by the installation of the dry cooling tower recirculation barrier as the inlet and discharge flows remain separated. The dry cooling tower recirculation barrier effectiveness is dependent upon ambient conditions and dry cooling tower heat load. The below illustration is a representation of the impact. The next section provides the specific dry cooling tower recirculation barrier results.

Before	After
	

4.5.2 Computational Fluid Dynamics Model

Engineering Report WF3-ME-15-00014 addresses a computational fluid dynamics investigation of recirculation flows for the dry and wet cooling towers under a range of temperature and wind conditions. The recirculation effect refers to the potential for the dry cooling tower or wet cooling tower to draw hotter exhaust side air into the inlet side, increasing the effective ambient temperature and reducing heat removal performance. The recirculation of the wet cooling tower and dry cooling tower affects the heat removal for the ultimate heat sink. The proposed modification to the dry cooling tower structure consists of a recirculation barrier to maintain separation between the dry cooling tower inlet air and heated dry cooling tower exhaust air.

The complex flow field produced under accident condition dry cooling tower and wet cooling tower operation was evaluated using ANSYS CFX, a 3D CFD software package. ANSYS CFX is an appropriate method for evaluating the complex geometry and mix of buoyancy, wind, and fan driven flows. ANSYS CFX is qualified for use on safety related projects. Model verification was accomplished through software verification, two independent computational fluid dynamic calculations, as well as through sensitivity studies. To ensure model quality, the general guidance provided in NUREG-2152 [Reference 7.22] was followed. NUREG-2152 describes best practice guidelines for computational fluid dynamics, specifically for dry storage cask applications. However, the practices described in NUREG-2152 are general in nature and are therefore applicable to a wide range of applications, including the evaluation described herein.

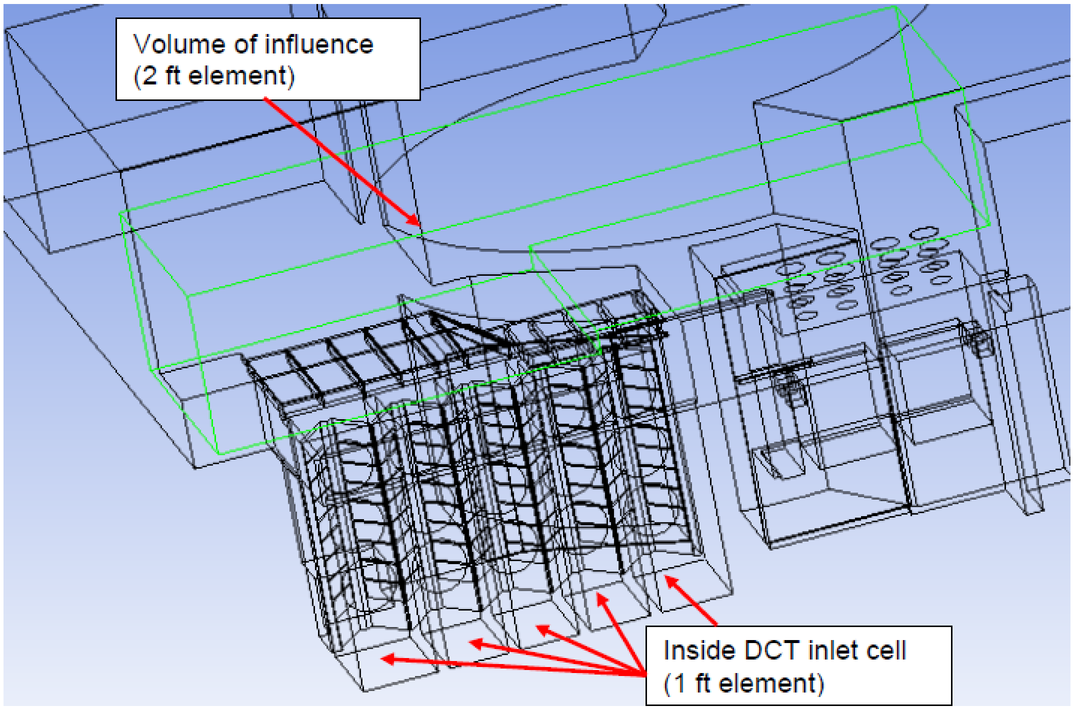
4.5.2.1 Model Geometry and Meshing

The plant buildings and cooling tower geometry were created in AutoCAD. This geometry file was imported to ANSYS Mechanical software for meshing. The geometry includes buildings around dry cooling tower and wet cooling tower that would affect air flow including containment, the fuel handling building, and turbine building, and additional structures such as the fuel oil storage tank cover, missile shield, and porous domains that represent the pipes and steel beams.

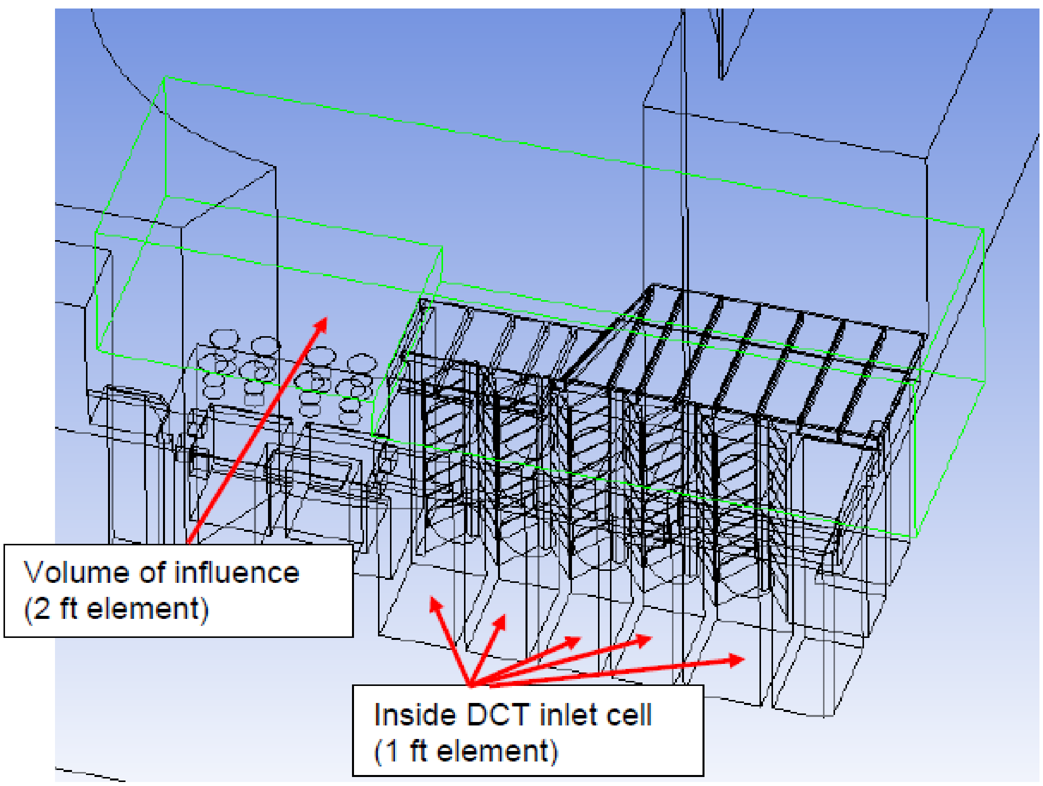
Meshing involves the division of the air spaces into many small elements for CFD analysis, which was performed automatically within the ANSYS Mechanical software. The CFD solver evaluates the fluid variables, i.e. pressure, velocity, temperature, etc., in each element numerically.

The total number of elements was 16 million in train A and 15 million in train B. The mesh size was controlled through the use of a “volume of influence” feature within ANSYS CFX. The volume of influence is shown as green boxes train A and train B below.

Train A Volume of Influence



Train B Volume of Influence



The volume of influence feature allows the definition of a more precise (smaller) element spacing within the zone and coarser spacing outside of the zone. The volume of influence was defined as roughly a box extending in height from the missile shield to ~15 ft below the top of the fuel handling building, extending in length from the fuel handling building vertical wall to the dry cooling tower inlet side exterior wall, and in width to cover all the dry cooling tower and wet cooling tower. Within the zone, elements were limited to 2 ft. Elements were limited to 5 ft outside of the zone and expanded to a maximum of 50 ft elements in the far field away from the plant. Additional cell volumes at the boundary were defined for each dry cooling tower inlet cell, with a maximum element size of 1 ft. This feature allowed more precise control of element density within the desired areas yet smaller overall element counts through the remainder of the mesh. Additional element size control at the boundary was done in the dry cooling tower outlet area for Train A, with a maximum of 0.5 ft element. Most of the elements are tetrahedral elements.

Mesh sensitivity studies were conducted with changes in the mesh size. The mesh element size inside the volume of influence was varied to be 1 ft (fine mesh), 2 ft, and 4 ft (coarse mesh). The cases in this study used the B Train geometry and simulated a south wind at 30mph with 90F ambient temperature. This case was used because it produces the highest recirculation among all cases. More accurate numerical evaluation showed subtle differences in fan inlet temperatures. The next table shows the resulting fan inlet temperatures for the 15 fans using the 4 ft, 2 ft, and 1 ft element size models. It can be seen that the average fan temperature for the 1 ft and 2 ft element size model were the same. The 4 ft model has a higher recirculation, which is due to the coarse mesh size. It can be seen that the maximum fan temperatures difference between the 4 ft and 1 ft model was 7.7°F, with an average difference of 1.5 over all fans. The 2 ft model provides a maximum difference of 0.8°F and average temperature within 0.1°F. Based on these results, the 2 ft element size model was determined to be sufficiently accurate for this study.

4 ft Element Model					
Individual fan temperature (deg F)					
Cell:	5	4	3	2	1
	105.1	102.8	101.8	102.1	100.0
	99.5	102.3	100.3	99.5	95.9
	97.2	97.6	97.2	93.9	93.6
Average fan temperature:				99.2	

2 ft Element Model					
Individual fan temperature (deg F)					
Cell:	5	4	3	2	1
	97.3	103.0	105.3	104.0	100.7
	93.9	95.8	100.4	98.7	95.6
	97.0	92.1	94.1	93.3	94.0
Average fan temperature:				97.7	

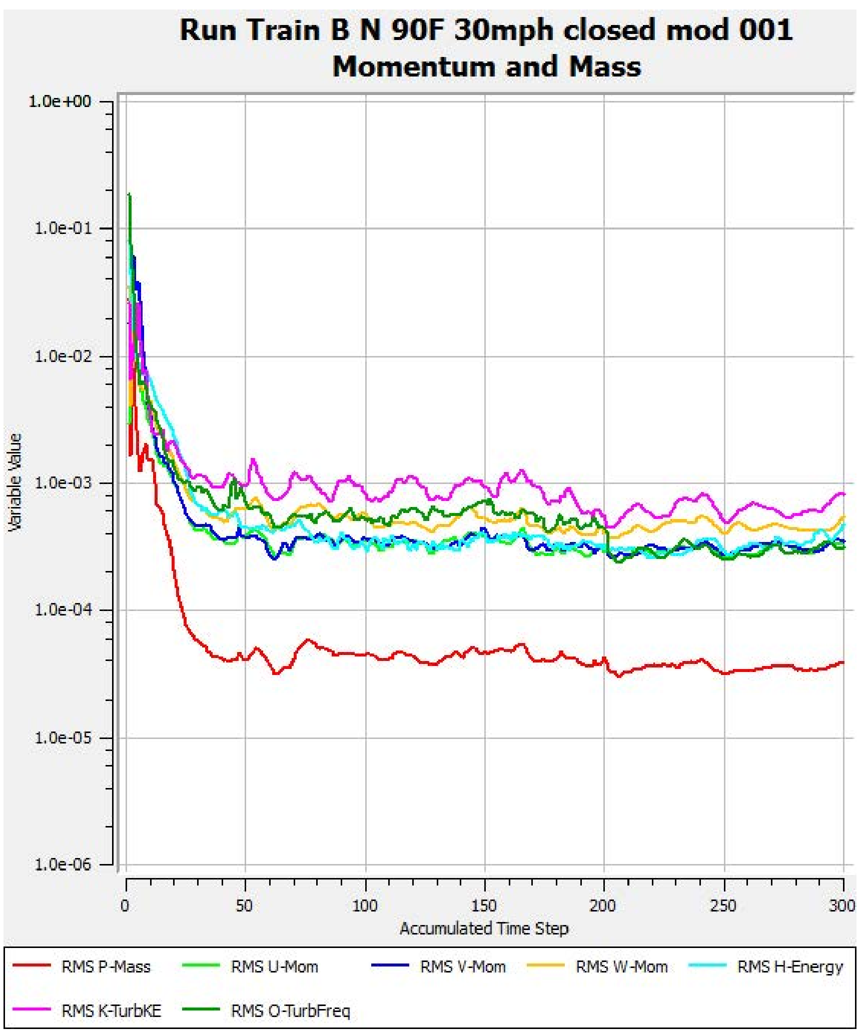
1 ft Element Model					
Individual fan temperature (deg F)					
Cell:	5	4	3	2	1
	97.4	102.2	105.0	104.0	101.2
	94.1	95.8	99.9	98.6	96.1
	96.5	92.5	94.3	93.7	94.6
Average fan temperature:				97.7	

4.5.2.2 Convergence Criteria

Each evaluation model was run for several hundred iterations (typically 500-600) prior to termination. Solution outputs were obtained from averaging the last 50-100 steps. Convergence on an acceptable solution set was determined based on two primary criteria:

1. Stable behavior of the average dry cooling tower inlet fan temperature. This is the average temperature of the 15 operating dry cooling tower fan inlets, and was judged acceptable if it oscillated within a small range.
2. Reduction of the model residuals to a stable range.

Residuals are associated with difference between the solution and a conservation law such as mass, momentum, or energy. In ANSYS CFX, the residuals are normalized by a reference value based on the solution range. A general criterion for residuals is 10^{-3} (1e-3) to 10^{-4} (1e-4). The next figure shows an example of residuals for dry cooling tower recirculation barrier train B. The values included in the plot are the residuals relative to conservation of mass, momentum in 3 directions, and energy. The residuals show the mass equations were under 1e-4 in all cases, and the momentum, energy, and turbulence residuals were approximately 1e-3. Results were judged acceptable within the general criterion of 1e-3 to 1e-4 range.



4.5.2.3 Mesh Quality

Mesh quality includes several parameters that help assure a numerically stable and accurate solution. This includes avoidance of the following: highly skewed elements with orthogonal angles <20 deg, large jumps in grid density, or large aspect ratios (>100).

The ANSYS CFX output file shows mesh quality metrics for the minimum orthogonal angle, maximum expansion factor between grids, and the maximum aspect ratio for each domain. Less than 1% of the fluid mesh elements were shown as poor quality which is considered insignificant.

4.5.2.4 Turbulence Modeling

There are several schemes to model turbulent flow available in ANSYS CFX. Three of the most common are the k-epsilon (k-ε) model, k-omega (k-ω) model, and the shear stress transport model (SST). The base k- ε model is the standard, while the k-ω model is considered an improvement in terms of the boundary layer and separated flow, The SST model combines many of the characteristics of the k-ω model near wall boundaries with the k-ε model further away from structures. Given the complex geometry and potential wake effects from the adjacent buildings, the SST model was chosen.

In this section, the k-ω turbulence model results are compared with other turbulence models, the k-ε and SST. The intent is to determine if there are significant differences in order to assure that error was not introduced through the choice of the SST scheme. The boundary conditions for all inlets and outlets were the same conditions as in the mesh density study. The mesh density used in this turbulence study is 2 ft elements size.

The next table shows a comparison of the fan inlet temperatures for the 3 turbulence models. The k-omega and SST models provide the same average temperature for the 15 fans (97.7°F). The k-epsilon model is considered less accurate for the prediction of separated flow, which is particularly important in the building wake region. As a second comparison, the table also provides the fan flow rate, calculated from the inlet and outlet pressures. It can be seen that the fan flows were between 177,000cfm and 180,000cfm. The differences are considered insignificant.

Based on the equivalent average temperatures, with only modest differences between the k-omega and the SST models, and based on the prediction of the fan flow using the SST compared to the other turbulence models, the selected SST model is considered to provide an accurate representation of turbulent flow.

K-Omega Model					
Individual fan temperature (deg F)					
Cell:	5	4	3	2	1
	95.3	97.4	107.1	106.0	103.2
	95.3	94.2	98.8	98.2	96.8
	97.0	93.0	94.1	94.0	95.5
Average fan temperature:				97.7	
Fan Flow Rate (x1000cfm)				177	

K-Epsilon Model					
Individual fan temperature (deg F)					
Cell:	5	4	3	2	1
	99.3	102.7	105.3	103.7	101.1
	96.0	96.9	100.5	99.5	97.3
	97.7	94.0	95.6	94.8	95.5
Average fan temperature:				98.7	
Fan Flow Rate (x1000cfm)				178	

SST Model					
Individual fan temperature (deg F)					
Cell:	5	4	3	2	1
	97.3	103.0	105.3	104.0	100.7
	93.9	95.8	100.4	98.7	95.6
	97.0	92.1	94.1	93.3	94.0
Average fan temperature:				97.7	
Fan Flow Rate (x1000cfm)				180	

4.5.2.5 Independent Model Verification

ANSYS CFX is a software code approved for nuclear safety related projects. In addition to verification requirements, two independent models using a separate computational fluid dynamics code (Fluent) were evaluated to verify the computational fluid dynamics model approach. This independent analysis performed a full transient simulation to verify the steady state conditions considered in the ANSYS CFX analysis as well as the adequacy of the ANSYS CFX software.

The ANSYS CFX to Fluent comparison for train A showed the dry cooling tower fan temperature results are within 1°F and there is a good correlation between the two models. The ANSYS CFX to Fluent comparison for train B showed that ANSYS CFX over predicted dry cooling tower fan temperature by 3.5°F. The flow patterns and temperatures showed a good correlation between the two models.

4.5.2.6 Model Benchmark

An ANSYS CFD model of the current configuration (i.e. no deflector walls) was benchmarked against the 1982 startup test measured data. The predicted dry cooling tower recirculation from ANSYS CFD result showed a good agreement with the measured data. Test data from the startup test case, from 8/19/82 from 10:00AM-10:30AM was evaluated. Wind was recorded for the A side test as northly at an average of 3.6 mph. The ambient temperature over this period averaged 85.87°F. The inlet to the dry cooling tower averaged 93.65°F for 3 temperature instruments, producing 7.8°F recirculation. The ANSYS CFD model relationship for recirculation produced 9.9°F recirculation. The ANSYS CFD model prediction was therefore comparable and conservative by approximately 2.1°F.

4.5.2.7 ANSYS CFD Model Results

Engineering Report WF3-ME-15-00014 primary goal was to evaluate the recirculation effect at the dry cooling tower and wet cooling tower inlets. The dry cooling tower results were numerically evaluated to determine the degree of recirculation by querying the model for the area temperature for the 15 dry cooling tower fan inlet circular planes. The wet cooling tower recirculation was calculated by the recirculated mass flow with 100% humid air, the increase in wet cooling tower inlet temperature and the resulting increase in inlet wet bulb temperature. This study included a range of wind and temperature conditions and the effects of removing dry cooling tower fans from service.

COOLING TOWER TRAIN A RESULTS

Eleven analysis cases, based on the bounding Waterford 3 site ambient temperature and wind combinations, were run to evaluate recirculation around the dry cooling tower and wet cooling tower. Wind direction included each 45 degree increment from North to South in the fuel handling building wake, i.e. North, Northeast, East, Southeast, and South. Because recirculation is most significantly influenced by the fuel handling building, wind from westerly directions does not produce significant recirculation. Five cases addressed high wind speed, i.e. 30mph with 90°F ambient temperature. Five cases addressed low wind speed (10mph) with high temperature (98°F). A 102°F/static wind condition was run to evaluate the UFSAR defined conditions. These cases were established based on the relationship between site ambient wind and temperature conditions as discussed in Section 4.5.4 as well as the observed increase in recirculation with wind speed.

The dry cooling tower summary results are tabulated in the next table and include the dry cooling tower average fan temperatures, recirculation effects, and fan flows. The average fan temperature is calculated from the area average of the 15 inlet boundary (fan) planes. Fan flows are shown to be 160,000 cfm or greater for all wind cases except for the East wind case, which showed 151,000 cfm but small recirculation effects. It can be seen that the deflector wall modification is effective in keeping dry cooling tower recirculation to minimal amounts (<3.1F) for all wind cases except the NE wind. The limiting case is approximately 5.6F based on NE 30mph wind.

Dry Cooling Tower Train A Recirculation Results

	Input Conditions			CFD Model Results		
Case	Wind Direction	Ambient Temp (F)	Wind speed (mph)	Average fan temp (F)	Recirc (F)	Fan flowrate (x1000 cfm)
1	NE	90	30	95.6	5.6	163
2	SE	90	30	93.1	3.1	157
3	N	90	30	91.3	1.3	168
4	S	90	30	92.2	2.2	171
5	E	90	30	91.5	1.5	151
6	NE	98	10	100.2	2.2	163
7	SE	98	10	98.7	0.7	165
8	N	98	10	98	0	161
9	S	98	10	98.7	0.7	166
10	E	98	10	99.4	1.4	162
11		102	0	102	0	166

For out-of-service fans with no backflow prevention, Engineering Report WF3-ME-15-00014 shows that dry cooling tower recirculation is increased by backflow through out-of-service dry cooling tower fans. The increase is bounded by 3°F for one uncovered out-of-service fan, 6°F for two uncovered out-of-service fans, 9°F for three uncovered out-of-service fans. ECM95-008 increases the recirculation impact by these amounts for varying fans being out-of-service.

Wet cooling tower recirculation data are presented in the next table. This table shows wet cooling tower recirculation over a range of ambient relative humidity values and the resulting maximum values. Bounding cases were produced by SE wind directions. The highest wet cooling tower recirculation case was 8.3°F, produced by Southeast wind at 30 mph.

Wet Cooling Tower Train A Recirculation Results

	Input Conditions			CFD Results			Calculated Values						
Case	Wind dir'n	Dry Bulb Temp.	Wind speed	Total mass flow	Mass Recirc	Average WCT temp	50% RH	60% RH	70% RH	80% RH	90% RH	100% RH	Max recirc
		(F)	(mph)	(lb/s)	(lb/s)	(F)	Twb increase (deg F)						
1	NE	90	30	507	71.6	94.4	3.5	3.7	3.8	3.9	4	4.1	4.1
2	SE	90	30	504	169	96.7	7.0	7.4	7.8	8.1	8.3	6.7	8.3
3	N	90	30	500	95.5	100.7	5.8	5.9	6	6.1	6.2	6.2	6.2
4	S	90	30	504	126	98.1	6.1	6.4	6.6	6.8	6.9	7.1	7.1
5	E	90	30	507	50	92	2.2	2.3	2.5	2.6	2.6	2.0	2.6
6	NE	98	10	504	42.2	99.9	2.0	2.1	2.2	2.3	2.4	1.9	2.4
7	SE	98	10	504	116	100.6	4.7	5.1	5.3	5.6	5.5	2.6	5.6
8	N	98	10	504	31.5	98.8	1.4	1.5	1.5	1.6	1.7	0.8	1.7
9	S	98	10	504	105	100.3	4.3	4.6	4.9	5.1	5.2	2.3	5.2
10	E	98	10	504	99.7	69.8	2.9	3.2	3.3	3.5	3.6	1.7	3.6
11		102	0	506	18	102.4	0.8	0.8	0.9	0.9	1.0	0.4	1.0

ECM95-008 uses the bounding wet cooling tower recirculation of 8.8°F for the analysis. The bounding temperature is taken from the cooling tower train B results.

COOLING TOWER TRAIN B RESULTS

Eleven analysis cases, based on the bounding site ambient temperature and wind combinations were run to evaluate recirculation around the dry cooling tower and wet cooling tower. Wind direction included each 45 degree increment from North to South in the fuel handling building wake, i.e. North, Northwest, West, Southwest, and South. Because recirculation is most significantly influenced by the fuel handling building, wind from easterly directions does not produce significant recirculation. Five cases addressed high wind speed, i.e. 30mph with 90°F ambient temperature. Five cases addressed low wind speed (10mph) with high temperature (98°F). A 102°F/static wind condition was run to evaluate the UFSAR defined conditions. These cases were established based on the relationship between site ambient wind and temperature conditions as discussed in Section 4.5.4 as well as the observed increase in recirculation with wind speed.

The dry cooling tower summary results are tabulated in the next table and include the dry cooling tower average fan temperatures, recirculation effects, and fan flows. The average fan temperature is calculated from the area average of the 15 inlet boundary (fan) planes. Fan flows are shown to be greater than 165,000cfm for all cases. The limiting case is based on a south wind at 30mph which produced dry cooling tower recirculation of 7.7°F.

Dry Cooling Tower Train B Recirculation Results

	Input Conditions			CFD Model Results		
Case	Wind direction	Ambient Temp (F)	Wind speed (mph)	Average fan temp (F)	Recirc (F)	Fan flowrate (x1000 cfm)
1	NW	90	30	96.5	6.5	177
2	SW	90	30	96.6	6.6	177
3	N	90	30	91.9	1.9	184
4	S	90	30	97.7	7.7	180
5	W	90	30	92.2	2.2	166
6	NW	98	10	102.7	4.7	177
7	SW	98	10	100.6	2.6	176
8	N	98	10	98	0.0	181
9	S	98	10	98.8	0.8	179
10	W	98	10	99.1	1.1	175
11		102	0	102.2	0.2	180

For out-of-service fans with no backflow prevention, Engineering Report WF3-ME-15-00014 shows that dry cooling tower recirculation is increased by backflow through out-of-service dry cooling tower fans. The increase is bounded by 3°F for one uncovered out-of-service fan, 6°F for two uncovered out-of-service fans, 9°F for three uncovered out-of-service fans. ECM95-008 increases the recirculation impact by these amounts for varying fans being out-of-service.

Wet cooling tower recirculation data are presented in the next table. This table shows wet cooling tower recirculation over a range of ambient relative humidity values and the resulting maximum values. For some cases, the wet cooling tower recirculation at 100% humidity was lower than 90% RH because air at 100% humidity was already saturated and more moisture could not be added. The bounding wet cooling tower recirculation was 8.8°F for the South wind 90°F 30mph case.

Wet Cooling Tower Train B Recirculation Results

	Input Conditions			CFD Results			Calculated Values						
Case	Wind dir'n	Dry bulb Temp.	Wind speed	Total mass flow	Mass Recirc	Average WCT temp	50% RH	60% RH	70% RH	80% RH	90% RH	100% RH	Max recirc
		(F)	(mph)	(lb/s)	(lb/s)	(F)	Twb increase (deg F)						
1	NW	90	30	506	102.0	94.6	4.5	4.8	5	5.2	5.3	4.6	5.3
2	SW	90	30	508	49.7	94	2.7	2.8	2.9	2.9	3	3.1	3.1
3	N	90	30	502	27.0	99	3.2	3.2	3.1	3	3	2.9	3.2
4	S	90	30	495	131.0	107.3	8.3	8.5	8.6	8.6	8.7	8.8	8.8
5	W	90	30	505	93.7	94.9	4.3	4.6	4.7	4.9	5	4.9	5
6	NW	98	10	503	66.3	100.8	3.1	3.2	3.4	3.5	3.6	2.8	3.6
7	SW	98	10	503	145.0	101.5	5.9	6.3	6.6	6.9	6.4	3.5	6.9
8	N	98	10	503	4.5	99.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4
9	S	98	10	503	96.5	100.4	4	4.3	4.5	4.7	4.9	2.4	4.9
10	W	98	10	503	103.0	100.8	4.4	4.7	4.9	5.1	5.3	2.8	5.3
11		102	0	505	54.0	103.4	2.4	2.5	2.7	2.8	2.9	1.4	2.9

ECM95-008 uses bounding wet cooling tower recirculation of 8.8F for the analysis.

4.5.3 Wet Cooling Tower Performance Curves

During the review for Waterford 3 license amendment 237, the NRC identified in their request for additional information that the methodology being used for analyzing wet cooling fans out of service was not appropriate. Waterford 3 letter W3F1-2012-0019 acknowledged that the methodology was not appropriate for the application. Waterford 3 letter W3F1-2012-0028 changed the Technical Specification request to require all wet cooling tower fans to be operable regardless of ambient temperature due to this condition. Waterford 3 license amendment 237 required all wet cooling tower fans for the system to be operable.

Engineering Report WF3-ME-16-00011 documents the development of the new wet cooling tower performance curves which are used to predict wet cooling tower thermal performance and water consumption rates as a function of water flow rate, range, wet bulb temperature, and cold water temperature. The wet cooling tower performance curves are based on the following empirical information:

1. The model of simultaneous heat and mass transfer developed by Friedrich Merkel. Merkel Theory has been adopted by The Cooling Technology Institute as the basis for thermal performance rating and testing of evaporative cooling towers of all types.
2. Thermal performance and airflow resistance characteristics for a 5 foot depth of Munters CF-12060 cooling tower fill developed by Balcke-Dürr Aktiengesellschaft (Zurn Industries Cooling Tower Division's German Licensor).
3. Pressure drop characteristics for the wet cooling tower design's stainless steel drift eliminators developed by Zurn Industries' Swartwout Division in Kokomo, Indiana.
4. Wet cooling tower fan performance characteristics published by Aerovent (original wet cooling tower fan manufacturer).

5. Wet cooling tower A with all 8 fans in service test data.
6. Wet cooling tower A natural draft thermal performance test data.

The wet cooling tower thermal performance curves with all eight fans and with one fan out-of-service were developed and verified by testing. The confirmatory testing was required to verify that the new wet cooling tower performance curves conservatively predicted actual wet cooling tower performance. The test results showed that the thermal performance curves used in the ultimate heat sink analysis were conservative.

Out-of-service wet cooling tower fans are required to be covered to prevent short cycling of air flow where air is drawn through the out-of-service fan rather than through the cooling tower fill.

4.5.4 Meteorological Parameters

UFSAR Section 9.2.5.3.2 states that the ultimate heat sink design is based on the meteorological conditions listed in UFSAR Table 2.3-2(a). The method for determining meteorological parameters for design of the ultimate heat sink is described in UFSAR section 2.3. UFSAR Section 2.3 establishes bounding combinations of dry bulb and wet bulb temperatures. Regulatory Guide 1.27 requires determining the most severe combinations of controlling meteorological parameters for the design of the ultimate heat sink for the duration of the critical time periods, based on examination of regional climatological (>30 years) measurements that are demonstrated to be representative of the site. Historical studies were used to establish bounding conditions included in UFSAR section 2.3. A constant recirculation effect was applied to both dry bulb and wet bulb temperature.

Engineering Report WF3-ME-15-00011 [Reference 7.23] determines the bounding relationship between wind speed, wind direction, and ambient temperature. This information is used in Engineering Report WF3-ME-15-00014 for the determination of the cooling tower maximum recirculation effects.

Engineering Report WF3-ME-16-00001 [Reference 7.24] validates the UFSAR Table 2.3-2(a) meteorological parameters for the critical time periods.

4.5.4.1 Wind Speed, Wind Direction, and Ambient Temperature

Engineering Report WF3-ME-15-00011 [Reference 7.23] addresses an investigation of the Waterford 3 site meteorology, specifically the combination of wind speed, wind direction, and ambient temperature. These parameters affect the performance of the dry cooling tower and wet cooling tower, particularly with respect to recirculation effects. This report establishes the relationship between site ambient wind and temperature conditions and develops the limiting ambient wind and temperature combinations in order to conservatively address cooling tower recirculation.

A set of bounding points for the hourly at 99.9% and 99% confidence interval, as well as 99% 1 day and 3 day average temperature and wind speeds were obtained and are provided in the next table. It can be seen that the limiting wind cases evaluated in the computational fluid dynamic analysis (90^{o}F and 30mph wind) bound the worst combination of conditions from the 1 hour data (88^{o}F and 29 mph) with 99.9% confidence.

Bounding Temperature / Wind Points

	99.9% (1 hour)		99% (1 hour)		99% (1 day)		99% (3 day)	
	Temp (°F)	Wind (mph)	Temp (°F)	Wind (mph)	Temp (°F)	Wind (mph)	Temp (°F)	Wind (mph)
North	86	29	85	19	81	18	81	16
East	85	22	84	18	82	18	82	17
South	88	26	86	21	82	18	82	17
West	88	19	86	16	82	14	81	14

4.5.4.2 Meteorological Parameters for Critical Time Periods

Engineering report WF3-ME-16-00001 [Reference 7.24] used historical studies for the development of bounding meteorological parameter relationships for the design of the ultimate heat sink which is consistent with the methods described in the UFSAR and also meet the requirements of Regulatory Guide 1.27 in that it determines the most severe combinations of controlling parameters for the duration of the critical time periods, based on examination of regional climatological (>30 years) measurements that are demonstrated to be representative of the site. Therefore, the method of establishing the meteorological parameters for design of the ultimate heat sink are consistent with those described in the licensing basis and continue to execute the constraints and limitations associated with Regulatory Guide 1.27 and the NUREG-0787 Section 9.2.5 and so the development of the new meteorological parameters for design does not adversely affect a method of evaluation that demonstrates intended design function of an SSC will be accomplished as described in the UFSAR.

The next table provides the bounding values used in the analysis to ensure conservative results.

	Bounding Average Inlet Temperature	
Critical Time Period	Dry Bulb (°F)	Associated Wet Bulb (°F)
One Hour	102 / 98 / 92	78 / 83 / 86*
One Day	92	77*
Three Day	89	76*
Seven Day	86	78*
*based on maximum dry bulb / wet bulb combination		

Engineering report WF3-ME-16-00001 provided the data for the next table, which gives the maximum average dry bulb temperature as a function of the time of year by month. This information will be added to the UFSAR (Enclosure Attachment 3 – Commitment). This new UFSAR table will be used to evaluate the average temperature restrictions as the forecast data when online forecast data is not available. It may also be conservatively used when the time of year is such that online forecast data is not needed to demonstrate the temperature requirements will be met. Note that the one hour column is consistent with the information in existing FSAR Table 2.3-31.

Month	1 hour	3 day	7 day
January	83	73	69
February	84	74	71
March	87	76	74
April	91	80	79
May	96	83	82
June	102	86	85
July	99	88	86
August	100	88	86
September	97	85	84
October	92	83	80
November	86	75	73
December	83	73	71

4.5.5 Component Cooling Water Supply Temperature Setpoint

EC 52043 authorizes raising the safety injection actuation signal component cooling water supply temperature setpoint from 115°F to 117.4°F to improve the heat transfer capacity of the dry cooling tower. The safety injection actuation signal automatically raises the component cooling water supply temperature, improving dry cooling tower heat transfer. Raising the setpoint to 117.4°F improves dry cooling tower heat transfer performance even more. Instrument uncertainty calculation ECI91-036 [Reference 7.32] calculates the maximum uncertainty in the temperature control loop as 2.6°F. Thus, the maximum component temperature during design basis accident conditions would be 120°F.

The design basis calculations were updated to demonstrate that component cooling water supplied at up to 120°F in the accident lineup adequately cools all safety related equipment, including the emergency diesel generators, containment fan coolers, shutdown cooling heat exchanger, high pressure safety injection pumps, low pressure safety injection pumps, containment spray pumps, system piping, and fuel pool cooling heat exchanger and maintains their design basis temperatures. The essential chillers are automatically swapped to auxiliary component cooling water coolant when component cooling water supply temperature reaches 102°F and thus is not impacted by the safety injection actuation signal component cooling water supply temperature setpoint change. The design basis calculations demonstrate that the ultimate heat sink is capable of supplying required component cooling water flow to all components at temperatures less than or equal to 120°F during peak accident heat load under bounding ambient conditions. Therefore, the supply temperature to safety related components after a design basis accident with a safety injection actuation signal will be controlled less than or equal to 120°F.

NUREG-0787 Section 2.4.5 (Ultimate Heat Sink) previously discussed that the maximum design temperature was 120°F.

> The staff has reviewed the analysis presented by the applicant and concludes that the UHS would be capable of providing cooling water to Waterford 3 below the design temperature of 120°F.

Raising the safety injection actuation signal component cooling water supply temperature setpoint will not adversely impact the ability to maintain design basis temperatures of safety related equipment, thus meeting the requirements of Regulatory Guide 1.27 and GDC 44.

4.5.6 Dry Cooling Tower Fan Backflow Preventers

The analyses and Technical Specification Table 3.7-3 allow for crediting dry cooling tower fan backflow preventers to reduce hot air recirculation through idle dry cooling tower fans. The computational fluid dynamic evaluations conclude that if fans are out-of-service, the additional recirculation effect due to backflow through idle fans could be as high as 3°F for each out of service fan without a dry cooling tower fan backflow preventers.

The dry cooling tower fan backflow preventers are a passive device and no operator action is credited to close the dry cooling tower fan backflow preventers during any design basis accident. The dry cooling tower fan backflow preventers forms a passive component that simply needs to remain in place and intact after design basis events and natural phenomena to block reverse flow though the idle fan. The dry cooling tower fan backflow preventers would require manual local installation prior to crediting for the Technical Specification. The dry cooling tower fan backflow preventers are to be utilized when a dry cooling tower fan is declared inoperable in order to gain additional flexibility for dry cooling tower fan requirements and water inventory margin. If the dry cooling tower fan backflow preventers are not utilized on the inoperable dry cooling tower fan, then more restrictive dry cooling tower fan operability requirements would apply.

The dry cooling tower fan backflow preventers are to maintain existing structural qualifications of the dry cooling tower, including seismic, wind, and tornado loads. The dry cooling tower fan backflow preventers will not impact dry cooling tower fan performance because the dry cooling tower fan backflow preventers will only be utilized for dry cooling tower fans that have already been declared inoperable.

A test of the dry cooling tower fan backflow preventers is required to ensure that the dry cooling tower fan backflow preventers eliminate backflow through an out-of-service dry cooling tower fan. The dry cooling tower fan backflow preventers will be tested to confirm analysis requirements are met prior to crediting in Technical Specification Table 3.7-3 (Enclosure Attachment 3 - Commitment).

4.5.7 Manual Operator Actions

For design basis events which do not initiate a safety injection actuation signal (which would automatically isolate component cooling water from the fuel pool cooling heat exchanger and raise the component cooling water supply temperature setting) credit is taken for two new manual operator actions to reduce water consumption and maintain component cooling water flow balance when initiating shutdown cooling. The initiation of shutdown cooling is already a manual operator action. The manual action for reducing water consumption is to raise component cooling water supply temperature setpoint from the normal 88°F - 92°F setpoint to approximately 117°F in the control room when shutdown cooling is being initiated several hours after the event initiation. The manual action to maintain component cooling water flow balance is to throttle flow to the fuel pool cooling heat exchanger by manipulating valve positions in the fuel handling building. This manual local operation is already credited during a loss of coolant accident and tornado event. However, it is in response to different procedures that prompt restoration of fuel pool cooling after it was isolated by a safety injection actuation signal or low level in the component cooling water surge tank. These two new manual actions are only credited after initiation of shutdown cooling, when the peak heat load is applied to the ultimate heat sink during events without safety injection actuation.

For design basis accidents where wet cooling tower basin inventory makeup is not assumed, credit is taken for a new manual operator action to reduce water consumption by securing wet cooling tower fans after wet cooling tower heat load is reduced to only the essential chiller heat load. This action is taken several days after the start of the accident when the component cooling water heat exchanger is no longer required to maintain component cooling water supply temperature ≤ 117.4°F. The analysis shows that the maximum essential chiller heat load can be removed by the wet cooling tower in natural draft mode without exceeding design basis chiller coolant temperature limit of 110°F. This condition is indicated by closure of the component cooling water temperature control valve, ACC-126A(B), or less than or equal to 250 gpm auxiliary component cooling water through the shell of the component cooling water heat exchanger and dry cooling tower water outlet temperature ≤ 117.4°F. This manual action is to turn off wet cooling tower fans from the control room.

Procedures will be updated to implement administrative controls and operator actions credited in the analyses. To ensure that the proposed operator actions do not create a situation in which operators do not have sufficient time to correctly complete the required actions, the operator actions for raising component cooling water temperature, throttling component cooling water to the fuel pool cooling heat exchanger, and securing wet cooling tower fans were evaluated against NRC Inspection Manual IMC-326 [Reference 7.33], NRC Information Notice (IN) 97-78 [Reference 7.34], and ANSI/ANS-58.8-1994 [Reference 7.35]. NRC Inspection Manual IMC-326 provides guidance regarding substituting manual operator actions for automatic actions. The proposed change does not substitute manual operator action for any Reactor Protection System or Engineered Safety Features Actuation System automatic actions. The proposed changes to credit manual operator actions to raise component cooling water supply temperature and throttle component cooling water flow to the fuel pool cooling heat exchanger are only for certain less severe accidents that do not include the conditions of more severe accidents, such as a loss of coolant accident, which would have initiated similar automatic actions (safety injection actuation signal) or that have no similar automatic action at all. The proposed changes to credit manual operator action to secure wet cooling tower fans several days into design basis accidents in order to conserve water inventory is also not replacing an automatic action.

The new manual operator actions were evaluated against NRC Information Notice 97-78 [Reference 7.34], NRC Inspection Manual IMC-326 [Reference 7.33], and ANSI/ANS-58.8-1994 [Reference 7.35] for system operation. The new manual actions can be accomplished based on the actions being control room actions or that the associated valves are fully accessible in accident scenarios of applicable safety analyses. There is ample time to perform each of the proposed credited operator actions, which reduces time pressure and the likelihood of error. It is appropriate to credit the operator actions in the analyses that demonstrate that the ultimate heat sink meets the requirements of Regulatory Guide 1.27 to ensure that a 30-day supply of water is available, that the design basis temperatures of safety related equipment are not exceeded, and that the UHS supports safe shutdown and cooldown of the reactor and maintaining it in a safe shutdown condition.

4.5.8 Ultimate Heat Sink Design Basis Reconstitution

Engineering change EC 52043 resolved multiple issues and updated analyses items within the 10 CFR 50.59 process. Even though these are covered by a separate process, many would still be pertinent to the NRC review of this change. A summary list is provided to support the NRC review of items impacted within the detailed calculation reviews.

1. Correct wet cooling tower storage capacity and level setpoint change.
2. Consolidation of calculations.
3. Address impact of damaged wet cooling tower fill in design basis documents.
4. Auxiliary component cooling water temperature control valve (ACC-126A(B)) throttling acceptance criteria.
5. Correct discrepancies in design and license basis documents.
6. Dry cooling tower recirculation barrier Impact on dry cooling tower ponding margin.
7. Post modification test plan.
8. Design and fabrication of wet cooling tower fan covers.
9. Dry cooling tower tube plugging and sleeving limits.
10. Refinement of design basis accident analyses of ultimate heat sink performance capacity and water inventory margin.
11. Bounding loss of coolant accident ultimate heat sink capacity and water consumption analysis.
12. Bounding Non loss of coolant accident ultimate heat sink capacity and water consumption analysis.
13. Bounding tornado event ultimate heat sink capacity and water consumption analysis.
14. Core offload and fuel pool cooling thermal hydraulic analyses.

4.5.9 Ultimate Heat Sink Design Basis Analysis Summary

Calculation ECM95-008 demonstrates that the ultimate heat sink is capable of supplying component cooling water less than or equal to 120°F during peak accident heat load under bounding ambient conditions. WF3-ME-16-00001 evaluates the worst and most severe combination of controlling parameters for the critical time periods unique to the specific design of the ultimate heat sink based on over 30 years of representative data and WF3-ME-15-00014 evaluates bounding recirculation effects as a function of ambient conditions and plant heat load. Procedures are updated to implement administrative controls and operator actions credited in the analyses. The analyses demonstrate that the ultimate heat sink meets the requirements of Regulatory Guide 1.27 to ensure that a 30 day supply of water is available, that the design basis temperatures of safety related equipment are not exceeded, and to permit safe shutdown and cooldown of the reactor and maintain it in a safe shutdown condition.

5.0 REGULATORY EVALUATION

5.1 Applicable Regulatory Requirements/Criteria

Entergy Operations, Inc. (Entergy) proposes to modify Technical Specification 3/4.7.4 (Ultimate Heat Sink) to address several non-conforming conditions. The issues addressed by this change are as follows:

- Wet cooling tower basin level discrepancy.
- Dry cooling tower and wet cooling tower recirculation impacts.
- Wet cooling tower methodology for determining fan requirements.

10 CFR Part 50 Appendix A [Reference 7.15] General Design Criterion (GDC) 44 - Cooling water defines the regulatory basis for the component cooling water and auxiliary component cooling water systems. A system to transfer heat from structures, systems, and components important to safety, to an ultimate heat sink shall be provided. The system safety function shall be to transfer the combined heat load of these structures, systems, and components under normal operating and accident conditions. Suitable redundancy in components and features, and suitable interconnections, leak detection, and isolation capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure.

NUREG 0800 Section 9.1.3 [Reference 7.16] defines the regulatory basis for the fuel pool cooling system. In summary, it requires that the fuel pool cooling system be designed to maintain the spent fuel pool temperature at or below 140°F for the maximum normal heat load assuming a single active failure. For the abnormal maximum heat load the temperature of the fuel pool water should be kept below boiling. A single active failure need not be considered for the abnormal case.

NUREG 0800 Section 9.2.5 [Reference 7.17] defines the licensing basis for the ultimate heat sink. In summary, it requires the ultimate heat sink to comply with General Design Criteria 2 (natural phenomena, including Regulator Guide 1.29 position C-1 (seismic category I designation) and Regulatory Guide 1.27 positions C-2 (natural phenomena and site events) and C-3 (redundancy)), 5 (shared systems), 44 (component cooling, including ultimate heat sink, redundancy for single failure and loss of offsite power, Regulatory Guide 1.27), 45 (inservice inspection), and 46 (functional testing). Note that Regulatory Guide 1.72 on spray pond piping made from fiberglass is not applicable to the Waterford 3 design.

NUREG 0800 BTP 5-4 [Reference 7.18] requires the capability of bringing the reactor to a cold shutdown condition within a reasonable period of time following shutdown using only safety grade systems.

Regulatory Guide 1.27 [Reference 7.3] describes a basis acceptable to the NRC that may be used to implement General Design Criterion 44 and defines the regulatory basis for the ultimate heat sink. In summary, Regulatory Guide 1.27 requires the ultimate heat sink to provide cooling for at least 30 days, where design basis temperatures of safety-related equipment are not exceeded. Meteorological conditions evaluated should be the worst combination of controlling parameters. For evaporation and drift losses, use the 30 day average combination of controlling parameters. For cooling, use the worst combination of controlling parameters, including diurnal variations where appropriate, for the critical time periods. The following is an acceptable method for selecting these conditions: Select the most severe observation for the critical time period for each controlling parameter or parameter combination, based on at least 30 years of representative data, with substantiation of the conservatism of these values for site use.

In conclusion, Entergy has determined that the proposed changes do not require any exception or relief from regulatory requirements, other than the Technical Specification, and do not adversely affect systems, structures, and components described in the Waterford 3 UFSAR. Based on UFSAR 9.2.5, the function of the ultimate heat sink is to dissipate the heat removed from the reactor and its auxiliaries during normal operation, during refueling or after a design basis accident. The proposed changes to the dry bulb temperature limits and allowable cooling tower fan configurations do not adversely affect the design function, method of controlling a design function, and any method of evaluation that demonstrates intended design function of the ultimate heat sink as described in the UFSAR.

5.2 No Significant Hazards Consideration

Entergy Operations, Inc. has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?
Response: No.

The proposed change modifies Technical Specification 3/4.7.4 to be consistent with the revised design basis calculations. This change is necessary to preserve the assumptions and limits of the revised ultimate heat sink design basis calculation. The calculation determines the maximum number of cooling tower fans allowed out-of-service for a given dry bulb temperature and establishes appropriate cooling tower fan operating requirements. The proposed change does not directly affect any material condition of the plant that could contribute to an accident or that could contribute to the consequences of an accident. The proposed change ensures that the mitigating effects of the ultimate heat sink will be consistent with the design basis analysis. Therefore, the proposed change will not involve a significant increase in the probability or consequences of any accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No.

The proposed change modifies Technical Specification 3/4.7.4 to be consistent with the revised design basis calculations. The revised calculation modifies the dry and wet fan requirements to account for increased recirculation impacts are different ambient conditions and heat loads. The proposed change to Technical Specification 3/4.7.4 does not alter the operation of the plant or the manner in which the plant is operated such that it created credible new failure mechanisms, malfunctions, or accident initiators. Therefore, the proposed change will not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

Response: No.

The proposed change modifies Technical Specification 3/4.7.4 to be consistent with the revised design basis calculations. The modified dry and wet cooling tower fan operability requirements result from placing lower limits on the dry bulb temperatures in the Technical Specification and limits on the number of wet cooling tower out-of-service fans per cell. The proposed change preserves the margin of safety by ensuring that the minimum number of operable fans for a given temperature are capable of removing the heat duty for the ultimate heat sink. The proposed change does not exceed or alter a design basis safety limit and maintains the ultimate heat sink capability of performing its safety function. Therefore, the proposed change will not involve a significant reduction in a margin of safety.

Based on the above, Entergy concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of “no significant hazards consideration” is justified.

5.3 Environmental Considerations

The proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 PRECEDENCE

There is no precedence identified.

7.0 REFERENCES

7.1 Technical Specifications through Amendment 250.

7.2 Updated Final Safety Analysis Report (UFSAR) Amendment 310.

7.3. Regulatory Guide 1.27 Revision 2, Ultimate Heat Sink for Nuclear Power Plants, January 1976.

7.4 NRC ADMINISTRATIVE LETTER 98-10, Dispositioning of Technical Specifications That Are Insufficient to Assure Plant Safety, December 29, 1998.

7.5 NRC Notice, Pre-submittal Meeting with Entergy Operations, Inc. Regarding a License Amendment Request to Revise Technical Specification Table 3.7-3 for Waterford Steam Electric Station, Unit 3, June 1, 2017 [NRC ADAMS Accession Number ML17151A314].

7.6 Waterford 3 Slides for Presentation to the NRC on the Ultimate Heat Sink Amendment Request, May 31, 2017 [NRC ADAMS Accession Number ML17151A295].

7.7 NRC Letter, Summary of June 1, 2017, Public Meeting With Entergy Operations, Inc., regarding Planned License Amendment Request to Revise Technical Specification (TS) Table 3.7-3 and TS 3/4.7.4, "Ultimate Heat Sink" For Waterford Steam Electric Station, Unit 3, June 28, 2017 [NRC ADAMS Accession Number ML17174B226].

7.8 NRC License Amendment 237, Waterford Steam Electric Station, Unit 3 – Issuance of Amendment Re: Proposed Change to Technical Specification 3/4.7.4 Table 3.7-3, "Ultimate Heat Sink Minimum Fan Requirements per Train," October 31, 2012 [NRC ADAMS Accession Number ML12250A435].

7.9 NRC Waterford 3 Ultimate Heat Sink Submittal Request for Additional Information, Wet Cooling Tower Fan Relationships, February 28, 2012 [NRC ADAMS Accession Number ML120580738].

7.10 W3F1-2012-0019, Response to Request for Additional Information, License Amendment Request to Revise Technical Specification 34.7.4 Table 3.7-3, "Ultimate Heat Sink Minimum Fan Requirements per Train," April 3, 2012 [NRC ADAMS Accession Number ML12095A308].

7.11 W3F1-2012-0028, Supplement 2 of License Amendment Request to Revise Technical Specification 34.7.4 Table 3.7-3, "Ultimate Heat Sink Minimum Fan Requirements per Train," May 22, 2012 [NRC ADAMS Accession Number ML12144A135].

7.12 W3F1-2012-0004, Calculations Requested for License Amendment Request, Proposed Change to Technical Specification 34.7.4 Table 3.7-3, "Ultimate Heat Sink Minimum Fan Requirements per Train," January 18, 2012 [NRC ADAMS Accession Number ML12023A080].

7.13 Calculation ECM95-008 Revision 3, Ultimate Heat Sink Design Basis [NRC ADAMS Accession Number ML12023A081].

7.14 Calculation ECM95-009 Revision 2, Ultimate Heat Sink Fan Requirements Under Various Ambient Conditions [NRC ADAMS Accession Number ML12023A082].

7.15 10 CFR Part 50 Appendix A – General Design Criteria (GDC).

7.16 NUREG-0800, Standard Review Plan Section 9.1.3, Spent Fuel Pool Cooling and Cleanup Systems.

7.17 NUREG-0800, Standard Review Plan, Section 9.2.5, including Branch Technical Position ASB 9-2, Residual Decay Energy for Light Water Reactors for Long-Term Cooling.

7.18 NUREG-0800, Standard Review Plan, Branch Technical Position 5-4, Design Requirements of the Residual Heat Removal System

7.19 EC-52043, Ultimate Heat Sink Margin Restoration.

7.20 ECM95-008 Revision 3 (EC52043), Ultimate Heat Sink Design Basis.

7.21 WF3-ME-15-00014 R0, Waterford 3 Ultimate Heat Sink CFD Investigation of the Dry Cooling Tower Deflector Wall Modification, October 2016.

7.22 NUREG-2152, Computational Fluid Dynamics Best Practice Guidelines for Dry Cask Applications [NRC ADAMS Accession Number ML13086A202].

7.23 WF3-ME-15-00011 Revision 1, Waterford 3 UHS Project Weather Investigation.

7.24 WF3-ME-16-00001 Revision 0, Meteorological Parameters and Parameter Relationships for Design and Operability of the Waterford 3 Ultimate Heat Sink.

7.25 WF3-ME-16-00011 Revision 0, Waterford 3 WCT Engineering Analysis Submittals.

7.26 Condition Report CR-WF3-2012-2332, Ultimate Heat Sink Recirculation Flow.

7.27 MNQ9-38 Revision 4 EC52043, Capacity of Wet Cooling Tower Basins.

7.28 Waterford 3 License Amendment 139, March 23, 1998 [NRC ADAMS Accession Number ML021790089].

7.29 NUREG-0787, Safety Evaluation Report related to the operation of Waterford Steam Electric Station, Unit No. 3, July 1981.

7.30 OP-903-118, Primary Auxiliaries Quarterly IST Valve Tests.

7.31 EP-002-100, Technical Support Center (TSC) Activation, Operation, and Deactivation.

7.32 ECI91-036, Component Cooling Water Heat Exchanger Outlet Temperature Dry Fan Control Instrument Loop Uncertainty Calculation.

7.33 NRC Inspection Manual IMC-326, OPERABILITY DETERMINATIONS & FUNCTIONALITY ASSESSMENTS FOR CONDITIONS ADVERSE TO QUALITY OR SAFETY, 1/31/14.

7.34 NRC INFORMATION NOTICE 97-78, CREDITING OF OPERATOR ACTIONS IN PLACE OF AUTOMATIC ACTIONS AND MODIFICATIONS OF OPERATOR ACTIONS, INCLUDING RESPONSE TIMES, October 23, 1997.

7.35 ANSI/ANS-58.8-1994, American National Standard Time Response Design Criteria for Safety Related Operator Actions, August 23, 1994.

Enclosure Attachment 1 to

W3F1-2017-0050

Proposed Technical Specification Changes (mark-up)

Attachment contains 5 pages

PLANT SYSTEMS

3/4.7.4 ULTIMATE HEAT SINK

LIMITING CONDITION FOR OPERATION

3.7.4 Two independent trains of ultimate heat sink (UHS) cooling towers shall be OPERABLE with each train consisting of a dry cooling tower (DCT) and a wet mechanical draft cooling tower (WCT) and its associated water basin with:

a. A minimum water level in each wet tower basin of 97% (-9.~~86~~ 77 ft MSL)

b. An average basin water temperature of less than or equal to 89°F.

c. Fans as required by Table 3.7-3.

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

ACTION:

a. With 1 UHS train inoperable, restore the inoperable train 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.

b. With both UHS trains inoperable, restore at least one UHS train to OPERABLE status within 1 hour or be in at least HOT STANDBY within the next 6 hours and COLD SHUTDOWN within the following 30 hours.

LIMITING CONDITION FOR OPERATION (Continued)

ACTION: (Continued)

Replace action c. with Insert 1 (see next page)

~~c. With a Tornado Watch in effect, all 9 DCT fans under the missile protected portion of the DCT shall be OPERABLE. If the number of fans OPERABLE is less than required, restore the inoperable fan(s) to OPERABLE status within 1 hour, or be in at least HOT STANDBY within 6 hours and in HOT SHUTDOWN within the following 6 hours.~~

Replace action d. with Insert 2 (see next page)

~~d. With any UHS fan inoperable, determine the outside ambient temperature at least once every 2 hours and verify that the minimum fan requirements of Table 3.7-3 are satisfied (required only if the associated UHS is OPERABLE).~~

Add new action e. (see Insert 3 on next page)

SURVEILLANCE REQUIREMENTS

4.7.4. Each train of UHS shall be determined OPERABLE:

a. In accordance with the Surveillance Frequency Control Program by verifying the average water temperature and water level to be within specified limits.

b. In accordance with the Surveillance Frequency Control Program, by verifying that each wet tower and dry tower fan that is not already running, starts and operates for at least 15 minutes.

Add new surveillance requirement 4.7.4.c.

c. Verify that each wet tower basin cross-connect valve is OPERABLE in accordance with the INSERVICE TESTING PROGRAM.

Insert 1

c. This action applies only when UHS tornado required equipment is inoperable. With a Tornado Watch or Warning in effect with the forecast 7 day average ambient dry bulb temperature greater than 74ºF, all 6 DCT tube bundles and all 9 DCT fans associated with the missile protected portion of both trains of the DCT shall be OPERABLE. With a Tornado Watch or Warning in effect with the forecast 7 day average ambient dry bulb temperature less than or equal to 74ºF, all 6 DCT tube bundles and at least 8 DCT fans associated with the missile protected portion of both trains of the DCT shall be OPERABLE. If the number of tube bundles or fans OPERABLE is less than required, restore the inoperable tube bundle(s) or fan(s) to OPERABLE status within 1 hour, or be in at least HOT STANDBY within the following 6 hours and in HOT SHUTDOWN within the following 6 hours.

Insert 2

d. When Table 3.7-3 dry bulb temperature restrictions apply with UHS fan(s) inoperable, determine the forecast ambient temperatures and verify that the minimum fan requirements of Table 3.7-3 are satisfied (required only if the associated UHS is OPERABLE). The more restrictive fan requirement shall apply when 1 hour and 3 day average temperatures allow different configurations.

Insert 3

e. With either or both wet cooling tower basin cross-connect valves not OPERABLE for makeup, restore the valve(s) to OPERABLE status within 7 days or be in at least HOT STANDBY within the next 6 hours or COLD SHUTDOWN within the following 30 hours.

Replace Table 3.7-3 with Insert 4 (see next page)

~~TABLE 3.7-3~~

~~ULTIMATE HEAT SINK MINIMUM FAN REQUIREMENTS PER TRAIN~~

~~AMBIENT CONDITION~~	~~DRY COOLING TOWER~~		
	~~DRY BULB ≥ 97°F~~	~~< 97°F DRY BULB ≥ 91°F~~	~~< 91°F DRY BULB~~
~~Fan Requirements(1)~~	~~15~~	~~14*~~	~~12*~~

~~WET COOLING TOWER~~

~~Fan Requirements - 8~~

~~(1) With any of the above required DCT Fans inoperable comply with ACTION d.~~

~~* With a tornado watch in effect, all 9 DCT fans under the missile protected portion of the DCT shall be OPERABLE.~~

Insert 4

TABLE 3.7-3

ULTIMATE HEAT SINK MINIMUM FAN REQUIREMENTS PER TRAIN [1]

ALLOWABLE FAN COMBINATIONS WITHOUT BACKFLOW PREVENTED THROUGH INOPERABLE DCT FAN(S)
1 hour / 3 day average dry bulb temperature restrictions

OPERABLE WCT Fans[2]	OPERABLE DCT Fans (Inoperable Fan Backflow NOT Prevented)							
	15		14		13		12	
	1 hour	3 day	1 hour	3 day	1 hour	3 day	1 hour	3 day
8	No Temperature Restrictions				≤88 °F	≤77 °F	Not Allowed	
7					≤87 °F	≤77 °F	Not Allowed	

ALLOWABLE FAN COMBINATIONS WITH BACKFLOW PREVENTED THROUGH INOPERABLE DCT FAN(S)
1 hour / 3 day average dry bulb temperature restrictions

OPERABLE WCT Fans[2]	OPERABLE DCT Fans (Inoperable Fan Backflow Prevented)							
	15		14		13		12	
	1 hour	3 day	1 hour	3 day	1 hour	3 day	1 hour	3 day
8	No Temperature Restrictions						≤89 °F	≤79 °F
7							≤88 °F	≤79 °F

(1) With any DCT tube bundle isolated, at least 14 DCT fans and 7 WCT fans shall be OPERABLE.
(2) Inoperable WCT fans shall be covered or the entire WCT shall be considered inoperable.

Enclosure Attachment 2 to

W3F1-2017-0050

Proposed Technical Specification Changes (clean copy)

Attachment contains 3 pages

PLANT SYSTEMS

3/4.7.4 ULTIMATE HEAT SINK

LIMITING CONDITION FOR OPERATION

3.7.4 Two independent trains of ultimate heat sink (UHS) cooling towers shall be OPERABLE with each train consisting of a dry cooling tower (DCT) and a wet mechanical draft cooling tower (WCT) and its associated water basin with:

a. A minimum water level in each wet tower basin of 97% (-9.77 ft MSL)

b. An average basin water temperature of less than or equal to 89°F.

c. Fans as required by Table 3.7-3.

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

ACTION:

a. With 1 UHS train inoperable, restore the inoperable train 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.

b. With both UHS trains inoperable, restore at least one UHS train to OPERABLE status within 1 hour or be in at least HOT STANDBY within the next 6 hours and COLD SHUTDOWN within the following 30 hours.

LIMITING CONDITION FOR OPERATION (Continued)

ACTION: (Continued)

c. This action applies only when UHS tornado required equipment is inoperable. With a Tornado Watch or Warning in effect with the forecast 7 day average ambient dry bulb temperature greater than 74°F, all 6 DCT tube bundles and all 9 DCT fans associated with the missile protected portion of both trains of the DCT shall be OPERABLE. With a Tornado Watch or Warning in effect with the forecast 7 day average ambient dry bulb temperature less than or equal to 74°F, all 6 DCT tube bundles and at least 8 DCT fans associated with the missile protected portion of both trains of the DCT shall be OPERABLE. If the number of tube bundles or fans OPERABLE is less than required, restore the inoperable tube bundle(s) or fan(s) to OPERABLE status within 1 hour, or be in at least HOT STANDBY within 6 hours and in HOT SHUTDOWN within the following 6 hours.

d. When Talbe 3.7-3 dry bulb temperature restrictions apply with UHS fan(s) inoperable, determine the forecast ambient temperatures and verify that the minimum fan requirements of Table 3.7-3 are satisfied (required only if the associated UHS is OPERABLE). The more restrictive fan requirement shall apply when 1 hour and 3 day average temperatures allow different configurations.

e. With either or both wet cooling tower basin cross-connect valves not OPERABLE for makeup, restore the valve(s) to OPERABLE status within 7 days or be in at least HOT STANDBY within the next 6 hours or COLD SHUTDOWN within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.7.4. Each train of UHS shall be determined OPERABLE:

a. In accordance with the Surveillance Frequency Control Program by verifying the average water temperature and water level to be within specified limits.

b. In accordance with the Surveillance Frequency Control Program, by verifying that each wet tower and dry tower fan that is not already running, starts and operates for at least 15 minutes.

c. Verify that each wet tower basin cross-connect valve is OPERABLE in accordance with the INSERVICE TESTING PROGRAM.

TABLE 3.7-3

ULTIMATE HEAT SINK MINIMUM FAN REQUIREMENTS PER TRAIN [1]

ALLOWABLE FAN COMBINATIONS WITHOUT BACKFLOW PREVENTED THROUGH INOPERABLE DCT FAN(S)
1 hour / 3 day average dry bulb temperature restrictions

OPERABLE WCT Fans[2]	OPERABLE DCT Fans (Inoperable Fan Backflow NOT Prevented)							
	15		14		13		12	
	1 hour	3 day	1 hour	3 day	1 hour	3 day	1 hour	3 day
8	No Temperature Restrictions				≤88 °F	≤77 °F	Not Allowed	
7					≤87 °F	≤77 °F	Not Allowed	

ALLOWABLE FAN COMBINATIONS WITH BACKFLOW PREVENTED THROUGH INOPERABLE DCT FAN(S)
1 hour / 3 day average dry bulb temperature restrictions

OPERABLE WCT Fans[2]	OPERABLE DCT Fans (Inoperable Fan Backflow Prevented)							
	15		14		13		12	
	1 hour	3 day	1 hour	3 day	1 hour	3 day	1 hour	3 day
8	No Temperature Restrictions						≤89 °F	≤79 °F
7							≤88 °F	≤79 °F

(1) With any DCT tube bundle isolated, at least 14 DCT fans and 7 WCT fans shall be OPERABLE.
(2) Inoperable WCT fans shall be covered or the entire WCT shall be considered inoperable.

Enclosure Attachment 3 to

W3F1-2017-0050

List of Regulatory Commitments

Attachment contains 1 page

List of Regulatory Commitments

This table identifies actions discussed in this letter for which Entergy commits to perform. Any other actions discussed in this submittal are described for the NRC's information and are not commitments.

COMMITMENT	TYPE (Check one)		SCHEDULED COMPLETION DATE (If Required)
	ONE-TIME ACTION	CONTINUING COMPLIANCE	
The dry cooling tower fan backflow preventers will be tested to confirm analysis requirements are met.	X		Prior to crediting backflow preventer use in Technical Specification Table 3.7-3.
A UFSAR table will be added providing the maximum average dry bulb temperature as a function of the time of year by month for 1 hour, 3 day, and 7 day averages.	X		During implementation.