Enclosure 3
NND-10-0254

EVALUATION OF IMPACTS

CHANGE TO

MAXIMUM SAFETY NON-COINCIDENT AMBIENT WET BULB TEMPERATURE

FOR THE V C SUMMER SITE

(21 Total Pages Including Coversheet)

Westinghouse/ Stone & Webster – [redacted]

AP1000™

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June 30, 2010

Subject: **Transmittal of the Wet Bulb Temperature Evaluation for V.C. Summer Units 2&3**

Reference: **NRC RAIs No. 06.02.01-1 and 09.02.02-1 for V.C. Summer Nuclear Station Units 2&3 COL Application, Docket No. 52-027 and 52-028**

Attachment: **Evaluation of Impacts: Change to Maximum Safety Non-Coincident Ambient Wet Bulb Temperature for the V.C. Summer Site**

Action: **No Action Required**

Dear Mr. Clary:

Enclosed is the Westinghouse analysis justifying an increase in the maximum acceptable ambient wet bulb temperature from 86.1°F to 87.3°F. This analysis was requested by Amy Monroe in support of the V.C. Summer Units 2 and 3 COL Application.

The results of this evaluation will not be included in the AP1000 DCD. The evaluation is site-specific for V.C. Summer 2&3.

Westinghouse

Shaw® Stone & Webster, Inc.

If you have any questions regarding this matter, please contact Bill Hutchins at (803) 932-5427, or the undersigned.

Very truly yours,

Frederick P. Hughes
Consortium Project Director
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BJB/WEH/FPH/lll

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EVALUATION OF IMPACTS

CHANGE TO

MAXIMUM SAFETY NON-COINCIDENT AMBIENT WET BULB TEMPERATURE

FOR THE V C SUMMER SITE

Westinghouse Electric Company

[redacted]

Authored By: **M. Stella** **Date:6/30/2010**

Reviewed By: **J. DeBlasio** **Date:6/30/2010**

Brief Description of the Impact (what is being changed and why):

Impacts of an increase in the maximum safety wet bulb non-coincident temperature for the V C Summer site from 86.1 °F to 87.3 °F.

V C Summer FSAR Sections Impacted:
Impacts Tier 1 Chapter 5, Table 5.0-1 / Chapter 2 Table 2-1 (Sheet 1 of 3) (Tier 2). Other sections with impacts are 5.4.7.1.2.3, 6.2.2.3, 9.2.2.1.2.1 and Table 6.2.1.1-2

This evaluation is prepared to document the impacts of an increase in the value of maximum safety non-coincident wet bulb temperature at the V C Summer site. This document provides the justifications for the acceptability of a departure from the standard AP1000 DCD and certification basis that will be included in the Summer Combined Operating License Application (COLA).

I. TECHNICAL DESCRIPTION

AP1000 DCD Revision 17 Table 5.0-1 Tier 1 and Table 2-1 (sheet 1of 3) Tier 2 provides a listing of standard values for site environmental parameters. The V C Summer Plant maximum safety non-coincident wet bulb temperature exceeds the standard value given in the DCD.

The maximum safety non-coincident wet bulb temperature for the V C Summer site was recently re-evaluated and increased from the standard value of 86.1 °F to 87.3 °F to reflect expected site maximum temperature conditions. This change requires that an evaluation be performed for the various plant performance requirements and commitments affected by this parameter to confirm that the performance of the plant's safety systems remains within the bounds described in the AP1000 DCD.

The following sections in the AP1000 DCD describe areas that could be affected by an increase in maximum safety wet bulb temperature. Each of these areas has been reviewed and the evaluations demonstrate that there is sufficient margin to accommodate the increase in maximum safety non-coincident wet Bulb temperature without requiring changes to the certified AP1000 design.

- DCD Section 6.2.2, Passive Containment Cooling System performance
- DCD Section 5.4.7.1.2.3, Normal Residual Heat Removal System – In-Containment Refueling Water Storage Tank temperature control
- DCD Section 9.2.2.1.2.1, Component Cooling Water – Normal Operation temperature limit
- DCD Section 9.2.2.1.2.2, Component Cooling Water – Normal Plant Cooldown (time to temperature)
- DCD Section 9.1.3.1.3.1, Spent Fuel Pool Cooling-Partial Core Shuffle (normal refueling pool temperature control)
- DCD Section 9.2.1.2.3.4, Service Water System – Plant Cooldown/Shutdown maximum cooling water temperature at peak heat load
- DCD Section 9.2.2.1.2.3, Component Cooling Water – Refueling
- DCD Section 9.2.7.2.4, Central Chilled Water System – Normal Operation

II. CHANGE JUSTIFICATION

Design Assessment

The impact of the higher maximum safety non-coincident wet bulb temperature was evaluated on a system by system basis. The same type of analyses have been performed twice previously for two required increases in AP1000 standard site temperature conditions, and once to justify a departure for a specific site whose site temperature conditions exceeded standard site temperature conditions documented in the DCD.

Several of the areas of concern listed in Section I above are not affected by a change in maximum safety wet bulb temperature at V C Summer, since the performance of the potentially impacted systems depends only on dry bulb temperature and/or is based on the limiting AP1000 1% exceedance (maximum normal) wet bulb temperature value of 80.1°F. The equivalent V C Summer values for these parameters are bounded by the standard site values for AP1000.

The areas that could be affected by the increased maximum safety wet bulb temperature at the V C Summer site include:

- Passive containment cooling system (PCS) design and performance
- Component cooling system (CCS) and service water system (SWS) design and performance
- Spent fuel cooling system (SFS) design and performance
- Turbine building closed cooling water system (TCS) design and performance
- In-Containment Refueling Water Storage Tank (IRWST) temperature control
- Nuclear Island non-radioactive ventilation system (VBS) design and performance
- RTNSS availability and decay heat removal capability of SWS and CCS during RCS reduced-inventory operation in Modes 5 and 6

One of the safety systems described in the AP1000 DCD is affected only by changes in the site maximum safety dry bulb temperature and is therefore unaffected by the increase in maximum safety wet bulb temperature for the V C Summer site:

- Passive heat sink performance for the Main Control Room (MCR) and 1E electrical equipment rooms

Several other areas discussed in the DCD are unaffected by the increase in the maximum safety non-coincident wet bulb temperature because their performance is based on the limiting value of the site maximum normal non-coincident wet bulb temperature or on the coincident maximum dry bulb and wet bulb temperature. For V C Summer the site-specific values of these temperature parameters are bounded by the standard AP1000 values. The areas dependent only upon these unaffected temperature parameters include:

- Plant cooldown with the normal residual heat removal system (RNS) from 350 °F to 125 °F within 96 hours
- Maximum SWS cold water temperature at peak system heat load conditions associated with the beginning of RNS cooldown
- Normal high capacity chilled water system (VWS) design and performance
- Spent fuel pool cooling for full core off-load and emergency core off-load conditions

[redacted]

WESTINGHOUSE ELECTRIC COMPANY

- Steam and power conversion systems performance

Use of Reference Calculations as Basis for Conclusions

The maximum safety non-coincident wet bulb temperature value for the proposed Florida Power and Light (FP&L) Turkey Point AP1000 site (87.4 °F) exceeds the standard AP1000 site value (86.1 °F) specified for this parameter. FP&L previously requested that Westinghouse perform an evaluation to determine the potential design and performance impacts associated with the increased ambient wet bulb temperature value. This evaluation was used to prepare a Departure for the Turkey Point COLA.

The calculations performed for FP&L to determine the effects of the maximum safety non-coincident wet bulb temperature are cited herein as reference calculations for V C Summer, since the Turkey Point site value of this parameter bounds the V C Summer value (87.3 °F). The V C Summer maximum safety non-coincident wet bulb temperature (87.3 °F) has been determined using available historical records from the site by applying standard statistical methods to compute the 100 year return temperature. The same approach was also used to determine the value of this parameter for the Turkey Point site (87.4 °F). Therefore, comparisons of the results of calculations using the two values as input data are valid. Conclusions regarding the acceptability of the AP1000 design and performance areas affected by changes in maximum safety non-coincident wet bulb temperature for the Turkey Point site also apply to the V C Summer site.

It is important to note that conclusions in the referenced calculation notes regarding the impact of the increase of the Turkey Point site maximum normal non-coincident wet bulb temperature to 81.5 °F do not apply to V C Summer, since the maximum normal Summer site wet bulb value is bounded by the standard AP1000 value of 80.1 °F.

Safety System Design Basis

There are no changes to the AP1000 safety systems design required to address any safety issues associated with the increased maximum safety wet bulb temperature at the V C Summer site. Evaluations performed for Turkey Point (Westinghouse calculation note TPG-GW-GSC-001 Revision 0, *WGOTHIC Containment Peak Pressure Analysis for the Evaluation of FP&L Turkey Point COL Maximum Wet Bulb Temperature Departure from DCD*) and for the standard AP1000 plant design (APP-GW-GSC-040 Revision 0) demonstrate that the AP1000 accident analysis cases of record bound the performance expected at the Turkey Point site maximum safety non-coincident wet bulb temperature of 87.4 °F. The peak containment pressure at the slightly lower maximum safety wet bulb temperature of 87.3 °F for the V C Summer site is therefore also bounded by the results of the current AP1000 analysis.

The pressure decay curve for the containment is identical for wet bulb temperatures equal to the standard maximum safety wet bulb value and the Turkey Point value. The containment response for V C Summer at its maximum safety wet bulb temperature will therefore also be identical to the standard containment response.

The passive heat sinks associated with the Main Control Room Habitability System (VES) control the auxiliary building safety related room temperatures post-accident. The temperature profiles of these rooms are impacted by ambient dry bulb temperature only. The V C Summer maximum ambient dry bulb temperature (112 °F) is enveloped by the current AP1000 standard site value of 115 °F and thus the passive heat sink analysis of record for AP1000 remains valid for V C Summer as well.

In the emergency mode of operation, the control room and associated control area spaces are isolated from the normal ventilation systems. Discharge of dry air from the VES emergency air storage tanks controls the humidity levels in the MCR and associated control spaces for at least 72 hours following an accident. In this mode of operation, the VES is designed to control the air quality in the MCR and control spaces to within the requirements of ASHRAE Standard 62 - 1989.

Component Cooling System and Service Water System Design and Performance

The limiting temperature performance for the CCS and SWS occurs during normal power operation, with the site ambient wet bulb temperature at its maximum safety value. The AP1000 DCD maximum safety wet bulb temperature is defined as the annual "0% exceedence" value measured at or calculated for the site. It is based on the maximum observed wet bulb temperature value reached at the site, excluding periods less than 2 hours duration.

The original AP1000 design criterion for CCS and SWS performance was that the maximum CCS supply temperature should not exceed 95 °F for normal plant power operation with a single train of cooling water systems in service and wet bulb temperature at the maximum safety non-coincident value. Increases in the value of the standard site maximum safety wet bulb temperature from 81 °F to 85.5 °F and finally (in DCD Revision 17) to 86.1 °F have been made to include a larger number of candidate sites within the standard site temperature envelope for AP1000 and are reflected in the current revision of the DCD (Revision 17). The most limiting component cooled by the CCS, the RCP motor cooling system, has been designed to operate for at least 6 hours continuously with cooling water supplied at temperatures up to 100 °F, as a result of the increases in CCS temperature above 95 °F associated with the previous increases in wet bulb temperature. Each RCP is provided with four safety-related temperature sensors to monitor the stator cooling water temperature. These sensors generate a high temperature alarm when stator cooling water temperature rises above the normally expected operating range, and produce a reactor trip and RCP trip to protect the pumps if stator water temperature continues to rise beyond the trip setpoint. Operators monitor the cooling water temperature to verify that the RCPs are operating within normal temperature bounds at high ambient wet bulb conditions.

Calculation note TPG-CCS-M3C-001, Revision 0, *Turkey Point Units 6 and 7 Performance Evaluation using Elevated Maximum Non-Coincident Safety Wet Bulb Temperature* documents the performance of the standard AP1000 CCS and SWS for single cooling water train, full power operation at the higher maximum safety wet bulb temperature of 87.4 °F. The highest CCS temperature achieved at these conditions is 97.4 °F, for a period of less than 2 hours, consistent with the duration of the highest ambient wet bulb temperature. (The expected maximum CCS temperature will be slightly lower for V C Summer – approximately 87.3 °F - since the controlling wet bulb temperature is 0.1 °F lower than the comparable Turkey Point site value.) The SWS cooling water supply temperature assumed for this evaluation was determined in calculation note TPG-SWS-M3C-001, Revision 0, *Turkey Point Units 6 and 7 Cooling Tower Performance Evaluation Using Elevated Maximum Normal and Maximum Safety Wet Bulb Temperatures*.

As ambient wet bulb temperature decreases, the CCS temperature follows and will return to below 95 °F with ambient wet bulb temperature slightly lower than 84 °F, assuming nominal performance of both the CCS and SWS. Since the definition of the maximum normal wet bulb temperature value is the seasonal 1% exceedence value observed at the site, the annual total operating time for which CCS temperatures could exceed 95 °F is less than 30 hours per year, for periods of a few hours at most. The maximum CCS temperature of 97.3 °F expected for V C Summer is well below the maximum allowable cooling water temperature for Reactor Coolant Pumps (the most limiting component) and the increase in maximum safety wet bulb temperature for V C Summer is therefore acceptable on this basis. No changes to the design of the CCS or SWS are required for V C Summer.

Spent Fuel Cooling System Design and Performance

Only one of the several DCD spent fuel pool cooling performance cases uses the maximum safety non-coincident wet bulb temperature as the basis for determining heat removal performance. This case is the limiting spent fuel pool temperature immediately following plant restart after a normal (fuel shuffle) refueling. All other SFS cooling cases use the maximum normal non-coincident wet bulb temperature as the basis for calculation. Therefore, these latter cases are unaffected by the increase in site maximum safety wet bulb temperature and the performance conclusions described in the DCD and SFS System Design Description remain applicable for V C Summer.

Calculation note APP-SFS-M3C-042, Revision 0, *SFS HX Sizing Calculation Using Florida Power and Light (Turkey Point) Increased Wet Bulb Temperatures* documents the performance of the Turkey Point SFS in removal of spent fuel decay heat for both types of cases. The case representing SFS performance following restart after a normal refueling is the only one affected by a change in maximum safety wet bulb temperature. The results of the calculation confirm that spent fuel pool temperature remains below 115 °F with a CCS supply temperature of 97 °F at the specified pool spent fuel loading condition and decay time on the fuel fraction just replaced during the previous 17 day refueling outage.

The maximum CCS temperature expected for V C Summer is 97.3 °F. An increase of 0.3 °F in CCS supply temperature (assuming ambient wet bulb temperature achieved equals the V C Summer site maximum safety value of 97.3 °F instead of the 97 °F value used in the referenced calculation) will produce a similar differential increase in the spent fuel pool maximum temperature; therefore, the requirement to maintain spent fuel temperature below 120 °F is met with margin. Both SFS heat exchangers are required to operate to maintain SFS pool temperature below 120 °F for the first few weeks after refueling.

The remaining spent fuel pool temperature performance cases use the maximum normal wet bulb temperature as the basis for calculation. These cases are also described and evaluated in APP-SFS-M3C-042, but the CCS temperatures assumed in that calculation note exceed the temperatures expected for AP1000 plants with maximum normal wet bulb temperatures bounded by the DCD value of 80.1 °F. Therefore, the maximum spent fuel pool temperatures predicted in APP-SFS-M3C-042 will bound the temperatures expected for V C Summer with ambient wet bulb temperature at the site maximum normal value of 80.1 °F. The referenced calculation note demonstrates that all SFS pool temperature performance criteria are met with CCS temperatures above those expected for V C Summer.

It can be concluded that no design changes to the V C Summer SFS are required to accommodate the increase in maximum safety non-coincident wet bulb temperature.

Steam and Power Conversion Systems and Turbine Building Closed Cooling Water System (TCS) Design and Performance

Westinghouse has undertaken, with the NuStart utilities, an effort to optimize the turbine generator condenser and evaluate the performance of the condenser and turbine generator (TG) with various Circulating Water System (CWS) flow rates and temperatures. The optimized standard condenser that has been developed for the AP1000 will adequately accommodate the site conditions for V C Summer. Therefore no changes to the standard AP1000 steam and power conversion systems are anticipated for the increased maximum safety ambient wet bulb temperature at the Summer site.

The V C Summer Circulating Water System (CWS) is a site specific design, and is not part of the standard AP1000 design. However the CWS does interface with the condenser as well as TCS heat exchangers and condenser vacuum pump seal water heat exchangers and these are part of the AP1000 standard design. The CWS is designed to supply cooling water to the main condenser and the TCS at a nominal temperature of 91 °F at full power conditions, using mechanical draft cooling towers.

The exact design and performance characteristics of the V C Summer CWS cooling towers are not yet defined. However, the cooling tower cold water temperature variation with wet bulb temperature at full power conditions should be similar to that described for the proposed Turkey Point CWS cooling towers in calculation note TPG-TCS-M3C-001, Revision A, *TCS Supply Temperature at 87.4 °F Ambient Wet Bulb.* The maximum CWS supply temperature is determined by the maximum ambient wet bulb temperature attained, and for V C Summer would be nearly equivalent to the value estimated in the referenced calculation note. Assuming both CWS cold water temperature values are equal, the conclusions of the Turkey Point TCS performance calculation indicate that the maximum TCS temperature supplied to the plant turbine and generator auxiliaries will be significantly lower than the maximum design TCS supply temperature limit of 105 °F for the system.

No changes to the design of the V C Summer TCS or CWS are required to accommodate the increase in maximum safety ambient wet bulb temperature for the site.

In-Containment Refueling Water Storage Tank (IRWST) Temperature Control

The RNS heat exchangers are used to control the temperature of the water in the IRWST during normal operation, and to remove heat during Passive Residual Heat Removal System (PRHR) operation to prevent the IRWST from steaming to containment. The steaming prevention function is evaluated assuming the ambient wet bulb temperature is at the maximum safety value for the site. Therefore, an increase in the value of this parameter has the potential to affect the performance of the IRWST steaming prevention function provided by the RNS, CCS, and SWS.

During plant operation, maximum IRWST temperature is reduced below 120 °F whenever necessary by circulating IRWST water through one of the RNS heat exchangers, and removing the heat through the CCS and SWS. Since the RNS heat exchangers are not being used to remove decay heat with the plant at power, at least one is available for IRWST heat removal. Only one train of CCS (pump and heat exchanger) and one train of SWS (pump, strainer, and cooling tower cell) are normally in operation with the plant at power. There is sufficient margin in CCS pump flow capacity and motor size, and in CCS heat exchanger UA, to valve in one of the RNS heat exchangers and remove IRWST heat by directing CCS flow through the heat exchanger and transferring the excess heat to the SWS cooling tower. CCS temperature rises slightly above the normal full power CCS temperature during this evolution but does not approach the maximum allowable value of 100 °F.

Prevention of IRWST steaming following high pressure heat removal operations with the Passive Residual Heat Removal (PRHR) heat exchanger is accomplished in the same manner, by lining up both RNS heat exchangers to the CCS and the IRWST. CCS is delivered to the RNS heat exchangers at a temperature consistent with the maximum safety ambient wet bulb temperature and the CCS and SWS heat duty and flow rates. Cooling is assumed to begin two hours after reactor trip, with decay heat appropriate for that time after the event. Calculation note APP-PXS-M3C-060, Revision 0, *IRWST Heatup with FPL Wet Bulb Temperature* was performed to determine the maximum IRWST temperature achieved following a high pressure heat removal event using the PRHR heat exchanger. This calculation note assumes CCS temperature is determined by use of the maximum safety ambient wet bulb temperature value (87.4 °F) applicable to the Turkey Point site. Since the V C Summer site ambient wet bulb temperature value is bounded by the Turkey Point site value, the predicted performance of the RNS, CCS, and SWS bounds the anticpated performance for V C Summer.

The maximum predicted IRWST liquid temperature is 201 °F for Turkey Point. Therefore, it can be concluded that IRWST cooling performance (prevention of steaming) is also acceptable for V C Summer, since its maximum safety wet bulb temperature is lower than the value used in APP-PXS-M3C-060.

Nuclear Island Non-Radioactive Ventilation System Design and Performance

The Nuclear Island Non-radioactive Ventilation System (VBS) is the only HVAC system that is designed to accommodate the maximum safety temperature limits. The Low Capacity Chilled Water subsystem (LCCWS) also uses the maximum safety temperature limits (dry and wet bulb) as its design basis temperatures. The remainder of the HVAC systems are designed to accommodate the maximum normal temperature limits (1% exceedance values), including the High Capacity Chilled Water subsystem (HCCWS).

The VBS maintains the safety related heat sink temperatures and is designed with two 100% capacity subsystems. The VBS is served by the Low Capacity Chilled Water System (LCCWS) exclusively. The LCCWS also serves the RNS and CVS pump room coolers. The nominal refrigeration capacity of each of the air-cooled chillers used in the LCCWS is 322 tons at an ambient dry bulb temperature of 115 °F.

Calculation note APP-GW-M1C-002 Revision A, *AP1000 High Humidity HVAC Systems Design Evaluation* assesses the impact of changes in both maximum safety and maximum normal ambient wet bulb temperature on the design and performance of the HCCWS and LCCWS. The calculation note was prepared to evaluate the impacts of increases in both maximum safety and maximum normal non-coincident ambient wet bulb temperature values for the Turkey Point site. It assumes that maximum ambient wet bulb temperature increases to 87.4 °F and maximum normal ambient wet bulb temperature increases to 81.5 °F. The V C Summer maximum safety wet bulb temperature increase to 87.3 °F is bounded by the value assumed for Turkey Point; therefore, the results documented in APP-GW-M1C-002 bound the effects of this change on the V C Summer plants.

The increased heat load produced by operation at the higher V C Summer maxium safety ambient wet bulb temperature of 87.3 °F can be accommodated within the available capacity margin of the chiller units, without impacting the LCCWS or supporting systems design or plant operation. Cooling coil design calculations indicate that during operation at the standard plant design temperatures (115 °F dry bulb, 86.1 °F wet bulb), the VBS air handling unit has cooling coil and system margin.

At the V C Summer site design temperatures of 112 °F dry bulb, 87.3 °F wet bulb, the off coil temperatures for VBS do not change, based on the results of supplier coil performance calculations. Therefore, the MCR temperature and humidity at the higher V C Summer site outside air wet bulb temperature will remain at or below their desired design points during normal operation.

The Summer site maximum normal temperature has not been increased from the AP1000 standard value of 80.1 °F. Therefore, any conclusions in APP-GW-M1C-002 regarding changes needed as a result of increasing the maximum normal ambient wet bulb value do not apply to V C Summer.

No changes are needed in the AP1000 LCCWS design. Since these chillers are also air-cooled, their performance is not affected by changes in wet bulb temperature. Therefore, the existing, standard air-cooled chillers and the associated VBS both perform acceptably at the increased V C Summer site maximum safety ambient wet bulb temperature of 87.3 °F.

RTNSS Availability and Heat Removal Capability of SWS and CCS

The RTNSS function of the CCS and SWS is to remove decay heat during Mode 5 and Mode 6 reduced RCS inventory operations. Heat removal performance is reduced by increases in ambient wet bulb temperature that cause increases in SWS cold water temperature and CCS supply temperature. However, the total heat duty of the CCS and SWS is significantly lower during this mode of operation, as compared to the normal power or cooldown modes, because there is essentially no sensible heat to remove from the RCS and the core decay heat level is low. Primary plant component heat loads are also very small because no RCPs are in operation. Any slight increase in ambient wet bulb temperature will not compromise the heat removal capability of the systems.

The impact of an increase in the V C Summer maximum safety wet bulb temperature from 86.1 °F to 87.4 °F on the RTNSS performance of the CCS and SWS is therefore acceptable. No changes are needed to the Investment Protection Short Term Availability Control (IPSAC) requirements for V C Summer as a result of the increased value of maximum safety ambient wet bulb temperature.

Plant Cooldown With the Normal Residual Heat Removal System (RNS)

Cooldown from 350 °F to 125 °F must be accomplished within 96 hours after reactor shutdown, using both trains of RNS, CCS, and SWS. This evolution produces the peak heat duty on the cooling water systems. The basis temperature for plant cooldown performance is the maximum normal non-coincident wet bulb temperature. Since the maximum normal ambient wet bulb temperature for the V C Summer site has not changed from the standard AP1000 value (80.1 °F), there is no impact on cooldown performance caused by the change, compared to the performance predicted for the AP1000 standard plant at the design maximum normal ambient wet bulb temperature.

Calculation note APP-RNS-M3C-003, Revision 3, *AP1000 RNS Plant Cooldown Performance Calculation* demonstrates that the standard AP1000 plant (including the V C Summer units) can achieve the 96 hour cooldown requirement with the ambient wet bulb temperature assumed constant at its maximum value of 80.1 °F.

SWS Cold Water Temperature at Peak Heat Load Conditions

The DCD specifies that the maximum value of SWS cold water temperature (supply temperature to CCS heat exchangers) will be at or below 88.5 °F at the beginning of cooldown, 4 hours after reactor shutdown. This temperature is based on the use of the maximum normal wet bulb temperature as a reference for SWS cooling tower performance. Since the increase in V C Summer site maximum safety wet bulb temperature from 86.1 °F to 87.3 °F does not affect the value of the site maximum normal temperture, there is no change to the predicted value of SWS cold water temperature at the beginning of cooldown for V C Summer.

Calculation note APP-SWS-M3C-009, Revision 1, *Service Water Temperature Variation During RNS Cooldown*, provides a detailed analysis of the time dependence of SWS cold water temperature for several different ambient wet bulb temperatures at the expected peak heat duty. The calculated cold water temperature at 4 hours after reactor shutdown, for ambient wet bulb temperature of 80.1 °F, is 87.22 °F. This value satisfies the DCD commitment and applies to V C Summer as well as to all other AP1000 sites with maximum normal wet bulb temperatures bounded by the standard site temperature.

Conclusions

There are no design changes required in order to accommodate the increased value of maximum safety wet bulb temperature at the V C Summer site.

There are no impacts on the performance of V C Summer plant safety systems as a result of the increased value of maximum safety wet bulb temperature.

Licensing Documentation Changes

As described above, the design basis safety analysis cases continue to be the bounding analysis for containment pressure and auxiliary building safety related room temperature and humidity profiles. Therefore, no formal reanalysis of containment performance is required and no changes in either Section 6.2 or Section 6.4 are needed in the V C Summer COLA. However, there are several places within the FSAR, both Tier 1 and 2, where there are design commitments as well as descriptions of system design capabilities which do require changes as a result of the higher maximum safety non-coincident wet bulb temperature. The following is a summary of those instances and the proposed revisions to the appropriate FSAR pages are attached. The Summer FSAR pages to be modified are referenced to their corresponding page in the current revision of the AP1000 DCD (Revision 17).

Within Tier 1 it is necessary to modify Table 5.0-1 to reflect the higher maximum safety non-coincident wet bulb temperature of 87.3 °F that applies for the V C Summer site. This change will also be made in Tier 2 Table 2-1. Within Tier 2 of the V C Summer FSAR it will also be necessary to revise Table 2-1 to redefine the temperature conditions to accommodate the increased maximum safety non-coincident wet bulb temperature for the V C Summer site.

Additionally, sections 5.4.7.1.2.3, 9.1.3.1.3.1, 9.2.2.1.2.1 and Table 6.2.1.1-2 of the FSAR are being revised to reflect the change in maximum safety ambient wet bulb temperature. Mark-ups of these sections for inclusion in the V C Summer FSAR are provided in the following section of this report. Changes from the text of the AP1000 DCD are shown highlighted and in red font.

III DCD MARK-UPS FOR INCLUSION IN V C SUMMER FSAR

A. Proposed Change to V C Summer FSAR Tier 1, Table 5.0-1

Table 5.0-1
Site Parameters

Maximum Ground Water Level	Plant elevation 98 ft
Maximum Flood Level	Plant elevation 100 ft (design grade elevation)
Precipitation	
Rain	19.4 in./hr (6.3 in./5 min)
Snow/Ice	Ground snow load of 75 lb/ft^2 with exposure factor of 1.0 and importance factor of 1.2
Air Temperature	Maximum coincident temperature limits based on historical data excluding peaks of less than 2 hours duration; maximum wet bulb (noncoincident) limit based on statistical analysis of site data to determine 100-year return value Maximum temperature of 115° dry bulb/86.1°F coincident wet bulb Maximum wet bulb 87.3 °F (noncoincident)* Minimum temperature of -40°F
Tornado	
Wind Speed	Maximum wind speed of 300 mph
Maximum Pressure Differential	Maximum pressure differential of 2.0 lb/in^2
Tornado Missile Spectra	4000-lb automobile at 105 mph horizontal, 74 mph vertical 275-lb, 8-in. shell at 105 mph horizontal, 74 mph vertical 1-in.-diameter steel ball at 105 mph in the most damaging direction

* Maximum safety noncoincident ambient wet bulb temperature is a site-specific parameter for V C Summer.

B. Proposed Change to V C Summer FSAR Tier 2, Table 2-1

Table 2-1 (Sheet 1 of 4)

SITE PARAMETERS

Air Temperature	
Maximum Safety [(a)]	115°F dry bulb/86.1°F coincident wet bulb 87.3 °F wet bulb (noncoincident)[(g)]
Minimum Safety [(a)]	-40°F
Maximum Normal [(b)]	101°F dry bulb/80.1°F coincident wet bulb 80.1°F wet bulb (noncoincident) [(d)]
Minimum Normal [(b)]	-10°F
Wind Speed	
Operating Basis	145 mph (3 second gust); importance factor 1.15 (safety), 1.0 (nonsafety); exposure C; topographic factor 1.0
Tornado	300 mph
Seismic	
SSE	0.30g peak ground acceleration [(c)(f)]
Fault Displacement Potential	Negligible
Soil	
Average Allowable Static Bearing Capacity	Greater than or equal to 8,600 lb/ft^2 over the footprint of the nuclear island at its excavation depth
Maximum Allowable Dynamic Bearing Capacity for Normal Plus SSE	Greater than or equal to 35,000 lb/ft^2 at the edge of the nuclear island at its excavation depth
Shear Wave Velocity	Greater than or equal to 1,000 ft/sec based on low-strain best-estimate soil properties over the footprint of the nuclear island at its excavation depth

B. Proposed Change to V C Summer FSAR Tier 2, Table 2-1 (continued)

Table 2-1 (Sheet 3 of 4)

SITE PARAMETERS

Missiles	
Tornado	4000 - lb automobile at 105 mph horizontal, 74 mph vertical 275 - lb, 8 in. shell at 105 mph horizontal, 74 mph vertical 1 inch diameter steel ball at 105 mph horizontal and vertical
Flood Level	Less than plant elevation 100′
Ground Water Level	Less than plant elevation 98′
Plant Grade Elevation	Less than plant elevation 100′ except for portion at a higher elevation adjacent to the annex building
Precipitation	
Rain	19.4 in./hr (6.3 in./5 min)
Snow/Ice	75 pounds per square foot on ground with exposure factor of 1.0 and importance factors of 1.2 (safety) and 1.0 (non-safety)
Atmospheric Dispersion Values - χ/Q[e]	
Site boundary (0-2 hr)	$\leq 1.0 \times 10^{-3}$ sec/m^3
Site boundary (annual average)	$\leq 2.0 \times 10^{-5}$ sec/m^3
Low population zone boundary	
0 - 8 hr	$\leq 5.0 \times 10^{-4}$ sec/m^3
8 - 24 hr	$\leq 3.0 \times 10^{-4}$ sec/m^3
24 - 96 hr	$\leq 1.5 \times 10^{-4}$ sec/m^3
96 - 720 hr	$\leq 8.0 \times 10^{-5}$ sec/m^3
Population Distribution	
Exclusion area (site)	0.5 mi

Notes:

(a) Maximum and minimum safety values are based on historical data and exclude peaks of less than 2 hours duration.

(b) Maximum and minimum normal values are the 1 percent exceedance magnitudes.

(c) With ground response spectra as given in Figures 3.7.1-1 and 3.7.1-2. Seismic input is defined at finished grade except for sites where the nuclear island is founded on hard rock.

(d) The noncoincident wet bulb temperature is applicable to the cooling tower only.

(e) For AP1000, the terms "site boundary" and "exclusion area boundary" are used interchangeably. Thus, the χ/Q specified for the site boundary applies whenever a discussion refers to the exclusion area boundary.

(f) Sites that fall within the hard rock high frequency GMRS given in Figure 3I.1-1 and Figure 3I.1-2 are acceptable.

(g) The containment pressure response analysis is based on a conservative set of dry-bulb and wet-bulb temperatures. For V C Summer these results envelope any conditions where the dry-bulb temperature is 115°F or less and wet-bulb temperature of less than or equal to 87.3 °F.

C. Proposed Change to V C Summer FSAR Tier 2, Section 5.4.7.1.2.3

Core decay heat generation is based on the decay heat curve for a three-region core having burnups consistent with a 24-month or 18-month refueling schedule and based on the ANSI/ANS-5.1-1994 decay heat curve (Reference 5).

- A failure of an active component during normal cooldown does not preclude the ability to cool down, but lengthens the time required to reach 125°F. Furthermore, if such a single failure occurs while the reactor vessel head is removed, the reactor coolant temperature remains below boiling temperature.

- The system operates at a constant normal residual heat removal flow rate throughout refueling operations. This includes the time when the level in the reactor coolant system is reduced to a midloop level to facilitate draining of the steam generators or removal of a reactor coolant pump. Operation of the system at the minimum level that the reactor coolant system can attain using the normal reactor coolant system draining connections and procedures results in no incipient vortex formation which would cause air entrainment into the pump suction.

- The pump suction line is self-venting with continually upward sloped pipe from the pump suction to the hot leg. This arrangement prevents entrapment of air and minimizes system venting efforts for startup.

- Features are included that permit mid-loop operations to be performed from the main control room.

5.4.7.1.2.2 Shutdown Purification

The normal residual heat removal system provides reactor coolant system flow to the chemical and volume control system during refueling operations. The purification flow rate is consistent with the purification flow rate specified in Table 9.3.6-1.

5.4.7.1.2.3 In-Containment Refueling Water Storage Tank Cooling

The normal residual heat removal system provides cooling for the in-containment refueling water storage tank during operation of the passive residual heat removal heat exchanger or during normal plant operations when required. The system is manually initiated by the operator. The normal residual heat removal system limits the in-containment refueling water storage tank water temperature to less than boiling temperature during extended operation of the passive residual heat removal system and not greater than 120°F during normal operation. The system performs this function based on the following:

- Operation of the system with both subsystems of normal residual heat removal system pumps and heat exchangers available.

- The component cooling water system supply temperature to the normal residual heat removal system heat exchangers is based on an ambient design wet bulb temperature of no greater than 87.3 °F (100 year return maximum wet bulb temperature value). The 87.3 °F value is assumed for normal conditions and transients that start at normal conditions.

D. Proposed Change to V C Summer FSAR Tier 2, Section 9.2.2.1.2.1

9.2.2.1 Design Bases

9.2.2.1.1Safety Design Basis

Failure of the component cooling water system or its components will not affect the ability of safety-related systems to perform their intended safety functions. The component cooling water system serves no safety-related function except for containment isolation and therefore has no nuclear safety design basis except for containment isolation (see subsection 6.2.3).

9.2.2.1.2Power Generation Basis

The component cooling water system is designed to perform its operational functions in a reliable and failure tolerant manner. This reliability is achieved with the use of reliable and redundant equipment and with a simplified system design.

9.2.2.1.2.1 Normal Operation

The component cooling water system transfers heat from various plant components needed to support normal power operation with a single active component failure. The component cooling water system is designed for normal operation in accordance with the following criteria:

- The component cooling water supply temperature to plant components is not more than 100°F assuming a 0 percent exceedance ambient design wet bulb temperature of 87.3 °F for service water cooling at normal operations (maximum normal temperature per Table 2.1-1 for normal shutdown).
- The minimum component cooling water supply temperature to plant components is 60°F.
- The component cooling water system provides sufficient surge capacity to accept 50 gallons per minute leakage into or out of the system for 30 minutes before any operator action is required.

9.2.2.1.2.2 Normal Plant Cooldown

The first phase of plant cooldown is accomplished by transferring heat from the reactor coolant system via the steam generators to the main steam systems.

The component cooling water system, in conjunction with the normal residual heat removal system removes both residual and sensible heat from the core and the reactor coolant system and reduces the temperature of the reactor coolant system during the second phase of cooldown.

The component cooling water system reduces the temperature of the reactor coolant system from 350°F at approximately 4 hours after reactor shutdown to 125°F within 96 hours after shutdown by providing cooling to the normal residual heat removal system heat exchangers. This cooldown time is based on operation of both component cooling water system

E. Proposed Change to V C Summer FSAR Tier 2, Section 6.2.2.3

Table 6.2.2-3 presents a failure modes and effects analysis of the passive containment cooling system. Capability is provided to periodically test actuation of the passive containment cooling system. Active components can be tested periodically during plant operation to verify operability. The system can be inspected during unit shutdown. Additional information is contained in subsections 3.9.6 and 6.2.2.4, as well as in the Technical Specifications.

The passive containment cooling system components located inside containment, the containment pressure sensors, are tested and qualified to perform in a simulated design basis accident environment. These components are protected from effects of postulated jet impingement and pipe whip in case of a high-energy line break. The containment pressure analyses are based on an ambient air temperature of 115°F dry bulb and 87.3 °F ~~coincident~~ wet bulb. The passive containment cooling water storage tank water temperature basis is 120°F. Results of the analyses are provided in subsection 6.2.1.

6.2.2.4 Testing and Inspection

6.2.2.4.1 Inspections

The passive containment cooling system is designed to permit periodic testing of system readiness as specified in the Technical Specifications.

The portions of the passive containment cooling system from the isolation valves to the passive containment cooling water storage tank are accessible and can be inspected during power operation or shutdown for leak tightness. Examination and inspection of the pressure retaining piping welds is performed in accordance with ASME Code, Section XI. The design of the containment vessel and air baffle retains provisions for the inspection of the vessel during plant shutdowns.

6.2.2.4.2 Preoperational Testing

Preoperational testing of the passive containment cooling system is verified to provide adequate cooling of the containment. The flow rates are confirmed at the minimum initial tank level, an intermediate step with all but one standpipe delivering flow and at a final step with all but two standpipes delivering to the containment shell. The flow rates are measured utilizing the differential pressure across the orifices within each standpipe and will be consistent with the flow rates specified in Table 6.2.2-1.

The containment coverage will be measured at the base of the upper annulus in addition to the coverage at the spring line for the full flow case using the PCS water storage tank delivering to the containment shell and a lower flow case with both PCS recirculation pumps delivering to the containment shell. For the low flow case, a throttle valve is used to obtain a low flow rate less than the full capacity of the PCS recirculation pumps. This flow rate is then re-established for subsequent tests using the throttle valve. These benchmark values will be used to develop acceptance criteria for the Technical Specifications. The full flow condition is selected since it is

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F. Proposed Change to V C Summer FSAR Tier 2, Table 6.2.1.1-2

Table 6.2.1.1-2

INITIAL CONDITIONS

Internal Temperature (°F)	120
Pressure (psia)	15.7
Relative Humidity (%)	0
Net Free Volume (ft^3)	2.06E+06
External Temperature (°F)	115 dry bulb 87.3 wet bulb*

* Maximum safety noncoincident ambient wet bulb temperature is a site-specific parameter for V C Summer.

G. Proposed Change to V C Summer FSAR Tier 2, Section 9.1.3.1.3.1

9.1.3.1.3.1 Partial Core

The spent fuel pool cooling system is designed to remove heat from the spent fuel pool such that the spent fuel pool water temperature will be ≤ 120°F following a partial core fuel shuffle refueling. The system is designed to perform this function based on the following:

- The assumed heat load is based on the decay heat generated by the accumulated maximum number of fuel assemblies stored in the fuel pool, which includes 44% of a core (69 assemblies) being placed into the pool beginning at 120 hours after shutdown.
- Both trains of the spent fuel pool cooling system are assumed to be operating.
- The component cooling water system (CCS) supply temperature to the spent fuel pool cooling system heat exchangers is based on a service water system heat sink with a maximum normal ambient design wet bulb temperature as defined in Chapter 2, Table 2-1.

SFS performance following restart after a normal refueling will be affected by a change in maximum safety wet bulb temperature since this temperature is the basis for determining the CCS supply temperature during power operation. Calculations confirm that the spent fuel pool temperature remains below 120 °F with margin, with a CCS supply temperature of 97.3 °F, the highest temperature attained with the plant at power and ambient wet bulb temperature at the V C Summer site maximum safety value of 87.3 °F.