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UniStar
NUCLEAR ENERGY

10 CFR 50.4
10 CFR 52.79

April 30, 2013

UN#13-054

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

Subject: UniStar Nuclear Energy, NRC Docket No. 52-016
Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3,
RAI 365, Ultimate Heat Sink

References:
1) Surinder Arora (NRC) to Paul Infanger (UniStar Nuclear Energy), "FINAL RAI No. 365 BPTS 6582" email dated July 31, 2012

2) UniStar Nuclear Energy Letter UN#13-006, from Mark T. Finley to Document Control Desk, U.S. NRC, Calvert Cliffs Nuclear Power Plant, Unit 3 Updated RAI Closure Plan, dated January 30, 2013

The purpose of this letter is to respond to the request for additional information (RAI) identified in the NRC e-mail correspondence to UniStar Nuclear Energy, dated July 31, 2012 (Reference 1). This RAI addresses Ultimate Heat Sink, as discussed in Section 09.02.05 of the Final Safety Analysis Report (FSAR), as submitted in Part 2 of the Calvert Cliffs Nuclear Power Plant (CCNPP) Unit 3 Combined License Application (COLA), Revision 9.

Reference 2 indicated that a response to RAI 365, Question 09.02.05-30 would be provided to the NRC by April 30, 2013. Enclosure 1 provides our response to RAI No. 365, Question 09.02.05-30, and includes revised COLA content. A Licensing Basis Document Change Request has been initiated to incorporate these changes into a future revision of the COLA.

Enclosure 2 provides a Table of Changes to the COLA associated with this RAI 365 response.

Our response does not include any new regulatory commitments. This letter does not contain any sensitive or proprietary information.

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NRO

If there are any questions regarding this transmittal, please contact me at (410) 369-1907 or Mr. Wayne A. Massie at (410) 369-1910.

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

Executed on April 30, 2013

Mark T. Finley

Enclosures:

1) Response to NRC Request for Additional Information RAI No. 365, Question 09.02.05-30, Ultimate Heat Sink, Calvert Cliffs Nuclear Power Plant, Unit 3

2) Table of Changes to CCNPP Unit 3 COLA Associated with Response to RAI No. 365

cc: Surinder Arora, NRC Project Manager, U.S. EPR Projects Branch
Laura Quinn-Willingham, NRC Environmental Project Manager, U.S. EPR COL Application
Amy Snyder, NRC Project Manager, U.S. EPR DC Application, (w/o enclosures)
Patricia Holahan, Acting Deputy Regional Administrator, NRC Region II, (w/o enclosures)
Silas Kennedy, U.S. NRC Resident Inspector, CCNPP, Units 1 and 2,
David Lew, Deputy Regional Administrator, NRC Region I (w/o enclosures)

Enclosure 1

**Response to NRC Request for Additional Information
RAI No. 365, Question 09.02.05-30,
Ultimate Heat Sink,
Calvert Cliffs Nuclear Power Plant, Unit 3**

RAI No. 365

Question 09.02.05-30

RAI Letter #518 (RAI 6122), Question 09.02.05-38 response from AREVA, dated June 25, 2012, was recently received by the NRC. This RAI is related to the ultimate heat sink (UHS) and site wet bulb temperature. In the response, the applicant revised COL Item 9.2.7 and added COL Item 9.2.11.

COL Item 9.2.7 was revised to include:

A COL applicant that references the U.S. EPR design certification will confirm that the site characteristic sum of 0% exceedance maximum non-coincident wet bulb temperature and the sites specific wet bulb correction factor does not exceed the value provided in Table 9.2.5-2. If the value in Table 9.2.5-2 is exceeded, the maximum UHS cold-water return temperature of 95°F is to be confirmed by analysis (see Section 9.2.5.3.3).

COL Item 9.2.11 was added:

A COL applicant that references the U.S. EPR design certification will confirm that the maximum UHS cold-water return temperature of 95 °F is met by an analysis that confirms that the worst combination of site-specific wet bulb and dry bulb temperatures over a 24-hour period, from a 30-year hourly regional climatological data set, is bounded by the values presented in Table 9.2.5-4.

The COL applicant should address these COL Items as stated above.

Response

<u>Response to COL Item 9.2-7:</u>

The Calvert Cliffs Nuclear Power Project (CCNPP) Unit 3 site-specific 0% exceedance maximum non-coincident wet bulb temperature is determined to be 85.3°F using the guidance of Regulatory Guide 1.27 and 30 years of climatology data from the Patuxent River Naval Air Station.

The maximum site-specific wet bulb correction factor due to Ultimate Heat Sink (UHS) cooling tower interference and recirculation was determined by analysis to be 2.2°F (2.1°F ±0.1°F) as described below. Therefore, the sum of 0% exceedance non-coincident wet bulb temperature and wet bulb correction factor is 87.5°F. The U.S. EPR FSAR Table 9.2.5-2, Ultimate Heat Sink Cooling Tower Design Inlet Wet Bulb Temperature of 81°F (non-coincident, 0% exceedance value) is less than the maximum site-specific wet bulb temperature of 87.5°F. Therefore an analysis is required.

An analysis of the CCNPP Unit 3 UHS Cooling Towers was performed to determine the maximum UHS cold-water return temperature, considering a 24 hour meteorological data set from 30 years of hourly regional climatological data that maximizes the UHS cooling tower basin water temperature. This CCNPP Unit 3 UHS Cooling Tower analysis included a recirculation and interference correction factor of 2.5°F, the value assumed in the U.S. EPR FSAR that

resulted in a maximum 0% exceedance non-coincident wet bulb temperature of 87.8°F. The Large Break Loss of Coolant Accident (LB-LOCA) heat load was evaluated to have the most bounding integrated heat loads to determine the maximum UHS cold-water return temperature. Based on the UHS Cooling Tower analysis, the maximum UHS cooling tower basin water temperature was determined to be lower than 95°F. Therefore, the sum of the site-specific wet bulb correction factor of 2.2°F and the site-specific non-coincident wet bulb temperature of 85.3°F is bounded by the analysis, considering a 2.5°F recirculation and interference correction factor that resulted in a UHS cold-water return temperature less than 95°F .

To determine the correction factor for tower recirculation and interference, a computational fluid dynamics (CFD) analysis of the CCNPP Unit 3 UHS Cooling Towers was completed using the software CD-adapco Star-CCM+, to determine the increase in ambient wet bulb temperature of cooling tower intake air for cooling towers due to recirculation and interference effects. The CFD analysis considered both cells of two adjacent UHS Cooling Towers, or one each from either side of the power block, operating at a maximum wet bulb temperature (85.3°F) and heat duty based on a Design Basis Accident. Meteorological data with regard to wind speeds is considered from six years of measurements of wind speed at directions from the meteorological tower at CCNPP Unit 1 & 2. Isothermal CFD simulations were run for 16 individual and equally spaced wind directions (each at 22.5 degrees apart), using no heat load (neutrally buoyant) discharge from the UHS Cooling Tower, to determine the worst case wind directions. The recirculation effect is determined by using an iterative approach, where the discharge condition calculations are updated using intermediate CFD results at the UHS Cooling Tower air intakes, which iterate until convergence of the discharge parameters is obtained. The worst case condition of wind direction and UHS Cooling Tower operations was evaluated at various wind speeds to determine what conditions produced the highest ingestion of UHS Cooling Tower discharge. It was concluded that for low wind speeds (below 2.5 m/s [5.6 mph]), the cooling tower discharge rose high vertically, and the recirculation and interference are negligible. Wind speeds between the range of 5.0 m/s (11.2 mph) and 10 m/s (22.4 mph) at various wind directions yielded results with the highest associated increase in UHS Cooling Tower intake wet bulb temperature.

These CFD analyses result in a dry bulb temperature and water vapor mass fraction at the cooling tower intake that are converted into an increase in wet bulb temperature at the UHS cooling tower over the ambient value. The worst case increase of wet bulb temperature over the ambient value is the UHS Cooling Tower intake wet bulb correction for interference and recirculation, and was calculated to be 2.2°F. This value is below the 2.5°F allowance for impact of interference presented in the Design Certification RAI 351[1].

Response to COL Item 9.2-11:

The response to COL Item 9.2-11 is provided in the response to RAI 287 Q09.02.05-19[2].

[1] D. Williford (AREVA) to Snyder, Amy (NRC), "Response to U.S. EPR Design Certification Application RAI No. 351, FSAR Ch. 9, Supplement 10," email dated March 14, 2013.
[2] UniStar Nuclear Energy Letter UN#13-055, from Mark T. Finley to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 287, Ultimate Heat Sink, dated April 30, 2013

COLA Impact

The Calvert Cliffs Nuclear Power Plant Unit 3 COLA is revised as follows:

Table 1.8-2— FSAR Sections that Address COL Items

Item No.	Description	Section
....	....	....
9.2-7	A COL applicant that references the U.S. EPR design certification will confirm that the site characteristic sum of 0% excedance maximum non-coincident wet bulb temperature and the site-specific wet bulb correction factor does not exceed the value provided in Table 9.2.5-2. If the value in Table 9.2.5-2 is exceeded, the maximum UHS cold-water return temperature of 95°F is to be confirmed by analysis (see Section 9.2.5.3.3).	**9.2.5.3.1, 9.2.5.3.3**

9.2.5.3.1 Mechanical Draft Cooling Towers

The U.S. EPR FSAR includes the following COL Items in Section 9.2.5.3.1:

....

The COL Items are addressed as follows:

~~Confirmation that~~ An analysis determined the site characteristic sum of 0% exceedance maximum non-coincident wet bulb temperature and the site-specific wet bulb correction factor does ~~do not~~ exceed the value provided in U.S. EPR FSAR Table 9.2.5-2~~,~~. ~~or an analysis that the maximum UHS cold-water return temperature does not exceed 95°F, if applicable, is provided in Section 9.2.5.3.3.~~ Confirmation that an analysis was completed to determine that the sum of the 0% exceedance maximum non-coincident wet bulb temperature and site-specific wet bulb correction factor do not result in a UHS cold-water return temperature greater than 95°F is provided in Section 9.2.5.3.3.

Confirmation that potential UHS cooling tower interference effects on the safety-related air intakes does not result in air intake inlet conditions that exceed the U.S. EPR FSAR 2.1-1, Site Design Envelope Parameters for Air Temperature, is provided in Section 9.2.5.3.3.

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9.2.5.3.3 Cooling Tower Basin

....

Design Inlet Wet Bulb Temperature

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The temperature data provided in U.S. EPR FSAR Tables 9.2.5-3 and 9.2.5-4 envelops the temperature data for the Calvert Cliffs Site.

A computational fluid dynamics (CFD) analysis of the CCNPP Unit 3 UHS Cooling Towers was completed to determine the increase in ambient wet bulb temperature of cooling tower intake air for cooling towers due to recirculation and interference effects. The CFD analysis considered both cells of two adjacent UHS Cooling Towers, or one each from either side of the power block, operating at a maximum wet bulb temperature (85.3 °F) and heat duty based on the Large Break LOCA Design Basis Accident, which results in the worst case UHS Cooling Tower heat load.

Meteorological data with regard to wind speeds is considered from six years of measurements of wind speed at directions from the meteorological tower at CCNPP Unit 1 & 2. Isothermal CFD simulations were run for 16 individual and equally spaced wind directions (each at 22.5 degrees apart), using no heat load (neutrally buoyant) discharge from the UHS Cooling Tower discharge to determine the worst case wind directions. The recirculation effect is determined by using an iterative approach, where the discharge condition calculations are updated using intermediate CFD results at the UHS Cooling Tower air intakes, which iterate until convergence of the discharge parameters is achieved. The worst case condition of wind direction and UHS Cooling Tower operations was evaluated at various wind speeds to determine what conditions produced the highest ingestion of UHS Cooling Tower discharge. It was concluded that for low wind speeds (below 2.5 m/s [5.6 mph]), the cooling tower discharge rose high vertically, and the recirculation and interference are negligible. Wind speeds between the range of 5.0 m/s (11.2 mph) and 10 m/s (22.4 mph) at various wind directions yielded results with the highest associated increase in UHS Cooling Tower intake wet bulb temperature.

CFD analyses were performed on the worst cases determined from the neutrally buoyant studies, as described above, incorporating buoyancy and iteratively updated the UHS Cooling Tower discharge and intake analyses. These CFD analyses result in a dry bulb temperature and water vapor mass fraction at the cooling tower intake that are converted into an increase in wet bulb temperature at the UHS cooling tower over the ambient value. This increase of wet bulb temperature over the ambient value is the UHS Cooling Tower intake wet bulb correction for interference and recirculation.

The site-specific wet and dry bulb temperatures were determined using the guidance of Regulatory Guide 1.27 (NRC, 1976) and 30 years of climatology data (1976-2006) from Patuxent River Naval Air Station, just south of the site. The data analysis yielded a maximum calculated wet bulb temperature, when applying a 0% exceedance criterion, of 85° F (29° C) with a coincident dry bulb temperature of 99° F (37° C). This temperature is in excess of the U.S. EPR FSAR Table 9.2.5-2 site design parameter for the 0% exceedance non-coincident wet bulb temperature. ~~This variance is acceptable because the cooling tower performance at its design point is analyzed for the worst case, timedependent meteorological conditions noted below (including the highest recorded wet bulb temperature of 85°F (29°C)) and the similarly time-dependent DBA heat rejection curve.~~ This variance is acceptable because the cooling tower performance at its design point is analyzed for the worst case, time-dependent meteorological conditions, and the similarly time-dependent DBA heat rejection curve. The time-dependent meteorological conditions, noted below, were modified for UHS Cooling Tower recirculation and interference, which included the sum of the highest recorded wet bulb temperature of 85.3 °F (29.6 °C) and the site-specific wet bulb correction factor of 2.2 °F (1.2 °C). This analysis confirms that the UHS cold-water return temperature does not exceed 95 °F.

The 0% exceedance criterion means that the wet bulb temperature does not exceed the 0% exceedance value for more than two consecutive data occurrences, and the Patuxent River data was recorded hourly.

Enclosure 2

Table of Changes to CCNPP Unit 3 COLA Associated with Response to RAI No. 365

Table of Changes to CCNPP Unit 3 COLA Associated with Response to RAI No. 365

Change ID #	Subsection	Type of Change	Description of Change
Part 2 FSAR			
CC3-13-0079	Table 1.8-2	Incorporate COLA markups associated with the response to RAI 365.	The response to RAI 365 Question 09.02.05-30 involved an addition of reference to Section 9.2.5.3.3 for COL Item 9.2-7 to the table.
CC3-13-0079	9.2.5.3.1	Incorporate COLA markups associated with the response to RAI 365.	The response to RAI 365 Question 09.02.05-30 revised the text to state the site-specific wet bulb correction factor does exceed the value in U.S. EPR FSAR Table 9.2.5-2.
CC3-13-0079	9.2.5.3.3	Incorporate COLA markups associated with the response to RAI 365.	The response to RAI 365 Question 09.02.05-30 revised the text to state results of the analysis performed to verify the UHS cold water return does not exceed 95 °F, even though the site-specific wet bulb correction factor does exceed the value in U.S. EPR FSAR Table 9.2.5-2.