Paul Infanger
Manager, Regulatory Affairs & Engineering

5404 Wisconsin Ave. Suite 400
Chevy Chase, Maryland 20815

UniStar
NUCLEAR ENERGY

10 CFR 50.4
10 CFR 52.79

March 14, 2014

UN#14-025

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 410, Turbine Missiles

Reference: Surinder Arora (NRC) to Paul Infanger (UniStar Nuclear Energy), "CCNPP3 - Final RAI 410 MCB 7395," dated February 14, 2014

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 February 14, 2014 (Reference). This RAI addresses Turbine Missiles, as discussed in Section 3.5.1.3 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.

Enclosure 1 provides our response to RAI 410, Question 03.05.01.03-26, 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 CCNPP Unit 3 COLA associated with RAI 410, Question 03.05.01.03-26.

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

D096
NRO

If there are any questions regarding this transmittal, please contact me at (410) 369-1987 or Mr. Mark Finley at (410) 369-1907.

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

Executed on March 14, 2014

Paul Infanger

Enclosures: 1) Response to NRC Request for Additional Information RAI No. 410, Question 03.05.01.03-26, Turbine Missiles, Calvert Cliffs Nuclear Power Plant, Unit 3

2) Table of Changes to CCNPP Unit 3 COLA Associated with the Response to RAI No. 410, Question 03.05.01.03-26, Calvert Cliffs Nuclear Power Plant, Unit 3

cc: Surinder Arora, NRC Project Manager, U.S. EPR Projects Branch
Tomeka Terry, NRC Environmental Project Manager, U.S. EPR COL Application
George Wunder, 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)

UN#14-025

Enclosure 1

Response to NRC Request for Additional Information
RAI No. 410, Question 03.05.01.03-26,
Turbine Missiles,
Calvert Cliffs Nuclear Power Plant, Unit 3

RAI No. 410

Question 03.05.01.03-26

This RAI Question addresses an inconsistency between COLA Revision 9 and DCA Revision 5.

Section 3.5.1.3 of Revision 9 to the Calvert Cliffs COL FSAR addresses COL Item 3.5-2 identified in U.S. EPR FSAR, Tier 2, Table 1.8-2 by stating that the turbine missile analysis demonstrates that the probability of turbine rotor failure resulting in an ejection of the turbine rotor fragment through the turbine casing, P_1, is less than 1×10^{-4} for a favorably orientated turbine. However, the COL Item in Revision 5 of the U.S. EPR FSAR, Section 3.5.1.3 was revised and now specifies that P_1 should be less than 1×10^{-5} for an unfavorable orientated turbine. Therefore, verify that the turbine missile analysis meets the criteria for P_1 less than $1x10^{-5}$, and revise the FSAR and turbine analysis accordingly. The turbine missile analysis includes the following reports:

- Alstom, 2007. Alstom Report TSDMF 07-018 D, Unistar Project Turbine Missile Analysis, dated May 30, 2007.
- Alstom, 2010a. Alstom Report TNUD-EI 10-011, Unistar Project Turbine Missile Analysis, Fracture Mechanics Applied to the LP Rotor, dated June 30, 2010.
- Alstom, 2010b. Alstom Document 75RC10001, Unistar Project Steam Turbine Protection System Overspeed Reliability Evaluation, dated March 2, 2010.

In addition, please note that the final results of the reports should have units that are consistent with the criteria of P_1 less than $1x10^{-5}$ per year as specified in SRP Section 3.5.1.3, and not $1x10^{-5}$ per demand, month or day.

Response

The Calvert Cliffs Nuclear Power Plant (CCNPP) Unit 3 Combined License Application (COLA) Final Safety Analysis Report (FSAR) Section 3.5.1.3 has been revised to be consistent with COL Item 3.5-2 in Revision 5 of the U.S. EPR FSAR, Section 3.5.1.3.

In accordance with Regulatory Guide (RG) 1.115, a Turbine Generator is determined to be favorably or unfavorably positioned based on whether any "essential systems" requiring protection from turbine missiles is located within the low trajectory hazard zone for turbine missiles. If any structures, systems, and components (SSCs) are located within the low trajectory hazard zone the turbine generator is considered UNFAVORABLY positioned.

The US EPR Design places 2 of the 4 Essential Service Water Buildings (ESWBs) outside of the turbine low trajectory hazard zone for turbine missiles and 2 of the 4 ESWBs inside the turbine low trajectory hazard zone for turbine missiles. Although this is an acceptable design, per RG 1.115 the placement of any SSC within the low trajectory hazard zone results in the turbine generator being considered UNFAVORABLY positioned.

In accordance with Standard Review Plan (SRP) 3.5.1.3 and RG 1.115, for turbine generators located in an unfavorable position (the worst situation), the probability of turbine failure resulting in ejection of the turbine rotor (or internal structure) fragments through the turbine casing (P_1) must be less than $1x10^{-5}$.

As given in the last sentence on page 1 of Alstom Turbine Missile Analysis TSMDF 07-018B (RAI 29, Questions 03.05.01.03-1 and 03.05.01.03-2[1]), for a 10-year inspection interval, the cumulative missile generation probability (P_1) for the Low Pressure (LP) turbine rotor is $1x10^{-6}$ and for the High and Intermediate Pressure (HIP) rotor is $0.9x10^{-7}$. As both values are less than the maximum value of $1x10^{-5}$, the placement of the turbine generator in the as stated unfavorable position meets the requirement of SRP 3.5.1.3 and RG 1.115 and therefore no further engineering or analysis is required.

This is also illustrated graphically on pages 21 and 22 of the TSMDF 07-018B (RAI 29, Questions 03.05.01.03-1 and 03.05.01.03-2[1]), where P_1 versus the inspection interval for the LP and HIP turbines is shown graphically. (Note – the stated Alstom inspection interval is 10-years, as stated in the TSMDF 07-018B.).

The Turbine Missile Analysis document TSMDF 07-018B (Proprietary version) and 07-018D (Non-Proprietary or Redacted version), were provided to the NRC in the response to RAI 29, Questions 03.05.01.03-1 and 03.05.01.03-2[1] and RAI 29, Questions 03.05.01.03-1 and 03.05.01.03-2[2] concerning turbine missile generation probability. Table 1 identifies the required values of P1 and licensee actions. While neither the summary on page 1 nor the graphs contain the units of per year, the table identifies in its heading that the value of the probability, P1, is per unit year. In addition, Section 9 of the report provides the results of the analysis for both the LP turbine rotor and HP turbine rotor to determine the missile generation probability, P1, based on the specific characteristics of the Alstom turbine rotor (number of turbine flows, temperature, material yield strength, stress, etc.) and other variables that are time dependent (such as crack growth rate and critical crack size). These time dependent variables are identified in Table 3 with units of "per year" and therefor would lead to calculated values of P1 on a per year basis.

The outcome of the analysis using the inputs from Table 3 are values for P1 on a per year basis integrated over the service life of the turbine is expressed in Figures 15, 16, and 17. These plots allow the determination of the P1 Probability on a per year basis for any period of the turbine rotors service life. Using the specified turbine inspection interval of 10 years, the cumulative missile generation probability (P1) is demonstrated to be 1.0 x 10-6 per year for the LP rotor and 0.9 x 10-7 per year for the HP rotor.

Additionally, in response to RAI 211[3], Alstom provided an overspeed reliability evaluation for the Steam Turbine Protection System. The identified failure probabilities are based on the probability of a protection system component failing to operate when it is required (i.e., demanded) to operate. This evaluation was used to demonstrate expected probabilities for the

---

[1] UniStar Nuclear Energy Letter UN#09-112, from Greg Gibson to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 29, Questions 03.05.01.03-1 and 03.05.01.03-2, Turbine Missiles, dated March 2, 2009

[2] UniStar Nuclear Energy Letter UN#09-209, from Greg Gibson to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 29, Questions 03.05.01.03-1 and 03.05.01.03-2, Turbine Missiles, dated April 22, 2009

[3] UniStar Nuclear Energy Letter UN#10-188, from Greg Gibson to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 211, Turbine Missiles, dated July 9, 2010

failure of the protection system based on the reliability of the system's components. It is not part of the calculation of turbine missile probability and is therefore unrelated to the calculation of the P1, Turbine missile probability.

COLA Impact

CCNPP Unit 3 COLA FSAR has been revised has follows:

3.5.1.3 Turbine Missiles

The U.S. EPR FSAR includes the following COL Item in Section 3.5.1.3:

> A COL applicant that references the U.S. EPR design certification will confirm the evaluation of the probability of turbine missile generation for the selected turbine generator, P1, is less than 1E-5 for turbine generators unfavorably oriented.

This COL Item is addressed as follows:

...

The turbine missile analysis demonstrates that the probability of turbine rotor failure resulting in an ejection of the turbine rotor (or internal structure) fragments through the turbine casing, P1, is less than ~~1E-4~~ 1E-5 for an unfavorably oriented turbine ~~with respect to the containment~~.

UN#14-025

Enclosure 2

Table of Changes to CCNPP Unit 3 COLA
Associated with the Response to RAI No. 410, Question 03.05.01.03-26,
Calvert Cliffs Nuclear Power Plant, Unit 3

Table of Changes to CCNPP Unit 3 COLA

Associated with the Response to RAI No. 410

Change ID #	Subsection	Type of Change	Description of Change
Part 2 FSAR			
UN#08-003	3.5.1.3	Section 3.5.1.3 text was included in the submittal of Revision 2 to the CCNPP Unit 3 COLA[4].	Section 3.5.1.3 text (including the paragraph that provides the probability P_1) was included in the submittal of Revision 2 to the CCNPP Unit 3 COLA[1].
GN 14-0029	3.5.1.3	Incorporate COLA markups associated with the response to RAI 410 (this response).	Final Safety Analysis Report (FSAR) Section 3.5.1.3 (paragraph that provides the probability P_1) has been revised to be consistent with COL Item 3.5-2 in Revision 5 of the U.S. EPR FSAR, Section 3.5.1.3. as part of the response to RAI 410 (this response).

[4] UniStar Nuclear Energy Letter UN#08-003, from George Vanderheyden to Document Control Desk, U.S. NRC, Submittal of Revision 2 to the Partial Combined License Application for the Calvert Cliffs Nuclear Power Plant, Unit 3, and Application for Withholding of Documents, dated March 14, 2008