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UniStar
NUCLEAR ENERGY

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January 29, 2013

UN#13-004

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 376, Turbine Missiles

References:
1) Surinder Arora (NRC) to Paul Infanger (UniStar Nuclear Energy), "CCNPP3 - FINAL RAI 376 CIB 6813," email dated October 17, 2012

2) UniStar Nuclear Energy Letter UN#12-121, 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 376, Turbine Missiles, dated November 14, 2012

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 October 17, 2012 (Reference 1). 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 8.

Reference 2 indicated that a response to RAI 376, Questions 03.05.01.03-23, 03.05.01.03-24, and 03.05.01.03-25, would be provided to the NRC by January 31, 2013.

Enclosure 1 provides our response to RAI No. 376, Questions 03.05.01.03-23, 03.05.01.03-24, and 03.05.01.03-25, 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 this RAI 376 response.

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

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 January 29, 2013

Mark T. Finley

Enclosures:
1) Response to NRC Request for Additional Information RAI No. 376, Questions 03.05.01.03-23, 03.05.01.03-24, and 03.05.01.03-25, Turbine Missiles, Calvert Cliffs Nuclear Power Plant, Unit 3
2) Table of Changes to CCNPP Unit 3 COLA Associated with Response to RAI No. 376

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)
Patrica 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. 376, Questions 03.05.01.03-23, 03.05.01.03-24, and 03.05.01.03-25,**
**Turbine Missiles,**
**Calvert Cliffs Nuclear Power Plant, Unit 3**

**RAI No. 376**

**Question 03.05.01.03-23**

Section 3.0 of Alstom Document 75RC10001, dated March 2, 2010, states that the reliability data for the electronic overspeed protection system is based on the Alstom standard supplier, Jaquet, and it is assumed that this data would apply to a different supplier. However, there is no justification for why a different suppliers equipment would have similar reliability data. Therefore, provide justification on how the Jaquet reliability data would be the same for a different supplier. Also, discuss whether the COL FSAR should supplement the U.S. EPR FSAR, Tier 1, Table 2.8.1-3, ITAAC commitment number 2.5 to confirm that a different supplier's reliability data would be verified to demonstrate that the different suppliers equipment is still bounded by this analysis.

**Response**

The required reliability data would be provided regardless of the equipment supplier. Suppliers for equipment will be identified for an individual license applicant, including Calvert Cliffs Nuclear Power Plant (CCNPP) Unit 3.

The CCNPP Unit 3 Combined License Application (COLA) Final Safety Analysis Report (FSAR) does not require a supplement to the U.S. EPR FSAR, Tier 1, Table 2.8.1-3, Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) commitment number 2.5. ITAAC commitment 2.5, which requires an analysis for the "as-built" turbine design, confirms that a supplier's reliability data demonstrate that the supplier's equipment is bounded by this analysis for the supplier chosen.

**COLA Impact**

No change to the CCNPP Unit 3 COLA Part 2, FSAR, is required as a result of this response.

**RAI No. 376**

**Question 03.05.01.03-24**

Section 4.0 of Alstom Document 75RC10001, dated March 2, 2010, states that the Arabelle nuclear steam turbine has 4 HP inlet lines and 4 IP inlet lines, with each steam inlet line fitted with two valves in series. It also states that the EPR admission valves are similar to the design of valves used on series P4 and N4 turbines. The operating experience with the admission valves for the P4 and N4 series is provided in Section 4.1 of Alstom Document 75RC10001. Explain how the Alstom Document 75RC10001 includes all of the relevant information such as valve types, valve control and overspeed protection systems, etc. that is included in the U.S. EPR FSAR standard steam turbine. This should include at a minimum:

- Discuss and compare why the valves used in the P4 and N4 turbine series are similar to the valves used for the U.S. EPR valves, so that it can be concluded that the components are similar so that the failure rates (past operating experience) for the P4 and N4 turbine series can be used for the analysis of the U.S. EPR design.
- Specify what the turbine series and model number the CCNPP 3 is, and how it compares to the Arabelle nuclear steam turbine.
- Also, include what common cause failure modes occurred for each of the valve types, and how they have been corrected.
- Discuss how these corrective actions were included as part of the admission valve designed for the U.S. EPR.
- Provide similar operating experience for the extraction non-return valves to be used in the U.S. EPR design, to minimize the potential for turbine overspeed.
- Also, discuss whether the reheat stop valves and intercept valves should be included in this analysis for the probability of destructive overspeed.

**Response**

The Alstom Document 75RC10001 includes information relevant to the Arabelle nuclear steam turbine, such as valve types, valve control and overspeed protection systems. These components and systems are included in the U.S. EPR standard steam turbine.

The P4/P'4, N4, and EPR (Global and U.S.) designations represent different plant series, with each plant in a given series having a common design

- P4/P'4 series (P4 such as Flamanville-1, 2, and P'4 such as Penly-1, 2) = 1300MW-50hz,
- N4 series (Civaux-1, 2 and Chooz -1, 2) = 1550 MW-50hz,
- EPR series (Global EPR such as Flamanville-3, Taishan-1,2 and U.S. EPR) = 1700MW-50hz, 60hz.

The N4 and EPR series plants use the ARABELLE family turbine design, while the P4/P'4 series plants use the previous generation turbine from which the ARABELLE platform was developed.

1) Similar to the overall EPR design, the HP and IP valves are evolutionary and based on existing plant designs and operational feedback. The valves utilized in the P4/P'4 series plants use the same butterfly valve technology found in the later N4 and EPR series plants, but the N4 and EPR series valves have been updated to manage significantly higher steam flows, perform routine turbine valve testing at load with minimized load drop-off during partial stroke actuation, and to account for any operational and maintenance feedback. The N4 and EPR series plants also share a very similar butterfly-valve design and utilize the same internals (A356 Grade 2 bodies, X19CrMoVNbN11-1 discs, A356-F22 Class 3 seats). This design similarity can also be shown by comparison of the valve sizes (given below).

   a) <u>High Pressure (HP) Inlet valves</u>:
      i) P4/P'4 series: Stop valve diameter 500mm; Control valve diameter 400mm
      ii) N4 series: Stop valve diameter 500mm; Control valve diameter 450mm
      iii) EPR Series: Stop valve diameter 500mm; Control valve diameter 450mm

   b) <u>Intermediate Pressure (IP) valves</u> (Butterfly valves using the same technology as HP Inlet valves):
      i) P4/P'4 series: Stop valve diameter 1100mm; Control valve diameter 1100mm
      ii) N4 series: Stop valve diameter 1400mm; Control valve diameter 1400mm
      iii) EPR Series: Stop valve diameter 1400mm; Control valve diameter 1400mm

   Based on the similarity of valve type and component design, along with identical internals for the N4 and EPR series, the failure rates (past operating experience) for the P4 and N4 series valves can be used to support the analysis for failure rates for the EPR series valves.

2) CCNPP Unit 3 uses Alstom turbine model number 30NHIP17 (30Hz) (for comparison, the model number for Flamanville-3 and Taishan-1, 2 is 25NHIP17 (25Hz)). The CCNPP Unit 3 turbine, referred to as the ARABELLE 1700 60Hz, is one of the ARABELLE family of turbines. Other ARABELLE turbine families include the ARABELLE 1000 50Hz (such as Ling Ao II-1 and II-2) and 60Hz, ARABELLE 1550 50Hz (N4 series - Civaux-1, 2 and Chooz 1, 2), and the ARABELLE 1700 50Hz (Global EPR series - Flamanville-3 and Taishan-1, 2).

3) There have been no common cause failures in the IP and HP valves used in the N4 series plants. For Flamanville, common cause failure (CCF) modes have been analyzed for IP and HP valves (with results applicable to the whole EPR plant series.):

   a) IP inlet valves: In the Number 1 IP line, the IP control valve (IPCV) and the IP stop valve (IPSV) have a similar design, which can be a possible source of CCF. This was factored into an overall analysis that was performed to determine the CCF factor for the IP valves in accordance with the ISO 13849-1:1999 standard (Safety of machinery - Safety-related parts of control systems). This factor was then included in the reliability calculations.

   b) HP inlet valves: In the Number 1 HP line, the HP control valve (HPCV) and the HP stop valve (HPSV) have different designs. A complete CCF mode analysis has been done, based on the CCF potential causes listed in NRC NUREG/CR-6268, Rev. 1; INL/EXT-07-12969, "Common-Cause Failure, Database and Analysis System: Event Data Collection, Classification, and Coding." The HPSV design was modified by suppressing the stroke setting screw of the cartridge valve as a result of this analysis.

4) The design of the CCNPP Unit 3 HP and IP inlet valves will be identical to those in Flamanville Unit 3. Thus, CCNPP Unit 3 will benefit from the Flamanville Unit 3 CCF reduction measures.

5) The design of the EPR series plant's extraction non-return valves will be different from the non-return valves used in the previous generation N4 series plants. Therefore feedback and operating experience from the N4 series plants cannot be directly applied to CCNPP Unit 3. Feedback and operating experience from other EPR series plants (Flamanville-3, Taishan-1, -2) will be directly applied to the CCNPP Unit 3 as the Flamanville and Taishan EPRs will used identical non-return valves.

6) IP Reheat stop valves and intercept valves are included in Alstom analysis for the probability of overspeed.

**COLA Impact**

No change to the CCNPP Unit 3 COLA Part 2, FSAR, is required as a result of this response.

**RAI No. 376**

**Question 03.05.01.03-25**

The information provided in COL FSAR information item 3.5-2 only specifies Alstom Report No. TSDMF 07-018D, dated May 30, 2007, as the turbine missile probability analysis. However, Alstom Report No. TSDMF 07-018D, dated May 30, 2007, was supplemented by Alstom Report TNUD-EI 10-011, dated June 30, 2010, for evaluating the probability of fatigue, and Alstom Document 75RC10001, dated March 2, 2010, for evaluating the probability of destructive overspeed. Therefore, the staff requests that the applicant reference all of these reports in the COL FSAR to satisfy COL information item 3.5-2.

**Response**

References to Alstom Report TNUD-EI 10-011, dated June 30, 2010, and Alstom Document 75RC10001, dated March 2, 2010, have been added to the CCNPP Unit 3 COLA Part 2, FSAR.

**COLA Impact**

The CCNPP Unit 3 COLA Part 2, FSAR, has been revised as 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, P , is less than 1E-4 for turbine generators favorably oriented with respect to containment.

This COL Item is addressed as follows:

The turbine-generator design consists of a HP/IP turbine stage with three LP turbines as described in U.S. EPR FSAR Section 10.2. A turbine missile analysis has been developed for the selected turbine design (Alstom, 2007, Alstom, 2010a, Alstom, 2010b). The analysis considers stress corrosion cracking (SCC), brittle fracture and destructive overspeed as potential failure mechanisms. The analysis also addresses inspection intervals in regard to the probability of failure. The turbine missile analysis calculates the probability of turbine rotor failure consistent with the guidance in Regulatory Guide 1.115 (NRC, 1977) and in NUREG-0800 Section 3.5.1.3 (NRC, 2007b). The analysis includes charts on missile generation probabilities versus service time for the HP/IP and LP turbine rotors.

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**3.5.4 References**

**{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.

**Enclosure 2**

**Table of Changes to CCNPP Unit 3 COLA Associated with Response to RAI No. 376**

**Table of Changes to CCNPP Unit 3 COLA Associated with Response to RAI No. 376**

| Change ID # | Subsection | Type of Change | Description of Change |
|---|---|---|---|
| **Part 2 FSAR** | | | |
| CC3 10-0127 | 3.5.4 | CC3-10-0127 incorporated COLA markups associated with the response to RAI 211[1]. | The change associated with CC3-10-0127 added one reference to COLA FSAR section 3.5.4. |
| GN 10-0138 | 3.5.1.3 | GN-10-0138 incorporated COLA markups associated with the response to RAI 211[1]. | The change associated with GN-10-0138 added one reference to COLA FSAR section 3.5.1.3. |
| CC3 12-0194 | 3.5.4 | CC3-12-0194 incorporated COLA markups associated with the response to RAI 376. | The change associated with CC3-12-0194 added two references to COLA FSAR section 3.5.4. |
| GN 13-0007 | 3.5.1.3 | GN-13-0007 incorporated COLA markups associated with the response to RAI 376. | The change associated with GN-13-0007 added two references to COLA FSAR section 3.5.1.3. |

[1] 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