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10 CFR 50.4
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September 30, 2010

UN#10-249

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 218, Stability of Subsurface Materials and Foundations

Reference: 1) Surinder Arora (NRC) to Robert Poche (UniStar Nuclear Energy), "FINAL RAI 218 RGS1 4332" email dated March 7, 2010
2) UniStar Nuclear Energy Letter UN#10-207 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 218 and RAI 229, Stability of Subsurface Materials and Foundations, dated July 23, 2010

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 March 07, 2010 (Reference 1) This RAI addresses Stability of Subsurface Materials and Foundations, as discussed in Section 2.5.4 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 6.

Reference 2 anticipated that the response to RAI 218 Question 2.05.04-08 would be provided by September 30, 2010. Enclosure 1 provides the response to this question.

Our response does not include any new regulatory commitments and does not impact COLA content.

DOG
MFO

This letter does not contain any sensitive or proprietary information.

If there are any questions regarding this transmittal, please contact me at (410) 470-4205, or Mr. Wayne A. Massie at (410) 470-5503.

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

Executed on September 30, 2010

A handwritten signature in black ink, appearing to read 'Greg Gibson', with a long horizontal line extending to the right.

Greg Gibson

Enclosure: Response to NRC Request for Additional Information RAI 218 Question 02.05.04-08, Calvert Cliffs Nuclear Power Plant, Unit 3.

cc: Surinder Arora, NRC Project Manager, U.S. EPR Projects Branch
Laura Quinn, NRC Environmental Project Manager, U.S. EPR COL Application
Getachew Tesfaye, NRC Project Manager, U.S. EPR DC Application (w/o enclosure)
Loren Plisco, Deputy Regional Administrator, NRC Region II (w/o enclosure)
Silas Kennedy, U.S. NRC Resident Inspector, CCNPP, Units 1 and 2
U.S. NRC Region I Office

UN#10-249

Enclosure

Response to NRC Request for Additional Information

RAI 218 Question 02.05.04-08,

Calvert Cliffs Nuclear Power Plant, Unit 3

RAI 218

Question 02.05.04-8

Section 2.5.4.2.2.2 states that dolomite or calcite was identified as the cementing agent for the sand soil layer and the absence of dolomite or calcite in certain parts of the layer might be due to low pH groundwater. Since most of the Category I structures will be founded on the cemented sand, please discuss the possible soil strength reduction caused by the low pH ground water entering the cemented sand layers, and subsequently breaking the soil particles bond.

Response

The pH measurements from the Surficial aquifer are averaged as 5.2. As pointed out in the question, this pH is low and is considered as moderately acidic. The average pH from the surficial aquifer is very close to the pH of the rainwater and is believed to be due to the recharge of the Surficial aquifer from the local precipitation. In the Upper Chesapeake Unit (UCU) aquifer, the average pH was found to be 7.4. After the placement of the structural fill, the surficial run-off will be collected through drainage trenches located at the site periphery. The drainage trenches will direct the precipitation water to the storm water ponds. After the excavation and the backfill placement, the Surficial aquifer will be partially connected to the UCU aquifer. The possibility of strength reduction of the cemented sand layer due to mixing of low pH Surficial aquifer with the UCU aquifer is extremely low due to high buffering capacity of the UCU aquifer.

It is well documented that the natural waters are "buffered systems" and the subsurface pH is controlled by the groundwater pH which is in equilibrium with the subsurface material. One of the key parameters that control the pH of the groundwater is alkalinity. Alkalinity is the acid neutralizing capacity of an aqueous system, which is a strong indicator of how stable the groundwater pH is in an aquifer. The natural waters contain substantial amounts of dissolved carbon dioxide species, bicarbonate and carbonate, which are the principal source of alkalinity. The alkalinity of a solution may be defined as the capacity for solutes it contains to react with and neutralize acid. Alkalinity is typically reported as mg/L of CaCO_3 . This can be converted into milli equivalents per Liter (mEq/L) by dividing by 50 (the approximate Molecular Weight of $\text{CaCO}_3/2$).

The alkalinity of the groundwater samples from Surficial and UCU aquifers was measured periodically during 2008 and 2009. Table 1 shows the alkalinity measurements from the observation wells from November 2008 to November 2009. As can be seen from Table 1, except for some seasonal fluctuations, consistent alkalinity values were observed throughout the site. The monitoring wells that are close to the shore (OW 774A) have substantially higher alkalinity. The alkalinity values of the groundwater samples collected from UCU aquifer indicated that the UCU aquifer exhibits high alkalinity, which will provide significant buffering capacity. Observation wells sampled from the Surficial aquifer show that the Surficial aquifer had little alkalinity throughout monitoring period. With total alkalinity values averaging 209 mg/l (4.18 mEq/L), the UCU aquifer will buffer an intrusion of low pH from the Surficial aquifer.

In order to confirm the acid neutralizing capacity of the UCU aquifer when it mixes with the surficial aquifer, the capacity diagram given by Stumm and Morgan, (1970) is used with the groundwater parameters available from monitoring wells. This diagram (Figure 1) uses constant variables in an

aquatic system (i.e., a groundwater flowing in an aquifer) of alkalinity and total carbonate carbon concentration along with pH contours of the associated solutions. With the help of Figure 1, if one variable is not known, it can be determined from the two known variables. The effect of addition or removal of any acid/base on the pH can be evaluated using this diagram. In other words, the diagram facilitates calculation of the constant variable in equilibrium conditions.

As indicated by the groundwater monitoring results, the Surficial aquifer has essentially zero alkalinity, and with a pH of 5.4, the total carbonate carbon on the diagram is determined as zero from the diagram.

For the UCU aquifer, the alkalinity was calculated conservatively using the minimum alkalinity as 137 mg/L (2.74 mEq/L). Corresponding total carbonate carbon concentration of the UCU aquifer is approximately 3 milli moles/L. The groundwater models described in FSAR Section 2.4.12 have shown that surficial aquifer flow into the UCU aquifer will be limited. However, for this buffering capacity determination, it is conservatively assumed that the Surficial and UCU aquifers mix in equal volumes. Consequently, the alkalinity and the total carbonate carbon of the groundwater when two aquifers mix is calculated as 1.37 mEq/L alkalinity and 1.5 milli moles/L total carbonate carbon by averaging the two variables in equal proportion. The pH value for the mixed groundwater using these parameters is approximately 7.2 (shown as a shaded box on the capacity diagram).

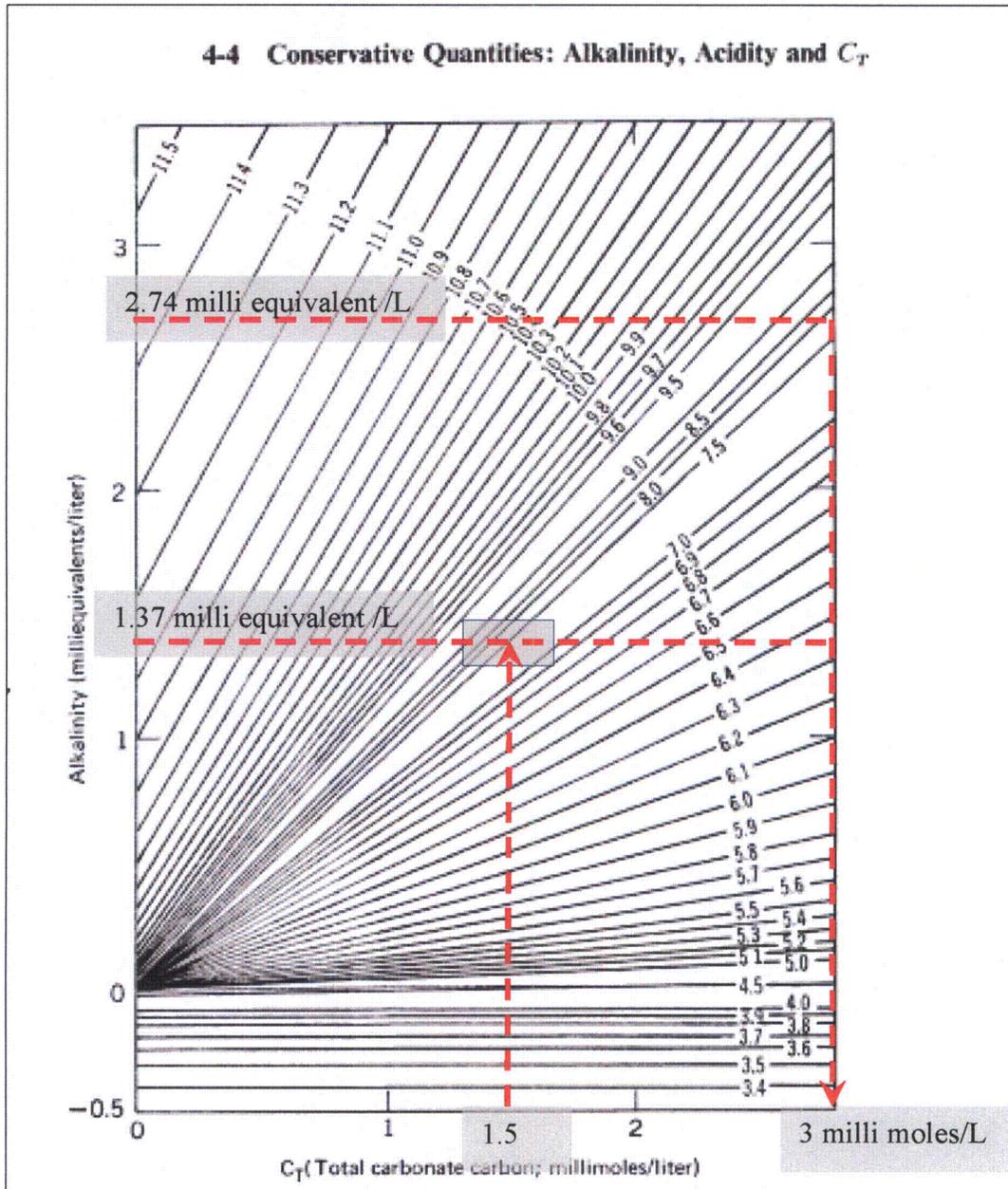
It is concluded that the UCU aquifer has enough buffering capacity to neutralize the Surficial aquifer when they mix after construction. At the neutral conditions, no dissolution of the dolomite and calcite bond will be expected; therefore no strength reduction is anticipated in the cemented sand layer.

Table 1 - Alkalinity Measurements from the Observation Wells

Total Alkalinity [mg/L]											
Well ID	Aquifer	Nov 08	Jan 09	Mar 09	May 09	Jul 09	Sep 09	Nov 09	MIN	MAX	AVE
OW-319A	Surficial	48	21	0	0	0	10.8	0	0	48	6
OW-323	Surficial	9	N/A	0	0	0	0	0			
OW-423	Surficial	14	0	0	0	0	8	8			
OW-756	Surficial	21	0	0	0	0	8	8			
OW-301	UCU	195	196	197	186	188	188	188	137	399	209
OW-304	UCU	153	189	167	206	193	187	180			
OW-308	UCU	165	165	206	154	167	165	157			
OW-313A	UCU	138	140	141	144	141	140	137			
OW-319B	UCU	185	187	195	190	193	177	174			
OW-328	UCU	168	167	184	155	166	157	150			
OW-336	UCU	158	157	N/A	188	162	152	150			
OW-705	UCU	190	182	138	183	171	178	174			
OW-754	UCU	353	365	352	315	335	322	315			
OW-774A	UCU	359	399	386	399	378	362	368			

Note: If multiple measurements were made, the lowest value is included.

Figure 1 – Capacity Diagram



References:

Stumm, W., and J. J. Morgan (1970). Aquatic Chemistry. Wiley-Inter Science, New York.

COLA Impact

The COLA will not be revised as a result of this response.