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UniStar
NUCLEAR ENERGY

10 CFR 52.3
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January 9, 2009

UN#09-001

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

Subject: UniStar Nuclear Energy, NRC Docket No. 52-016
Calvert Cliffs Nuclear Power Plant, Unit 3
Supplemental Response for RAIs HS-4, HS-9 and HS-13

Reference: Letter UN#08-018 G. Vanderheyden (UniStar Nuclear Energy) to Document Control Desk (U.S. Nuclear Regulatory Commission), Submittal of Response to Requests for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3 and Request for Withholding of Documents, dated June 12, 2008

The referenced letter provided UniStar Nuclear Energy's responses to Requests for Additional Information (RAIs) related to the Calvert Cliffs Nuclear Power Plant (CCNPP), Unit 3 Environmental Report (ER). Specifically, the referenced letter stated that a supplemental response providing the results of the site specific groundwater model analysis would be provided at a later date.

Enclosed is the supplemental response providing the groundwater model analysis. The supplemental response for RAI HS-9 is based on the site specific groundwater flow model for the Surficial Aquifer, Bechtel Calculation 25237-103-KOC-HMMG-00001 Revision 001. Also enclosed are the "Visual MODFLOW" input files for Bechtel Calculation 25237-103-KOC-HMMG-00001 Revision 001 on a CD. A scanned version of this calculation will be provided in

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color in the Hanford reading room as requested by the NRC during a conference call on October 9, 2008. Please note that the calculation is Bechtel proprietary but the enclosed input files are not. The Bechtel calculation will not be placed on the docket.

Also, the enclosed Groundwater Model Report 25237-000-30R-K01G-00001-000, "Evaluation of Potential Impacts of Construction Pumping on Declining Potentiometric Levels in the Aquia Aquifer," dated December 2008, can be made available to the public.

The regulatory commitments identified in the referenced letter for these 3 RAIs are considered closed with this submittal. The revised ER text will be included in a future COLA revision.

If you have any questions, please call Mr. Dimitri Lutchenkov at (410) 470-5524.

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

Executed on January 9, 2009

Greg Gibson

Enclosures:

1) Supplemental Response for RAIs HS-4, HS-9 and HS-13

2) CD – 25237-000-T8C-GAMC-00237 (Visual MODFLOW files for Surficial Aquifer) input files used in Bechtel calculation 25237-103-KOC-HMMG-00001 Revision 001 (Groundwater Flow Model of the Surficial Aquifer)

3) Groundwater Model Report 25237-000-30R-K01G-00001-000, "Evaluation of Potential Impacts of Construction Pumping on Declining Potentiometric Levels in the Aquia Aquifer," dated December 2008

cc: U.S. NRC Region I
U.S. NRC Resident Inspector, Calvert Cliffs Nuclear Power Plant, Units 1 and 2
NRC Environmental Project Manager, U.S. EPR Combined License Application
NRC Safety Project Manager, U.S. EPR Combined License Application
NRC Project Manager, U.S. EPR Design Certification Application (w/o enclosures)

Enclosure 1

Supplemental Response for RAIs HS-4, HS-9 and HS-13

RAI No. HS-4 **ESRP/ER Section 2.3.2.2.7 and 2.3.2.3**

NRC Request:

Groundwater level declines have been especially large in Southern Maryland and parts of the eastern shore where groundwater pumpage is projected to increase by more than 20% between 2000 and 2030 as population within the region is expected to grow by 37% (USGS 2006, as reported by Section 2.3.2.2.7 page 1.3-42). Two areas in Calvert County show cones of depression in the Aquia aquifer. A small depression north of the site is present in the North Beach and Chesapeake Beach area and a large depression south of the site in the Solomons area appears to be having a significant regional effect on the Aquia aquifer. This larger cone of depression is influencing regional groundwater flow out to a radius of at least 15 mi (24 km) from the pumping centers in the Solomons area as shown in Figure 2.3.2-7. This area of influence includes the CCNPP site (Section 2.3.2.2.7 Page 1.3-(42-43)). Because of these considerations, water supply managers in these counties are seeking to shift some groundwater usage from the Aquia aquifer to deeper aquifers (MGS 2005, as reported by Section 2.3.2.2.2.2 page 2.3-38). UniStar reports submitting a permit request to the State of Maryland to utilize any excess water not being used under the existing Units 1 and 2 permit. Provide an analysis of the impacts to the aquifer and surrounding users of the aquifer in the event that any excess from the Units 1 and 2 permit would be used for Unit 3.

UniStar Supplemental Response:

Note - This response supplements the response previously provided to the NRC in UniStar Letter UN#08-018, Enclosure 3, Item Number HS-4, dated June 12, 2008 and addresses the commitment made to evaluate impacts from increased groundwater withdrawals by CCNPP using a numerical model. Sufficient information to address the issue was provided by a groundwater model developed and used by the Maryland Geological Survey to evaluate potential impacts of increased groundwater withdrawals from the coastal plain aquifers of southern Maryland.

Planned increased water withdrawal from the Aquia aquifer during construction of CCNPP Unit 3

A portion of the water needed during construction of the CCNPP Unit 3 is planned to be supplied by the difference between the withdrawal permitted by Maryland Department of the Environment (MDE) Water Appropriation Permit (WAP) CA69G-010 (05) and the current average withdrawal rate. This water will be derived from the Aquia aquifer. The permitted withdrawal rate is 450,000 gpd (about 164 million gallons per year). The average water use for the five years between July 2001 and June 2006 was 141.2 million gallons per year (about 387,000 gpd, with a range of from 122 to 152 million gallons per year) (Table 2.3.2-7). Assuming this average water use for Units 1 and 2 during the period of construction of Unit 3, a net additional water withdrawal (up to the permitted value of 450,000 gpd) of 23 millions gallons per year (about 63,000 gpd) would result from pumping at the permitted rate. This value is also presented in Section 5.4.1.2 of the CCNPP Unit 3 CPCN Technical Report.

<u>Effect on drawdown in coastal plain aquifers by increasing groundwater withdrawal from CCNPP to the permitted amount in permit CA69G-010 (05)</u>

As noted in the RAI and described in ER Section 2.3.2.2.7, Rev 2, groundwater withdrawals from the coastal plain aquifers of southern Maryland over the past decades have resulted in significant drawdowns of a regional extent. These drawdowns extend to the CCNPP site. A series of modeling studies have been conducted by the Maryland Geological Survey (MGS) and an ongoing multiyear effort is planned in cooperation with the U.S. Geological Survey (USGS 2006) to evaluate the water-supply potential of the coastal plain aquifers of southern Maryland.

The additional water withdrawal from the Aquia aquifer necessary to support construction of CCNPP Unit 3 is about 63,000 gpd, an increase of about 16% from the current average water use of about 387,000 gpd. The following paragraphs summarize the minimal impact this additional water use is expected to have on the Aquia aquifer and the surrounding users of groundwater. The principal focus of the analysis is on the users of the Aquia aquifer in Calvert County. This is appropriate because the coastal plain aquifers are hydrologically confined and the regional effects of other users that are more remote are accommodated within the bounds of the analysis for Calvert County. However, it is acknowledged that the overall Aquia aquifer water balance is significantly affected by these other users, who are located several miles from CCNPP, and appear to be dominating the observed water-level declines (see Figure 2.3.2-7 based on USGS 2005a) as well as the simulated potentiometric surface (see Figure 4b of MGS 2005).

A useful approach to evaluating the potential impacts associated with increasing groundwater withdrawal from the Aquia aquifer during construction of CCNPP Unit 3 to the permitted rate is to use the results of the ground-water flow model developed by the MGS and used to evaluate the water-supply potential of the coastal plain aquifers in Calvert, Charles and St. Mary's Counties (documented in MGS 2005 and MGS 2007). This model was used by the MGS to evaluate the effects of continued groundwater withdrawal at either the current rates or various scenarios of projected rates until the year 2030. The model was initially calibrated to reproduce the potentiometric head measured in 2002. Figure 4b of MGS 2005 indicates a predicted water level in 2002 of about – 80 ft msl in the Aquia aquifer in the vicinity of the CCNPP, which is close to the – 81.5 ft msl observed (Figure 2.3.2-20, which is based on USGS 2007).

Results of the MGS model indicate that increasing the annual water withdrawal from domestic users and public-supply wells to account for projected population increases (Scenario 1 of MGS 2005) while maintaining all other major users (defined as those with withdrawals in excess of 10,000 gpd) at their actual withdrawal rates measured in 2002 results in an additional drawdown in the Aquia aquifer in the vicinity of CCNPP of between 20 and 30 ft by 2030 (Figure 10b of MGS 2005 and Figure 94 of MGS 2007). Simulated drawdowns in the Piney Point-Nanjemoy aquifer in 2030 are less than 10 ft (Figure 93 of MGS 2007).

Increasing the withdrawal rates of domestic water users by the same amount as modeled in Scenario 1 and setting the water use of all major users at their average WAP rates instead of their actual withdrawal rates measured in 2002 (Scenario 4 of MGS 2005 and MGS 2007) also results in an additional drawdown in the Aquia aquifer near CCNPP of between 20 and 30 ft by 2030 (Figure 114 of MGS 2007). At CCNPP, this scenario corresponds to increasing groundwater withdrawal from the Aquia aquifer from 391,833 gpd (the average rate for 2002, Table 2.3.2-7) to the permitted rate of 450,000 gpd.

Simulated drawdowns in the Piney Point-Nanjemoy aquifer at 2030 for this scenario are also less than 10 ft (Figure 113 of MGS 2007). These increased drawdowns are principally the result of increased withdrawals by domestic and other users of this aquifer, rather than leakage across the low vertical conductivity Middle Confining Bed due to increased pumping from the underlying Aquia aquifer.

The above published results assume that the increased groundwater withdrawals continue for the entire 28 years of the simulated period from 2002 to 2030. A more relevant analysis of the effects of increasing the groundwater withdrawal at CCNPP to the permitted value of 450,000 gpd is to examine the results at year 2010. This date corresponds to a period of 8 years of increased withdrawal, which is still more than the anticipated construction period of about 6 years. The unpublished intermediate results for 2010 were provided by the Maryland Geological Survey in response to Request for Information (RFI) number 25237-000-GRI-GEKC-00016 (see UniStar 2008). These results indicate a drawdown from 2002 water levels in the vicinity of CCNPP of between 5 and 10 feet in the Aquia aquifer and less than 5 feet in the Piney Point – Nanjemoy aquifer.

Based on the above results, if the permitted volume of groundwater is pumped from the Aquia aquifer for 8 years (significantly longer than the 6-year construction period during which the additional water is anticipated to be needed) an additional drawdown near CCNPP of less than 10 ft is anticipated in the Aquia aquifer. Note that the additional drawdown includes the effects from increased withdrawals by other domestic and major users of the Aquia and other coastal plain aquifers. The effects of the increased withdrawals at CCNPP alone would be much less.

<u>Effect on drawdown in coastal plain aquifers by increasing groundwater withdrawal from CCNPP to the permitted amount in permit CA69G-010 (05) plus an additional 200 gpm above the permitted amount</u>

As discussed above, the Maryland Geological Survey numerical model (MGS 2005 and MGS 2007) simulates the effect on water levels in the Aquia aquifer during the construction period for Unit 3 by pumping the CCNPP wells at their combined maximum permitted rate (450,000 gpd) for eight years. The effect is a drawdown from 2002 water levels in the vicinity of CCNPP of between 5 and 10 feet. Bechtel Power Corporation developed a separate numerical model of the Aquia aquifer within a 5-mile radius of CCNPP ("Evaluation of Potential Impacts of Construction Pumping on Declining Potentiometric Levels in the Aquia Aquifer"), based upon the MGS model. The Bechtel model simulates the effect on Aquia aquifer water levels by pumping the CCNPP wells for six years at their combined maximum permitted rate plus 200 gpm (total of 738,000 gpd). The Bechtel model predicts increased drawdown after six years of about 52 feet at CCNPP and about 13 feet in the closest off-site wells of major water users. These are the Beaches Water Company, approximately 2.75 miles to the north in Long Beach and the Dominion Cover Point LNG Terminal, approximately 3.85 miles to the south. This model also predicts that following the six-year period, water levels return in approximately three years to where they would have been if the pre-construction pumping rate had been maintained.

Analysis of potential impacts of additional drawdown associated with groundwater withdrawal from the Aquia aquifer at the CCNPP

Based on the discussion of ground-water management in MGS 2007, five water-management factors are evaluated with respect to the potential impacts associated with increasing groundwater withdrawal at CCNPP, as follows: 1) the 80-percent water management level, 2) impacts on other ground-water users, 3) lowered water table, 4) brackish-water and river-water intrusion, and 5) land subsidence. In the analysis of potential impacts, it is conservatively assumed that the increase in drawdown in the Aquia aquifer in the vicinity of CCNPP is 13 ft.

80-Percent Management Level – Currently, the primary criterion used by the MDE for evaluating water-appropriation permit applications in the confined aquifers of the Maryland Coastal Plain is the 80-percent management level (MGS 2007, p. 20 and Figure 43). The 80-percent management level is defined as 80-percent of the available drawdown in an aquifer. Figure 45 of MGS 2007 illustrates the 80-percent management surface of the Aquia aquifer, which is at an elevation of about –350 ft msl in the vicinity of CCNPP. Increasing drawdown in the Aquia aquifer at CCNPP by 52 ft from the 2002 level of about – 110 ft msl, yields an estimated groundwater elevation at CCNPP of about – 162 ft msl, well above the 80-percent management level.

Impacts on other ground-water users – Analysis of impacts to other users generally relates to the effect of lowering the groundwater level in other wells. Those wells most vulnerable to such impacts are small diameter "telescoping wells". Such wells are typically constructed with a 4-inch diameter casing near the surface that reduces to a 2-inch diameter in the deeper portion of the well. The submersible pump in these wells is typically installed near the bottom of the 4-inch part of the well (MGS 2007). Because the diameter of the pump is too large to be lowered below the depth where the well diameter is reduced, its yield will be adversely affected if regional declines cause the groundwater level to be lowered to a depth near the well's "reduction point". This type of well construction is typically used in the region for domestic supplies and other wells of relatively low yield. Most of these wells, as well as those of some major users of groundwater in the vicinity of CCNPP, such as the White Sands subdivision to the west and the Calvert Cliffs state park to the south, are completed in the Piney Point or Nanjemoy Formations and impacts from increased withdrawals from the deeper Aquia aquifer are negligible.

Major users of the Aquia aquifer in the vicinity of CCNPP, including the Beaches Water Company to the north and the Dominion Cove Point LNG Terminal to the south, are several miles from CCNPP. Wells for these major users are not small diameter "telescoping wells". The pumps in these wells are typically set much deeper and, therefore, their yields are not significantly impacted by lowering water levels by about thirteen feet. Therefore, the likelihood of the additional drawdown in the Aquia aquifer affecting other users is small, given the lack of small diameter telescoping wells in the Aquia aquifer in the vicinity of CCNPP and the fact that other users of groundwater in the vicinity of CCNPP generally pump from the overlying Piney Point – Nanjemoy aquifer.

Lowered water table – The outcrop of the Aquia Formation, where the aquifer is unconfined and under water-table conditions, is about 30 miles northwest of CCNPP. As noted in MGS 2007, regional groundwater withdrawals from the confined portion of an aquifer can affect the water table elevation. However, the additional withdrawal from the CCNPP wells would be a small fraction of the total groundwater withdrawal from the Aquia aquifer and would be unlikely to affect the water table surface 30 miles away.

In the vicinity of the CCNPP site, the Surficial aquifer is unconfined and under water table conditions. The level of the water table is controlled primarily by recharge and discharge in the Surficial aquifer rather than by the relatively small amount of leakage across the Upper Confining Bed beneath the Surficial aquifer that might be induced by increased pumping from the deeper Aquia aquifer. The thickness of the Upper Confining Bed in the vicinity of CCNPP is about 250 ft (MGS, 1997, Figure 3). MGS modeled results demonstrate that the potentiometric head in the underlying Piney Point-Nanjemoy aquifer changes by less than 5 ft after 8 years of increased withdrawals from the deeper Aquia aquifer. These results, in addition to the thickness and low vertical hydraulic conductivity of the Upper Confining Bed, suggest there will be no effect on the Surficial aquifer water table due to increased pumping from the CCNPP wells in the Aquia aquifer.

Brackish-water and river-water intrusion – As noted in MGS 2007, brackish-water and river-water intrusion is possible in the shallow aquifers in the area if they are hydraulically connected to surface water and the potentiometric heads in these aquifers are reduced below sea level. Increased withdrawal from the Aquia aquifer would not significantly affect the water level in the Surficial aquifer or the Piney Point-Nanjemoy aquifer and, therefore, would result in negligible brackish or river-water intrusion. In addition, as noted in MGS 2007 (p. 22), brackish-water intrusion is not expected in the Aquia aquifer because the overlying confining units would prevent the downward migration of salty water. Although the top of the Piney Point-Nanjemoy aquifer is projected to subcrop in the Chesapeake Bay in areas where the formation is eroded by ancestral Susquehanna River channels (MGS 1996, Figures 3 and 5), there remains over 100 ft of the Middle Confining Bed (MGS 1996, Figure 6) between the Piney Point-Nanjemoy and Aquia aquifers to prevent the downward migration of salty water to the Aquia aquifer.

Land subsidence – As noted in MGS 2007, land subsidence caused by large potentiometric head declines as a result of groundwater withdrawals has not been documented in Maryland, but is possible. Considering a pre-consolidation stress equivalent of 65 ft of water-level drawdown and a maximum subsidence to water-level decline ratio of 0.0037 (MGS 1997, p. 79), an additional 52 ft of drawdown at CCNPP after 6 years of increased withdrawals from the Aquia aquifer may yield about 0.192 ft of subsidence, or a rate of about 0.032 ft/yr (about 0.384 in/yr).

Because of the length of time required for drainage of the thick confining units above the Aquia aquifer, as noted in MGS 2007 (p. 22), the actual subsidence rate is likely to be less than this value and subsidence would continue after water levels in the aquifer have stabilized. This estimated subsidence rate is the maximum that could occur over the area of greatest drawdown. A lower average rate would apply over the area of the aquitard and subsidence would be distributed over a large area as the stresses are redistributed vertically.

Conclusions

Based on the above analysis, there would be no significant impact from increasing groundwater withdrawal from the Aquia aquifer to a rate of 738,000 gpd for a six-year period at CCNPP Unit 3. Although the water level in the vicinity of CCNPP will be lowered, the results of numerical modeling indicate the projected drawdown in the closest wells of major water users to be approximately 13 ft, even after 6 years of increased pumping from the CCNPP wells and from those of other domestic and major users of the Aquia aquifer. Drawdowns of this amount do not significantly impact the relevant water management factors.

It is important to note that the anticipated use of the additional groundwater is for construction purposes which are expected to last approximately 6 years. After that time, a desalination plant is planned to be on-line producing 1,225 gpm (1,764,000 gpd). As indicated in the response to RAI HS-32, about 413 gpm (595,000 gpd) of this production will be excess capacity that may be used to decrease the overall future groundwater withdrawals for CCNPP Units 1 and 2 (starting in about 2014). Three and a half years of this excess capacity, if used to reduce the groundwater extracted from the Aquia aquifer for Units 1 and 2, would compensate for the 6 years of additional water withdrawal during construction of CCNPP Unit 3.

References

MGS, 1996. Hydrostratigraphic Framework of the Piney Point-Nanjemoy Aquifer and Aquia Aquifer in Calvert and St. Mary's Counties, Maryland, Maryland Geological Survey Open File Report No. 96-02-8, Maryland Geological Survey, H. Hansen, 1996.

MGS, 1997. Hydrogeology, Model Simulations, and Water-Supply Potential of the Aquia and Piney Point-Nanjemoy Aquifers in Calvert and St. Mary's Counties, Maryland, Maryland Geological Survey Report of Investigations No. 64, Maryland Geological Survey, G. Achmad and H. Hansen, 1997.

MGS, 2005. Water Supply Potential of the Coastal Plain Aquifers in Calvert, Charles, and St. Mary's Counties, Maryland, with Emphasis on the Upper Patapsco and Lower Patapsco Aquifers, Maryland Geological Survey Administrative Report, Maryland Geological Survey, D. Drummond, June 2005.

MGS, 2007. Water Supply Potential of the Coastal Plain Aquifers in Calvert, Charles, and St. Mary's Counties, Maryland, with Emphasis on the Upper Patapsco and Lower Patapsco Aquifers, Maryland Geological Survey Report of Investigation No. 76, Maryland Geological Survey, D. Drummond, August 2007.

UniStar, 2008. Response to RFI 25237-000-GRI-GEKC-00016, Request for Maryland Geological Survey results of simulated drawdowns 2002 – 2010, based on Scenario 4 of Report of Investigation No. 76 (25237-000-L8C-GAMU-00019).

USGS, 2005a. Potentiometric Surface of the Aquia Aquifer in Southern Maryland: September 2003, USGS Open-File Report 2005-1004, U.S. Geological Survey, S. Curtin, D. Andreasen, and J. Wheeler, 2005.

USGS, 2006. Sustainability of the Ground-Water Resources in the Atlantic Coastal Plain of Maryland, USGS Fact Sheet FS 2006-3009, U.S. Geological Survey, 2006.

USGS, 2007. Water Resources of Maryland, Delaware, and D.C. Area, Ground-Water Level Monitoring in Calvert County, MD, U.S. Geological Survey, Website: http://md.water.usgs.gov/groundwater/calvert, Date accessed: March 31, 2007.

ER Impact:

Application Text Revision (Revision to ER 2.3.2.2.7 and 2.3.2.3, Rev 3):
(Text Revision to ER Revision 3 marked in red)

2.3.2.2.7 {Southern Maryland} Groundwater Demands

{Withdrawals from Maryland Coastal Plain aquifers have caused groundwater levels in confined aquifers to decline by tens to hundreds of feet from their original levels (USGS, 2006). Beginning in the 1940s, with the development of the Patuxent River Naval Air Station, water levels within the Aquia aquifer began to decline significantly. Between 1960 and 1985, groundwater levels within the Aquia aquifer in Southern Maryland declined at a relatively constant rate as groundwater use increased over time. Since 1985, the decline in groundwater levels has sharply increased as the demand for water from the Aquia aquifer and, to a lesser extent, deeper aquifers (Magothy and Patapsco) has increased substantially. The current rate of decline in many of the confined aquifers has been estimated at about 2 ft (0.6 m) per year. Declines have been especially large in Southern Maryland and parts of the eastern shore where groundwater pumpage is projected to increase by more than 20% between 2000 and 2030 as population within the region is expected to grow by 37% (USGS, 2006).

Potentiometric surface maps developed on a regional scale by the U.S. Geological Survey (USGS) were used to evaluate the areal extent of groundwater elevation decreases through time as discussed in Section 2.3.2.2.2. The USGS potentiometric surface maps for the Aquia, Magothy, Upper Patapsco, and Lower Patapsco aquifers in Southern Maryland for 2003 are shown in Figures 2.3-62 through 2.3-65. Two areas in Calvert County show cones of depression in the Aquia aquifer. A small depression north of the site is present in the North Beach and Chesapeake Beach area and a large depression south of the site in the Solomons area appears to be having a significant regional effect on the Aquia aquifer. This larger cone of depression is influencing regional groundwater flow out to a radius of at least 15 mi (24 km) from the pumping centers in the Solomons area as shown in Figure 2.3-62. This area of influence includes the CCNPP site. Similar cones of depression are present in the lower aquifers, although they are not as pronounced in Calvert County as shown in Figures 2.3-62 through 2.3-65.

The USGS has also compiled historical water elevations for the Aquia, Magothy, Upper Patapsco, and Lower Patapsco aquifers in Southern Maryland to determine the magnitude of potentiometric surface declines through time. Potentiometric surface difference maps of these four southern Maryland aquifers are shown in Figures 2.3-69 through 2.3-72, respectively, for various periods between 13 and 28 years (USGS, 2003a) (USGS, 2003b) (USGS, 2003c) (USGS, 2003d). As expected, the areas showing the largest cones of depression correlate with the largest historical declines in potentiometric surface elevations. From 1982 to 2003, the Aquia aquifer potentiometric surface has decreased over 100 ft (30 m) in elevation inside the center of the cone of depression at Solomons in southern Calvert County as shown in Figure 2.3-69. Decreases of over 70 ft (21 m) were observed in the Magothy aquifer in northeastern Charles County as shown in Figure 2.3-70, and smaller decreases were observed in the Upper and Lower Patapsco aquifers as shown in Figure 2.3-71 and Figure 2.3-72.

In 1943, the USGS and the Maryland Geological Survey (MGS) began a statewide cooperative groundwater monitoring network. Several private wells in the Solomons area of Calvert County were among the first to be monitored by what now is referred to as the Calvert County Ground Water Level Monitoring Network, which is a cooperative program between the Calvert County Department of Public Works, Bureau of Utilities, the MGS, and the USGS (USGS, 2007). This network of approximately 42 wells is mainly focused on monitoring the deeper, confined aquifers that are affected by local and regional groundwater withdrawal. The major aquifers of interest are the Piney Point-Nanjemoy, Aquia, and Magothy aquifers. Recently, wells have been added to the system in order to study the availability of water in the deeper Upper and Lower Patapsco aquifers. Water table monitoring wells have also been added, which are used as climate response wells for indicating local groundwater recharge and drought conditions. A USGS web page provides water level trends for selected wells in the network (USGS, 2007). These wells are shown on Figure 2.3-73.

Selected well hydrographs from the Calvert County Ground Water Level Monitoring Network were reviewed to evaluate the temporal trends of the potentiometric surfaces of the aquifers underlying southern Calvert County. For each aquifer, the Calvert County Ground Water Level Monitoring Network well closest to the CCNPP site is evaluated in the following bullets:

- Well CA Fd 51 is screened in the Piney Point-Nanjemoy aquifer and is located approximately 2.5 mi (4 km) southeast of the CCNPP site at Calvert Cliffs State Park. Groundwater levels have been monitored since 1977 and show a nearly steady decrease in elevation from approximately 15.0 ft to -3.0 ft (4.6 to -0.9 m) msl. This rate of decline is approximately 0.6 ft/yr (0.2 m/yr). The rate of decline appears to have decreased slightly since 2000 as shown in Figure 2.3-74.

- Well CA Ed 42 is screened in the Aquia aquifer and is one of the production wells at the CCNPP site. Groundwater levels have been monitored since 1978 and show much higher rate of groundwater elevation decrease from approximately -19.0 ft to -92 ft (-5.8 to -28 m) msl. This corresponds to an overall rate of decline of approximately 2.6 ft/yr (0.8 ft/yr), although relatively stable elevations have been observed since 2003 as shown in Figure 2.3-75.

- Well CA Dc 35 monitors the Magothy aquifer and is located approximately 6 mi (10 km) northwest the CCNPP site at Scientists Cliffs. Groundwater levels have been monitored since 1975 and the data exhibit a very steady rate of groundwater elevation decrease from approximately 8 ft to -37 ft (2.4 to -11.3 m) msl. This rate of decline of approximately 1.6 ft/yr (0.5 m/yr) is less than that observed in the overlying Aquia aquifer as shown in Figure 2.3-76.

- Groundwater elevations in the Upper Patapsco aquifer were evaluated at well CA Db 96, located approximately 10 mi (16 km) northwest of the CCNPP site in Prince Frederick. Groundwater levels in this well have only been monitored since 2003, but groundwater level decreases in this aquifer are also observed. Groundwater elevation decreased at a rate of approximately 1.4 ft/yr (0.4 m/yr) from approximately -35.5 ft to -40.0 ft (-10.8 to -12.2 m) msl as shown in Figure 2.3-77.

- Groundwater elevations in the Lower Patapsco aquifer were evaluated at well CA Fd 85, located approximately 3.5 mi (5.6 km) southeast of the CCNPP site at Chesapeake Ranch Estates. Groundwater levels in this well have only been monitored since 2001, but groundwater level decreases in this aquifer are observed. Groundwater elevation decreased steadily from approximately -14.5 ft to -20.0 ft (-4.4 to -6.1 m) msl (Figure 2.3-78), a rate of approximately 1.1 ft/yr (0.34 m/yr).

Calvert County and St. Mary's County are rapidly growing areas. Between 1980 and 1990, the combined population of the two-county area increased significantly (as described in Section 2.5) and will continue to increase, putting additional demand on the groundwater resources for this area.

A 2004 report by an advisory committee on the management and protection of Maryland's water resources identified the need for a comprehensive assessment of groundwater resources of the Maryland Coastal Plain (MDE, 2004). The assessment will be conducted by the MGS and the USGS in three phases between 2006 and 2013. The goal of the assessment is to develop tools to facilitate scientifically sound management of the groundwater resources in the region.

MDE regulates major groundwater users (those users pumping an average of 10,000 gpd (37,854 lpd) or more) by requiring them to obtain Groundwater Appropriation Permits to prevent the regional potentiometric surface from declining below the 80% management level (80% of the aquifer's available drawdown). Because substantial population growth is anticipated in both Calvert County and St. Mary's County, the MGS developed a model to simulate water level trends through 2020 (MGS, 1997) and subsequently updated through 2025 (MGS, 2001) using several future alternative pumping scenarios for the Piney Point-Nanjemoy and the Aquia aquifers. The model was calibrated by matching simulated water levels against 1952, 1980, and 1982 data and verified by matching simulated data against 1991 through 1994 water levels in 198 observations wells. Future domestic pumpage for 1995 to 2025 simulations were based on estimated population increases and evaluated by comparing simulated drawdowns with the permitted 80% management levels. Major appropriated pumpage and domestic pumpage for the Piney Point-Nanjemoy and Aquia aquifers were simulated in the calibration and predictive scenarios for Anne Arundel County, Charles County, and Prince George's County. Major appropriated pumpage was also taken into account for the Maryland Eastern Shore counties. The Piney Point-Nanjemoy aquifer water levels remained substantially above the Aquia aquifer water levels, but it was suggested that in the future, large appropriators should be restricted from using this aquifer, leaving it to accommodate self-supplied domestic usage. In areas where Aquia domestic wells predominate, water levels could be stabilized by allocating major withdrawals to deeper, more productive aquifers such as the Magothy and Upper Patapsco.

The MGS recently developed a model to simulate and evaluate the potential for increasing groundwater withdrawals from the deeper Upper Patapsco and Lower Patapsco Aquifers in southern Maryland (Calvert County, Charles County, and St. Mary's County) (MGS, 2005). The results of this study projected that water demands within Calvert County and St. Mary's County through 2030 could be met without reducing water levels below the 80% management level by increasing pumpage in the Aquia aquifer. Shifting a portion of the public supply withdrawals from the Aquia to the Upper Patapsco aquifer would result in an increase in available drawdown in the Aquia aquifer in many areas with minimal effect on drawdown near the aquifer outcrop areas in Charles County.

The MGS continues to conduct studies, including modeling efforts, to understand and predict the effects of increasing groundwater demands of the Coastal Plain aquifers within the State of Maryland. New users (or existing user applying to increase its withdrawal) would not be granted a permit if the proposed withdrawal rate is predicted to cause the regional head to fall below the management level.

Planned increased water withdrawal from the Aquia aquifer during construction of CCNPP Unit 3

A portion of the water needed during construction of the CCNPP Unit 3 is planned to be supplied by the difference between the permitted withdrawal from Maryland Department of the Environment (MDE) water appropriation permit (WAP) CA69G-010 (05) and the current average withdrawal rate. This water is derived from the Aquia aquifer. The permitted value is 450,000 gpd (about 164 million gallons per year). The average water use for the five years between July 2001 and June 2006 is 141.2 million gallons per year (about 387,000 gpd, with a range of from 122 to 152 million gallons per year) (Table 2.3.2-7). Assuming this average water use for Units 1 and 2 during the period of construction of Unit 3, a net additional water withdrawal (up to the permitted value of 450,000 gpd) of 23 millions gallons per year (about 63,000 gpd) would result from pumping at the permitted rate.

Effect on drawdown in coastal plain aquifers of increasing groundwater withdrawal from CCNPP to the permitted amount in permit CA69G-010 (05)

A useful approach to evaluating the potential impacts associated with increasing groundwater withdrawal from the Aquia aquifer during construction of CCNPP Unit 3 to the permitted rate is to use the results of the ground-water flow model developed by the MGS and used to evaluate the water-supply potential of the coastal plain aquifers in Calvert, Charles and St. Mary's Counties (documented in MGS 2005 and MGS 2007). This model was used by the MGS to evaluate the effects of continued groundwater withdrawal at either the current rates or various scenarios of projected rates until the year 2030. The model was initially calibrated to reproduce the potentiometric head measured in 2002. Figure 4b of MGS 2005 indicates a predicted water level in 2002 of about – 80 ft msl in the Aquia aquifer in the vicinity of the CCNPP, which is close to the – 81.5 ft msl observed (Figures 2.3.2-7 and 2.3.2-20).

Results of the MGS model indicate that increasing the annual water withdrawal from domestic users and public-supply wells to account for projected population increases while maintaining all other major users (defined as those with withdrawals in excess of 10,000 gpd) at their actual withdrawal rates measured in 2002 results in an additional drawdown in the Aquia aquifer in the vicinity of CCNPP of between 20 and 30 ft by 2030. Simulated drawdowns in the Piney Point-Nanjemoy aquifer in 2030 are less than 10 ft.

Increasing the withdrawal rates of domestic water users by the same amount as modeled in Scenario 1 and setting the water use of all major users at their average WAP rates instead of their actual withdrawal rates measured in 2002 (Scenario 4 of MGS 2005 and MGS 2007) results in an additional drawdown in the Aquia aquifer of between

5 and 10 ft by 2010 (UniStar 2008) and between 20 and 30 ft by 2030. At CCNPP, this scenario corresponds to increasing groundwater withdrawal from the Aquia aquifer from 391,833 gpd (the average rate for 2002, Table 2.3.2-7) to the permitted rate of 450,000 gpd.

Simulated drawdowns in the Piney Point-Nanjemoy aquifer for this scenario are less than 5 ft at 2010 and less than 10 ft at 2030. These increased drawdowns are principally the result of increased withdrawals from domestic and other users of this aquifer, rather than leakage across the low vertical conductivity Middle Confining Bed due to increased pumping from the underlying Aquia aquifer.

Based on the above results, if the permitted volume of groundwater is pumped from the Aquia aquifer for 8 years (significantly longer than the approximately 6-year construction period during which the additional water is anticipated to be needed) an additional drawdown near CCNPP of less than 10 ft is anticipated in the Aquia aquifer. Note that the additional drawdown includes the effects from increased withdrawals by other domestic and major users of the Aquia and other coastal plain aquifers. The effects of the increased withdrawals at CCNPP alone would be much less.

Effect of increasing groundwater withdrawal from CCNPP to the permitted amount in permit CA69G-010 (05) plus an additional 200 gpm on drawdown in coastal plain aquifers

As discussed above, the Maryland Geological Survey numerical model (MGS 2005 and MGS 2007) simulates the effect on water levels in the Aquia aquifer during the construction period for Unit 3 by pumping the CCNPP wells at their combined maximum permitted rate (450,000 gpd) for eight years. The effect is a drawdown from 2002 water levels in the vicinity of CCNPP of between 5 and 10 feet. A separate numerical model of the Aquia aquifer within a 5-mile radius of CCNPP ("Evaluation of Potential Impacts of Construction Pumping on Declining Potentiometric Levels in the Aquia Aquifer") that is based upon the MGS model has been developed by the applicant. This model simulates the effect on Aquia aquifer water levels during the construction period for Unit 3 by pumping the CCNPP wells for six years (a truer estimate of the construction period) at their combined maximum permitted rate plus 200 gpm (total of 738,000 gpd). The applicant's model predicts increased drawdown after six years of about 52 feet at CCNPP and about 13 feet in the closest off-site wells of major water users. These are the Beaches Water Company approximately 2.75 miles to the north in Long Beach and the Dominion Cover Point LNG Terminal approximately 3.85 miles to the south. This model also predicts that following the six-year construction period, water levels return in approximately three years to where they would have been if the pre-construction pumping rate had been maintained.

Analysis of potential impacts of additional drawdown associated with groundwater withdrawal from the Aquia aquifer at the CCNPP

Based on the discussion of ground-water management in MGS 2007, five water-management factors are evaluated with respect to the potential impacts associated with increasing groundwater withdrawal at CCNPP, as follows: 1) the 80-percent water management level, 2) impacts on other ground-water users, 3) lowered water table, 4) brackish-water and river-water intrusion, and 5) land subsidence. In the analysis of potential impacts, it is conservatively assumed that the increase in drawdown in the Aquia aquifer in the vicinity of CCNPP is 13 ft.

<u>80-Percent Management Level</u> – Currently, the primary criterion used by the MDE for evaluating water-appropriation permit applications in the confined aquifers of the Maryland Coastal Plain is the 80-percent management level. The 80-percent management level is defined as 80-percent of the available drawdown in an aquifer. This level for the Aquia aquifer in the vicinity of CCNPP is at an elevation of about – 350 ft msl. Increasing drawdown in the Aquia aquifer at CCNPP by 52 ft from the 2002 level of about – 110 ft msl, yields an estimated groundwater elevation at CCNPP of about – 162 ft msl, well above the 80-percent management level.

<u>Impacts on other ground-water users</u> – Analyses of impacts to other users generally relates to the effect of lowering the groundwater level in other wells. Those wells most vulnerable to such impacts are small diameter "telescoping wells". Such wells are typically constructed with a 4-inch diameter casing near the surface that reduces to a 2-inch diameter in the deeper portion of the well. The submersible pump in these wells is typically installed near the bottom of the 4-inch part of the well (MGS 2007). Because the diameter of the pump is too large to be lowered below the depth where the well diameter is reduced, its yield will be adversely affected if regional declines cause the groundwater level to be lowered to a depth near the well's "reduction point". This type of well construction is typically used in the region for domestic supplies and other wells of relatively low yield. Most of these wells, as well as those of some major users of groundwater in the vicinity of CCNPP, such as the White Sands subdivision to the west and the Calvert Cliffs state park to the south, are completed in the Piney Point or Nanjemoy Formations and impacts from increased withdrawals from the deeper Aquia aquifer are negligible.

Major users of the Aquia aquifer in the vicinity of CCNPP, including the Beaches Water Company to the north and the Dominion Cove Point LNG Terminal to the south are several miles away from CCNPP. Wells for these major users are not small diameter "telescoping wells". The pumps in these wells are typically set much deeper and, therefore, their yields are not significantly impacted by lowering water levels by about thirteen feet. Therefore, the likelihood of the additional drawdown in the Aquia aquifer affecting other users is small, given the lack of small diameter telescoping wells in the Aquia aquifer in the vicinity of CCNPP and the fact that other users of groundwater in the vicinity of CCNPP generally pump from the overlying Piney Point – Nanjemoy aquifer.

<u>Lowered water table</u> – The outcrop of the Aquia Formation, where the aquifer is unconfined and under water-table conditions, is about 30 miles northwest of CCNPP. Regional groundwater withdrawals from the confined portion of an aquifer can affect the water table elevation. However, the additional withdrawal from the CCNPP wells would be a small fraction of the total groundwater withdrawal from the Aquia aquifer and would be unlikely to affect the water table surface 30 miles away.

In the vicinity of the CCNPP site, the Surficial aquifer is unconfined and under water table conditions. The level of the water table is controlled primarily by recharge and discharge in the Surficial aquifer rather than by the relatively small amount of leakage across the Upper Confining Bed beneath the Surficial aquifer that might be induced by increased pumping from the deeper Aquia aquifer. The thickness of the Upper Confining

Bed in the vicinity of CCNPP is about 250 ft. MGS modeled results demonstrate that the potentiometric head in the underlying Piney Point-Nanjemoy aquifer changes by less than 5 ft after 8 years of increased withdrawals from the deeper Aquia aquifer. These results, in addition to the thickness and low vertical hydraulic conductivity of the Upper Confining Bed, suggest there will be no effect on the Surficial aquifer water table due to increased pumping from the CCNPP wells in the Aquia aquifer.

Brackish-water and river-water intrusion –Brackish-water and river-water intrusion is possible in the shallow aquifers in the area if they are hydraulically connected to surface water and the potentiometric heads in these aquifers are reduced below sea level. Increased withdrawal from the Aquia aquifer would not significantly affect the water level in the Surficial aquifer or the Piney Point-Nanjemoy aquifer and, therefore, brackish or river-water intrusion would be negligible. In addition, brackish-water intrusion is not expected in the Aquia aquifer because the overlying confining units would prevent the downward migration of salty water. Although the top of the Piney Point-Nanjemoy aquifer is projected to subcrop in the Chesapeake Bay in areas where the formation is eroded by ancestral Susquehanna River channels, there remains over 100 ft of the Middle Confining Bed between the Piney Point-Nanjemoy and Aquia aquifers to prevent the downward migration of salty water to the Aquia aquifer.

Land subsidence – Land subsidence caused by large potentiometric head declines as a result of groundwater withdrawals has not been documented in Maryland, but is possible. Considering a pre-consolidation stress equivalent of 65 ft below sea level and a maximum subsidence to water-level decline ratio of 0.0037, an additional 52 ft of drawdown at CCNPP after 6 years of increased withdrawals from the Aquia aquifer may yield about 0.192 ft of subsidence, or a rate of about 0.032 ft/yr (about 0.384 in/yr).

Because of the length of time required for drainage of the thick confining units above the Aquia aquifer, the actual subsidence rate is likely to be less than this value and subsidence would continue after water levels in the aquifer have stabilized. This estimated subsidence rate is the maximum that could occur over the area of greatest drawdown. A lower average rate would apply over the area of the aquitard and subsidence would be distributed over a large area as the stresses are redistributed vertically.

Conclusions

Based on the above analysis, there would be no significant impact from increasing groundwater withdrawal from the Aquia aquifer to a rate of 738,000 gpd for the six years of construction of CCNPP Unit 3. Although the water level in the vicinity of CCNPP will be lowered, the results of numerical modeling indicate the projected drawdown in the closest wells of major water users to be approximately 13 ft, even after 6 years of increased pumping from the CCNPP wells and from those of other domestic and major users of the Aquia aquifer. Drawdowns of this amount do not significantly impact the relevant water management factors.

It is important to note that the anticipated use of the additional groundwater is for construction purposes which are expected to last approximately 6 years. After that time, a desalination plant is planned to be on-line producing 1,225 gpm (1,764,000 gpd). About 413 gpm (595,000 gpd) of this production will be excess capacity that may be used to decrease the overall future groundwater withdrawals for CCNPP Units 1 and 2 (starting in about 2014). Three and a half years of this excess capacity, if used to reduce the groundwater extracted from the Aquia aquifer for Units 1 and 2, would compensate for the 6 years of additional water withdrawal during construction of CCNPP Unit 3.}

2.3.2.3 References

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RAI No. HS-9 **ESRP/ER Section 4.2.2.3 and 4.2.2.14**

NRC Request:

If properly managed, construction activities at CCNPP and any additional groundwater withdrawals for construction of CCNPP Unit 3 should not adversely affect the local or regional groundwater systems. There are currently no known or projected site discharges that are or could affect the local groundwater system. Construction activities will affect the shallower, non-utilized water-bearing units beneath the site (the Surficial aquifer and upper water bearing units within the Chesapeake Group) (SAR Section 2.4.12.1.4 page 2.4.12-12). A potential stormwater management plan calls for a series of bio-retention basins and sedimentation basins to divert, collect, and promote infiltration to the Surficial aquifer which feeds Johns Creek. Provide the basis for stating that groundwater withdrawals would not adversely impact the local or regional groundwater systems. Include the impact to the Surficial aquifer, Aquia aquifer, connected aquifers, and water availability to other users. Identify the impact to the Surficial aquifer and Johns Creek due to a potential stormwater management plan, which calls for a series of bio-retention basins and sedimentation basins to divert, collect, and promote infiltration. (See Item HS-8, which is related.).

Note – This response is broken into two parts. The first part (addressed herein) relates to "**provide the basis for stating the groundwater withdrawals would not adversely impact the local or regional groundwater systems. Include the impacts to the Surficial aquifer, Aquia aquifer, connected aquifers, and water availability to other users.**" The second part (already addressed in the initial response to this RAI and not included in the discussion below) is "**identify the impact to the Surficial aquifer and Johns Creek due to a potential stormwater management plan, which calls for a series of bio-retention basins and sedimentation basins to divert, collect, and promote infiltration.**"

UniStar Supplemental Response:

Note - This response supplements the response previously provided to the NRC in UniStar letter UN#08-018, Enclosure 3, Item Number HS-9, dated June 12, 2008.

As noted in ER Section 4.2.2.3, Rev 2 and Rev 3, a number of changes during construction of CCNPP Unit 3 could affect the Surficial and deeper coastal plain aquifers in the vicinity of the CCNPP. However, these changes are expected to have an insignificant impact on the local and regional groundwater systems, including the Surficial aquifer, the Piney Point – Nanjemoy aquifer, and the Aquia aquifer, and the availability of groundwater. Principal among these changes are the potential for reduced infiltration in some areas, induced recharge in other areas, temporary dewatering of foundations, and a temporary increase in withdrawal from the Aquia aquifer to the permitted rate in permit CA69G-010 (05).

Effects of Surficial aquifer changes on recharge to and users of the Piney Point – Nanjemoy aquifer - As a result of the low vertical hydraulic conductivity, large thickness and continuity of the confining beds between the Surficial aquifer and the principal aquifers in the vicinity of the CCNPP (the Piney Point – Nanjemoy and Aquia aquifers), changes at the surface that may locally affect the recharge to, discharge from, or water table elevation in the Surficial aquifer are not expected to alter the groundwater potentiometric surface or water availability in these deeper aquifers. While the Surficial aquifer may provide recharge to the deeper aquifers as either leakage through the intervening confining layers or as direct infiltration where it directly contacts an underlying aquifer (MGS 2007, p. 6), this recharge occurs over the entire areal extent of the Surficial aquifer, where it overlies the deeper aquifers. The portion that is attributable to local recharge immediately above the Piney Point – Nanjemoy and Aquia aquifers at CCNPP is a small fraction of their total recharge.

The planned construction of Unit 3 may lead to a slight reduction in recharge of the Surficial aquifer in some areas (due to construction of impermeable surfaces or temporary dewatering effects) or an increase in other areas (such as stormwater retention basins). Therefore, it is difficult to determine the ultimate impact of Unit 3 to the underlying aquifers. However, it is possible to make some reasonable bounding assumptions. Considering the 2006 water table elevation of about 80 ft msl in the Surficial aquifer (Figure 2.3.1-42), and a potentiometric head in the Piney Point – Nanjemoy aquifer of about 0 ft msl (Figure 2.3.2-19), a vertical thickness of about 250 ft and a vertical hydraulic conductivity of 10^{-4} ft/day for the intervening Upper Confining Bed (MGS, 1997) implies a vertical flux of about 3.2 x 10^{-5} ft^3/ft^2 day (about 0.14 in/yr) between the Surficial aquifer and the Piney Point – Nanjemoy aquifer. This flux is analogous to the value modeled by MGS 2007 (Figure 82), which has a simulated flux rate north of CCNPP of 0.1 in/yr.

If one considers a 10^6 ft^2 area approximately the size of the Unit 3 power block (e.g. a square area with sides 1,000 ft long) over which groundwater recharge is totally eliminated, recharge to the Piney Point – Nanjemoy aquifer would be reduced by about 40 ft^3/day or about 300 gpd. In reality, the volume of recharge would be reduced less than 300 gpd because surface runoff within the power block will be directed to bioretention ditches and basins where infiltration is enhanced.

Three hundred gpd is not significant in comparison to the overall recharge to the deeper aquifers in southern Maryland. This value is also not significant in comparison to one of the major users of the Piney Point - Nanjemoy aquifer in the vicinity of the CCNPP, the White Sands subdivision, with a Groundwater Appropriation Permit average withdrawal rate of 8,000 gpd (Table 2.3.2-4). Therefore, even assuming a reduced recharge from the Surficial aquifer to the Piney Point – Nanjemoy aquifer of 300 gpd, the effect on the Piney Point – Nanjemoy aquifer is negligible and users of groundwater from that unit are not expected to see any effect of the reduced recharge on water levels in the vicinity of the CCNPP.

<u>Effects of changes to the Surficial aquifer on the level of the water table and discharge to John's Creek –</u> Bechtel Power Corporation has developed a numerical model of the Surficial aquifer ("Groundwater flow Model of the Surficial Aquifer"). The model encompasses all areas affected by construction of Unit 3 and contributing discharge to John's Creek.

Simulation of post-construction conditions in the Surficial aquifer indicates that maximum groundwater levels around the power block area will be around 77 ft msl. The depth to the water table in this area is estimated to be 2 to 12 ft below grade level. Groundwater levels in this area are dependent on many factors including the hydraulic conductivity of the fill material and the rate of groundwater recharge over the graded areas of the site.

The impact of the construction of Unit 3 on groundwater discharge to John's Creek is also dependent upon the rate of groundwater recharge over the graded areas of the site. This rate is difficult to predict because while grading, construction of buildings and impermeable surfaces, and installation of stormwater drains all have the effect of reducing recharge, removal of vegetation and its associated evapotranspiration and construction of stormwater retention ditches and basins have the effect of increasing recharge. Model simulations indicate that if the rate of groundwater recharge remains relatively unchanged in the areas of the Unit 3 site to be graded, which are currently wooded and undisturbed, the discharge to John's Creek will be reduced by about 20 percent. On the other hand, groundwater discharge to John's Creek could increase by as much as 40 percent if recharge in the graded areas of the site is twice as high as in the existing undisturbed areas.

<u>Effects of withdrawals from the Aquia aquifer on users of the Aquia and Piney Point – Nanjemoy aquifers</u> – Increasing withdrawal from the Aquia aquifer from the average values withdrawn over the past 5 years (an average of about 387,000 gpd from July 2001 to June 2006) (Table 2.3.2-7) to the value permitted in CA69G-010 (05) of 450,000 gpd (Table 2.3.2-4), is expected to cause increased drawdowns in the vicinity of the CCNPP production wells. The effects of the increased withdrawal, even though limited to about 68 months for the duration of Unit 3 construction, may extend several thousand feet from the pumping wells.

For example, considering an infinite confined aquifer with no leakage (to maximize the potential drawdown), a transmissivity of about 1,000 ft^2/day, a storativity of about 10^{-4} (MGS 1997) and discharge of 63,000 gpd from one well for 2,040 days would yield drawdown in the Aquia aquifer of about 4 ft at a distance of about 10,000 ft and drawdown of about 7 ft at a distance of about 1,000 ft from the pumping well. This drawdown would be insignificant to other users of the Aquia aquifer in the vicinity of CCNPP and would have an insignificant effect on increasing leakage from the overlying Piney Point – Nanjemoy aquifer to the Aquia aquifer. Also, it should be noted that the increased withdrawal would be dispersed among the five CCNPP production wells, the associated increase in drawdown would be transient in nature, and the drawdown would recover after the desalination plant is operational and the increased withdrawal ceases.

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ER Impact:

Application Text Revision (Revision To ER 4.2.2.3 and 4.2.2.14, Rev 3):
(Text Revision to ER Revision 3 marked in red)

4.2.2.3 Physical Effects of Hydrologic Alterations

{Impacts from the construction of CCNPP Unit 3 are similar to those associated with any large construction project. The construction activities that could produce hydrologic alterations to surface water bodies and groundwater aquifers are presented in Section 4.2.1.2. The potentially affected surface water bodies and groundwater aquifers are described in Section 4.2.1.4. The potential construction effects on surface water bodies and groundwater aquifers are presented in Section 4.2.1.5.

Surface Water Impacts

Because of the potential for impacting surface water resources, a number of environmental permits are needed prior to initiating construction. Table 1.3-1 in Chapter 1 provides a list of construction-related consultations and permits that have to be obtained prior to initiating construction activities.

The construction activities expected to produce the greatest impacts on the surface water bodies occur from:

- Reducing the available infiltration area
- Grading and the subsequent covering of the 46 acre (19 hectare) CCNPP Unit 3 power block foundation
- Grading and covering of the 18 acre (7 hectare) CCNPP Unit 3 cooling tower pad
- Grading and covering of the 59 acre (24 hectare) CCNPP Unit 3 switchyard/substation
- Vegetation removal and grading of 151 acres (61 hectares) for temporary construction laydown areas, concrete batch plant, offices, parking, warehouses, and shop preparation areas
- Creation of impoundments
- Elimination of an existing impoundment (i.e., Camp Conoy Fishing Pond)
- Elimination of existing branches of Johns Creek

Site grading and new building foundations will cover and reduce existing infiltration and recharge areas. Runoff will be directed into bio-retention ditches that could discharge to new impoundments, altering the Surficial aquifer recharge areas. Possible increases in runoff volume and velocity in the downstream creeks may cause erosion and adversely affect riparian habitat if not controlled.

Dewatering for the proposed foundation excavations could also impact surface water bodies. Effluent from the dewatering system, and any stormwater accumulating during the excavation, would be pumped to a stormwater discharge point or into onsite impoundments. If pollutants (e.g., oil, hydraulic fluid, concrete slurry) exist in these effluents from construction activities, they could enter the impoundments, downstream channel sections, or other surface water bodies. Monitoring of construction effluents and stormwater runoff would be performed as required in the stormwater management plan, NPDES permit, and other applicable permits obtained for the construction. Depending on the design of the stormwater impoundments and discharge systems, outflow rates into the surface streams could be altered.

All water bodies within the CCNPP site boundary could have the potential to indirectly receive untreated construction effluents. The water bodies listed in Section 4.2.1.1 are potentially subject to receiving untreated construction effluents directly. It will be necessary to implement proper BMPs under state regulations such as a: General NPDES Permit for Stormwater associated with Construction Activity, Erosion and Sediment Control Plan, and a stormwater pollution prevention plan. Table 1.3-1 lists and presents additional information on the Federal, State and Local Authorizations associated with this project.

If proper BMPs are implemented under these permits, treated construction effluents could be released to the site water bodies without adverse impacts. Flow rates for untreated construction effluents will depend upon the usage of water during site construction activities and the amount of precipitation contacting construction debris during construction activities. Flow rates and physical characteristics of the construction effluents are discussed in Section 4.2.1.4. A quantitative calculation and evaluation of the construction effluents and runoff will be done as part of the state construction permit process. BMPs would be implemented to control runoff, soil erosion, and sediment transport. Good housekeeping practices and engineering controls will be implemented to prevent and contain accidental spills of fuels, lubricants, oily wastes, sanitary wastes, etc.

BMPs are implemented under a Spill Prevention Plan, a SWPPP, and an Erosion Control Plan, as described in Section 4.2.1.7 and Section 4.2.2.10. Environmental control systems installed to minimize impacts related to construction activities will comply with all Federal, state and local environmental regulations and requirements. Once the initial controls are in place, they are maintained through the completion of construction and during plant operation, as needed.

Surface water use impacts are MODERATE, primarily due to the loss of wetlands and wetland buffers, and will require mitigation. The mitigation measures associated with the wetlands and wetland buffers are described in Section 4.3.1.4.

Groundwater Impacts

Depending on the design of the stormwater impoundments and discharge systems, outflow velocity and volume in the surface streams could change, and change the volume of water available to infiltrate and recharge the Surficial aquifer.

Increasing groundwater withdrawals for construction needs from the onsite Aquia aquifer production wells, could produce a local depression of the potentiometric surface in that aquifer. These increased withdrawals could potentially induce salt water intrusion or produce land subsidence, but as discussed earlier, neither had been reported as a significant problem in Calvert County or St. Mary's County.

The hydrologic alterations that could be produced in the groundwater aquifers are expected to be localized and possibly temporary. Most of the effects are expected to occur in the uppermost or Surficial aquifer. Any effects in the deeper aquifers are expected to be minor, due to remaining within the existing permit withdrawal limits, and dependent to a large extent on groundwater travel time, thickness and physical properties of the intervening stratigraphic units, and the nature of the hydraulic connection between aquifers.

The construction activities listed in Section 4.2.1.2 that are expected to produce the greatest impacts on the Surficial aquifer are related to:

- Changing the existing recharge and discharge areas
- Possibly changing the amount of runoff available for infiltration
- Dewatering of foundation excavations during construction

Site grading and leveling for the building foundations and laydown areas will cover and possibly eliminate existing recharge areas. Runoff from the graded areas will be directed into bio-retention ditches and several proposed impoundments, possibly creating new "focused" recharge areas. Runoff velocity may be increased in the channels downstream of the impoundments, which could decrease the amount of runoff available for infiltration and recharge. Fine-grained sediments could settle out in the impoundments and channels and create less-permeable areas for infiltration and recharge. These changes affect local recharge to the Surficial aquifer. Impacts on the deeper Aquia aquifer are likely to be SMALL.

Dewatering foundation excavations also produce localized impacts on the Surficial aquifer. The deepest excavations anticipated are for the proposed reactor and auxiliary building foundations, and extend approximately 40 ft (12 m) below plant grade and approximately 60 ft (18.3 m) below pre-construction grade. The dewatering system and activities are not expected to have any significant impact on the deeper Aquia aquifer due to the main recharge area of the Aquia aquifer is to the north. Hence, it is insensitive to perturbances of the Surficial aquifer. Effluent from the dewatering system will be pumped to a stormwater discharge point. Monitoring of construction effluents and stormwater runoff will be performed as required in the stormwater pollution prevention plan, NPDES permit, and other applicable permits obtained for the construction.

The locally lowered Surficial aquifer water level would be expected to eventually recover after the dewatering and other subsurface construction activities are complete. Although it would be altered by buildings and paved areas, rainwater is still allowed to infiltrate in other plant areas to recharge the aquifer.

The impact to groundwater is SMALL and localized, changes to the Surficial aquifer water level are expected to eventually recover once construction is complete.

Effects of Surficial aquifer changes on recharge to and users of the Piney Point – Nanjemoy aquifer - As a result of the low vertical hydraulic conductivity, large thickness and continuity of the confining beds between the Surficial aquifer and the principal aquifers in the vicinity of the CCNPP (the Piney Point – Nanjemoy and Aquia aquifers), changes at the surface that may locally affect the recharge to, discharge from, or water table elevation in the Surficial aquifer are not expected to alter the groundwater potentiometric surface or water availability of these deeper aquifers. While the Surficial aquifer may provide recharge to the deeper aquifers as either leakage through the intervening confining layers or as direct infiltration where it directly contacts an underlying aquifer, this recharge occurs over the entire areal extent of the Surficial aquifer, where it overlies the deeper aquifers. The portion that is attributable to local recharge immediately above the Piney Point – Nanjemoy and Aquia aquifers at CCNPP is a small fraction of their total recharge.

The planned construction activities may lead to a slight reduction in recharge of the Surficial aquifer in some areas (due to construction of impermeable surfaces or temporary dewatering effects) or an increase in other areas (such as stormwater retention basins). Therefore, it is difficult to determine the ultimate impact of Unit 3 to the underlying aquifers. However, it is possible to make some reasonable bounding assumptions. Considering the 2006 water table elevation of about 80 ft msl in the Surficial aquifer (Figure 2.3.1-42), and a potentiometric head in the Piney Point – Nanjemoy aquifer of about 0 ft msl (Figure 2.3.2-19), a vertical thickness of about 250 ft and a vertical hydraulic conductivity of 10^{-4} ft/day for the intervening Upper Confining Bed (MGS, 1997) implies a vertical flux of about 3.2 x 10^{-5} ft^3/ft^2 day (about 0.14 in/yr) between the Surficial aquifer and the Piney Point – Nanjemoy aquifer. This flux is analogous to the value modeled by MGS 2007, which has a simulated flux rate north of CCNPP of 0.1 in/yr.

If one considers a 10^6 ft^2 area approximately the size of the Unit 3 power block (e.g. a square with sides 1,000 ft long) over which groundwater recharge is totally eliminated, recharge to the Piney Point – Nanjemoy aquifer would be reduced by about 40 ft^3/day or about 300 gpd. In reality, the volume of recharge would be reduced less than 300 gpd because surface runoff within the power block will be directed to bio-retention ditches and basins where infiltration is enhanced.

Three hundred gpd is not significant in comparison to the overall recharge to the deeper aquifers in southern Maryland. This value is also not significant in comparison to one of the major users of the Piney Point - Nanjemoy aquifer in the vicinity of the CCNPP: the White Sands subdivision, with a Groundwater Appropriation Permit average withdrawal rate of 8,000 gpd (Table 2.3.2-4). Therefore, even assuming a reduced recharge from the Surficial aquifer to the Piney Point – Nanjemoy aquifer of 300 gpd, the effect on the Piney Point – Nanjemoy aquifer is negligible and users of groundwater from that unit are not expected to see any effect of the reduced recharge on water levels in the vicinity of the CCNPP.

Effects of changes to the Surficial aquifer on the level of the water table and discharge to John's Creek – A numerical model has been developed of the Surficial aquifer at CCNPP ("Groundwater Flow Model of the Surficial Aquifer"). The model encompasses all areas affected by construction of Unit 3 and contributing discharge to John's Creek.

Simulation of post-construction conditions in the Surficial aquifer indicates that maximum groundwater levels around the power block area will be around 77 ft msl. The depth to the water table in this area is estimated to be 2 to 12 ft below grade level. Groundwater levels in this area are dependent on many factors including the hydraulic conductivity of the fill material and the rate of groundwater recharge over the graded areas of the site.

The impact of the construction of Unit 3 on groundwater discharge to John's Creek is also dependent upon the rate of groundwater recharge over the graded areas of the site. This rate is difficult to predict because while grading, construction of buildings and impermeable surfaces, and installation of stormwater drains all have the effect of reducing recharge, removal of vegetation and the associated evapotranspiration and construction of stormwater retention ditches and basins have the effect of increasing recharge. Model simulations indicate that if the rate of groundwater recharge remains relatively unchanged in the areas of the Unit 3 site to be graded, which are currently wooded and undisturbed, the discharge to John's Creek will be reduced by about 20 percent. On the other hand, groundwater discharge to John's Creek could increase by as much as 40 percent if recharge in the graded areas of the site is twice as high as in the existing undisturbed areas.

Effects of withdrawals from the Aquia aquifer on the users of the Aquia and Piney Point – Nanjemoy aquifers – Increasing withdrawal from the Aquia aquifer from the average values withdrawn over the past 5 years (an average of about 387,000 gpd from July 2001 to June 2006) (Table 2.3.2-7) to the value permitted in CA69G-010 (05) of 450,000 gpd (Table 2.3.2-4), is expected to cause increased drawdowns in the vicinity of the CCNPP production wells. The effects of the increased withdrawal, even though limited to about 68 months for the duration of Unit 3 construction, may extend several thousand feet from the pumping wells. For example, considering an infinite confined aquifer with no leakage (to maximize the potential drawdown), a transmissivity of about 1,000 ft^2/day, a storativity of about 10^{-4} (MGS 1997) and discharge of 63,000 gpd from one well for 2,040 days would yield drawdown in the Aquia aquifer of about 4 ft at a distance of about 10,000 ft and drawdown of about 7 ft at a distance of about 1,000 ft from the pumping well. This drawdown would be insignificant to other users of the Aquia aquifer in the vicinity of CCNPP and would have an insignificant effect on increasing leakage from the overlying Piney Point – Nanjemoy aquifer to the Aquia aquifer. Also, it should be noted that the increased withdrawal would be dispersed among the five CCNPP production wells, the associated increase in drawdown would be transient in nature and the drawdown would recover after the desalination plant is operational and the increased withdrawal ceases.}

4.2.2.14 References

{**MDE, 1994.** 1994 Standards and Specifications for Soil Erosion and Sediment Control, Website: http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/erosionsedimentcontrol/standards.asp, Date accessed: March 14, 2007.

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MGS, 2007. Water Supply Potential of the Coastal Plain Aquifers in Calvert, Charles, and St. Mary's Counties, Maryland, with Emphasis on the Upper Patapsco and Lower Patapsco Aquifers, Maryland Geological Survey Report of Investigations No. 76, Maryland Geological Survey, D. Drummond, August 2007.

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USC, 2007. Title 33, United States Code, Part 1251, Federal Water Pollution Control Act, 2007.

USGS, 2007. Hydrogeology of the Piney Point-Nanjemoy, Aquia, and Upper Patapsco aquifers, Naval Air Station Patuxent River and Webster Outlying Field, St. Mary's County, Maryland, 2000-06, USGS Scientific Investigations Report 2006-5266, 26p, U.S. Geological Survey, C. Klohe and R. Kay, 2007.}

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Request:

A permanent groundwater dewatering system is not anticipated to be a design feature for the CCNPP Unit 3 facilities. Removal of a portion of the Surficial aquifer during construction may eventually lower the expected depth to groundwater. Surface water controls to minimize precipitation infiltration and the redirection of surface runoff away from the facility area are expected, further minimizing water infiltration to the groundwater system beneath the site. Groundwater elevations will continue to be monitored, and any observed deviations in groundwater elevations potentially impacting the current design basis will be accounted for to design a construction dewatering system, as appropriate (Section 2.3.2.2.11 page 2.3-47). Provide if possible a topographic map with an overlay of the construction foot print and with contours that can be easily read. Describe how the recharge to the Surficial aquifer would be impacted in the short term. Long term is presented in Figures 2.3.2-(24-25). Identify how the seeps and streams would be impacted and how this would impact local wells.

Supplemental Response:

Note - This response supplements the response previously provided to the NRC in UniStar Letter UN#08-018, Enclosure 3, Item Number HS-13, dated June 12, 2008 and addresses the commitment made to evaluate impacts from increased groundwater withdrawals by CCNPP on the Surficial Aquifer. The supplemental response to RAI HS-9 provides an evaluation of offsite impacts due to changes in recharge as well as impacts to local seeps and springs.

ER Impact:

No changes are required.

Enclosure 2

CD – 25237-000-T8C-GAMC-00237 (Visual MODFLOW files for Surficial Aquifer) input files used in Bechtel calculation 25237-103-KOC-HMMG-00001 Revision 001 (Groundwater Flow Model of the Surficial Aquifer)

Enclosure 3

Groundwater Model Report 25237-000-30R-K01G-00001-000, "Evaluation of Potential Impacts of Construction Pumping on Declining Potentiometric Levels in the Aquia Aquifer," dated December 2008