Eugene S. Grecheck
Vice President
Nuclear Development

Dominion Energy, Inc. • Dominion Generation
Innsbrook Technical Center
5000 Dominion Boulevard, Glen Allen, VA 23060
Phone: 804-273-2442, Fax: 804-273-3903
E-mail: Eugene.Grecheck@dom.com

Dominion®

September 27, 2012

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

Serial No. NA3-11-020RB
Docket No. 52-017
COL/DBE

DOMINION VIRGINIA POWER
NORTH ANNA UNIT 3 COMBINED LICENSE APPLICATION
SRP 09.02.01: REVISED RESPONSE TO RAI LETTER 65

On April 14, 2011, the NRC requested additional information to support the review of certain portions of the North Anna Unit 3 Combined License Application (COLA), which consisted of five questions. The response to Request for Additional Information (RAI) 5554, Question 09.02.01-14 was provided in Dominion letter NA3-11-020RA, dated June 9, 2011 (ML11165A035).

Dominion has since determined that the response to RAI 5554, Question 09.02.01-14 should be revised to clarify the discussion regarding simultaneous operation of the Ultimate Heat Sink transfer pump and Emergency Service Water pump from the same basin. A revised response that supersedes the June 9, 2011 response is enclosed. Please note that the revision pertains only to the second paragraph in the response under section "A. COL 9.2(1)" but the entire response is provided for completeness. The revised response is shown in text markup format.

Please contact Regina Borsh at (804) 273-2247 (regina.borsh@dom.com) if you have questions.

Very truly yours,

Eugene S. Grecheck

D089
NRO

Enclosure:

1. Revised Response to NRC RAI Letter No. 65, RAI 5554, Question 09.02.01-14.

Commitments made by this letter:

1. The clarification provided in Enclosure 1 will be incorporated into a future submission of the North Anna Unit 3 COLA, as described in the enclosure.

COMMONWEALTH OF VIRGINIA

COUNTY OF HENRICO

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Eugene S. Grecheck, who is Vice President-Nuclear Development of Virginia Electric and Power Company (Dominion Virginia Power). He has affirmed before me that he is duly authorized to execute and file the foregoing document on behalf of the Company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 27th day of September, 2012
My registration number is 7173057 and my
Commission expires: August 31, 2016

Wanda K. Marshall
Notary Public

WANDA K. MARSHALL
NOTARY PUBLIC
REGISTRATION # 7173057
COMMONWEALTH OF VIRGINIA
MY COMMISSION EXPIRES
AUGUST 31, 2016

cc: U. S. Nuclear Regulatory Commission, Region II
C. P. Patel, NRC
T. S. Dozier, NRC
G. J. Kolcum, NRC

ENCLOSURE 1

Revised Response to NRC RAI Letter No. 65

RAI No. 5554, Question 09.02.01-14

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5554 (RAI LETTER NO. 65)

SRP SECTION: 09.02.01 – STATION SERVICE WATER SYSTEM

QUESTIONS for Balance of Plant Branch 1 (AP1000/EPR Projects) (SBPA)

DATE OF RAI ISSUE: 04/14/2011

QUESTION NO.: 09.02.01-14

This Request for Additional Information (RAI) is necessary for the staff to determine if the application meets the requirements of General Design Criteria (GDC) 44.

The essential service water system (ESWS) must be capable of removing heat from systems, structures and components (SSCs) important to safety during normal operating and accident conditions over the life of the plant in accordance with General Design Criteria (GDC) 44 requirements. Standard Review Plan (SRP) Section 9.2.1, "Station Service Water System," Sections II and III provide guidance on the specific information that should be included in the application for evaluation by the staff.

US-APWR Design Control Document (DCD) Revision 2 COL 9.2 (1) requires the COL Applicant to provide the evaluation of the ESWS pump(s) at the lowest probable water level in the ultimate heat sink (UHS). DCD COL 9.2 (6) specifies that the COL Applicant should provide the ESWP design details including required total dynamic head and net positive suction head (NPSH) available. The ESWS pumps are important components used in part for heat transfer to satisfy GDC 44 and adequate ESWS pump performance including required NPSH for the ESWS pumps needs to be considered as part of the system design. For the above reasons, the NRC staff requests the applicant to consider providing the following information related to GDC 44 and NSPH consideration:

A. COL 9.2(1)

- Discuss pump vortex formation as part of the NPSH evaluation.
- Provide drawings indicating the elevation of the ESWS pump impellers.
- Include in the FSAR the low water level in the UHS to support adequate NPSH.

- Include in the FSAR the NPSH instrumentation for minimum water level to assure ESWS operability.
- Add the minimum water level to the Technical Specifications (TS), Section 3.7.9, "Ultimate Heat Sink," Surveillance Requirements. The TS currently addresses that the UHS basin is equal to or greater than the total volume of 10.6 million liters (2,800,000 gallons).

B. COL 9.2(6)

- Provide a clarification to the following FSAR sections related to basin level to support NPSH. FSAR Section 9.2.1.2.2.1, "ESWPS" describes the available NPSH with the lowest expected water level (after 30 days of accident mitigation) in the basin to be approximately 12.2 meters (40 feet). However the UHS basin level is described as 8.8 meters (29 feet) deep in FSAR Section 9.2.5.3, "Safety Evaluation".
- Provide in the FSAR the bases for the ESWS pump total dynamic head (TDH) of 67.1 meters (220 feet) and describe the margins available for the pump as related to system losses. Include in the FSAR a discussion related to TDH, flow requirements and time durations to the fire protection system that supports the reactor building and essential service water pump house.

Revised Dominion Response (This response supersedes Dominion's June 9, 2011 response)

Background Discussion:

As noted in FSAR Section 9.2.5, each cooling tower structure consists of the Ultimate Heat Sink (UHS) basin, which is located underneath the tower, and the Essential Service Water (ESW) intake basin, which is located underneath the ESW pump house. Within each structure, the UHS basin and the ESW intake basin are interconnected and maintain the same water level. The ESW intake basin floor is 12 feet deeper than the UHS basin floor. During normal plant operation, a water level of approximately 34 feet above the UHS basin floor is maintained, which provides a water level of approximately 46 feet from the ESW intake basin floor. These elevations and configurations are shown in FSAR Figure 3.8-209 which provides a typical section view of the combined UHS basin and ESW intake basin structure including the ESW pump elevation. The minimum water level to guarantee the minimum Technical Specification UHS volume is 4 feet less than the normal operating water level or 30 feet above the UHS basin floor.

A. COL 9.2(1)

- Following 30 days of operation (without makeup) after a design basis accident, the water level in the ESW intake basin will be at elevation 282 feet which corresponds to the bottom of the UHS basin. This elevation is 12 feet above the

ESW intake basin bottom and equates to an available NPSH of approximately 40 feet. (See response to the first item in B. COL 9.2(6) below.)

One ESW pump and one UHS transfer pump are located in each basin. The ESW pump is located approximately 10 feet from the nearest basin wall. ~~The ESW pump and the UHS transfer pump from the same basin would not be operated simultaneously since it would be undesirable to be transferring water out of the UHS basin that is in service following a design basis accident. There is no other disturbance in the basin that would contribute to vortex formation. Thus the pump location, adequate submergence and the lack of competing pump suctions and disturbances make vortex formation highly unlikely.~~ Although it is not a normal operating condition, the UHS transfer pump and the ESW pump may operate simultaneously from the same basin. Under these conditions, the UHS transfer pump and ESW pumps will be able to perform their safety functions because the basin water inventory is sufficient even at the minimum allowable basin water level for both pumps to operate simultaneously until the UHS transfer pump is stopped by operators. Transfer pump location and adequate submergence preclude vortex formation.

- The attached Figure 1 depicts the cooling tower basin structure elevations of interest including the ESW pump impeller. The ESW intake basin floor elevation is 270 feet, and the UHS basin floor elevation is 282 feet. The normal operating water level is 316 feet. The minimum operating water level is 312 feet. The impeller (eye) of the ESW pump is located approximately 2 feet off of the ESW intake basin floor at an elevation of 272 feet. A vaned basket is installed at the suction of the vertical ESW pump. The actual ESW pump impeller elevation is subject to the final design details.

- During normal plant operation, the available NPSH for the ESW pump is approximately 74 feet with a corresponding water level of 46 feet above the ESW intake basin floor. As noted in the FSAR Subsection 9.2.1.2.2.1, the ESW pump available NPSH at the lowest expected water level in the intake basin is approximately 40 feet. This occurs after 30 days of accident mitigation without external make up and, as shown in the attached Figure 1. At this time, the water level will be approximately 12 feet above the ESW intake basin floor. The design of the ESW pumps will assure that adequate NPSH margin exists at these worst-case conditions and that the ESW pumps will remain capable of satisfying flow requirements.

  FSAR Subsection 9.2.1.2.2.1 will be revised to clarify the minimum water level and that adequate NPSH will be available at this condition.

- FSAR Subsection 9.2.5.5 describes UHS level instrumentation to monitor and control the normal operating water level above UHS basin floor. FSAR Figure 9.2.5-201 shows the level instrumentation. UHS basin low water level of 30 feet

(elevation 312 feet) is alarmed in the Main Control Room (MCR). Technical Specification (TS) 3.7.9 surveillance requirements associated with monitoring water level in the basin assure minimum required water inventory is maintained. As noted above in the second bullet, this assures that ESW pump NPSH requirements are satisfied.

As noted in FSAR Subsection 9.2.5.5 water level is monitored in the MCR. During accident conditions, the instrumentation used to monitor the water level in the operating basins is used by the Control Room operators to start the UHS transfer pump to transfer water from the idle basin to the operating basins. Water inventory from three basins is used for accident mitigation and after 30 days expected minimum water level will be approximately 12 feet above ESW intake basin floor.

- A specific Technical Specifications Surveillance Requirement for UHS minimum water level is not necessary. As noted, the current Technical Specifications Surveillance Requirement, SR 3.7.9.1 requires verification of a minimum usable volume of 2.8 million gallons in each UHS basin. Technical Specifications Section B3.7.9, BACKGROUND, states that the stored water level corresponding to 2.8 million gallons usable volume provides adequate NPSH to the ESW pump during a 30-day period of operation following the design basis LOCA without makeup.

  The TS bases for this SR states that plant procedures provide the corresponding water level to be verified in each basin accounting for unusable volume and measurement uncertainty. This includes trending of sedimentation and instrument uncertainties. This ensures that the minimum usable volume requirement for each UHS train is met. Thus, the SR confirms minimum water level and adding the requirement to SR 3.7.9.1 would be redundant.

B. COL 9.2(6)

- The 40 feet NPSH from FSAR Section 9.2.1.2.2.1 and the 29 feet water depth from FSAR Section 9.2.5.3 are not comparable values.

  The 29 feet water depth in the UHS basin described in FSAR Subsection 9.2.5.3 is used to calculate available usable water volume (allowing for sedimentation and measurement uncertainties) from the low water level alarm point. Figure 1 provides the elevation and sediment information to illustrate the 29 feet water level in the UHS basin.

  As noted in item A.COL 9.2(1) above, following a design basis accident and after 30 days of pump operation without external makeup water supplied to the basin, the water level is in the ESW intake basin will be approximately 12 feet. At these conditions, the available NPSH is computed as follows:

NPSH = Atmospheric Pressure + Static Head – Pressure drop through suction piping – Vapor pressure corresponding to water temperature of 95 degrees F at pump suction

= (14.61x2.31/0.995) ft + 10 ft (water level elevation above Impeller eye elevation) – 0.0 – 1.88 ft = 42.04 ft

For conservatism 40 feet NPSH is used.

FSAR Subsection 9.2.5.3 will be revised to clarify that adequate NPSH is available.

- Total dynamic head (TDH) is computed by adding the pressure drop through the flow path with higher resistance and the maximum static head (lift). Pressure drop across ESW users, including strainers, are conservatively estimated. Total calculated system losses are approximately 200 feet. The pump design TDH is 220 feet and thus provides ample (10%) margin. Also in this computation, static lift is calculated using the minimum expected water level in the basin (12 feet above ESW intake basin floor). At the initiation of an accident, water level will be a minimum of approximately 42 feet above the ESW intake basin floor, providing additional margin at the initiation of the accident and during subsequent mitigation.

FSAR Subsection 9.2.1.2.2.1 will be revised to reflect ESW pump TDH margin.

As noted in the FSAR Subsection 9.2.1.3, the ESW system may be used as a seismic category I backup source of water for the fire protection system. If required after the safe-shutdown earthquake, two hose stations supply a total of approximately 150 gpm for a maximum of two hours duration.

Total continuous flow required by all components supported by the ESW system during all modes of plant operation is 12,043 gpm per train (two trains operating during a design basis LOCA). Each ESW pump is designed for 13,000 gpm flow rate thus providing adequate flow margin. System losses from the pump discharge to the fire protection system tap in the reactor building are computed using design flow of 13,000 gpm and thus the additional fire protection flow usage of 150 gpm has no impact on the ESW pump TDH margin or pump design capacity.

FSAR Section 9.2.1.3 will be revised to clarify that this backup water supply for the fire protection system is not required for any accident condition other than a safe-shutdown earthquake.

Proposed COLA Revision

FSAR Subsection 9.2.1.2.2.1 will be revised as indicated on the attached markup. The proposed revisions associated with the original RAI response submitted on June 9, 2011 were incorporated in the December 2011 COLA submission and remain unaffected by the revised response.

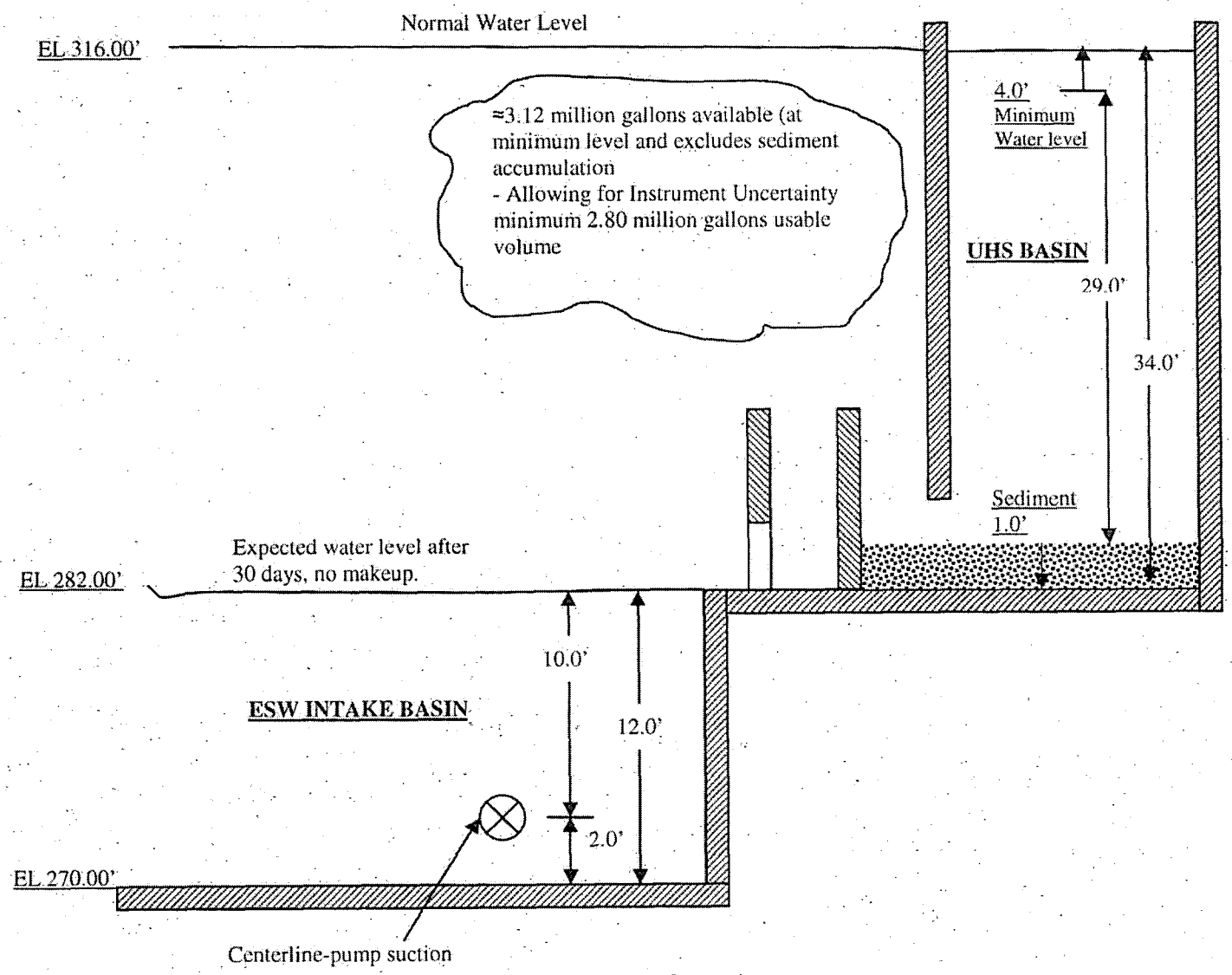
Normal Water Level
EL 316.00'
≈3.12 million gallons available (at minimum level and excludes sediment accumulation
- Allowing for Instrument Uncertainty minimum 2.80 million gallons usable volume
4.0'
Minimum Water level
UHS BASIN
29.0'
34.0'
Sediment
1.0'
Expected water level after 30 days, no makeup.
EL 282.00'
10.0'
12.0'
ESW INTAKE BASIN
2.0'
EL 270.00'
Centerline-pump suction

Figure 1

Markup of North Anna COLA

The attached markup represents Dominion's good faith effort to show how the COLA will be revised in a future COLA submittal in response to the subject RAI. However, the same COLA content may be impacted by revisions to the DCD, responses to other COLA RAIs, other COLA changes, plant design changes, editorial or typographical corrections, etc. As a result, the final COLA content that appears in a future submittal may be somewhat different than as presented herein.

and NPSH for 30 days without makeup. This is discussed further in Subsection 9.2.5.2.

NAPS COL 9.2(8)
NAPS CDI

Replace the ninth and tenth paragraphs in DCD Subsection 9.2.1.2.1 with the following.

Chemicals are added to the basin to control corrosion, scaling, and biological growth. The water chemistry is managed through a Chemistry Control Program such as following a standard Langelier Saturation Index. The Cooling Tower Chemical Feed System (CCS) is described in Subsection 10.4.5.2.2.8.

Blowdown is used to maintain acceptable water chemistry composition. This is accomplished by tapping each essential service water pump (ESWP) discharge header. Additional description about blowdown is discussed in Subsection 9.2.5.2.

NAPS COL 9.2(31)

Replace the eleventh paragraph in DCD Subsection 9.2.1.2.1 with the following.

Layout of the ESWS and UHS piping and equipment, and system operating procedures, ensure that the water pressure remains above saturation conditions for all operating modes.

STD COL 9.2(26)

Replace the twelfth paragraph in DCD 9.2.1.2.1 with the following:

Maintenance and test procedures (see Operating and Maintenance Procedures in Subsection 13.5.2.1) are followed to monitor and flush debris accumulated in the system.

9.2.1.2.2 Component Description

STD COL 9.2(6)

Replace the sentence in DCD Subsection 9.2.1.2.2 with the following.

Table 9.2.1-1R shows the design parameters of the major components in the system.

9.2.1.2.2.1 ESWPs

NAPS COL 9.2(6)

Replace the third and fourth sentences of the third paragraph in DCD Subsection 9.2.1.2.2.1 with the following.

Total dynamic head (TDH) of an ESWP is 220 feet. Total calculated system head losses including maximum expected static lift are

approximately 182 feet. This provides approximately 38 feet margin. The static lift is based on the lowest expected water level in an ESW intake basin of approximately 12 feet. During plant operation and the initiation of the design basis accident, the water level will be at a minimum of approximately 42 feet above the ESW intake basin floor. This reduces the expected static lift by 30 feet, increasing the available margin.

Available NPSH with the lowest expected water level (after 30 days of accident mitigation) in the basin is approximately 40 feet. The minimum available NPSH is based on the lowest expected water level of approximately 12 feet, noted above and a maximum water temperature of 95°F. Available NPSH is approximately 70 feet based on a water level of approximately 42 feet, noted above, and a temperature of 93°F at the initiation of the accident.

STD* COL 9.2(6)

Replace the fifth sentence of the third paragraph in DCD Subsection 9.2.1.2.2.1 with the following.

The system pressure during shut-off head operation of the ESW pump including the static head of the system is below the ESWS design pressure of 150 psig.

NAPS COL 9.2(6)

Replace the eighth sentence of the third paragraph in DCD Subsection 9.2.1.2.2.1 with the following.

The lowest expected water level of approximately 12 feet in an ESW intake basin provides adequate submergence at the pump suction, precluding vortex formation. ~~Under these conditions, no other pump operates simultaneously with an ESWP in an ESW intake basin. This precludes vortex formation.~~

NAPS COL 9.2(6)

Replace the last paragraph in DCD Subsection 9.2.1.2.2.1 with the following.

The ESW pump motors are air-cooled. Each UHS ESW pump house ventilation system maintains the air temperature within the required range in an ESW pump room.