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Dominion®

August 30, 2012

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

Serial No. NA3-12-011R
Docket No. 52-017
COL/DBE

DOMINION VIRGINIA POWER
NORTH ANNA UNIT 3 COMBINED LICENSE APPLICATION
SRP 09.02.05: RESPONSE TO RAI LETTER 99

On May 7, 2012, 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 twelve questions. As a result of conversations with the NRC project manager during weekly status calls, additional time beyond the originally allotted response time was granted. The responses to six of the twelve Request for Additional Information (RAI) Questions are provided in Enclosures 1 through 6:

- RAI 6402, Question 09.02.05-4 UHS Piping System Materials
- RAI 6402, Question 09.02.05-5 Operation of ESW and Transfer Pumps
- RAI 6402, Question 09.02.05-6 UHS Pump House Electrical Separation
- RAI 6402, Question 09.02.05-9 UHS Basin Make-up
- RAI 6402, Question 09.02.05-12 UHS Basin Overflow Protection
- RAI 6402, Question 09.02.05-13 UHS Basin Biofouling

This information will be incorporated into a future submission of the North Anna Unit 3 COLA, as described in the enclosures.

The responses to the remaining six questions require additional time to prepare. Dominion will submit responses to these questions by December 21, 2012.

As stated in Dominion's letter submitted on May 3, 2012 (Serial No. NA3-12-007) the endorsement process of Comanche Peak R-COLA RAI responses will be simplified going forward. R-COLA RAI responses will be addressed on an individual response basis. This endorsement process is reflected in several of the responses to the RAI questions included in the enclosures.

D089
NRO

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

Very truly yours,

Eugene S. Grecheck

Enclosures:

1. Response to NRC RAI Letter No. 99, RAI 6402, Question 09.02.05-4.
2. Response to NRC RAI Letter No. 99, RAI 6402, Question 09.02.05-5.
3. Response to NRC RAI Letter No. 99, RAI 6402, Question 09.02.05-6.
4. Response to NRC RAI Letter No. 99, RAI 6402, Question 09.02.05-9.
5. Response to NRC RAI Letter No. 99, RAI 6402, Question 09.02.05-12.
6. Response to NRC RAI Letter No. 99, RAI 6402, Question 09.02.05-13.

Commitments made by this letter:

1. This information will be incorporated into a future submission of the North Anna Unit 3 COLA, as described in the enclosures.
2. Dominion will submit responses to RAI questions 09.02.05-3, 09.02.05-7, 09.02.05-8, 09.02.05-10, 09.02.05-11, and 09.02.05-14 by December 21, 2012.

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 30th day of August, 2012
My registration number is 112536 and my
Commission expires: April 30, 2015

Jane M. Macek
Notary Public

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

ENCLOSURE 1

Response to NRC RAI Letter No. 99

RAI No. 6402, Question 09.02.05-4

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: **6402 (RAI LETTER NO. 99)**

SRP SECTION: 09.02.05 – ULTIMATE HEAT SINK

QUESTIONS for Balance of Plant and Technical Specifications Branch (BPTS)

DATE OF RAI ISSUE: 05/07/2012

QUESTION NO.: 09.02.05-4

The staff reviewed this COL FSAR supplemental information related to COL Items 9.2(3) and 9.2(28) and finds that additional information is required to determined compliance with 10 CFR Part 50, GDC 44, “Cooling Water”.

Specifically, the application is requested to address in the FSAR:

UHS piping materials (including the UHS transfer piping material) which is not adequately described in the FSAR. For the UHS piping system, outside the scope of the Essential Service Water System (ESWS), describe the materials to be utilized (carbon or alloy), ASME Code class, and if the system is internal lined and/or has cathodic protection. This FSAR description should be similar to the description in US-APWR DCD and COL FSAR Sections 9.2.1.2.2.5, “Piping” (ESWS).

Dominion Response

Dominion endorses Luminant’s response to Comanche Peak RAI 6358, Question 09.02.05-19, submitted June 7, 2012 (ML12163A012), which describes that the UHS piping material, including the UHS transfer piping, is carbon steel with an internal polyethylene lining. The piping is not buried, so cathodic protection is not provided. The following clarification is made to Luminant’s response:

The “CW makeup water main header line” in the Comanche Peak R-COLA is referred to as the “Cooling Tower Makeup and Blowdown System Line” in the North Anna Unit 3 COLA and has an equipment classification of EC9.

Proposed COLA Revision

FSAR Subsection 9.2.5.2.1 and Figure 9.2.5-1R will be revised as indicated on the attached markup.

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.

9.2.5.2.1 General Description

NAPS COL 9.2(3)
NAPS COL 9.2(4)
NAPS COL 9.2(5)
NAPS COL 9.2(18)
NAPS COL 9.2(19)
NAPS COL 9.2(20)
NAPS COL 9.2(21)
NAPS CDI

Replace the content of DCD Subsection 9.2.5.2.1 with the following.

The UHS consists of four 50 percent capacity mechanical draft cooling towers, one for each ESWS train, and four 33 1/3 percent capacity basins to satisfy the thirty day cooling water supply criteria of RG 1.27.

Each cooling tower consists of two cells with fans and motors, drift eliminators, film fills, risers, and water distribution system all enclosed and supported by a seismic category I reinforced concrete structure. Each basin includes an ESWP intake structure that contains one 50 percent capacity ESWP and one 100 percent capacity UHS transfer pump, and associated piping and components. The UHS piping material, including the UHS transfer piping, is carbon steel with an internal polyethylene lining. The piping is not buried; therefore, cathodic protection is not utilized. Tornado missile protection for the cooling tower components, ESWPs and piping is provided by the UHSRS safety-related seismic category I structures and UHSRS pipe chase as discussed in Subsection 3.8.4. The UHS structural design, including pertinent dimensions, is also discussed in Subsection 3.8.4.

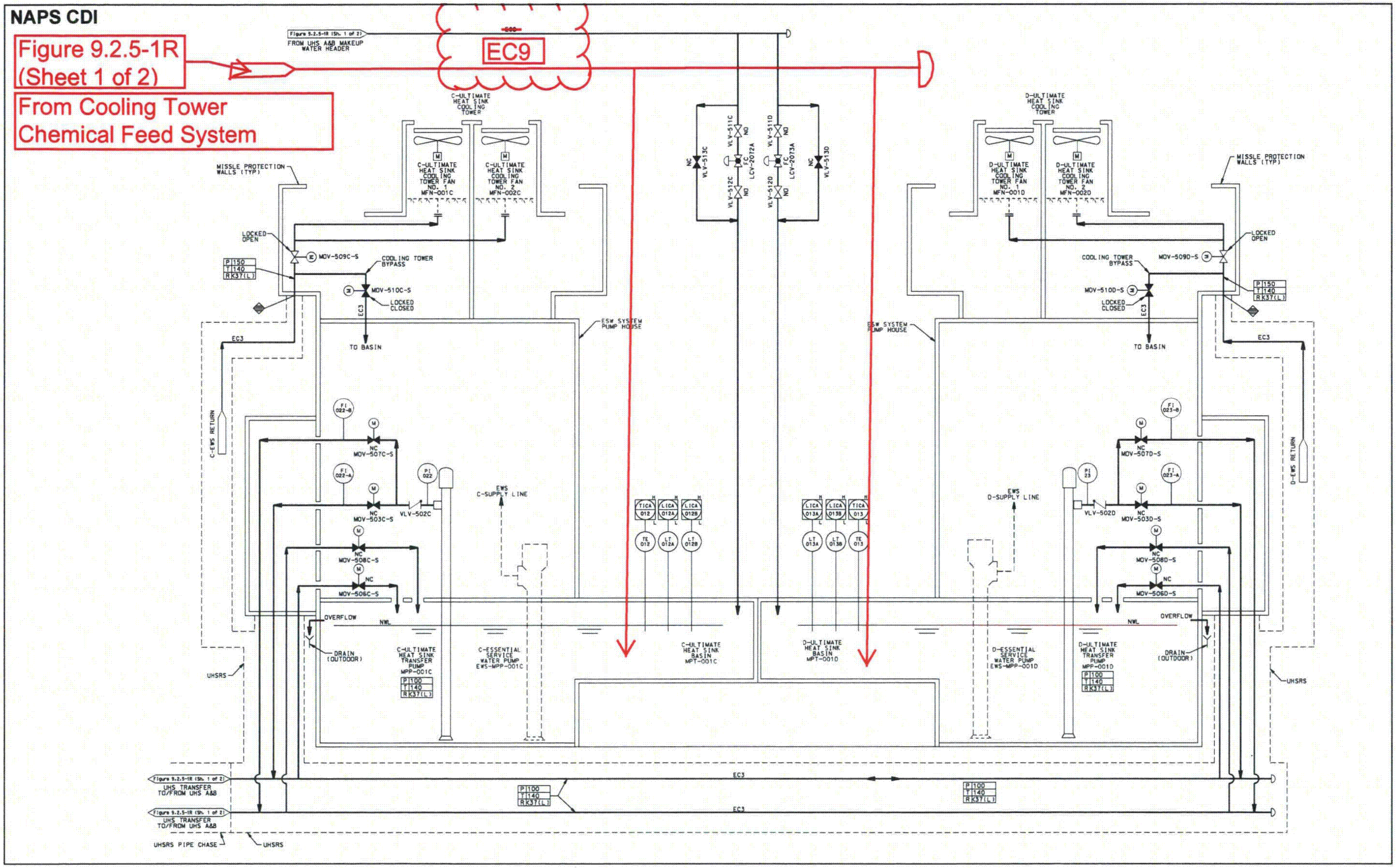
Each cooling tower consists of two cells, each with a motor-driven (M/D) fan driven with a right-angle gear reducer. The fan motors are powered from the Class 1E normal ac power system. On LOOP, the motors are automatically powered from their respective division emergency power source, i.e., the Class 1E GTGs.

The cooling towers are designed for the following conditions: water flow of 12,000 gpm, hot (inlet) water temperature of 128°F, cold (outlet) water temperature of 95°F, ambient wet bulb temperature of 78.3°F, and DBA design heat load of 196 million Btu/hr.

As noted in DCD Subsection 5.4.7.1, "Design Bases," and DCD Subsection 5.4.7.3, "Performance Evaluation," with ESW water temperature of 95°F, the RHRS is capable of reducing the reactor coolant temperature from 350°F to 200°F within 36 hours after shutdown. As the Technical Specifications surveillance requires that the UHS basin water temperature be 93°F or less, the evaluation provided in DCD Section 5.4.7 is bounding.

RAI 09.02.05-4
RAI 09.02.05-9

NAPS COL 9.2(20) **Figure 9.2.5-1R Ultimate Heat Sink System Piping and Instrumentation Diagram (Sheet 2 of 2)**



ENCLOSURE 2

Response to NRC RAI Letter No. 99

RAI No. 6402, Question 09.02.05-5

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: **6402 (RAI LETTER NO. 99)**

SRP SECTION: 09.02.05 – ULTIMATE HEAT SINK

QUESTIONS for Balance of Plant and Technical Specifications Branch (BPTS)

DATE OF RAI ISSUE: 05/07/2012

QUESTION NO.: 09.02.05-5

The staff reviewed this COL FSAR supplemental information related to COL Item 9.2(18) finds that additional information is required to determined compliance with 10 CFR Part 50, GDC 44, "Cooling Water".

Specifically, the applicant is requested to address in the FSAR:

(1) The applicant stated in several places (for example FSAR 9.2.5.2.1 and 9.2.5.2.3), that the cooling towers are designed for 12,000 gpm whereas Table 9.2.1-1R, "Ultimate Heat Sink System Design Data," states the design flow rate of the ESWS pumps is 13,000 gpm. This discrepancy needs to be clarified.

(2) COL FSAR Section 9.2.5.2.2 describes that the UHS transfer pump and the ESW pump from the same basin do not operate simultaneously. Describe what controls are in place, such as interlocks or operator actions, during quarterly UHS transfer pump testing (COL FSAR Table 3.9-202, "Site-Specific Pump IST Requirements"), that prevent the ESWS pumps from operating simultaneously with the UHS transfer pump; for instance, if there were an automatic start signal of the ESWS pumps during a ECCS actuation signal, as described in DCD Section 9.2.1.2.3.2, "Emergency Operations."

(3) Describe any negative consequences on the ESWS if both pumps remain running during accident conditions.

(4) Describe in the FSAR if the UHS transfer system remains full of water or is placed in 'layup' after UHS transfer pump testing and what chemical controls (to

prevent pipe wall thinning) are used if extended wet layup conditions are utilized.

Dominion Response

(1) The difference between the ESWS pump design flow rate of 13,000 gpm and the UHS cooling tower analysis flow rate of 12,000 gpm is described in FSAR Subsection 9.2.5.2.3 which states, "The UHS is analyzed using the heat loads provided in DCD Table 9.2.5-2 for LOCA and safe shutdown conditions with LOOP and a maximum ESW supply temperature of 95°F. Per Subsection 9.2.1.2.2, each ESWP is designed to provide 13,000 gpm flow. Since cooling water flow is inversely proportional to the cooling tower temperature range, for conservatism, a lower ESW flow of 12,000 gpm to each cooling tower is used in the analysis."

(2) 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. Each UHS transfer pump is manually operated. An alarm will annunciate in the main control room when the basin water level reaches the low water setpoint. The operator can stop the running UHS transfer pump and start the transfer pump from one of the two idle basins, allowing water to be supplied as necessary. FSAR Subsection 9.2.5.2.2 will be revised in order to address this mode of operation.

(3) There are no negative consequences on the ESWS if both pumps (i.e., ESWS and UHS in the same basin) remain running during accident conditions. FSAR Subsection 9.2.5.2.2 states that the maintained water level in each UHS basin assures adequate NPSH for all operating modes, including LOCA and LOOP, with one train out of service for maintenance, when the source of makeup water is assumed lost for a period of thirty days after the accident.

(4) In conjunction with the response to part (4) of RAI Question 09.02.05-9, included in Enclosure 4 of this letter, the Cooling Tower Chemical Feed System (CCS) injects chemicals to maintain non-corrosive, non-scale forming conditions and to limit biological film formation on the components in the Circulating Water System. The CCS also injects silt dispersant, scale and corrosion inhibitors, pH adjusters and algaecide/biocide chemicals into the Ultimate Heat Sink (UHS) cooling tower basins to maintain water quality in order to protect UHS and Essential Service Water System (EWS) piping and components.

After UHS transfer pump testing, the UHS transfer system remains full of chemically treated emergency service water, except for the discharge piping from

the basin inlet valve, which is drained. Procedures will ensure the transfer pump piping to the basin inlet valve is full before turning off the transfer pumps for layup.

The UHS transfer system piping is carbon steel with an internal polyethylene lining to reduce corrosion and water does not flow in the transfer piping except during periodic operation of the UHS transfer pump. The UHS transfer system is designed such that pipe wall thinning will not occur. Additional information on pipe thinning can be found in FSAR Subsection 10.3.6.3.

Proposed COLA Revision

FSAR Subsection 9.2.5.2.2 will be revised as indicated on the attached markup.

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.

9.2.5.2.2 System Operation

NAPS COL 9.2(3)
NAPS COL 9.2(4)
NAPS COL 9.2(5)
NAPS COL 9.2(18)
NAPS COL 9.2(19)
NAPS COL 9.2(20)
NAPS COL 9.2(21)
NAPS COL 9.2(28)
NAPS COL 9.2(31)
NAPS CDI

Replace the content of DCD Subsection 9.2.5.2.2 with the following.

The ESWPs take suction from the basins as described in Subsection 9.2.1.2.1. The water flows through the CCW heat exchangers and essential chiller units and then is cooled by the cooling tower before being returned to the basins.

Heat rejection to the environment is effected by direct contact with a cooling tower forced airflow, which provides evaporative cooling of a ESW return flow. During normal operation, evaporation, drift and blowdown losses are replaced with the makeup from Lake Anna. Water level controllers provided in each basin automatically open and close the makeup CVs. Low and high water level annunciation in the MCR indicates a malfunction of the makeup CV or the blowdown CV.

The maintained water level in each UHS basin assures adequate NPSH for the ESWP under all operating modes, including LOCA and LOOP, with one train out of service for maintenance, when the source of makeup water is assumed lost for a period of thirty days after the accident. During such conditions, the combined inventory of three basins provides a thirty-day cooling water supply assuming the worst combination of meteorological conditions and accident heat loads.

The ESWS together with the UHS is designed, arranged and operated to minimize the effects of water hammer forces.

The system layout assures water pressure remains above saturation conditions throughout the system. The ESW discharge pipe from the pump house passes to the pipe tunnel located at an elevation below grade. The ESWS flows to the CCW heat exchanger and the essential chiller unit located at an elevation below grade in the R/B. The discharge pipe is connected to the cooling tower riser and spray nozzles located above grade. The ESW pump is designed to provide positive pressure at the spray nozzle headers. This together with the high point vents minimize system drain down in the idle trains or upon LOOP and subsequent pump trip.

The following features preclude or minimize water hammer forces:

- On LOOP, the discharge motor-operated valve (MOV) of the operating train is closed. This, together with the discharge check valve, prevents draindown to the basin.
- The ESW pump start logic interlocks the discharge MOV operation with the pump operation. The re-start of the tripped pump or start of the stand-by pump, opens the discharge valve slowly after a pre-determined time delay, sweeping out voids from the discharge piping and cooling tower riser and distribution piping.
- The system valve lineup and periodic IST of the idle trains, including testing of the high point vents, help minimize potential voids and water hammer forces.

Four 100% capacity UHS transfer pumps, one located in each UHS ESW pump house, are provided to transfer cooling water from a non-operating UHS basin to the operating UHS basins when required during accident conditions.

RAI 09.02.05-12
RAI 09.02.05-13

All transfer pumps discharge into one of the two common headers which in turn discharge to individual UHS basins. Use of two headers facilitates simultaneous transfer of water between the operating and non-operating basins. All discharge piping is located in missile protected and tornado protected areas. The common discharge headers and other UHS system piping are designed to seismic Category I requirements. The piping is located in seismic Category I structures. There is no non-seismic piping in the vicinity of this header, and there are no seismically induced failures. Pipes are protected from tornado missiles. The UHS transfer pump(s) operate during accident conditions, during IST in accordance with plant Technical Specifications, during maintenance, and for brief periods during cold weather conditions for recirculation. As the header is normally not in service, deterioration due to flow-accelerated corrosion is insignificant. Transfer of water inventory is required assuming one train/basin of ESW/UHS is out of service (e.g., for maintenance), and a second train is lost due to a single failure. When a transfer pump is in operation, fluid velocity in the header is approximately 5.1 ft/sec. Operating conditions are approximately 20 psig and 95°F. Therefore, header failures are not considered credible.

The UHS transfer pump is designed to supply 800 gpm flow at a total dynamic head (TDH) of 45 feet. Transfer pump capacity is more than

adequate to replenish the maximum water inventory losses from two operating ESWS trains. Minimum available NPSH is approximately 40 feet. This is based on the lowest expected water level of approximately 12 feet in the UHS ESW intake basin and 95°F water temperature. Transfer pump location and submergence level precludes vortex formation. ~~In addition, the transfer pump and the ESW pump from the same basin do not operate simultaneously.~~ RAI 09.02.05-5

RAI 09.02.05-5 Although it is not a normal operating condition, the UHS transfer pump and the ESW pump in the same basin may operate simultaneously. 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. An alarm will be annunciated to the MCR when the basin water level reaches the low water set point. The operator can stop the running UHS transfer pump and start the transfer pump from an idle basin to supply water as necessary.

The chemical condition and quality of the ESW is controlled by the Cooling Tower Chemical Feed System (CCS). The UHS transfer system piping is carbon steel with an internal polyethylene lining to reduce corrosion and water does not flow in the transfer piping except during periodic operation of the UHS transfer pump. The UHS transfer system is designed such that pipe wall thinning will not occur. Procedures will ensure the transfer pump piping to the basin inlet valve is full before turning off the transfer pumps for layup. After UHS transfer pump testing, the UHS transfer system remains full of chemically treated ESW except for the discharge piping from the basin inlet valve, which is drained.

The UHS transfer pump and the ESWP located in each basin are powered by different Class 1E buses, e.g., for basin A, the ESWP is powered from bus A, and the UHS transfer pump is powered from bus C or D, depending on manual breaker alignment. The power operated valve at each transfer pump discharge and instrumentation associated with each individual transfer pump are powered from the same buses as the transfer pump. The power operated valves at the transfer lines discharging into the UHS basins are powered from different buses than the transfer pumps in their respective basins.

ENCLOSURE 3

Response to NRC RAI Letter No. 99

RAI No. 6402, Question 09.02.05-6

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: **6402 (RAI LETTER NO. 99)**

SRP SECTION: 09.02.05 – ULTIMATE HEAT SINK

QUESTIONS for Balance of Plant and Technical Specifications Branch (BPTS)

DATE OF RAI ISSUE: 05/07/2012

QUESTION NO.: 09.02.05-6

The staff reviewed this COL FSAR supplemental information related to COL Item 9.2(19) and finds that additional information is required to determined compliance with 10 CFR Part 50, GDC 44, "Cooling Water".

Specifically, the applicant is requested to address in the FSAR:

(1) Neither COL FSAR Section 9.2.5 nor Section 8.3 clearly states what are the power supplies for the UHS transfer pumps, associated pump discharge motor operated valves (MOVs), and associated basin inlet MOVs since no reference drawings, figures, or tables could be found in the COL FSAR. This information should be provided in the FSAR.

(2) The applicant is requested to discuss how electrical separation will be maintained in the ESW pump house considering there may be multiple trains of safety related power in the same room susceptible to flooding or fire.

(3) Since the UHS cooling tower fans are automatically activated by automatic signals, describe in the COL FSAR the consequences to the fans of the automatic accident start signal if the fans are previously operating in reverse for freeze protection.

Dominion Response

(1) Dominion endorses Luminant's response to Comanche Peak RAI 6358, Question 09.02.05-21, submitted June 7, 2012 (ML12163A012), which states that the power supplies are based on each of the four basins having 33 1/3% capacity of the 30-day cooling requirement.

(2) Dominion endorses Luminant's response to Comanche Peak RAI 6358, Question 09.02.05-21, submitted June 7, 2012 (ML12163A012), which describes that electrical separation between the UHS transfer and ESW pumps, as well as their associated valves and instrumentation, is maintained by routing cables within the respective fire areas.

In addition to the information provided in Luminant's response, North Anna Unit 3 COLA Part 10, Table A.1-1, ITAAC #6.b confirms electrical separation between redundant divisions of Class 1E cables within the ESW and UHS systems.

(3) The counter-flow cooling tower design utilized for North Anna Unit 3 minimizes the potential for ice formation in the UHS cooling tower. During extended periods of low ambient temperature conditions, ice could form on the cooling tower and fan surfaces, as well as air inlets. During such conditions, cooling tower fans can be operated at a low speed in the reverse direction for short periods of time to minimize ice buildup.

With the initiation of the LOOP signal or ECCS activation signal, the cooling tower fans rotating in the reverse direction will be de-energized. A permissive in the form of a time delay will be provided to delay fan operation in the forward direction. This time delay will include the time required for the fan to stop spinning in the reverse direction completely (typically 2 minutes) plus any additional time recommended by the cooling tower vendor, for conservatism. Fans not operating in the reverse direction will bypass the time delay permissive and start automatically with the initiation of the LOOP signal or ECCS actuation signal.

When the ESWS/UHS is in the freeze protection mode, the UHS basin water temperature is relatively low and the basin water can absorb initial accident heat loads (when the cooling tower fans are not operating due to a time delay permissive) without exceeding the UHS basin water design temperature of 95°F. Therefore, the time delay to reverse the fan direction will have no impact on the UHS performance during a design basis accident.

This information will be added to FSAR Subsection 9.2.5.3.

Proposed COLA Revision

FSAR Subsection 9.2.5.3 will be revised as indicated on the attached markup.

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.

The required total water usage (due to cooling tower drift and evaporation) over the postulated 30 day period is determined as follows:

Total Evaporation (E) and Drift (D) rates were calculated using the ESW flow rate (GPM) of 12,000 gpm times the temperature rise (CR) and a conservative cooling tower factor of 0.0009, E (total) = GPM × CR × 0.0009.

a. The cooling tower factor of 0.0009 is considered conservative since it is based on standard cooling tower evaporation factor of 0.0008, and typical cooling tower drift rate of 0.0002 This is expressed as

   Total Evaporation (E) = GPM × CR × 0.0008 + GPM × 0.0002

b. The ESW temperature rise (CR) was based on heat rate equation of H as

   Heat Rate (H) = m × specific heat × CR,

   where, m = mass flow rate

c. Accumulative evaporation (gallons/cooling tower) is calculated by multiplying the evaporation rate (gpm) and its corresponding time interval.

d. The total water loss due to evaporation and drift for the 30-day period is calculated and is defined as the plant unit minimum required water capacity for the basin design in accordance with RG 1.27.

Based on the above analyses, the governing case for the maximum required 30-day cooling water capacity is two-train operation during safe shutdown with LOOP condition, with a total required cooling water of approximately 8.40 million gallons. For the cooling tower design heat load the governing case is the safe shutdown conditions with LOOP for two-train operation, with a heat load of 196 million Btu/hr.

9.2.5.3 Safety Evaluation

NAPS COL 9.2(22) Replace the content of DCD Subsection 9.2.5.3 with the following.

The results of the UHS capability and safety evaluation are discussed in detail in Subsection 9.2.5.2.3 and in this Subsection. The UHS is capable of rejecting the heat under limiting conditions as discussed in Subsection 9.2.5.2.3.

The UHS is arranged to support separation of the four divisions of ESWS.

System functional capability is maintained assuming one division is unavailable due to on-line maintenance during a design basis accident with a single active failure, with or without a LOOP.

The FMEA for the UHS is included in Table 9.2.5-4R and demonstrates that the UHS satisfies the single failure criteria.

The safety-related SSCs of the UHS and the ESWS are classified as seismic Category I. The site-specific safety-related components are identified in Table 3.2-201. The non-seismic SSCs are physically separated from the seismic Category I SSCs. Structural failure of the UHS non-safety related SSCs will not adversely impact the seismic category I SSCs. These non-safety SSCs are classified as non-seismic.

The basins are designed to withstand the effect of natural phenomena, such as earthquakes, tornadoes, hurricanes, and floods taken individually, without loss of capability to perform their safety functions.

The basis for the structural adequacy of the UHSRS is provided in Sections 3.3, 3.4, 3.5, 3.7, and 3.8.

Site-specific UHS design features to address limiting hydrology-related events are addressed in Subsection 2.4.2, 2.4.3, 2.4.4, 2.4.7, 2.4.8, 2.4.11, and 2.4.14.

The combined volume of water in three basins is sufficient to provide at least 30 days required cooling capacity.

The total required 30 days cooling water capacity is approximately 8.40 million gallons, or approximately 2.80 million gallons per basin. Each basin dimension, not including any column or wall sections, is 120 feet x 120 feet with a water depth of 29 feet from the minimum maintained water level, the usable water volume available for each basin is approximately 3.12 million gallons. The water depth excludes one foot of unusable space from the basin floor, where sedimentation may accumulate. The UHS basin volume of 2.8 million gallons does not include water volume in the ESW intake basin below the UHS basin floor level (elevation 282 ft. NAVD88).

As clarified in Subsection 9.2.1.2.2.1, 29 feet water depth in the UHS basin excluding 1 foot for sedimentation accumulation provides approximately 70 feet of available NPSH at the initiation of an accident.

This assures adequate pump NPSH for 30 days without make up under design basis event conditions.

During normal power operation, the UHS basin water temperature is at or below 93°F under the worst-case ambient conditions (i.e. wet bulb temperature of 84.9°F based on the 0% annual exceedance value).

At the initiation of a design basis event, each basin contains approximately 3.12 million gallons of water (minimum required is 2.8 gallons of water per Technical Specification 3.7.9). The UHS basin water temperature limit evaluation is based on Technical Specification minimum required water volume.

For a Safe Shutdown with LOOP event, the heat load for first three hours is 29.5 million Btu/hr/train. The heat load peaks at 196 million Btu/hr/train at four hours into the event and then decreases continuously. The heat load is approximately 81 million Btu/hr/train at 24 hours into the event. Initially, the cooling tower water discharge is below 93°F due to the small heat load and mixes at a flow rate of 12,000 gpm with the large quantity of basin water resulting in a decrease in basin water temperature. With the peak heat load at the fourth hour, the cooling tower water discharge temperature increases to 95°F and the basin water temperature starts increasing until equilibrium is reached. However, since the cooling tower is designed for 95°F discharge water at a peak heat load of 196 million Btu/hr/train, the basin water temperature will not exceed 95°F.

At the initiation of a LOCA, the heat load is 151.5 million Btu/hr/train. The heat load peaks at 158 million Btu/hr/train within two hours of the accident, and then decreases continuously. The heat load is approximately 80 million Btu/hr/train at 24 hours into the accident. The basin water temperature increases from the initiation of the event until equilibrium is reached. Since the cooling tower is designed for 95°F discharge water at a peak load of 196 million Btu/hr/train, and the LOCA peak heat load is less than the design heat load, the basin water temperature does not exceed 95°F.

Due to higher initial heat loads, the LOCA is the bounding design basis event for establishing the basin water temperature limit 93°F during normal power operation.

During accident conditions, including LOCA and LOOP, makeup to the basin is presumed lost. During such conditions, the UHS transfer pump operates to permit the use of three of the four basin water volumes. The

power supply for each transfer pump is from a different division than the ESWP and cooling tower in that basin. Therefore, loss of one electrical train does not compromise the ability to satisfy the short-term accident requirements.

Subsection 9.2.1.3 describes the features to prevent freezing of the ESWS and the UHS. The following design and operation features provide protection against freezing in the basin and ice formation on the cooling tower fill:

- In operating trains, the water is manually bypassed directly to a basin without passing through spray nozzles, when the water temperature reaches pre-determined low value. The water flow is switched manually back to the spray nozzles at a pre-determined value of basin water temperature. Each UHS cooling tower bypass valve is interlocked with the UHS cooling tower isolation valve so it cannot be opened unless the UHS cooling tower isolation valve is closed. During accident conditions these valves will receive an automatic signal to realign to their normal position. When the operating trains are in winter mode or in normal mode, the cooling tower bypass valves are closed and the cooling tower isolation valves are open in the non-operating (i.e., standby) trains.
- The cooling tower fans are operated at a lower speed reducing the cooling rate. The fans may be operated at a lower speed in the reverse direction for short periods of time to minimize ice buildup at the air inlets. With the fans in reverse rotation mode, a time delay permissive prevents operation of the fans in the forward direction automatically with the initiation of the LOOP signal or ECCS actuation signal. The low temperature basin water can absorb initial accident heat loads without exceeding the UHS basin design water temperature of 95°F, and the delayed forward operation will have no impact on the UHS performance, during a design basis accident.
- Heat Tracing is provided for exposed stagnant piping in the unheated areas.
- UHS transfer pumps circulate water between non-operating and operating basins on a pre-determined low water temperature in the non-operating basins. The pumps in the non-operating basins transfer cold water to operating basins and the transfer pump(s) in the operating basins transfer hot water to the non-operating basins. The UHS transfer pump operation is manual.

ENCLOSURE 4

Response to NRC RAI Letter No. 99

RAI No. 6402, Question 09.02.05-9

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: **6402 (RAI LETTER NO. 99)**

SRP SECTION: 09.02.05 – ULTIMATE HEAT SINK

QUESTIONS for Balance of Plant and Technical Specifications Branch (BPTS)

DATE OF RAI ISSUE: 05/07/2012

QUESTION NO.: 09.02.05-9

The staff reviewed this COL FSAR supplemental information related to COL Item 9.2(21) and finds that additional information is required to determined compliance with 10 CFR Part 50, GDC 2, "Design Basis for Protection Against Natural Phenomena and GDC 44, "Cooling Water".

Specifically, the applicant is requested to address in the FSAR:

(1) Given a possible seismic event, describe if a UHS basin siphon event is possible (drain-down event) from the interconnection with the nonsafety-related normal water basin makeup from the circulating water system (CWS) (Figure 9.2.5-1R).

(2) Describe how normal make-up from the CWS is isolated during accident conditions to preclude flooding the UHS basins.

(3) Clarify location of the makeup control valves shown on Figure 9.2.5-1R, since they appear to be between the two cooling towers.

(4) Chemical treatment (used to limit biological film formation) of the UHS basin during normal operations and accident conditions is not clearly described in Sections 9.2.5 or 10.4.5.2.2.8 of the FSAR. Section 9.2.1 of the FSAR points to Section 10.4.5.2.2.8 which has insufficient information relating to the UHS basin and chemical injection.

Dominion Response

(1) Dominion endorses Luminant's response to Comanche Peak RAI 6358, Question 09.02.05-23, submitted June 7, 2012 (ML12163A012), which describes that a UHS basin siphon event has minimal impact on the amount of water available to the UHS/ESWS.

(2) Since the normal make-up water line from CWS is non-safety related, it may not be isolated during accident conditions. The failure of the normal make-up water line to isolate does not have an adverse safety impact for the following reason:

FSAR Section 9.2.5.2.1 states the UHS basin floor elevation (282 ft NAVD88) is the reference point for measuring the basin water level.

Furthermore, normal Water Elevation is 316 ft NAVD88. This provides a normal water level depth of 34 ft. Grade elevation in the vicinity of the basin is 290 ft NAVD88. A four feet thick basin wall extends four feet above normal water level to 320 ft NAVD88. In the unlikely event of the water level reaching the top of the wall, it will spill over and flow to site drainage. No special design for the spillway or drain pipe is deemed necessary. This information will be added to FSAR Subsection 9.2.5.2.1.

(3) Dominion endorses Luminant's response to Comanche Peak RAI 6358, Question 09.02.05-23, submitted June 7, 2012 (ML12163A012), which describes the UHS make-up water control valves and their requirements. FSAR Subsection 9.2.5.2.1 has been revised to include the same information as Luminant's proposed revision.

(4) As noted in FSAR Subsection 10.4.5.2.2.8, circulating water chemistry is maintained by a chemical injection system, the Cooling Tower Chemical Feed System (CCS). The CCS injects chemicals to maintain non-corrosive, non-scale forming conditions and limits biological film formation on the components in the Circulating Water System (CWS). The CCS also injects silt dispersant, scale and corrosion inhibitors, pH adjusters and algaecide/biocide chemicals into the Ultimate Heat Sink (UHS) cooling tower basins to maintain water quality in order to protect UHS and Essential Service Water System (ESWS) piping and components. The algaecide/biocide chemicals, hypochlorite, bromine and quaternary amine are injected as required into the ESW pump bay just before entering the pumps.

Chemicals may not be injected in the UHS basin water during accident conditions. The chemical injection system functions to preserve the ESW piping and components over the life of the plant by maintaining non-corrosive, non-scale forming conditions. Non-injection of chemicals during accident conditions would have minimal impact on piping and components.

Proposed COLA Revision

FSAR Subsections 9.2.1.2.1, 9.2.5.2.1, 9.2.5.2.2, 9.2.10, 10.4.5.2.2.8 and FSAR Figures 9.2.5-1R sheets 1 and 2 and Figure 10.4.5-203 will be revised, as indicated on the attached markup.

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.

9.2 Water Systems

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

9.2.1.2.1 General Description

STD COL 9.2(7)

Replace the first sentence of the first paragraph in DCD Subsection 9.2.1.2.1 with the following.

Figure 9.2.1-1R shows the piping and instrumentation diagrams (P&IDs) of the essential service water system (ESWS).

STD COL 9.2(31)
STD CDI

Replace the first and second sentences of the fifth paragraph in DCD Subsection 9.2.1.2.1 with the following.

The piping layout of the UHS maintains the ESWS/UHS system pressure downstream of the pump discharge check valve above their saturation pressure at 140°F design temperature by ensuring that no piping high points are above the cooling tower spray header.

NAPS COL 9.2(25)

Replace the seventh paragraph in DCD 9.2.1.2.1 with the following:

Filling, venting and operating procedures are developed and followed to minimize the occurrence of water hammer and mitigate its effects. These are included in the Operating and Maintenance Procedures described in Subsection 13.5.2.1.

The system is analyzed for water hammer impact and the system piping is designed to withstand the potential water hammer forces in accordance with NUREG-0927.

STD COL 9.2(6)
STD CDI

Replace the fifth to seventh sentences of the eighth paragraph in DCD Subsection 9.2.1.2.1 with the following.

The design of the UHS cooling tower to deliver the design water flow rate to the ESWS does not exceed the maximum design temperature of 95°F under all operating conditions to assure sufficient cooling capacity. Design of the basin provides adequate submergence of the pumps to assure the NPSH for the pumps. The ESWP is designed to operate with the lowest expected water level (after 30 days of accident mitigation). The basins have sufficient water inventory to assure adequate cooling

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

~~STD COL 9.2(8)~~
~~STD CDI~~
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 ~~chemical injection system~~ 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

9.2.5.2.1 General Description

NAPS COL 9.2(3)
NAPS COL 9.2(4)
NAPS COL 9.2(5)
NAPS COL 9.2(18)
NAPS COL 9.2(19)
NAPS COL 9.2(20)
NAPS COL 9.2(21)
NAPS CDI

Replace the content of DCD Subsection 9.2.5.2.1 with the following.

The UHS consists of four 50 percent capacity mechanical draft cooling towers, one for each ESWS train, and four 33 1/3 percent capacity basins to satisfy the thirty day cooling water supply criteria of RG 1.27.

Each cooling tower consists of two cells with fans and motors, drift eliminators, film fills, risers, and water distribution system all enclosed and supported by a seismic category I reinforced concrete structure. Each basin includes an ESWP intake structure that contains one 50 percent capacity ESWP and one 100 percent capacity UHS transfer pump, and associated piping and components. The UHS piping material, including the UHS transfer piping, is carbon steel with an internal polyethylene lining. The piping is not buried; therefore, cathodic protection is not utilized. Tornado missile protection for the cooling tower components, ESWPs and piping is provided by the UHSRS safety-related seismic category I structures and UHSRS pipe chase as discussed in Subsection 3.8.4. The UHS structural design, including pertinent dimensions, is also discussed in Subsection 3.8.4.

RAI 09.02.05-4

Each cooling tower consists of two cells, each with a motor-driven (M/D) fan driven with a right-angle gear reducer. The fan motors are powered from the Class 1E normal ac power system. On LOOP, the motors are automatically powered from their respective division emergency power source, i.e., the Class 1E GTGs.

The cooling towers are designed for the following conditions: water flow of 12,000 gpm, hot (inlet) water temperature of 128°F, cold (outlet) water temperature of 95°F, ambient wet bulb temperature of 78.3°F, and DBA design heat load of 196 million Btu/hr.

As noted in DCD Subsection 5.4.7.1, "Design Bases," and DCD Subsection 5.4.7.3, "Performance Evaluation," with ESW water temperature of 95°F, the RHRS is capable of reducing the reactor coolant temperature from 350°F to 200°F within 36 hours after shutdown. As the Technical Specifications surveillance requires that the UHS basin water temperature be 93°F or less, the evaluation provided in DCD Section 5.4.7 is bounding.

Inside dimensions of each basin are approximately 123 feet x 123 feet and 34 feet deep at normal water level. The cooling towers utilize the basins for structural foundation.

The ESW intake basin located underneath the ESW pump house occupies the southwest corner of the UHS basin. The ESW intake basin is 12 feet deeper than the UHS basin (elevation 270 ft NAVD88). Water volume occupying this 12 feet depth in the ESW intake basin is not included in the UHS basin inventory. This is to assure adequate NPSH to the ESW pump. The UHS basin floor elevation (282 ft NAVD88) is the

RAI 09.02.05-9 reference point for measuring the basin water level. Normal Water Elevation is 316 ft NAVD88. Grade elevation in the vicinity of the basin is 290 ft NAVD88. A four feet thick basin wall extends four feet above normal water level to 320 ft NAVD88. In the unlikely event of the water level reaching the top of the wall, it will spill over and flow to site drainage.

The UHS operates in conjunction with the ESWS. The ESWS is described in Subsection 9.2.1. P&IDs of the UHS are provided in Figure 9.2.5-1R. The UHS design and process parameters are provided in Table 9.2.5-3R. The normal makeup water to the UHS inventory is from Lake Anna via the cooling tower makeup water and blowdown system described in Subsection 10.4.5.2.1. A CV with instrumentation located in

RAI 09.02.05-9 each makeup line maintains basin water level during normal operation. A control valve and isolation valve in each makeup line are located in the UHSRS for accessibility and to not be affected by potential plume and heat from a cooling tower. The blowdown water is discharged to the

RAI 09.02.05-13 WHTF via the cooling tower makeup water and blowdown system. Design of the station water intake structure minimizes aquatic plant and debris intake and prevents entrainment of fish and other aquatic life. The makeup water system configuration is such that most of the water flows to the Circulating Water System cooling tower basins. The relatively small amount of makeup water flow to the UHS basin further diminishes debris and fouling agents carried to the UHS basins.

RAI 09.02.05-12 A 16-inch diameter overflow pipe is provided at each basin to drain the excess water inventory from the basin. The drain is located above the high water level (elevation approximately 316'-6") in the basin and carries water to the grade level and the surface drainage system.

The mechanical draft cooling towers are the UHS. Hence, no discharge structure is necessary.

9.2.5.2.2 System Operation

NAPS COL 9.2(3)
NAPS COL 9.2(4)
NAPS COL 9.2(5)
NAPS COL 9.2(18)
NAPS COL 9.2(19)
NAPS COL 9.2(20)
NAPS COL 9.2(21)
NAPS COL 9.2(28)
NAPS COL 9.2(31)
NAPS CDI

Replace the content of DCD Subsection 9.2.5.2.2 with the following.

The ESWPs take suction from the basins as described in Subsection 9.2.1.2.1. The water flows through the CCW heat exchangers and essential chiller units and then is cooled by the cooling tower before being returned to the basins.

Heat rejection to the environment is effected by direct contact with a cooling tower forced airflow, which provides evaporative cooling of a ESW return flow. During normal operation, evaporation, drift and blowdown losses are replaced with the makeup from Lake Anna. Water level controllers provided in each basin automatically open and close the makeup CVs. Low and high water level annunciation in the MCR indicates a malfunction of the makeup CV or the blowdown CV.

The maintained water level in each UHS basin assures adequate NPSH for the ESWP under all operating modes, including LOCA and LOOP, with one train out of service for maintenance, when the source of makeup water is assumed lost for a period of thirty days after the accident. During such conditions, the combined inventory of three basins provides a thirty-day cooling water supply assuming the worst combination of meteorological conditions and accident heat loads.

The ESWS together with the UHS is designed, arranged and operated to minimize the effects of water hammer forces.

The system layout assures water pressure remains above saturation conditions throughout the system. The ESW discharge pipe from the pump house passes to the pipe tunnel located at an elevation below grade. The ESWS flows to the CCW heat exchanger and the essential chiller unit located at an elevation below grade in the R/B. The discharge pipe is connected to the cooling tower riser and spray nozzles located above grade. The ESW pump is designed to provide positive pressure at the spray nozzle headers. This together with the high point vents minimize system drain down in the idle trains or upon LOOP and subsequent pump trip.

The following features preclude or minimize water hammer forces:

- On LOOP, the discharge motor-operated valve (MOV) of the operating train is closed. This, together with the discharge check valve, prevents draindown to the basin.
- The ESW pump start logic interlocks the discharge MOV operation with the pump operation. The re-start of the tripped pump or start of the stand-by pump, opens the discharge valve slowly after a pre-determined time delay, sweeping out voids from the discharge piping and cooling tower riser and distribution piping.
- The system valve lineup and periodic IST of the idle trains, including testing of the high point vents, help minimize potential voids and water hammer forces.

Four 100% capacity UHS transfer pumps, one located in each UHS ESW pump house, are provided to transfer cooling water from a non-operating UHS basin to the operating UHS basins when required during accident conditions.

RAI 09.02.05-12
RAI 09.02.05-13

All transfer pumps discharge into one of the two common headers which in turn discharge to individual UHS basins. Use of two headers facilitates simultaneous transfer of water between the operating and non-operating basins. All discharge piping is located in missile protected and tornado protected areas. The common discharge headers and other UHS system piping are designed to seismic Category I requirements. The piping is located in seismic Category I structures. There is no non-seismic piping in the vicinity of this header, and there are no seismically induced failures. Pipes are protected from tornado missiles. The UHS transfer pump(s) operate during accident conditions, during IST in accordance with plant Technical Specifications, during maintenance, and for brief periods during cold weather conditions for recirculation. As the header is normally not in service, deterioration due to flow-accelerated corrosion is insignificant. Transfer of water inventory is required assuming one train/basin of ESW/UHS is out of service (e.g., for maintenance), and a second train is lost due to a single failure. When a transfer pump is in operation, fluid velocity in the header is approximately 5.1 ft/sec. Operating conditions are approximately 20 psig and 95°F. Therefore, header failures are not considered credible.

The UHS transfer pump is designed to supply 800 gpm flow at a total dynamic head (TDH) of 45 feet. Transfer pump capacity is more than

adequate to replenish the maximum water inventory losses from two operating ESWS trains. Minimum available NPSH is approximately 40 feet. This is based on the lowest expected water level of approximately 12 feet in the UHS ESW intake basin and 95°F water temperature. Transfer pump location and submergence level precludes vortex formation. ~~In addition, the transfer pump and the ESW pump from the same basin do not operate simultaneously.~~ RAI 09.02.05-5

RAI 09.02.05-5 Although it is not a normal operating condition, the UHS transfer pump and the ESW pump in the same basin may operate simultaneously. 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. An alarm will be annunciated to the MCR when the basin water level reaches the low water set point. The operator can stop the running UHS transfer pump and start the transfer pump from an idle basin to supply water as necessary.

The chemical condition and quality of the ESW is controlled by the Cooling Tower Chemical Feed System (CCS). The UHS transfer system piping is carbon steel with an internal polyethylene lining to reduce corrosion and water does not flow in the transfer piping except during periodic operation of the UHS transfer pump. The UHS transfer system is designed such that pipe wall thinning will not occur. Procedures will ensure the transfer pump piping to the basin inlet valve is full before turning off the transfer pumps for layup. After UHS transfer pump testing, the UHS transfer system remains full of chemically treated ESW except for the discharge piping from the basin inlet valve, which is drained.

The UHS transfer pump and the ESWP located in each basin are powered by different Class 1E buses, e.g., for basin A, the ESWP is powered from bus A, and the UHS transfer pump is powered from bus C or D, depending on manual breaker alignment. The power operated valve at each transfer pump discharge and instrumentation associated with each individual transfer pump are powered from the same buses as the transfer pump. The power operated valves at the transfer lines discharging into the UHS basins are powered from different buses than the transfer pumps in their respective basins.

The cooling tower fans are automatically activated by the ECCS actuation signal, the LOOP sequence actuation signal, or the remote manual actuation signal in case of automatic actuation failure.

The ECCS actuation signal ensures continuous cooling to the reactor during accidents to allow the reactor to be brought to safe shutdown conditions. The LOOP sequence actuation signal automatically starts the Class 1E GTGs to resume power to the active components in each UHS train during LOOP events.

The basins are concrete seismic category I structures and are located partially below grade. The design conditions are discussed in Section 3.8. This partially underground design in addition to the structural integrity of the basin wall provide assurance that a complete failure of the basin resulting in a loss of water inventory will be highly improbable.

Operation details of the ESWS, including chemical treatment, pump NPSH, and freeze protection operation, are provided in Subsection 9.2.

A portion of the basin water is discharged through blowdown via ESWS when makeup water is available. The blowdown rate is determined using a conductivity cell located at ESW pump discharge and is based on the total dissolved solids in the water and the makeup water source. CVs are interlocked to close on a low UHS basin water level, LOOP signal or ECCS actuation signal to maintain the UHS basin inventory required for cooling the unit for a minimum of 30 days without makeup water. The blowdown valves are also interlocked to close when the ESW pump is stopped to preclude system inventory drain down, which could result in water hammer at pump restart. Table 9.2.5-4R shows the redundancy for the above functions.

The CCS injects chemicals into the UHS basin water during normal plant operation. This protects piping and components over the life of the plant. Chemicals may not be added during accident mode operation. The CCS is described in Subsection 10.4.5.2.2.8.

9.2.10 Combined License Information

Replace the content of DCD Subsection 9.2.10 with the following.

NAPS COL 9.2(1)

9.2(1) ***The evaluation of ESWP at the lowest probable water level of the UHS and the recovery procedures when UHS approaches low water level***

This COL item is addressed in Subsection 9.2.1.3.

NAPS COL 9.2(2)

9.2(2) ***The protection against adverse environmental, operating and accident condition that can occur such as freezing, thermal over pressurization***

This COL item is addressed in Subsection 9.2.1.3.

NAPS COL 9.2(3)

9.2(3) ***Source and location of the UHS***

This COL item is addressed in Subsections 9.2.5.2, 9.2.5.2.1, 9.2.5.2.2, and 9.2.5.2.3.

NAPS COL 9.2(4)

9.2(4) ***The location and design of the ESW intake structure***

This COL item is addressed in Subsections 9.2.5.2, 9.2.5.2.1, 9.2.5.2.2, and 9.2.5.2.3.

NAPS COL 9.2(5)

9.2(5) ***The location and the design of the discharge structure***

This COL item is addressed in Subsections 9.2.5.2, 9.2.5.2.1, 9.2.5.2.2, and 9.2.5.2.3.

STD COL 9.2(6)
STD* COL 9.2(6)
NAPS COL 9.2(6)

9.2(6) ***The ESWP design details – required total dynamic head, NPSH available***

This COL item is addressed in Subsections 9.2.1.2.1, 9.2.1.2.2, 9.2.1.2.2.1 and Table 9.2.1-1R.

STD COL 9.2(7)
NAPS COL 9.2(7)

9.2(7) ***The design of ESWS related with the site specific UHS***

This COL item is addressed in Subsections 9.2.1.2.1, 9.2.1.2.2.5, 9.2.1.2.3.1, 9.2.1.3, and Figure 9.2.1-1R.

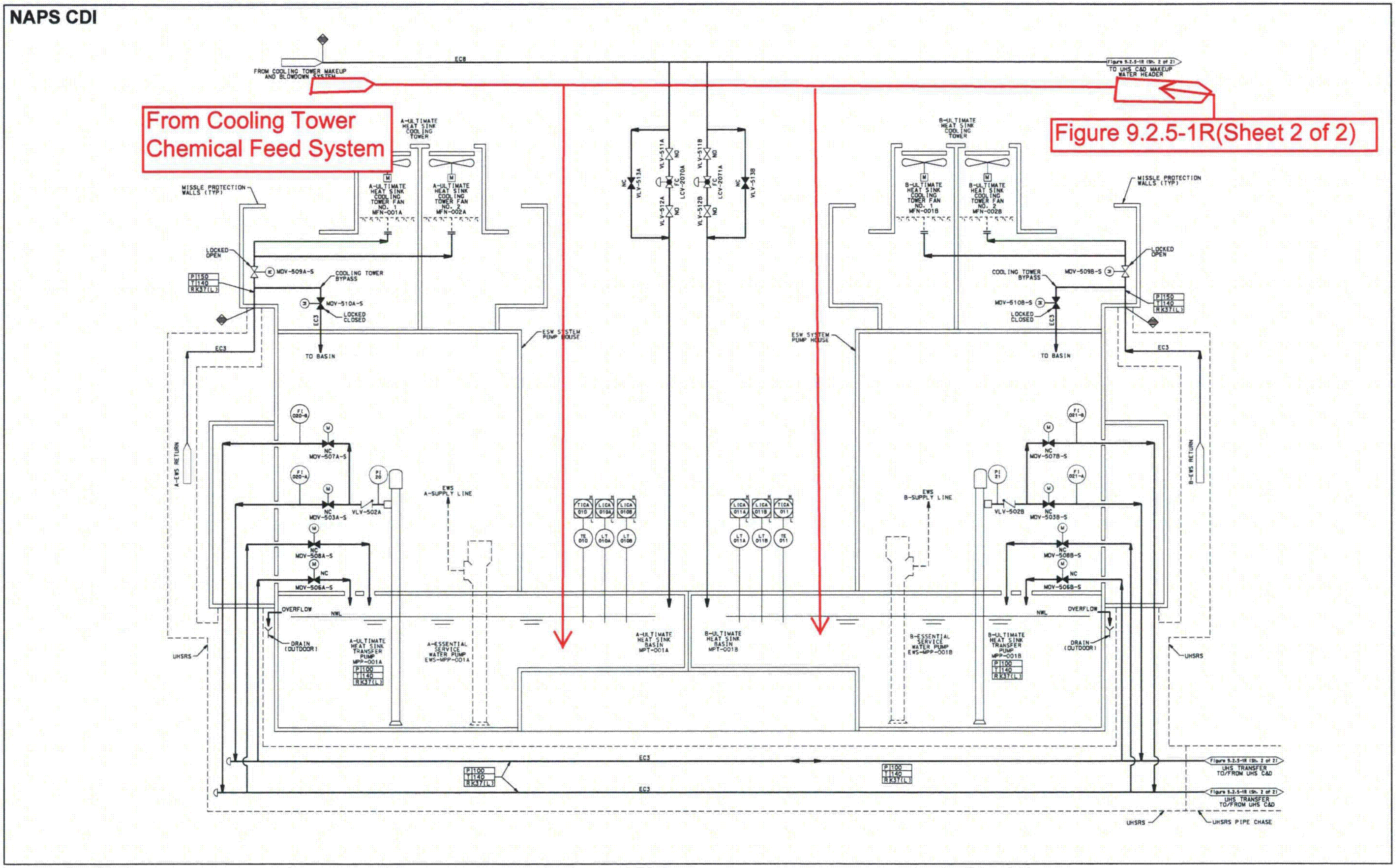
~~STD COL 9.2(8)~~
NAPS COL 9.2(8)

9.2(8) ***The ESW specific chemistry requirements***

This COL item is addressed in Subsection 9.2.1.2.1.

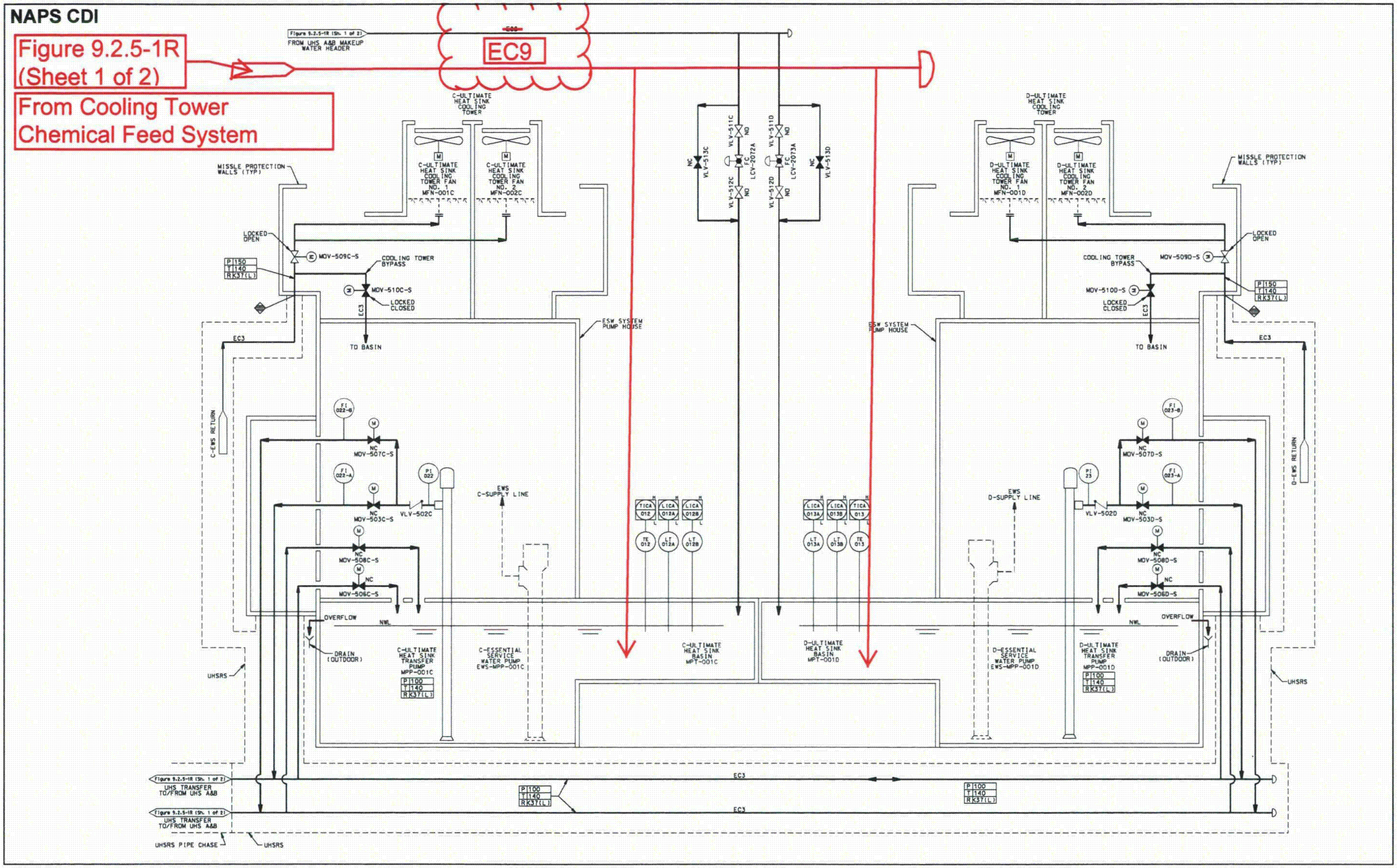
NAPS COL 9.2(20) Figure 9.2.5-1R Ultimate Heat Sink System Piping and Instrumentation Diagram (Sheet 1 of 2)

NAPS CDI



RAI 09.02.05-4
RAI 09.02.05-9

NAPS COL 9.2(20) **Figure 9.2.5-1R Ultimate Heat Sink System Piping and Instrumentation Diagram (Sheet 2 of 2)**



10.4.5.2.2.8 Chemical Injection

NAPS COL 10.4(1)
NAPS CDI

Replace the content of DCD Section 10.4.5.2.2.8 with the following.

Circulating water chemistry is maintained by the ~~chemical injection system~~ CCS. Chemical feed equipment injects the required chemicals into the circulating water at the pump forebay before water enters the circulating water pumps. Chemical injection maintains a non-corrosive, non-scale-forming condition and limits the biological film formation that reduces the heat transfer rate in the condenser and cooling towers.

The CCS also maintains the water chemistry for the UHS and Essential Service Water System(ESWS). Chemical injection maintains a non-corrosive and non-scale forming condition and limits biological film formation protecting the ESW and the UHS piping and components for the life time of the plant. As required, the chemicals are injected into the basin water at the ESW pump bay before entering the pump. Chemicals injected into the UHS basin water are the same as those used in the CWS.

Plant chemistry specifies the required chemicals used within ~~the~~ each system. The chemicals can be divided into ~~five~~ six categories based upon function: biocide, algaecide, pH adjuster, corrosion inhibitor, ~~and~~ scale inhibitor, and silt dispersant. The pH adjuster, corrosion inhibitor, and scale inhibitor are metered into the system continuously or as required to maintain proper concentrations. Biocide application frequency may vary with seasons. Algaecide is applied, as necessary, to control algae formation in the cooling towers. Silt dispersants are added to cause silt and larger solids to precipitate and accumulate on the basin floor. Chemicals that are injected in the CWS, ESWS, and UHS include sodium hypochlorite, acid, bromide, dispersants, and non-oxidizing biocides.

Circulating water and UHS water chemistry ~~is~~ are also controlled as required with blowdown. Chemicals selected are compatible with selected materials or components used in the CWS, ESWS, and UHS.

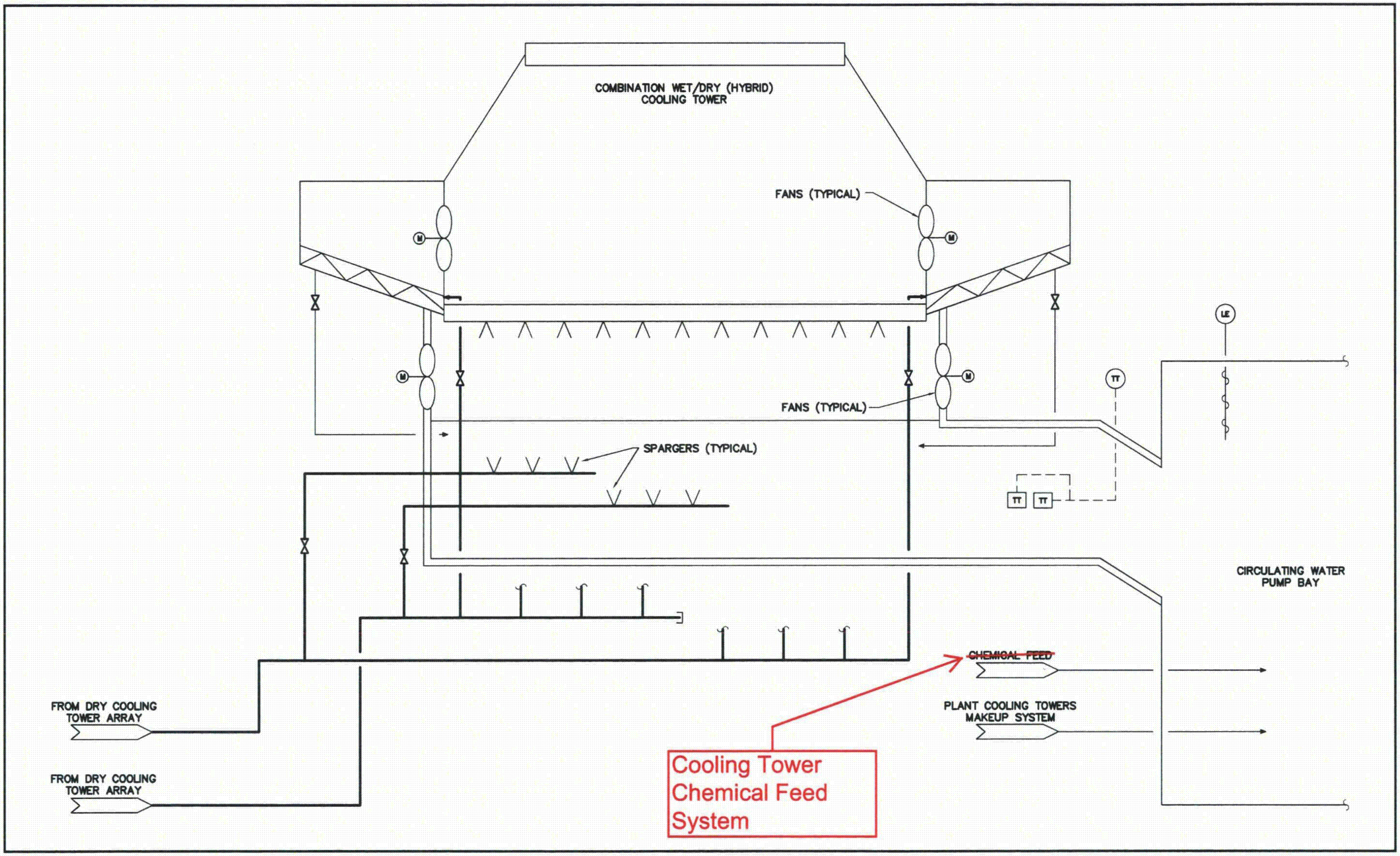
10.4.5.3.2 Normal Operation

NAPS COL 10.4(1)
NAPS COL 10.4(6)
NAPS CDI

Replace the content of DCD Section 10.4.5.3.2 with the following.

The four circulating water pumps take suction from the pump forebay and circulate the water through the main condenser. Circulating water returns

NAPS COL 10.4(1) **Figure 10.4.5-203 Hybrid Cooling Tower**



ENCLOSURE 5

Response to NRC RAI Letter No. 99

RAI No. 6402, Question 09.02.05-12

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: **6402 (RAI LETTER NO. 99)**

SRP SECTION: 09.02.05 – ULTIMATE HEAT SINK

QUESTIONS for Balance of Plant and Technical Specifications Branch (BPTS)

DATE OF RAI ISSUE: 05/07/2012

QUESTION NO.: 09.02.05-12

The UHS must be capable of removing heat from structures, systems and components (SSCs) important to safety during normal operating and accident conditions over the life of the plant in accordance with the requirements of GDC 44. The UHS description and piping and instrumentation diagram (P&ID) were reviewed to assess the design adequacy of the UHS for performing its heat removal functions. However, the NRC staff found that some of the descriptive information that was provided for the UHS requires further clarifications. In order for the NRC staff to complete this assessment, the applicant is requested to address the following items and revise the FSAR related to COL Item 9.2(20), as appropriate to reflect this information:

(1) COL FSAR Figure 9.2.5-1R indicates that overflow protection for the basin is provided by a spillway or drain line, but this is not described in FSAR Section 9.2.5, and design specifications, size requirements, and other design details are not provided.

(2) FSAR Figures 1.2-206 and 1.2-210 appear to show a single transfer pump discharge pipe header while Figure 9.2.5-R1 indicates two transfer pump discharge pipe headers. FSAR Figures 1.2-206 and 1.2-210 should be revised to state that there are two transfer pump discharge pipe headers and to state the importance of the two headers. COL Figure 2.8-200 series also should be clarified with respect to transfer headers.

Dominion Response

(1) FSAR Figure 9.2.5-1R shows overflow protection for each basin by means of a drain line. This drain pipe is 16" in diameter, schedule 40S, 304 SS pipe which will be routed to discharge to grade level, where the water will then be carried away by the surface drainage system. This pipe size is more than adequate to drain the additional water in the basin due to a failed-open 8" diameter transfer pump header. The water sources to the basin are shown in FSAR Figure 9.2.5-1R. The drain connection is located above the high water level (elevation approximately 316' – 6") in the basin close to the top of the basin wall (elevation 320' – 0"). A description of the overflow line will be added to FSAR Subsection 9.2.5.2.1.

(2) FSAR Section 1.2 provides a general description of North Anna Unit 3, and only general descriptions of the EWS and UHS are provided in this section. The design details of the EWS and UHS are provided in FSAR Section 9.2. FSAR Figures 1.2-201 thru 1.2-211 also provide general arrangement and sectional views of the Ultimate Heat Sink and Related Structures (UHSRS). These figures are not intended to show piping details in the UHSRS. Figures 1.2-206 and 1.2-210 show sectional views of cooling towers C & D, and A & B respectively. Section D1-D1 (cooling towers C & D) and Section D2-D2 (cooling towers A & B) show the ESW pump and associated discharge pipe. No UHS transfer pump discharge pipe header is shown in these FSAR figures.

There are no 2.8-200 series figures in the FSAR. FSAR Section 3.8 provides design details for Seismic Category I structures, and Subsections 3.8.4 and 3.8.5 describe the UHSRS. The COL 3.8-200 series figures showing the UHSRS are associated with these subsections and are intended to show the structural details and not piping details. Piping shown in these figures are ESW supply and return lines; no UHS transfer pump pipe header is shown in these figures.

Two UHS transfer pump discharge headers are provided to facilitate water transfer from non-operating basin(s) to operating basin(s) and vice versa simultaneously. All transfer pumps discharge into one of the two common headers which in turn discharge to individual UHS basins. This facilitates simultaneous water transfer between two basins. FSAR Section 9.2.5 will be revised to clarify two header operation.

Proposed COLA Revision

FSAR Subsections 9.2.5.2.1 and 9.2.5.2.2 will be revised as indicated on the attached mark up.

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.

9.2.5.2.1 General Description

NAPS COL 9.2(3)
NAPS COL 9.2(4)
NAPS COL 9.2(5)
NAPS COL 9.2(18)
NAPS COL 9.2(19)
NAPS COL 9.2(20)
NAPS COL 9.2(21)
NAPS CDI

Replace the content of DCD Subsection 9.2.5.2.1 with the following.

The UHS consists of four 50 percent capacity mechanical draft cooling towers, one for each ESWS train, and four 33 1/3 percent capacity basins to satisfy the thirty day cooling water supply criteria of RG 1.27.

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Each cooling tower consists of two cells with fans and motors, drift eliminators, film fills, risers, and water distribution system all enclosed and supported by a seismic category I reinforced concrete structure. Each basin includes an ESWP intake structure that contains one 50 percent capacity ESWP and one 100 percent capacity UHS transfer pump, and associated piping and components. The UHS piping material, including the UHS transfer piping, is carbon steel with an internal polyethylene lining. The piping is not buried; therefore, cathodic protection is not utilized. Tornado missile protection for the cooling tower components, ESWPs and piping is provided by the UHSRS safety-related seismic category I structures and UHSRS pipe chase as discussed in Subsection 3.8.4. The UHS structural design, including pertinent dimensions, is also discussed in Subsection 3.8.4.

Each cooling tower consists of two cells, each with a motor-driven (M/D) fan driven with a right-angle gear reducer. The fan motors are powered from the Class 1E normal ac power system. On LOOP, the motors are automatically powered from their respective division emergency power source, i.e., the Class 1E GTGs.

The cooling towers are designed for the following conditions: water flow of 12,000 gpm, hot (inlet) water temperature of 128°F, cold (outlet) water temperature of 95°F, ambient wet bulb temperature of 78.3°F, and DBA design heat load of 196 million Btu/hr.

As noted in DCD Subsection 5.4.7.1, "Design Bases," and DCD Subsection 5.4.7.3, "Performance Evaluation," with ESW water temperature of 95°F, the RHRS is capable of reducing the reactor coolant temperature from 350°F to 200°F within 36 hours after shutdown. As the Technical Specifications surveillance requires that the UHS basin water temperature be 93°F or less, the evaluation provided in DCD Section 5.4.7 is bounding.

Inside dimensions of each basin are approximately 123 feet x 123 feet and 34 feet deep at normal water level. The cooling towers utilize the basins for structural foundation.

The ESW intake basin located underneath the ESW pump house occupies the southwest corner of the UHS basin. The ESW intake basin is 12 feet deeper than the UHS basin (elevation 270 ft NAVD88). Water volume occupying this 12 feet depth in the ESW intake basin is not included in the UHS basin inventory. This is to assure adequate NPSH to the ESW pump. The UHS basin floor elevation (282 ft NAVD88) is the
RAI 09.02.05-9 reference point for measuring the basin water level. Normal Water Elevation is 316 ft NAVD88. Grade elevation in the vicinity of the basin is 290 ft NAVD88. A four feet thick basin wall extends four feet above normal water level to 320 ft NAVD88. In the unlikely event of the water level reaching the top of the wall, it will spill over and flow to site drainage.

The UHS operates in conjunction with the ESWS. The ESWS is described in Subsection 9.2.1. P&IDs of the UHS are provided in Figure 9.2.5-1R. The UHS design and process parameters are provided in Table 9.2.5-3R. The normal makeup water to the UHS inventory is from Lake Anna via the cooling tower makeup water and blowdown system described in Subsection 10.4.5.2.1. A CV with instrumentation located in
RAI 09.02.05-9 each makeup line maintains basin water level during normal operation. A control valve and isolation valve in each makeup line are located in the UHSRS for accessibility and to not be affected by potential plume and heat from a cooling tower. The blowdown water is discharged to the
RAI 09.02.05-13 WHTF via the cooling tower makeup water and blowdown system. Design of the station water intake structure minimizes aquatic plant and debris intake and prevents entrainment of fish and other aquatic life. The makeup water system configuration is such that most of the water flows to the Circulating Water System cooling tower basins. The relatively small amount of makeup water flow to the UHS basin further diminishes debris and fouling agents carried to the UHS basins.

RAI 09.02.05-12 A 16-inch diameter overflow pipe is provided at each basin to drain the excess water inventory from the basin. The drain is located above the high water level (elevation approximately 316'-6") in the basin and carries water to the grade level and the surface drainage system.

The mechanical draft cooling towers are the UHS. Hence, no discharge structure is necessary.

9.2.5.2.2 System Operation

NAPS COL 9.2(3)
NAPS COL 9.2(4)
NAPS COL 9.2(5)
NAPS COL 9.2(18)
NAPS COL 9.2(19)
NAPS COL 9.2(20)
NAPS COL 9.2(21)
NAPS COL 9.2(28)
NAPS COL 9.2(31)
NAPS CDI

Replace the content of DCD Subsection 9.2.5.2.2 with the following.

The ESWPs take suction from the basins as described in Subsection 9.2.1.2.1. The water flows through the CCW heat exchangers and essential chiller units and then is cooled by the cooling tower before being returned to the basins.

Heat rejection to the environment is effected by direct contact with a cooling tower forced airflow, which provides evaporative cooling of a ESW return flow. During normal operation, evaporation, drift and blowdown losses are replaced with the makeup from Lake Anna. Water level controllers provided in each basin automatically open and close the makeup CVs. Low and high water level annunciation in the MCR indicates a malfunction of the makeup CV or the blowdown CV.

The maintained water level in each UHS basin assures adequate NPSH for the ESWP under all operating modes, including LOCA and LOOP, with one train out of service for maintenance, when the source of makeup water is assumed lost for a period of thirty days after the accident. During such conditions, the combined inventory of three basins provides a thirty-day cooling water supply assuming the worst combination of meteorological conditions and accident heat loads.

The ESWS together with the UHS is designed, arranged and operated to minimize the effects of water hammer forces.

The system layout assures water pressure remains above saturation conditions throughout the system. The ESW discharge pipe from the pump house passes to the pipe tunnel located at an elevation below grade. The ESWS flows to the CCW heat exchanger and the essential chiller unit located at an elevation below grade in the R/B. The discharge pipe is connected to the cooling tower riser and spray nozzles located above grade. The ESW pump is designed to provide positive pressure at the spray nozzle headers. This together with the high point vents minimize system drain down in the idle trains or upon LOOP and subsequent pump trip.

The following features preclude or minimize water hammer forces:

- On LOOP, the discharge motor-operated valve (MOV) of the operating train is closed. This, together with the discharge check valve, prevents draindown to the basin.
- The ESW pump start logic interlocks the discharge MOV operation with the pump operation. The re-start of the tripped pump or start of the stand-by pump, opens the discharge valve slowly after a pre-determined time delay, sweeping out voids from the discharge piping and cooling tower riser and distribution piping.
- The system valve lineup and periodic IST of the idle trains, including testing of the high point vents, help minimize potential voids and water hammer forces.

Four 100% capacity UHS transfer pumps, one located in each UHS ESW pump house, are provided to transfer cooling water from a non-operating UHS basin to the operating UHS basins when required during accident conditions.

RAI 09.02.05-12
RAI 09.02.05-13

All transfer pumps discharge into one of the two common headers which in turn discharge to individual UHS basins. Use of two headers facilitates simultaneous transfer of water between the operating and non-operating basins. All discharge piping is located in missile protected and tornado protected areas. The common discharge headers and other UHS system piping are designed to seismic Category I requirements. The piping is located in seismic Category I structures. There is no non-seismic piping in the vicinity of this header, and there are no seismically induced failures. Pipes are protected from tornado missiles. The UHS transfer pump(s) operate during accident conditions, during IST in accordance with plant Technical Specifications, during maintenance, and for brief periods during cold weather conditions for recirculation. As the header is normally not in service, deterioration due to flow-accelerated corrosion is insignificant. Transfer of water inventory is required assuming one train/basin of ESW/UHS is out of service (e.g., for maintenance), and a second train is lost due to a single failure. When a transfer pump is in operation, fluid velocity in the header is approximately 5.1 ft/sec. Operating conditions are approximately 20 psig and 95°F. Therefore, header failures are not considered credible.

The UHS transfer pump is designed to supply 800 gpm flow at a total dynamic head (TDH) of 45 feet. Transfer pump capacity is more than

ENCLOSURE 6

Response to NRC RAI Letter No. 99

RAI No. 6402, Question 09.02.05-13

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: **6402 (RAI LETTER NO. 99)**

SRP SECTION: 09.02.05 – ULTIMATE HEAT SINK

QUESTIONS for Balance of Plant and Technical Specifications Branch (BPTS)

DATE OF RAI ISSUE: 05/07/2012

QUESTION NO.: 09.02.05-13

The UHS must be capable of removing heat from SSCs important to safety during normal operating and accident conditions over the life of the plant in accordance with the requirements of GDC 44. FSAR Section 9.2.5.2.1 indicates that the normal makeup water source for the cooling tower basins is Lake Anna. Lake water can cause silt accumulation and the introduction of fish, clams, algae, grass, and other aquatic organisms and biofouling agents. These things can degrade the operation of ESWS pumps, heat exchangers, and UHS transfer pumps; cause clogging of spray nozzles and fill material; and ultimately degrade the capability of the ESWS and UHS to remove heat. While chemical treatment can address corrosion and biofouling issues to some extent, it does not address all of the problems that can occur. Therefore, the applicant is requested to provide additional information in FSAR Section 9.2.5 to address these considerations.

<u>Dominion Response</u>

The Cooling Tower Chemical Feed System (CCS) is designed to provide non-corrosive, non-scale forming conditions in the UHS basin to limit biological film formation. Chemicals such as biocide, algaecide, pH adjuster, corrosion inhibitor and silt dispersant are injected into the UHS basin to maintain non-scale forming conditions and limit biological growth. Chemical treatment is one of several design features included to address the problems that can occur with the use of lake water as a make-up source.

Makeup water pumps supply makeup water to the Ultimate Heat Sink (UHS) cooling tower basins from Lake Anna. These pumps are located in the Station Water Intake/Fire Pump House, which is designed to meet the requirements of the Clean

Water Act, Section 316(b). Dual flow, traveling water screens located at the intake structure, consisting of a trash rack with a rake and a traveling screen, are designed for a low water velocity of 0.5 fps. The traveling screen mesh has square openings that are 3/8 inch on a side. The low velocity and small size screen mesh preclude large debris, fish and other aquatic life from entering the intake structure.

The Essential Service Water (ESW) pump is located in the ESW intake basin which is located in the southwest corner of the UHS basin. The floor in this area is 12 feet below the rest of the UHS basin floor, as shown in FSAR Figures 3.8-208 and 3.8-209. The water from the UHS basin flows at low velocity through the baffles between the UHS and ESW intake basin, also shown in FSAR Figures 3.8-208 and 3.8-209. The layout of the UHS together with ESW intake basins ensures that most of the debris accumulates on the UHS basin floor. This minimizes debris carryover to the ESW pump. A vaned basket provided at the pump inlet prevents large pieces of debris from entering the pump suction. Strainers with 3 mm mesh located in the ESW pump discharge provide additional protection against debris carryover which could otherwise degrade Component Cooling Water (CCW) heat exchangers or clog cooling tower spray nozzles or fill material.

As described in FSAR Subsection 9.2.5.4, in-service testing of ESW pumps and UHS transfer pumps monitor pump degradation. The maintenance program addresses pump degradation and assures pump operability. The performance of CCW heat exchanges, essential chiller units and cooling towers is monitored per GL 89-13 requirements. Corrective actions will be taken to address any degradation. Accumulated debris will be removed from the basin floor per the maintenance program.

Thus, UHS and ESW design features, along with in-service inspection, testing and maintenance programs described above will ensure that the UHS makeup water from Lake Anna will have no adverse impact on ESW and UHS performance.

Proposed COLA Revision

FSAR Subsections 9.2.5.2.1 and 9.2.5.2.2 will be revised, as indicated on the attached markup.

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.

9.2.5.2.1 General Description

NAPS COL 9.2(3)
NAPS COL 9.2(4)
NAPS COL 9.2(5)
NAPS COL 9.2(18)
NAPS COL 9.2(19)
NAPS COL 9.2(20)
NAPS COL 9.2(21)
NAPS CDI

Replace the content of DCD Subsection 9.2.5.2.1 with the following.

The UHS consists of four 50 percent capacity mechanical draft cooling towers, one for each ESWS train, and four 33 1/3 percent capacity basins to satisfy the thirty day cooling water supply criteria of RG 1.27.

RAI 09.02.05-4

Each cooling tower consists of two cells with fans and motors, drift eliminators, film fills, risers, and water distribution system all enclosed and supported by a seismic category I reinforced concrete structure. Each basin includes an ESWP intake structure that contains one 50 percent capacity ESWP and one 100 percent capacity UHS transfer pump, and associated piping and components. The UHS piping material, including the UHS transfer piping, is carbon steel with an internal polyethylene lining. The piping is not buried; therefore, cathodic protection is not utilized. Tornado missile protection for the cooling tower components, ESWPs and piping is provided by the UHSRS safety-related seismic category I structures and UHSRS pipe chase as discussed in Subsection 3.8.4. The UHS structural design, including pertinent dimensions, is also discussed in Subsection 3.8.4.

Each cooling tower consists of two cells, each with a motor-driven (M/D) fan driven with a right-angle gear reducer. The fan motors are powered from the Class 1E normal ac power system. On LOOP, the motors are automatically powered from their respective division emergency power source, i.e., the Class 1E GTGs.

The cooling towers are designed for the following conditions: water flow of 12,000 gpm, hot (inlet) water temperature of 128°F, cold (outlet) water temperature of 95°F, ambient wet bulb temperature of 78.3°F, and DBA design heat load of 196 million Btu/hr.

As noted in DCD Subsection 5.4.7.1, "Design Bases," and DCD Subsection 5.4.7.3, "Performance Evaluation," with ESW water temperature of 95°F, the RHRS is capable of reducing the reactor coolant temperature from 350°F to 200°F within 36 hours after shutdown. As the Technical Specifications surveillance requires that the UHS basin water temperature be 93°F or less, the evaluation provided in DCD Section 5.4.7 is bounding.

Inside dimensions of each basin are approximately 123 feet x 123 feet and 34 feet deep at normal water level. The cooling towers utilize the basins for structural foundation.

The ESW intake basin located underneath the ESW pump house occupies the southwest corner of the UHS basin. The ESW intake basin is 12 feet deeper than the UHS basin (elevation 270 ft NAVD88). Water volume occupying this 12 feet depth in the ESW intake basin is not included in the UHS basin inventory. This is to assure adequate NPSH to the ESW pump. The UHS basin floor elevation (282 ft NAVD88) is the reference point for measuring the basin water level. Normal Water Elevation is 316 ft NAVD88. Grade elevation in the vicinity of the basin is 290 ft NAVD88. A four feet thick basin wall extends four feet above normal water level to 320 ft NAVD88. In the unlikely event of the water level reaching the top of the wall, it will spill over and flow to site drainage.

RAI 09.02.05-9

The UHS operates in conjunction with the ESWS. The ESWS is described in Subsection 9.2.1. P&IDs of the UHS are provided in Figure 9.2.5-1R. The UHS design and process parameters are provided in Table 9.2.5-3R. The normal makeup water to the UHS inventory is from Lake Anna via the cooling tower makeup water and blowdown system described in Subsection 10.4.5.2.1. A CV with instrumentation located in each makeup line maintains basin water level during normal operation. A control valve and isolation valve in each makeup line are located in the UHSRS for accessibility and to not be affected by potential plume and heat from a cooling tower. The blowdown water is discharged to the WHTF via the cooling tower makeup water and blowdown system. Design of the station water intake structure minimizes aquatic plant and debris intake and prevents entrainment of fish and other aquatic life. The makeup water system configuration is such that most of the water flows to the Circulating Water System cooling tower basins. The relatively small amount of makeup water flow to the UHS basin further diminishes debris and fouling agents carried to the UHS basins.

RAI 09.02.05-9

RAI 09.02.05-13

RAI 09.02.05-12

A 16-inch diameter overflow pipe is provided at each basin to drain the excess water inventory from the basin. The drain is located above the high water level (elevation approximately 316'-6") in the basin and carries water to the grade level and the surface drainage system.

The mechanical draft cooling towers are the UHS. Hence, no discharge structure is necessary.

9.2.5.2.2 System Operation

NAPS COL 9.2(3)
NAPS COL 9.2(4)
NAPS COL 9.2(5)
NAPS COL 9.2(18)
NAPS COL 9.2(19)
NAPS COL 9.2(20)
NAPS COL 9.2(21)
NAPS COL 9.2(28)
NAPS COL 9.2(31)
NAPS CDI

Replace the content of DCD Subsection 9.2.5.2.2 with the following.

The ESWPs take suction from the basins as described in Subsection 9.2.1.2.1. The water flows through the CCW heat exchangers and essential chiller units and then is cooled by the cooling tower before being returned to the basins.

Heat rejection to the environment is effected by direct contact with a cooling tower forced airflow, which provides evaporative cooling of a ESW return flow. During normal operation, evaporation, drift and blowdown losses are replaced with the makeup from Lake Anna. Water level controllers provided in each basin automatically open and close the makeup CVs. Low and high water level annunciation in the MCR indicates a malfunction of the makeup CV or the blowdown CV.

The maintained water level in each UHS basin assures adequate NPSH for the ESWP under all operating modes, including LOCA and LOOP, with one train out of service for maintenance, when the source of makeup water is assumed lost for a period of thirty days after the accident. During such conditions, the combined inventory of three basins provides a thirty-day cooling water supply assuming the worst combination of meteorological conditions and accident heat loads.

The ESWS together with the UHS is designed, arranged and operated to minimize the effects of water hammer forces.

The system layout assures water pressure remains above saturation conditions throughout the system. The ESW discharge pipe from the pump house passes to the pipe tunnel located at an elevation below grade. The ESWS flows to the CCW heat exchanger and the essential chiller unit located at an elevation below grade in the R/B. The discharge pipe is connected to the cooling tower riser and spray nozzles located above grade. The ESW pump is designed to provide positive pressure at the spray nozzle headers. This together with the high point vents minimize system drain down in the idle trains or upon LOOP and subsequent pump trip.

The following features preclude or minimize water hammer forces:

- On LOOP, the discharge motor-operated valve (MOV) of the operating train is closed. This, together with the discharge check valve, prevents draindown to the basin.
- The ESW pump start logic interlocks the discharge MOV operation with the pump operation. The re-start of the tripped pump or start of the stand-by pump, opens the discharge valve slowly after a pre-determined time delay, sweeping out voids from the discharge piping and cooling tower riser and distribution piping.
- The system valve lineup and periodic IST of the idle trains, including testing of the high point vents, help minimize potential voids and water hammer forces.

Four 100% capacity UHS transfer pumps, one located in each UHS ESW pump house, are provided to transfer cooling water from a non-operating UHS basin to the operating UHS basins when required during accident conditions.

RAI 09.02.05-12
RAI 09.02.05-13

All transfer pumps discharge into one of the two common headers which in turn discharge to individual UHS basins. Use of two headers facilitates simultaneous transfer of water between the operating and non-operating basins. All discharge piping is located in missile protected and tornado protected areas. The common discharge headers and other UHS system piping are designed to seismic Category I requirements. The piping is located in seismic Category I structures. There is no non-seismic piping in the vicinity of this header, and there are no seismically induced failures. Pipes are protected from tornado missiles. The UHS transfer pump(s) operate during accident conditions, during IST in accordance with plant Technical Specifications, during maintenance, and for brief periods during cold weather conditions for recirculation. As the header is normally not in service, deterioration due to flow-accelerated corrosion is insignificant. Transfer of water inventory is required assuming one train/basin of ESW/UHS is out of service (e.g., for maintenance), and a second train is lost due to a single failure. When a transfer pump is in operation, fluid velocity in the header is approximately 5.1 ft/sec. Operating conditions are approximately 20 psig and 95°F. Therefore, header failures are not considered credible.

The UHS transfer pump is designed to supply 800 gpm flow at a total dynamic head (TDH) of 45 feet. Transfer pump capacity is more than