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Dominion®

July 18, 2011

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

Serial No. NA3-11-027RA
Docket No. 52-017
COL/DEA

DOMINION VIRGINIA POWER
NORTH ANNA UNIT 3 COMBINED LICENSE APPLICATION
SRP 06.04: RESPONSE TO RAI LETTER 70

On May 12, 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 three of the five RAI questions was previously submitted by Dominion letter NA3-11-020R on June 13, 2011. The responses to the two remaining Request for Additional Information (RAI) Questions are provided in Enclosures 1 and 2:

- RAI 5669, Question 06.04-3 — Operator actions upon sensing toxic chemicals / asphyxiates
- RAI 5669, Question 06.04-5 — RG 1.78 evaluation in FSAR of refrigerants to be used at NA3

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

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

Very truly yours,

Eugene S. Grecheck

D089
NRO

Enclosures:

1. Response to NRC RAI Letter No. 70, RAI 5669 Question 06.04-3.
2. Response to NRC RAI Letter No. 70, RAI 5669 Question 06.04-5.

Commitments made by this letter:

1. Incorporate proposed changes in a future COLA submission.

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 18th day of July, 2011

My registration number is 310847 and my

Commission expires: 4/30/15

Ginger L Rutherford

Notary Public

Ginger Lynn Rutherford
NOTARY PUBLIC
Commonwealth of Virginia
Reg. # 310847
My Commission Expires 4/30/2015

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

ENCLOSURE 1

Response to NRC RAI Letter 70

RAI 5669 Question 06.04-3

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5669 (RAI Letter 70)

SRP SECTION: 6.4 – CONTROL ROOM HABITABILITY SYSTEM

QUESTIONS for Containment and Ventilation Branch 1 (AP1000/EPR Projects) (SPCV)

DATE OF RAI ISSUE: 05/12/2011

QUESTION NO.: 06.04-3

Dominion indicated in its letter (ML103160406) to the staff of November 10, 2010 (Serial No. NA3-10-019), that the SCOL applicant did not endorse the RCOL applicant's response to RAI #3451, (CP RAI # 77) Question #06.04-5. There was no note provided in the letter's "Endorsement Clarification" column that would explain the SCOL applicant's reasons for non endorsement. As similarly documented in Question #06.04-5, the staff requests that the SCOL applicant provide resolutions to the following issues:

North Anna 3 FSAR section 6.4.3 "System Operational Procedures" does not address the threat of asphyxiates to main control room (MCR) habitability. Table 6.4-201 lists several asphyxiates as potential threats to MCR habitability.

The staff notes that the expectation created in Section 3.1 of RG 1.78, MCR operators will take protective measures within two minutes (adequate time to don a respirator and protective clothing) of perception (e.g. odor threshold) of a toxic gas to prevent prolonged exposure levels to IDLH concentration levels.

The staff notes that all the toxic chemicals and asphyxiates of SCOL FSAR Table 6.4-201 screened in as potential threats to control room habitability. With respect to these potential threats, would the control room concentrations of any of these toxic chemicals or asphyxiates reach levels perceptible to the MCR operator?

The staff requests that the SCOL applicant clarify in the FSAR, the operator actions that would be captured in the plant's toxic gas response procedures upon sensing the presence of toxic chemicals versus asphyxiates. Would donning a respirator and protective clothing take precedence over isolating the control room envelope for a toxic gas? Upon the MCR operators sensing a toxic gas or asphyxiate, would donning a respirator and/or protective clothing be a mandatory response or a prescribed response? In particular, how would the procedural response to a perceived threat from a toxic gas differ from a perceived threat from an asphyxiate?

Dominion Response

As indicated in Regulatory Guide 1.78, asphyxiating chemicals should only be considered if their release results in displacement of a significant fraction of the main control room (MCR) air leading to an oxygen deficient environment. Accordingly, the asphyxiating chemicals listed in the markup for FSAR Table 6.4-201 (see Response to RAI 5669 Question 06.04-5 provided in Enclosure 2) were analyzed to determine if a release could lead to concentrations in the MCR resulting in the displacement of a significant fraction of oxygen. The results indicated that for each asphyxiating chemical analyzed, the decreased oxygen levels in the MCR would not lead to an oxygen-deficient environment.

Additionally, as specified in Regulatory Guide 1.78, evaluations were conducted for each toxic chemical identified in FSAR Table 6.4-201. The analyses show that the maximum concentrations in the MCR remain below the IDLH or other specified toxicity limit.

The modeled maximum MCR hazardous chemical concentrations were compared to the odor threshold levels of those chemicals listed in FSAR Table 6.4-201 to ascertain if the MCR concentrations of any toxic or asphyxiating chemicals reach levels perceptible to the MCR operator. This comparison, provided in Table 1 below, shows that there are several chemical releases which may cause MCR concentrations to reach levels of perception. Physiological effects, such as irritation of the eyes and respiratory tract, may occur from short-term exposure of some of these hazardous chemicals at or before the odor threshold levels, alerting the MCR operator to take even earlier procedural action.

In addition to the markup for the response to RAI 5669 Question 06.04-4 previously submitted by Dominion letter NA3-11-020R on June 13, 2011 (ML11172A282), FSAR Section 6.4.3, "System Operational Procedures," will be revised to address the threat of toxic or asphyxiating chemicals (listed in Table 6.4-201) to MCR habitability and to clarify the operator actions to be taken upon sensing the toxic or asphyxiating chemical. Procedures, consistent with the applicable positions in RG 1.78 and RG 1.196, will include guidance to operators as to the assessment of the threat of toxic chemicals and asphyxiating chemicals to the operators and will provide criteria for the implementation of a range of potential protective actions, such as donning of respirators and manually actuating the emergency isolation mode of the MCR HVAC system.

Table 1: Perceptible Concentration Levels of Toxic Chemicals and Asphyxiants at North Anna 3 (1 of 2)

Chemical	Maximum MCR Concentration (ppm)	Odor Threshold (ppm)	Short-Term Physiological Effects[1]
Unit 3			
Acetone	28.9	100[3]	Vapor irritates eyes and the respiratory tract.
Ammonium Hydroxide (19% wt solution)	266	50[3]	Corrosive to the eyes, the skin and respiratory tract.
Carbon Dioxide	995	Odorless[3]	Risk of suffocation at high levels.
Dimethylamine (40% wt solution)	216	0.047[3,6]	Corrosive to the eyes and skin. Vapor is severely irritating to the respiratory tract.
Dimethylamine (2% wt solution)	52.1	0.047[3,6]	Corrosive to the eyes and skin. Vapor is severely irritating to the respiratory tract.
Ethanol	127	10[3]	Irritates the eyes.
Hydrazine (20% wt solution)	29.3	3-4[3,6]	Corrosive to the eyes, the skin and respiratory tract.
Hydrazine (85% wt solution)	3.79	3-4[3,6]	Corrosive to the eyes, the skin and respiratory tract.
Hydrochloric Acid (30% solution)	22.2	1-5[6]	Corrosive to the eyes, the skin and respiratory tract.
Hydrogen	2,880	Odorless[3]	If atmosphere does not contain enough oxygen, inhalation can cause dizziness.[3]
Morpholine (40% wt solution)	584	0.01[3]	Corrosive to the eyes, the skin and respiratory tract.
NALCO H-130 as ethanol – Hybrid Cooling Tower	25.2	10[3]	May cause severe eye and skin irritation
NALCO H-130 as ethanol – Ultimate Heat Sink	194	10[3]	May cause severe eye and skin irritation
Nitrogen	2,280	Odorless[3]	If atmosphere does not contain enough oxygen, inhalation can cause dizziness.[3]
NOVEC 1230	2,400	N/A[8]	Not expected to result in significant eye and skin irritation. Not considered a carcinogen.[2]
R-134a - 1,1,1,2-tetrafluoroethane as asphyxiant	58,000	N/A[8,9]	High vapor concentrations are irritating to the eyes and respiratory tract.[7]
R-134a - 1,1,1,2-tetrafluoroethane (Non-Essential Chiller System functions as designed)	43,500	N/A[8,9]	High vapor concentrations are irritating to the eyes and respiratory tract.[7]

Table 1: Perceptible Concentration Levels of Toxic Chemicals and Asphyxiants at North Anna 3 (2 of 2)

Chemical	Maximum MCR Concentration (ppm)	Odor Threshold (ppm)	Short-Term Physiological Effects[1]
R-134a - 1,1,1,2-tetrafluoroethane (Non-Essential Chiller System fails)	13,000	N/A[8,9]	High vapor concentrations are irritating to the eyes and respiratory tract.[7]
Sodium Hypochlorite (12% Solution)[4] – Access Building	No significant concentration[5]	3.5[3]	Corrosive to the eyes, the skin and respiratory tract.
Sodium Hypochlorite (12% Solution)[4] – Hybrid Cooling Tower	0.0754	3.5[3]	Corrosive to the eyes, the skin and respiratory tract.
Sodium Hypochlorite (12% Solution)[4] – Station Water Intake	0.0294	3.5[3]	Corrosive to the eyes, the skin and respiratory tract.
Sodium Hypochlorite (12% Solution)[4] – UHS	0.0679	3.5[3]	Corrosive to the eyes, the skin and respiratory tract.
Units 1 & 2			
Acetone	5.65	100[3]	Vapor irritates eyes and the respiratory tract.
Ammonium Hydroxide (30% Solution)	48.0	50[3]	Corrosive to the eyes, the skin and respiratory tract.
Carbon Dioxide	11,300	Odorless[3]	Risk of suffocation at high levels.
H-130 Microbiocide (Ethanol)	58.9	10[3]	Irritates the eyes.
Halon 1301 (Bromotrifluoromethane)	9.71	Odorless[1]	Irritates the eyes.
Hydrazine (35% Solution)	13.0	3-4[3,6]	Corrosive to the eyes, the skin and respiratory tract.
Hydrochloric Acid (31% Solution)	1.59	1-5[3,6]	Corrosive to the eyes, the skin and respiratory tract.
Hydrogen	1,060	Odorless[3]	If atmosphere does not contain enough oxygen, inhalation can cause dizziness.[3]
Nitrogen, liquid	2,670	Odorless[3]	If atmosphere does not contain enough oxygen, inhalation can cause dizziness.[3]
Sodium Hypochlorite (15% Solution)[4]	No significant concentration[5]	3.5[3]	Corrosive to the eyes, the skin and respiratory tract.

[1]The National Institute for Occupational Safety and Health (NIOSH) unless otherwise noted.
[2]Occupational Safety and Health Administration.
[3]United States Coast Guard, Chemical Hazards Response Information System.
[4]Concentration conservatively reported as chlorine.
[5]Concentrations under 0.00100 ppm are reported as "No significant concentration."
[6]Odor threshold is of pure substance.
[7]Material Safety Data Sheet from Arkema Inc.
[8]Not Available
[9]Ether-like odor (See Note 7)

Proposed COLA Revision

FSAR Section 6.4.3 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.

6.3 Emergency Core Cooling Systems

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

6.3.2.5 System Reliability

NAPS DEP 14.2(3)

Replace the first sentence of the sixth paragraph of DCD Subsection 6.3.2.5 with the following.

Chapter 14 discusses the initial test program for the ECCS.

6.3.4.1 ECCS Performance Tests

NAPS DEP 14.2(3)

Replace the seventh paragraph of DCD Subsection 6.3.4.1 with the following.

The initial test program for the ECCS is described in Section 14.2.

6.4 Habitability Systems

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

6.4.3 System Operational Procedures

STD* COL 6.4(2)

Replace the third paragraph in DCD Subsection 6.4.3 with the following.

RAI 06.04-3

The analyses of control room habitability during a postulated release of toxic or asphyxiating chemicals described in Subsection 6.4.4.2 identify no hazardous chemical that exceeds the IDLH criteria of RG 1.78, ~~so that~~ or displaces a significant fraction of the control room air in accordance with RG 1.78. Therefore, no specific automatic action of MCR HVAC system is required to protect operators within the CRE against toxic gas release event. The emergency isolation mode may be initiated by manual action as described in Subsection 6.4.4.2.

RAI 06.04-4

Procedures and training address the toxic or asphyxiating chemical events addressed in Sections 2.2 and 6.4, consistent with the guidance provided in Regulatory Position C.5 of Regulatory Guide 1.78, including arrangements with Federal, State, and local agencies or other cognizant organizations for the prompt notification of the nuclear power plant when accidents involving hazardous chemicals occur within five miles of the plant.

Procedures provide appropriate directions to operators upon sensing of toxic or asphyxiating chemicals or upon notification by external sources that a release of such material has occurred. The procedures are consistent with the guidance of Regulatory Position C.2.6 of Regulatory Guide 1.196 on "Reactor Control." The procedures include guidance to operators as to the assessment of the threat to the operators and provide criteria for the implementation of a range of potential protective actions, such as the donning of respirators and manual isolation of the CRE.

Procedures for testing and maintenance are consistent with DCD Section 6.4.5; Technical Specifications, Section 5.5.20, "Control Room Envelope Habitability Program"; the Maintenance Rule Program (Section 17.6); and the guidance provided in Regulatory Position C.2.7.1 of Regulatory Guide 1.196.

6.4.4.1 Radiological Protection

NAPS SUP 6.4(1)

Add the following text after the paragraph in DCD Subsection 6.4.4.1:

[The impact of a post-accident release on the maximum MCR dose has been evaluated and addressed in the DCD. The DCD analysis credits operation of the MCR HVAC system in the pressurization mode. Impact from North Anna Unit 1 or Unit 2 design basis accidents to Unit 3, without credit for any benefit of the MCR HVAC system, is bounded by the DCD analyses. Simultaneous post-accident radiological releases from multiple units at a single site are not considered to be credible.]

6.4.4.2 Toxic Gas Protection

NAPS COL 6.4(1)
NAPS COL 6.4(2)

Replace the second paragraph in DCD Subsection 6.4.4.2 with the following.

[Accidents involving the release of toxic or asphyxiating chemicals are evaluated to confirm that an external release of hazardous chemicals does not impact control room habitability. These sources include: 1) offsite industrial facilities and transportation routes; 2) Units 1 and 2; and 3) Unit 3.

Evaluation of potentially hazardous off-site chemicals within 8 km (5 miles) of the MCR is addressed in Section 2.2. As described therein, there are no manufacturing plants, chemical plants, storage facilities, major water transportation routes, oil pipelines or gas pipelines within

8 km (5 miles) of the MCR. There are also no significant control room habitability impacts due to chemicals being transported along offsite routes within 8 km (5 miles) of the plant.]

Toxic gas analysis for potentially hazardous chemicals stored on site is performed in accordance with the guidelines of RG 1.78. RG 1.78 establishes the Occupational Safety and Health Administration (OSHA) National Institute for Occupational Safety and Health (NIOSH) Immediately Dangerous to Life and Health (IDLH) guidelines for 30-minute exposure as the required screening criteria for airborne hazardous chemicals. Per RG 1.78, the NIOSH IDLH values were used to screen chemicals and to evaluate concentrations of hazardous chemicals to determine their effect on control room habitability. Asphyxiating chemicals were evaluated to determine if their release resulted in the displacement of a significant fraction of the MCR air defined by the OSHA in accordance with RG 1.78. The on-site storage locations and quantities for potentially toxic chemicals at Units 1 and 2 and Unit 3 are identified in Table 2.2-202. Table 2.2-203 provides the toxicity limits for these chemicals.

In the evaluation of control room habitability following a postulated release of hazardous chemicals, RG 1.78 states that the atmospheric transport of a released hazardous chemical should be calculated using a dispersion or diffusion model that permits temporal as well as spatial variations in release terms and concentrations. With the exception of the
RAI 06.04-5 evaluation of NOVEC 1230, and the asphyxiation analysis for R-134a, the subject evaluation for Unit 3 used the ALOHA air dispersion model. The ALOHA air dispersion model provides the required evaluation consistent with the requirements presented in RG 1.78 to predict the concentrations of toxic or asphyxiating chemical clouds as they disperse downwind. Using the ALOHA model, a meteorological sensitivity analysis was performed.

RAI 06.04-5 NOVEC 1230 is a fire suppressant that is used inside the Unit 3 MCR, and R-134a is a refrigerant contained in the Essential Chiller System and Non-Essential Chiller System in the Power Source and Auxiliary Buildings, respectively. To evaluate ~~this chemical~~ NOVEC 1230 and R-134a for asphyxiation hazards, the entire quantity of ~~NOVEC 1230~~ each was released and the maximum concentration was determined by dividing the gaseous volume by the MCR volume. A second chemical, sodium hypochlorite, required an upfront evaluation prior to modeling the release. Because of the nature of this chemical, sodium hypochlorite may decompose, especially upon heating, and release chlorine. Thus, a decomposition analysis was performed to determine the quantity of chlorine that may be released into the atmosphere over a 60 minute period. That quantity was then released, as chlorine, and evaluated using the ALOHA code. The results of the hazardous chemical dispersion analyses are presented in Table 6.4-201, which provides the postulated maximum MCR concentrations for the evaluated chemicals.

[Hydrogen and nitrogen storage facilities are 986 ft and 910 ft from the Unit 3 MCR, respectively.] Nitrogen and hydrogen can cause asphyxiation if enough oxygen is displaced in the MCR. Standard air contains 21 percent oxygen by volume. An oxygen-deficient atmosphere is any atmosphere containing oxygen at a concentration below 19.5 percent per 29 CFR 1910.134. Calculations performed to evaluate the habitability of the MCR for accidental releases of hydrogen or nitrogen indicate MCR personnel are not subject to the hazard of breathing air with insufficient oxygen inside the MCR due to a release of hydrogen or nitrogen.

The relative locations for the chemical storage areas, as well as the MCR intakes and refresh rates for Unit 3 were considered in the analysis along with the properties of the stored chemicals. The analysis performed shows that the MCR concentration for a given chemical does not exceed the applicable toxicity limit. However, in the event of a hazardous

RAI 06.04-3

chemical release, the MCR operators ~~have the option of~~ are provided with criteria for the implementation of a range of potential protective actions, such as donning of respirators and manually actuating the emergency isolation mode of the MCR HVAC system.

RAI 06.04-1

In accordance with RG 1.196, Regulatory Position C.2.5, Hazardous Chemicals, surveys will be conducted annually for onsite chemical hazards. The periodicity of surveys for offsite chemical hazards is determined based on the number, size, and types of industrial and transportation activities, as well as changes in regional and local land use in the vicinity of the plant. As described in SSAR Section 2.2.3, there are no industrial facilities within a 5-mile radius of the NAPS site. As such, offsite mobile and stationary sources of hazardous chemicals within five miles of the site will be surveyed every five years.

The control room habitability program will be developed in accordance with RGs 1.196 and 1.78.

ENCLOSURE 2

Response to NRC RAI Letter 70

RAI 5669 Question 06.04-5

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5669 (RAI Letter 70)

SRP SECTION: 6.4 – CONTROL ROOM HABITABILITY SYSTEM

QUESTIONS for Containment and Ventilation Branch 1 (AP1000/EPR Projects) (SPCV)

DATE OF RAI ISSUE: 05/12/2011

QUESTION NO.: 06.04-5

The refrigerants used for refrigeration and HVAC cooling systems throughout North Anna Unit 3 have not been evaluated with respect to the guidance of Regulatory Guide (RG) 1.78, "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," for toxic gas analyses for the control room envelope.

Neither the SCOL application FSAR subsection 2.2.3.1.3 "On-Site Chemicals" discusses refrigerants nor do Tables 2.2-202, 2.2-203 & 6.4-201 list refrigerants. The staff acknowledges that the SCOL applicant has endorsed RCOL applicant's response to CP RAI #172, Question #06.04-11 (Reference Dominion Letter of March 16, 2011, Serial No. NA3-11-014) but the SCOL applicant failed to include any "Endorsement Clarification" note that would indicate their intent to update the FSAR.

From Section 6.4.7 of the US-APWR DCD, Revision 2:

> *COL 6.4(1) states "The COL Applicant is responsible to provide details of specific toxic chemicals of mobile and stationary sources within the requirements of RG 1.78 (Ref 6.4-4) and evaluate the control room habitability based on the recommendation of RG 1.78 (Ref 6.4-4)."*

Please provide a RG 1.78 evaluation in the FSAR for the refrigerants to be used at North Anna Unit 3. The applicant's response should also address the issue of the oil charge laced in the refrigerant.

Dominion Response

A control room habitability analysis was conducted to analyze the potential impacts of a release of refrigerant from the Non-Essential Chilled Water System (NECWS) and Essential Chilled Water System (ECWS). The NECWS consists of four chiller units located in the Auxiliary Building approximately 123 feet (straight line distance) from the west main control room (MCR) door. Each non-essential chiller unit contains 2,120 pounds of R-134a refrigerant (1,1,1,2-Tetrafluoroethane) laced with a polyalkylene glycol (PAG) oil charge. The ECWS consists of four independent trains, two of which are located in each of the two Power Source Buildings. The closest chiller unit in each Power Source Building is approximately 104 feet (straight line distance) from a MCR door. Each essential chiller unit contains 891 pounds of R-134a laced with a PAG oil charge. Because R-134a can act as an asphyxiant in high concentrations and has a toxicity limit of 50,000 ppm, a control room habitability analysis was conducted to evaluate the potential impacts of a refrigerant release on the control room operators. The Material Safety Data Sheet (MSDS) for PAG shows "None Known" for any exposure limits. Therefore, the refrigerant oil is not considered hazardous and does not require further analysis.

For the asphyxiation analysis, it was conservatively assumed that the complete charge (2,120 pounds) of R-134a would be released from the NECWS directly inside the MCR. An "oxygen-deficient atmosphere" is defined by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) at 29 CFR 1910.134(b) as having an oxygen concentration of less than 19.5 percent. The results indicated that inside of the MCR, the displacement of oxygen by R-134a would not result in an oxygen-deficient atmosphere. Thus, the refrigerant does not represent an asphyxiation hazard to the control room operators.

Because the toxicity limit of R-134a is lower than the concentration necessary to displace enough oxygen to create an oxygen-deficient atmosphere, a toxicity analysis was conducted. As a result, three additional release scenarios were evaluated:

1) A direct path indoor release from the NECWS to the MCR door was evaluated using the computer program ALOHA. In this scenario, the entire charge of refrigerant contained in the NECWS was released over a 10-minute period using meteorological conditions representative of indoor conditions.

2) A direct path indoor release from the ECWS to the MCR door was evaluated using the computer program ALOHA. In this scenario, the entire charge of refrigerant contained in the ECWS was released over a 10-minute period using meteorological conditions representative of indoor conditions.

3) An indoor to outdoor release scenario was evaluated. In this scenario, it was assumed that the refrigerant contained within the NECWS was vented to the outside and subsequently introduced into the MCR through the air intake. ALOHA was used to estimate the dispersion behavior of the release from the vent to the air intake under a range of meteorological conditions.

The results of the direct path indoor release evaluations indicated that the toxicity limit of R-134a would not be exceeded at the MCR door. Thus, the release of the refrigerant from either the ECWS or the NECWS to the MCR door would not present a threat to the control room operators. The results of the indoor to outdoor release evaluation indicated that the toxicity limit of R-134a would not be exceeded at the MCR air intake. Thus, the release of the refrigerant from the NECWS to the outside would not present a threat to the control room operators.

Details of the control room habitability analyses and results are included in the calculation *US-APWR Unit 3 Onsite Chemical Hazards Revision 002*, which will be made available to the NRC staff as described in the response to RAI 5669, Question 06.04-2 previously submitted by Dominion letter NA3-11-020R on June 13, 2011 (ML11172A282).

Proposed COLA Revision

FSAR Section 6.4.4.2 and Tables 2.2-202, 2.2-203 and 6.4-201 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.

NAPS ESP COL 2.2-2 **Table 2.2-202 North Anna Onsite Chemical Storage Locations and Quantities**

Chemical/Material (Formula/Trade/State)	Location	No. × Quantity (Container) (2)
NOVEC 1230	Main Control Room	2 x 141 lb
	Staff Room	2 x 141 lb
Oxalic Acid	Access Building	30 lb
p-Dimethylamino-benz-aldehyde	Access Building	40 lb
Phenol	Access Building	410 lb
Polyalkylene Glycols (PAGs)	Auxiliary Building	Unknown(4)
	Power Source Buildings	Unknown(4)
Polymer A (Dimethylamine 1% - 5%)	PRTP(3)	400 gal
Polymer B (Dimethylamine 1% - 5%)	PRTP(3)	400 gal
Potassium Chloride (pH inside liquid of an electrode)	Access Building	20 gal
R-134a (1,1,1,2-Tetrafluoroethane)	Auxiliary Building	4 x 2,120 lb/chiller
	Power Source Buildings	4 x 891 lb/chiller(5)
Sodium Bicarbonate (12%)	Water Treatment Building (Inside)	200 gal
Sodium Bisulfite (10%)	Unit 3 Discharge (Inside)	1,056 gal
Sodium Bromide (44.7%)	Hybrid Cooling Tower (Adjacent)	2,378 gal
	UHS (Inside)	300 gal
Sodium Hydroxide	Access Building	90 lb
Sodium Hydroxide (25%)	Water Treatment Building (Inside)	180 gal
Sodium Hypochlorite	Access Building	10 gal
Sodium Hypochlorite (12%)	Hybrid Cooling Tower (Adjacent)	15,870 gal
	Station Water Intake	2,113 gal
	UHS (Inside)	1,057 gal
	Adjacent to Unit 3 Sewage Treatment Plant	2 x 330 gal
Sodium Sulfite (2.2%)	Aux. Boiler Building	555 gal

NAPS ESP COL 2.2-2 **Table 2.2-202 North Anna Onsite Chemical Storage Locations and Quantities**

Chemical/Material (Formula/Trade/State)	Location	No. × Quantity (Container) [(2)]
Sodium Bromide (30-60%)	Bearing Cooling Tower, Warehouse #7	400 gal
Sodium Hydroxide (50%)	Warehouse #7, Next to Units 1 & 2 Containment, GE Water System	55 gal
Sodium Hypochlorite (15%)	Warehouse #7, Bearing Cooling Tower	400 gal
Sodium Chloride	Warehouse #7, Storage Bay at NE Corner of SCOBN Bldg, GE Water Treatment System (S of Intake Structure)	99,999 lb [(1)]
Sulfuric Acid	Warehouse #7	60 gal
TRC-256 Sodium Molybdate	Chemical Addition Building	4,000 gal
Zinc Chloride (65%)	Turbine Building	1,100 gal

(1) Maximum quantities from (Superfund Amendments and Reauthorization Act) SARA Report

(2) If more than 1 container

(3) Phosphate Removal Treatment Plant

(4) PAGs are additives to the R-134a refrigerant. The quantity of PAGs in the refrigerants is unknown.

(5) Total number of chillers, evenly divided between the East and West Power Source Buildings.

NAPS ESP COL 2.2-2 Table 2.2-203 North Anna On-Site Chemicals, Disposition

Chemical/ Chemical Product	Toxicity Limit (IDLH)	Vapor Pressure	Flammable/ Explosive? Yes/No	Disposition
p-Dimethylaminobenzaldehyde	None listed	NA/Solid	No	No further analysis required(2)
Phenol	None listed	NA/Solid	Yes (1.7% - 8.6%)	No further analysis required(2)
Polyalkylene Glycols (PAGs)	None Listed	None Listed	No	No further analysis required(2)
Polymer A (Dimethylamine 1% - 5%)	500 ppm	1,270 mmHg @ 68°F (6,7,9)	Yes (2.8% - 14.4%)	Bounded by dimethylamine in turbine building
Polymer B (Dimethylamine 1% - 5%)	500 ppm	1,270 mmHg @ 68°F (6,7,9)	Yes (2.8% - 14.4%)	Bounded by dimethylamine in turbine building
Potassium Chloride (pH inside liquid of an electrode)	None listed	Solid in solution	No	No further analysis required(2)
R-134a (1,1,1,2-Tetrafluoroethane)	50,000 ppm	85.7 psia @ 70°F(9)	No	Toxicity Analysis(11)
Sodium Bicarbonate (12%)	None listed	Solid in solution	No	No further analysis required(2)
Sodium Bisulfite (10%)	5 mg/m^3 TLV-TWA(3)	Solid in solution	No	No further analysis required(2)
Sodium Bromide (44.7%)	None listed	Solid in solution	No	No further analysis required(2)
Sodium Hydroxide	10 mg/m^3	NA/Solid	No	No further analysis required(2)
Sodium Hydroxide (25%)	10 mg/m^3	Solid in solution	No	No further analysis required(2)
Sodium Hypochlorite	10 ppm as chlorine	17.5 mmHg @ 68°F(8,9)	No	Toxicity Analysis
Sodium Hypochlorite (12%)	10 ppm as chlorine	17.5 mmHg @ 68°F(8,9)	No	Toxicity Analysis
Sodium Sulfite (2.2%)	None listed	Solid in solution	No	No further analysis required(2)

NAPS ESP COL 2.2-2 **Table 2.2-203 North Anna On-Site Chemicals, Disposition**

Chemical/ Chemical Product	Toxicity Limit (IDLH)	Vapor Pressure	Flammable/ Explosive? Yes/No	Disposition

Notes:

(1) There are no isolation and protective action distances for spills listed in the Emergency Response Guidebook (ERG). The ERG doesn't predict that large amounts of toxic-by-inhalation gases will be produced if this material is spilled in water.

(2) Chemicals with very low vapor pressures (including solids/solids in solution) were not analyzed due to there being a low likelihood of vapor cloud formation—an air dispersion hazard resulting from the formation of a toxic vapor cloud is not a likely route of exposure.

(3) TLV-TWA: Threshold Limit Value – Time Weighted Average

(4) STEL: Short Term Exposure Limit

(5) Gasoline is stored in an underground tank, therefore formation of a vapor cloud is unlikely. Hazards associated with transport are discussed in Section 2.2.3.1.1.

(6) Vapor pressure of solution presented as the vapor pressure of the pure substance.

(7 Vapor pressure corrected to 68°F to maintain consistency with Units 1 & 2 values.

(8) Sodium hypochlorite Vapor Pressure presented for representative sodium hypochlorite solutions.

(9) Temperature corrected to °F for consistency

(10) TLV-TWA value from Units 1 & 2 analysis used to maintain consistency.

(11) R-134a analyzed for both asphyxiation and toxicity hazards.

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Procedures provide appropriate directions to operators upon sensing of toxic or asphyxiating chemicals or upon notification by external sources that a release of such material has occurred. The procedures are consistent with the guidance of Regulatory Position C.2.6 of Regulatory Guide 1.196 on "Reactor Control." The procedures include guidance to operators as to the assessment of the threat to the operators and provide criteria for the implementation of a range of potential protective actions, such as the donning of respirators and manual isolation of the CRE.

Procedures for testing and maintenance are consistent with DCD Section 6.4.5; Technical Specifications, Section 5.5.20, "Control Room Envelope Habitability Program"; the Maintenance Rule Program (Section 17.6); and the guidance provided in Regulatory Position C.2.7.1 of Regulatory Guide 1.196.

6.4.4.1 Radiological Protection

NAPS SUP 6.4(1)

Add the following text after the paragraph in DCD Subsection 6.4.4.1:

The impact of a post-accident release on the maximum MCR dose has been evaluated and addressed in the DCD. The DCD analysis credits operation of the MCR HVAC system in the pressurization mode. Impact from North Anna Unit 1 or Unit 2 design basis accidents to Unit 3, without credit for any benefit of the MCR HVAC system, is bounded by the DCD analyses. Simultaneous post-accident radiological releases from multiple units at a single site are not considered to be credible.

6.4.4.2 Toxic Gas Protection

NAPS COL 6.4(1)
NAPS COL 6.4(2)

Replace the second paragraph in DCD Subsection 6.4.4.2 with the following.

Accidents involving the release of toxic or asphyxiating chemicals are evaluated to confirm that an external release of hazardous chemicals does not impact control room habitability. These sources include: 1) offsite industrial facilities and transportation routes; 2) Units 1 and 2; and 3) Unit 3.

Evaluation of potentially hazardous off-site chemicals within 8 km (5 miles) of the MCR is addressed in Section 2.2. As described therein, there are no manufacturing plants, chemical plants, storage facilities, major water transportation routes, oil pipelines or gas pipelines within

8 km (5 miles) of the MCR. There are also no significant control room habitability impacts due to chemicals being transported along offsite routes within 8 km (5 miles) of the plant.

Toxic gas analysis for potentially hazardous chemicals stored on site is performed in accordance with the guidelines of RG 1.78. RG 1.78 establishes the Occupational Safety and Health Administration (OSHA) National Institute for Occupational Safety and Health (NIOSH) Immediately Dangerous to Life and Health (IDLH) guidelines for 30-minute exposure as the required screening criteria for airborne hazardous chemicals. Per RG 1.78, the NIOSH IDLH values were used to screen chemicals and to evaluate concentrations of hazardous chemicals to determine their effect on control room habitability. Asphyxiating chemicals were evaluated to determine if their release resulted in the displacement of a significant fraction of the MCR air defined by the OSHA in accordance with RG 1.78. The on-site storage locations and quantities for potentially toxic chemicals at Units 1 and 2 and Unit 3 are identified in Table 2.2-202. Table 2.2-203 provides the toxicity limits for these chemicals.

In the evaluation of control room habitability following a postulated release of hazardous chemicals, RG 1.78 states that the atmospheric transport of a released hazardous chemical should be calculated using a dispersion or diffusion model that permits temporal as well as spatial variations in release terms and concentrations. With the exception of the evaluation of NOVEC 1230, and the asphyxiation analysis for R-134a, the subject evaluation for Unit 3 used the ALOHA air dispersion model. The ALOHA air dispersion model provides the required evaluation consistent with the requirements presented in RG 1.78 to predict the concentrations of toxic or asphyxiating chemical clouds as they disperse downwind. Using the ALOHA model, a meteorological sensitivity analysis was performed.

NOVEC 1230 is a fire suppressant that is used inside the Unit 3 MCR, and R-134a is a refrigerant contained in the Essential Chiller System and Non-Essential Chiller System in the Power Source and Auxiliary Buildings, respectively. To evaluate ~~this chemical~~ NOVEC 1230 and R-134a for asphyxiation hazards, the entire quantity of ~~NOVEC 1230~~ each was released and the maximum concentration was determined by dividing the gaseous volume by the MCR volume. A second chemical, sodium hypochlorite, required an upfront evaluation prior to modeling the

NAPS COL 6.4(1)

Table 6.4-201 MCR Toxic Gas Concentrations

Chemical/Material	Distance to Nearest Control Room Intake (ft)	Toxicity Limit (ppm)	Distance to IDLH (ft)	Maximum MCR Concentration (ppm)
Unit 3				
Acetone (6)	223	2,500	< 33	28.9
Ammonium Hydroxide (19% wt solution) (6)	360	300	813	266
Carbon Dioxide (7)	959	40,000	423	995
Dimethylamine (40% wt solution) (6)	360	500	474	216
Dimethylamine (2% wt solution) (6)	360	500	306	52.1
Ethanol (6)	223	3,300	54	127
Hydrazine (20% wt solution) (6)	360	50	417	29.3
Hydrazine (85% wt solution) (6)	223	50	75	3.79
Hydrochloric Acid (30% solution) (6)	223	50	234	22.2
Hydrogen	986	Asphyxiant	NA	2,880
Morpholine (40% wt solution)	290	1,400	255	584
NALCO H-130	1,627	3,300 (3)	90	25.2
NALCO H-130	429	3,300 (3)	81	194
Nitrogen (7)	910	Asphyxiant	NA	2,280
NOVEC 1230	0 (4)	100,000	NA	2,400
R-134a (1,1,1,2- Tetrafluoroethane) (8)	0	Asphyxiant (11)	NA	58,000
R-134a (1,1,1,2- Tetrafluoroethane) (9)	15 (12)	50,000	33	43,500
R-134a (1,1,1,2- Tetrafluoroethane) (10)	123	50,000	66	13,000
Sodium Hypochlorite (12% Solution) - Access Building (1), (6)	223	10 (5)	39	No significant concentration (2)
Sodium Hypochlorite (12% Solution) - Hybrid Cooling Tower (1)	1627	10 (5)	168	0.0754
Sodium Hypochlorite (12% Solution) - Station Water Intake (1)	952	10 (5)	57	0.0294
Sodium Hypochlorite (12% Solution) - UHS (1)	429	10 (5)	39	0.0679

NAPS COL 6.4(1) **Table 6.4-201 MCR Toxic Gas Concentrations**

Chemical/Material	Distance to Nearest Control Room Intake (ft)	Toxicity Limit (ppm)	Distance to IDLH (ft)	Maximum MCR Concentration (ppm)

Notes:

(1) As Chlorine gas based on a decomposition analysis of sodium hypochlorite.

(2) Concentrations under 0.00100 ppm are reported as "No significant concentration"

(3) As ethanol

(4) This chemical is stored inside the MCR

(5) As chlorine

(6) For those chemicals stored inside the Access Building or Turbine Building, an Urban or Forest roughness factor was selected in ALOHA

(7) An Urban or Forest roughness factor was selected in ALOHA when evaluating Nitrogen and Carbon Dioxide to account for the wakes/eddies that would be generated as the formed cloud moves past the UHS structure

(8) Asphyxiation case, entire volume of refrigerant in the Non-Essential Chiller System is released directly into control room. Resulting oxygen concentration is greater than the OSHA 29 CFR 1910.134(b) confined space lower limit of 19.5%.

(9) Assumes pressure relief device on the Non-Essential Chiller System functions as designed and vents refrigerant to exterior of building.

(10) Assumes pressure relief device on the Non-Essential Chiller System fails and the refrigerant plume enters MCR through the MCR door. No credit is taken for MCR air exchange rate.

(11) Concentration required to displace sufficient oxygen to generate an oxygen deficient atmosphere (<19.5%) as defined by OSHA 29 CFR 1910.134(b) is calculated to be 71,400 ppm.

(12) ANSI/ASHRAE Standard 15 requires that the pressure relief vents be located greater than 20 feet horizontal distance from any ventilation intake, and 15 feet off of the ground. Conservatively, the toxicity analysis was conducted using a 15 foot separation between the refrigeration release point and MCR intake.