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Dominion®

December 12, 2011

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

Serial No. NA3-11-060R
Docket No. 52-017
COL/DEA

**DOMINION VIRGINIA POWER**
**NORTH ANNA UNIT 3 COMBINED LICENSE APPLICATION**
**SRP 6.4: RESPONSE TO RAI LETTER 87**

On October 13, 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 two questions. The responses to the following Request for Additional Information (RAI) questions are provided in Enclosures 1 and 2:

- RAI 5953 Question 06.04-6 Onsite Hazards Analysis Calculation
- RAI 6054 Question 06.04-7 Carbon Dioxide Dispersion Model

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

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

Very truly yours,

Eugene S. Grecheck

D089
NRO

Enclosure:

1. Response to NRC RAI Letter Number 87, RAI 5953 Question 06.04-6.
2. Response to NRC RAI Letter Number 87, RAI 6054 Question 06.04-7.

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 12th day of December, 2011
My registration number is 7173057 and my
Commission expires: August 31, 2012

Wanda K. Marshall
Notary Public

WANDA K. MARSHALL
Notary Public
Commonwealth of Virginia
7173057
My Commission Expires Aug 31, 2012

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 87**

**RAI 5953 Question 06.04-6**

## RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

**North Anna Unit 3**

**Dominion**

**Docket No. 52-017**

**RAI NO.: 5953 (RAI Letter 87)**

**SRP SECTION: 06.04 – CONTROL ROOM HABITABILITY SYSTEM**

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

**DATE OF RAI ISSUE: 10/13/2011**

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**QUESTION NO.: 06.04-6**

The Dominion North Anna COL Unit 3 calculation "25161-ENV-505, US-APWR Onsite Hazards Analysis, Rev 3" states that

"For 40% dimethylamine solution inside Turbine, the puddle was assumed contained a dike with an area of 20 square meters. Based on available data, a dike of this size or smaller (i.e., form a deeper puddle) was necessary in order to alleviate the threat from this chemical."

The staff is not aware that anywhere in the COL FSAR a dike in the Turbine building is designed for this purpose to satisfy GDC 19. Please explain if a dike in the Turbine building is required or not.

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**Dominion Response**

The confinement of a 40% dimethylamine solution spill is not required to satisfy GDC 19, but is required for the delayed ignition explosion hazard analysis. Calculation "25161-ENV-505, US-APWR Onsite Chemical Hazards Analysis" has been revised to include an additional chemical hazard evaluation for main control room (MCR) habitability, assuming an unconfined, uniform 1 cm deep spill of 40% dimethylamine solution. For comparison, Table 1 shows the unconfined spill toxicity hazard results along with the confined spill toxicity hazard results from FSAR Table 6.4-201.

Table 1: ALOHA Chemical Hazards Results for 40% Dimethylamine Solution Storage

| | MCR Concentration | Distance to the IDLH |
|---|---|---|
| Unconfined | 361 ppm | 555 feet |
| Confined | 216 ppm | 474 feet |

Note: The Immediately Dangerous to Life or Health (IDLH) value of dimethylamine is 500 ppm.

The results of the revised analysis demonstrate that, although the MCR concentration increased, the concentration remains below the IDLH of 500 ppm. Therefore, confinement of the 40% dimethylamine solution spill in the turbine building is not necessary to satisfy the requirements of GDC 19. The 40% dimethylamine solution toxicity hazard results in FSAR Table 6.4-201 will be revised to show the unconfined spill results.

For the analysis of a delayed ignition explosion hazard for the 40% dimethylamine solution, the confinement provided by the chemical storage room in the turbine building was considered. The area of the confinement must be at most 20 $m^2$ and be at a distance of at least 245 feet from the nearest safety-related structure (NSRS). With these constraints, the chemical storage room is effective in minimizing the surface area of a spill, which limits the rate of formation of a vapor cloud and the resulting overpressure at the NSRS that would cause a delayed ignition explosion. Footnote 7 in FSAR Table 2.2-204 will be clarified to add the confinement requirement for the chemical storage room in the turbine building.

**Proposed COLA Revision**

FSAR Table 2.2-204 and Table 6.4-201 will be revised as indicated in 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 2.2-204 Design Basis Events, Explosions, Flammable Vapor Clouds (Delayed Ignition) and Vapor Cloud Explosions**

1. "No Detonation" is listed when ALOHA reports that there is not a detonation of the formed vapor cloud – (e.g., no part of the vapor cloud is above the LFL at any time).
2. Dimethylamine analysis results use a correction for solution's vapor pressure.
3. Because concentration was not considered in TNT equivalence analysis, the 1000 gallon 2% Dimethylamine tank analysis is bounding for 400 gallon 40% Dimethylamine tank.
4. Urban or Forest Terrain Input.
5. Open Country Terrain Input.
6. NALCO H-130 must be stored outside of the UHS structures and at least 33 feet from the nearest safety-related structure.
7. The ~~Dimethylamine (40%)~~ 40% dimethylamine solution must be stored within the ~~designated~~ chemical storage ~~area~~ room in the Turbine Building such that the area of confinement is at most 20 $m^2$ and the distance to the nearest safety-related structure is at least 245 feet.
8. The acetone must be stored within the designated area in the Access Building such that the safe distance to the NSRS is 105 feet.
9. In a 40% solution, the partial vapor pressure of morpholine is below 10 torr (mm Hg), as such, the vapor concentration above the liquid surface would be too lean to detonate.
10. The partial vapor pressure of ethanol in NALCO H-130 is sufficiently low such that the vapor concentration above the liquid surface would be too lean to detonate as supported by the MSDS which states that combustible mixtures may only form above the flashpoint of 109°F.
11. Analysis performed using 100% ethanol.
12. Analysis performed using 100% methyl ethyl ketone.
13. Analysis performed using 100% toluene.

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][14] | 360 | 500 | ~~474~~ 555 | ~~216~~ 361 |
| Dimethylamine (2% wt solution)[6] | 360 | 500 | 306 | 52.1 |
| Ethanol[6] | 223 | 3,300 | 54 | 127 |
| Hydrazine (20% wt solution)[6][13] | 360 | 50 | 417 | 29.3 |
| Hydrazine (85% wt solution)[6][13] | 223 | 50 | 75 | 3.79 |
| Hydrochloric Acid (30% solution)[6] | 223 | 50 | 234 | 22.2 |
| Hydrogen | 986 | Asphyxiant[11] | 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[11] | 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 Chilled Water 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 Chilled Water System functions as designed and vents refrigerant to exterior of building.

(10) Assumes pressure relief device on the Non-Essential Chilled Water 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.

(13) All hydrazine solutions were analyzed as pure hydrazine.

(14) Toxicity analyses do not credit confinement provided by the Turbine Building chemical storage room.

**ENCLOSURE 2**

**Response to NRC RAI Letter 87**

**RAI 6054 Question 06.04-7**

## RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

**North Anna Unit 3**

**Dominion**

**Docket No. 52-017**

**RAI NO.: 6054 (RAI Letter 87)**

**SRP SECTION: 06.04 – CONTROL ROOM HABITABILITY SYSTEM**

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

**DATE OF RAI ISSUE: 10/13/2011**

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**QUESTION NO.: 06.04-7**

In the chemical spill cases for on-site carbon dioxide and off-site carbon dioxide, the staff noticed, during the staff's confirmatory analysis, that the ALOHA Code appeared to be missing the boiling point (normal) of carbon dioxide and the code automatically chose Gaussian Dispersion model. When the staff manually input the boiling point (normal) of carbon dioxide as 216.6 ok, the Code chose Heavy Gas Dispersion model. The applicant's calculation result was close to the staff's calculation result using Gaussian Dispersion model, per applicant's calculations 25161-ENV-507 Revision 2 and 25161-ENV-505 Revision 3. It is believed that Heavy Gas Dispersion model may be the more appropriate model for the present cases.

Please provide a justification on the dispersion model selected for its' carbon dioxide chemical spill calculations to clarify the licensing basis for this application.

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**Dominion Response**

Previous experience modeling carbon dioxide using the ALOHA code has shown that the Gaussian Dispersion model generally yields more conservative results for a main control room (MCR) air intake than the Heavy Gas Dispersion model.

An additional analysis has been conducted comparing the Gaussian and Heavy Gas Dispersion models for carbon dioxide. The worst-case results of the chemical hazards analysis for the Unit 3 MCR from storage of Unit 3 and Units 1 and 2 carbon dioxide are shown in Tables 1 and 2, respectively.

Table 1: ALOHA Chemical Hazards Results for Unit 3 Carbon Dioxide Storage

| | MCR Concentration | Distance to the IDLH |
|---|---|---|
| Heavy Gas Model | 598 ppm | 453 ft |
| Gaussian Model | 995 ppm | 423 ft |

Table 2: ALOHA Chemical Hazards Results for Units 1 and 2 Carbon Dioxide Storage

| | MCR Concentration | Distance to the IDLH |
|---|---|---|
| Heavy Gas Model | 9,380 ppm | 1,446 ft |
| Gaussian Model | 11,300 ppm | 1,902 ft |

Note: The Immediately Dangerous to Life or Health (IDLH) value of carbon dioxide is 40,000 ppm. Worst-case results occurred at "F" stability conditions with 1 m/s winds.

The above results from the analyses indicate the Gaussian Dispersion model provides the more conservative Unit 3 MCR concentrations.

**Proposed COLA Revision**

None.