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Dominion®

October 20, 2008

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

Serial No. NA3-08-118
Docket No. 52-017
COL/JPH

DOMINION VIRGINIA POWER
NORTH ANNA UNIT 3 COMBINED LICENSE APPLICATION
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 025
(FSAR CHAPTER 2)

On August 12, 2008, the NRC requested additional information to support the review of certain portions of the North Anna Unit 3 Combined License Application (COLA). The letter contained seven RAIs. The responses to the following two RAIs are provided in Enclosures 1 and 2:

- RAI Question 02.02.03-1 Explosion Hazard
- RAI Question 02.02.03-4 Sodium Hydroxide Quantities

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

Of the remaining five RAIs associated with RAI Letter No. 25, question 03.05.01.05-1, Unit 1 & 2 Turbine Missile Impact on Unit 3 response was submitted in Dominion Letter Serial No. NA3-08-102R dated September 26, 2008. Question 12.02.10, Clarification of FSAR Tables in Chapter 12 and question 15.06.05-1, Dose Evaluation Factors was submitted in Dominion Letter Serial No. NA3-08-116 dated October 17, 2008. The responses to RAI questions 02.02.03-2, Evaluation of Potential Control Room Accidents, and 02.02.03-3, Evaporation Rate Sensitivity Analysis, will be provided by October 27, 2008.

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

Very truly yours,

Eugene S. Grecheck

D089
NRO

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 20th day of October, 2008

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

Enclosures:

1. Response to NRC RAI Letter No. 025, RAI Question No. 02.02.03-1
2. Response to NRC RAI Letter No. 025, RAI Question No. 02.02.03-4

Commitments made by this letter:

1. The information provided in the RAI responses will be incorporated into a future submission of the North Anna Unit 3 COLA, as described in the Enclosures.
2. The responses to RAI questions 02.02.03-2, Evaluation of Potential Control Room Accidents, and 02.02.03-3, Evaporation Rate Sensitivity Analysis, will be provided by October 27, 2008.

cc: U. S. Nuclear Regulatory Commission, Region II
T. A. Kevern, NRC
J. T. Reece, NRC
J. J. Debiec, ODEC
G. A. Zinke, NuStart/Entergy
T. L. Williamson, Entergy
R. Kingston, GEH
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ENCLOSURE 1

Response to NRC RAI Letter 025

RAI Question 02.02.03-1

NRC RAI 02.02.03-1

10 CFR 52.79(a)(1)(vi) requires a safety assessment of a site to determine its suitability for building a reactor on that site. COL Information Item 2.0-6-A related to evaluation of potential accidents to be covered under ESP COL Action item 2.2-2 is one facet of that safety assessment. The NRC staff noticed that there are two 10,000 gallon underground gasoline storage tanks identified on-site with Unit 3 in FSAR Table 2.2-202. The applicant did not address these tanks for hazard consideration due to either confined vapor explosion or flammable vapor cloud explosion. Provide the potential explosion hazard due to these tanks from the perspective of fuel storage and delivery of fuel to the tanks onsite.

Dominion Response

1. Explosion Hazards from Gasoline Storage

The two existing 10,000 gallon underground gasoline storage tanks are located onsite at the North Anna Power Station (NAPS) vehicle motor pool and vehicle maintenance garage. The tanks are not subject to catastrophic failures that could release gasoline in a manner that could result in an explosion hazard for Unit 3 safety-related structures due to either a flammable vapor cloud explosion or a confined vapor explosion hazard. Each scenario is discussed below.

Flammable Vapor Cloud Explosion Hazard During Storage

If an underground tank were to rupture, the gasoline would still be below grade and contained by the surrounding structures and soils. Any releases would tend to flow down into the surrounding soil structure and be contained in a pool around the tank, or would seep down into the soil. The liquid gasoline would not flow up to the ground surface immediately in a quantity that could result in a large evaporating puddle. This scenario is more typical of the failure of an above-ground gasoline storage tank in which the above-ground puddles are the source of vapors that evaporate and are analyzed for possible formation of a flammable vapor cloud and subsequent explosion hazard above or downwind of the tank location.

Assuming a pool of gasoline results underground due to a leaking or ruptured storage tank, gasoline vapors would not form a dispersing flammable vapor cloud because the tanks are below grade and covered, any vaporization of the gasoline would occur underground, and the gasoline vapors formed would tend to migrate upward, permeate the soil, and dissipate harmlessly into the atmosphere. Due to the slower evaporation rate underground compared to an above-ground puddle, a flammable gasoline vapor cloud could not form above or downwind of the tank location because not enough vapors could mix with oxygen and form a vapor cloud that would reach concentrations above the lower flammability limit (LFL). Such a concentration would be necessary to create conditions that would potentially allow for a vapor cloud explosion, i.e., needed for a detonation to occur.

Therefore, for gasoline storage in the underground tanks, there is not a flammable vapor cloud explosion hazard because the formation of a flammable gasoline vapor cloud due to an underground storage tank gasoline release is not a credible event.

Confined Vapor Explosion Hazard During Storage

In addition, there is not a confined vapor explosion hazard for Unit 3 safety-related structures if an underground tank were to rupture and release gasoline vapors into the space around the tank. Ignition sources are typically not present with underground gasoline storage tanks. The underground location precludes accidental impacts (e.g., vehicle collisions) that could cause a tank rupture and ignition due to sparking of contacting metal surfaces.

Other possible sources of ignition are sparks created during routine maintenance and lightning strikes. If such an ignition source is assumed present for an assumed ruptured or leaking underground gasoline storage tank, the hazard from accidental detonation of confined vapors is low due to the location below grade. The underground gasoline storage tanks are covered and the surrounding materials provide barriers to free release of the explosive gases. Each tank is in a hole in the ground that would tend to contain explosive gases and direct debris upward in the nearby area, rather than outwards and towards Unit 3 during the explosion. Given the large distances from the locations of the underground gasoline storage tanks to Unit 3 safety-related structures (the vehicle maintenance garage is about 1670 feet away and the motor pool is about 2100 feet away), there is no potential that a confined vapor explosion at either of the two tanks could adversely affect the safe operation and/or shutdown of Unit 3.

Therefore, for gasoline storage in the underground tanks, there is not a confined vapor explosion hazard because damage to Unit 3 due to overpressure from such an explosion is not a credible event.

2. Explosion Hazards from Gasoline Delivery

Because the on-site gasoline delivery transportation route is closer to the nearest Unit 3 safety-related structure than the safe separation distance, a probability analysis was performed in accordance with NRC Regulatory Guide 1.91 to demonstrate that the risk of a potential explosion hazard due to gasoline deliveries is sufficiently low.

According to RG 1.91, the risk from potential explosion hazards can be shown to be sufficiently low on the basis of low probability of explosions when the rate of exposure to a peak overpressure in excess of 1 pound per square inch (psi) is less than 10^{-6} per year using conservative assumptions or less than 10^{-7} per year using realistic assumptions. The methodology presented in RG 1.91 was used to determine the probability of an explosion from a gasoline tanker truck delivery resulting in an overpressure that exceeds 1 psi at the nearest Unit 3 safety-related structure. The following equation was used (Reference 1):

$$r = n_1 \times n_2 \times f \times s$$

where,

r = exposure rate (the probability of an explosion occurring),
n_1 = accidents per mile for the transportation mode (truck transport),
n_2 = cargo explosion per accident for the transportation mode,
f = frequency of shipment for the substance, in shipments per year,
s = exposure distance in miles.

The number of accidents per mile, n_1, is 2×10^{-6} based on an average value for large trucks (References 2 and 3). This is comparable to the 2006 accident rate per mile for all vehicle types for the Commonwealth of Virginia. The national average accident rate includes accidents at highway speeds and those involving multiple vehicles. Under the controlled conditions on the NAPS site, specifically, supervised truck movements and low speed limits, the accident rate per mile would be significantly lower. Therefore, the use of 2×10^{-6} as an estimate of the number of accidents per mile is conservative.

The probability of a cargo spill resulting in an explosion per accident, n_2, is determined using the assumption that 20% of highway truck crashes result in releases/spills, 20% of those releases involve a complete release of total cargo (Reference 2), and the probability of ignition, given a release, is 1. This results in an overall number of cargo explosions per accident of 0.04 or 4%. Accidents involving total cargo release were considered in this scenario because an explosion of a gasoline tanker truck would result in complete release of total cargo.

Historically, the frequency of shipment, f, for onsite delivery of gasoline to the NAPS site is 3 to 4 times per year. Conservatively assuming that there are 2 deliveries per unit per year, the addition of a third unit would increase the number of onsite gasoline deliveries per year to 6. Therefore a value of 6 deliveries per year is used to determine the accident rate for onsite gasoline delivery by truck.

The exposure distance, s, was calculated using RG 1.91 methodology based on a conservative estimate of 1900 feet for the safe separation distance. This value was presented in the North Anna ESP Application Site Safety Analysis Report (SSAR), Section 2.2.3.1.1, *Truck Traffic*, which assumed all 8500 gallons of gasoline in a tanker truck would be consumed in the explosion. With that much material consumed in a blast, a peak overpressure of 1 psi would be experienced as far as 1900 feet away from the point of explosion.

However, for chemicals stored or transported as liquids at atmospheric conditions (such as gasoline), the methodology for determining the TNT equivalent mass (W) presented in RG 1.91 is not applicable and the safe distance of 1900 feet is overly conservative. If the empty volume of the gasoline tanker truck is considered filled with gasoline and air at the upper flammability limit (UFL) and consumed in the blast, a much smaller safe separation distance would be obtained. This methodology is applied in FSAR Section 2.2.3.1.3, *On-Site Chemicals*, for the evaluation of on-site storage of materials with a confined vapor explosion hazard.

Given 1900 feet as the safe separation distance from the Unit 3 safety-related structures, there will be an exposure distance of 1.62 miles for the on-site delivery routes to both of the underground gasoline storage tanks. If the FSAR methodology is used instead, a much smaller safe separation distance would be obtained and therefore the exposure distance of 1.62 miles is also conservative.

Regulatory position C.2 of RG 1.91 states that if it is demonstrated that the rate of exposure to a peak positive incident overpressure in excess of 1 psi is less than 10^{-6} per year, when based on conservative assumptions, the rate of exposure is acceptable. Using the conservative inputs to the equation as described above, an annual exposure rate of 7.8×10^{-7} was obtained and thus the risk from explosion during on-site gasoline tanker truck deliveries is acceptable.

Proposed COLA Revision

A supplement will be added to FSAR Section 2.2.3.1.1 describing the probability analysis discussed above.

References

1. Regulatory Guide 1.91, Rev. 1, *Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants,* U.S. Nuclear Regulatory Commission, February 1978.

2. Federal Emergency Management Agency, U.S. Department of Transportation and U.S. EPA, *Handbook of Chemical Hazard Analysis Procedures, Section 11.3, Bulk Transportation of Hazardous Materials by Highway*, 1989.

3. NUREG/CR-6624, *Recommendations for Revision of Regulatory Guide 1.78*, U.S. Nuclear Regulatory Commission, November 1999.

4. Virginia Department of Motor Vehicles, *2006 Virginia Traffic Crash Facts.*

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 ESBWR 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.

Table 1.9-205 NUREG Reports Cited

NUREG No.	Issue Date	Title	Comment/ Section Where Discussed
1835, Supp. 1	11/2006	Safety Evaluation Report for an Early Site Permit (ESP) at the North Anna ESP Site, Supplement 1	1.8 2.0
CR-4013	04/1986	LADTAP II Technical Reference and User Guide	12.2
CR-4653	03/1987	GASPAR II Technical Reference and User Guide	12.2
CR-5512, Vol. 1	10/1992	Residual Radioactive Contamination from Decommissioning, Vol. 1	2.4
CR-6624	11/1999	Recommendations for Revision of Regulatory Guide 1.78	2.2
CR-6697	11/2000	Development of Probabilistic RESRAD 6.0 and RESRAD-BUILD 3.0 Computer Codes	2.4
CR-6728	10/2001	Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk-consistent Ground Motion Spectra Guidelines	2.5

2.2.2.6.2 **Airways**

The first paragraph of this SSAR section is supplemented as follows with information to identify an additional military training flight in the vicinity of NAPS.

NAPS COL 2.0-5-A

One civil airway (V223) and four military training routes (IR714, IR760, VR1754, and VR1755) pass near the Unit 3 site as shown in Figure 2.2-201, which is based on the Washington Sectional Aeronautical Chart issued in 2007 (Reference 2.2-202). The U.S. Department of the Navy identifies a total of 341 flight operations in the year 2006 for the four routes (Reference 2.2-203), as compared to the SSAR assumption of 6000 flights per year. As a result, the number of military training flights assumed in the SSAR remains bounding.

The second paragraph of this SSAR section is supplemented as follows with information on distances from military training flight routes to Unit 3.

The centerlines of three of the military training routes IR714, IR760, and VR1754, which are 16.1 km (10 mi) across, lie within 1.6 km (1 mi) of the Unit 3 site. The centerline of the fourth military training route, VR1755, is more than 12.9 km (8 mi) from Unit 3.

2.2.3 **Evaluation of Potential Accidents**

NAPS COL 2.0-6-A

The information needed to address DCD COL Item 2.0-6-A is included in SSAR Section 2.2.3, which is incorporated by reference with the following supplements.

2.2.3.1.1 **Truck Traffic**

Add the following at the end of this section.

NAPS COL 2.0-8-A

Gasoline tanker truck explosion hazards due to local deliveries on-site are addressed by considering the likelihood of an accident leading to a significant overpressure. According to RG 1.91, the risk from potential explosion hazards can be shown to be sufficiently low on the basis of low probability of an explosion when the rate of exposure to a peak overpressure in excess of 7 kPa (1 psi) is less than 10^{-6} per year using conservative assumptions. Per RG 1.91, the following equation was used:

$$r = n_1 \times n_2 \times f \times s \qquad (2.2.3.1.1\text{-}1)$$

where,

r = exposure rate (the probability of an explosion occurring)

n_1 = accidents per km (mi) for the transportation mode (truck transport)

n_2 = cargo explosion per accident for the transportation mode

f = frequency of shipment for the substance, in shipments per year

s = exposure distance in km (mi)

The number of accidents per km (mi) for truck transport, n_1, is 1.25×10^{-6}/km (2×10^{-6}/mi) based on an average value for large trucks (References 2.2-213 and 2.2-214). This is comparable to the 2006 accident rate per mile for all vehicle types for the Commonwealth of Virginia. The national average accident rate includes accidents at highway speeds and those involving multiple vehicles. Whereas, under the controlled conditions on the NAPS site; specifically, supervised truck movements and low speed limits, the accident rate per mile would be much lower. Therefore, the use of 1.25×10^{-6}/km (2×10^{-6}/mi) as an estimate of the accident rate for tractor-trailers carrying hazardous materials is very conservative.

The probability of a release and cargo explosion per accident, n_2, is determined using the assumption that 20 percent of highway truck crashes result in releases/spills, 20 percent of those releases involve a complete release of total cargo (Reference 2.2-213), and the probability of ignition given a release is 1. This results in an overall number of cargo explosions per accident of 0.04 or 4 percent.

The frequency of shipment, f, for on-site delivery of gasoline to the North Anna site is two to three times per year. Conservatively assuming that there are two deliveries per unit per year, the addition of a third unit would increase the number of gasoline deliveries per year to six. Therefore, a value of six deliveries per year is used to determine the accident rate for onsite gasoline delivery by truck.

Considering the portions of on-site delivery truck routes within 580 m (1900 ft) of Unit 3 safety-related structures, the exposure distance, s, would be 2.61 km (1.62 mi). However, using 580 m (1900 ft) is conservative in comparison with the methodology described in Section 2.2.3.1.3 for determining the safe separation distance. Therefore, the exposure distance of 2.61 km (1.62 mi) is also conservative.

Using the conservative inputs to Equation 2.2.3.1.1-1 as described above, an annual exposure rate of 7.8×10^{-7} was obtained, which is less than 10^{-6} per year, so there is a sufficiently low risk from explosion during on-site gasoline tanker truck deliveries.

NAPS ESP COL 2.2-2

2.2.3.1.3 On-Site Chemicals

The chemical materials stored on-site at Units 1, 2, and 3 are identified in Table 2.2-202. This table also identifies storage locations and the quantity of each chemical/material. Properties relative to the hazards of each chemical and the results of a screening analysis based on these hazardous properties are provided in Table 2.2-203. The on-site chemicals with the potential to be flammable or explosive are evaluated for possible effects on Unit 3 safety-related SSCs.

Table 2.2-203 shows that the majority of the chemicals are not toxic. For chemicals with immediately dangerous to life or health (IDLH) values listed in this table, the effects of toxic vapors or gases and their potential for incapacitating Unit 3 control room operators are evaluated and the results presented in Section 6.4.

Table 2.2-203 also shows that very few chemicals present a flammability or explosive hazard. As shown by the table column labeled "Flammable/Explosive?", three of the materials have flammability and explosive properties that needed analysis. These are hydrogen, hydrazine, and Nalco H-130© (a non-oxidizing biocide). The analysis of these materials is described below.

For each of these materials, minimum safe separation distances for flammable materials and explosive materials were determined for comparison with the actual distance from the storage location to the nearest Unit 3 safety-related SSC. For flammable materials, there are two minimum safe separation distances based on whether the material vaporizes and burns (thermal exposure hazard) or whether the material vaporizes and detonates (explosion overpressure hazard).

The safe separation distance for the storage of explosive materials is determined according to RG 1.91 and FM Global Guidelines for Evaluating the Effects of Vapor Cloud Explosions Using a TNT Equivalency Method (Reference 2.2-204).

Per RG 1.91, 7 kPa (1 psi) is a conservative value of peak positive incident overpressure, below which no significant damage to safety-related SSCs would be expected. The minimum safe separation

2.2-209 NALCO Company, Material Safety Data Sheets, H-130 issued December 30, 2005, 3D TRASAR® 3DT177 - issued February 14, 2007, and 3D TRASAR® 3DT104 - issued February 15, 2007.

2.2-210 Perry, R. H., D. W. Green. (1977) Perry's Chemical Engineer's Handbook (7th Edition) (Table 2-5). McGraw-Hill.

2.2-211 Mallinckrodt Baker, Inc., Material Safety Data Sheets, Sodium Bromide - effective date October 19, 2005, Sodium Bisulfate - effective date March 16, 2006, Trisodium Phosphate -effective date November 10, 2005, Sodium Sulfite - effective date June 16, 2005, Disodium Phosphate - effective date May 9, 2005, Sand - effective date August 2, 2006, and Sodium Carbonate - effective date August 17, 2006.

2.2-212 National Institute for Occupational Safety and Health (NIOSH), Center for Disease Control and Prevention (CDC), November 2007.

2.2-213 Federal Emergency Management Agency, U.S. Department of Transportation and U.S. EPA, Handbook of Chemical Hazard Analysis Procedures, Section 11.3, Bulk Transportation of Hazardous Materials by Highway, 1989.

2.2-214 NUREG/CR-6624, Recommendations for Revision of Regulatory Guide 1.78, U.S. Nuclear Regulatory Commission, November 1999.

2.2-215 Virginia Department of Motor Vehicles, 2006 Virginia Traffic Crash Facts.

ENCLOSURE 2

Response to NRC RAI Letter 025

RAI Question 02.02.03-4

NRC RAI 02.02.03-4

In accordance with 10 CFR 52.79(a)(1)(vi) a safety assessment of a site is needed to determine suitability of building a reactor on that site. COL Information Item 2.0-6-A related to evaluation of potential accidents to be covered under ESP COL Action item 2.2-2 is one facet of that safety assessment. The quantity of sodium hydroxide in NAPS 3 FSAR Table 2.2-202 is 180 gallons and is not analyzed for toxicity, whereas NAPS 1 and 2 UFSAR version 42 (Table 6.4-1) gives sodium hydroxide quantity of 55 gallons, and is analyzed for toxicity. It has control room concentration of 7.73 mg/m3 compared to limiting concentration of 10 mg/m3. Please clarify the discrepancy and correct if required for NAPS 3 FSAR.

Dominion Response

The discrepancy between the control room habitability evaluations for sodium hydroxide solution in North Anna Power Station (NAPS) Units 1 and 2 Updated Final Safety Analysis Report (UFSAR) and North Anna Unit 3 (NA3) Final Safety Analysis Report (FSAR) is due to differences in the methodology used. Sodium hydroxide solution is not analyzed in the control room habitability evaluation for the NA3 FSAR because it does not present a toxic hazard. Sodium hydroxide solution has a low vapor pressure. The vapor pressure of 50% sodium hydroxide is 6.33 mmHg (6.33 torr) at 40 °C (104 °F) (Reference 1). As described in Note 1 of NA3 FSAR Table 2.2-203, *NAPS On-Site Chemicals, Disposition*, if a chemical has a vapor pressure below 10 torr it is not considered a hazard. For such materials, the evaporation rate at normal temperatures is not sufficient to form a vapor cloud capable of reaching hazardous concentrations (Reference 2). Therefore, sodium hydroxide solution does not present a toxic hazard, and no further analysis is required.

By contrast, the methodology in NAPS 1 and 2 UFSAR, Revision 42, assumes that the entire quantity of sodium hydroxide vaporizes and immediately enters the control room air intake with no dilution. This is an extremely conservative assumption that does not take into account either the evaporation rate of sodium hydroxide or the dilution of the vapor cloud due to transport from the spill location to the air intake.

Using the more reasonable but still conservative approach of evaluating the potential for vaporization to occur eliminates the necessity for further analysis of sodium hydroxide in NA3 FSAR.

References:

1. MSDS Ref. No.: 1310-73-2-3, Revision 4, "Material Safety Data Sheet: Sodium Hydroxide 50% Solution," FMC Wyoming Corporation, 01/26/2004.

2. U.S. Nuclear Regulatory Commission Regulatory Guide 1.78, "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," Revision 1, December 2001.

Proposed COLA Revision

None.