Duke Energy®

CHRISTOPHER M. FALLON
Vice President
Nuclear Development (Acting)

Duke Energy
EC09D/ 526 South Church Street
Charlotte, NC 28201-1006

Mailing Address:
P.O. Box 1006 – EC09D
Charlotte, NC 28201-1006

704-382-9248
704-519-6173 (cell)
Christopher.Fallon@duke-energy.com

March 28, 2012

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Duke Energy Carolinas, LLC
William States Lee III Nuclear Station – Docket Nos. 52-018 and 52-019
AP1000 Combined License Application for the
William States Lee III Nuclear Station Units 1 and 2
Response to Request for Additional Information (RAI No. 6339)
Ltr# WLG2012.03-07

Reference: Letter from Brian Hughes, (NRC) to James Thornton (Duke Energy), Request for Additional Information Letter No. 103 Related to SRP Section 02.02.03 – Evaluation of Potential Accidents for the William States Lee III Units 1 and 2 Combined License Application, dated February 28, 2012 (ML12059A492)

This letter provides the Duke Energy response to the Nuclear Regulatory Commission's request for additional information (RAI) 02.02.03-008 included in the referenced letter.

The response to the NRC information request described in the referenced letter is addressed in a separate enclosure, which also identifies associated changes to be made in a future revision of the Final Safety Analysis Report for the Lee Nuclear Station.

If you have any questions or need any additional information, please contact James R. Thornton, Nuclear Plant Development Licensing Manager (Acting), at (704) 382-2612.

Sincerely,

Christopher M. Fallon

Christopher M. Fallon
Vice President
Nuclear Development (Acting)

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NRO

www.duke-energy.com

Enclosure:

1) Lee Nuclear Station Response to Request for Additional Information (RAI), Letter No. 103, RAI 02.02.03-008.

xc (w/o enclosure):
Charles Casto, Deputy Regional Administrator Region II

xc (w/enclosure):
Brian Hughes, Senior Project Manager, DNRL

AFFIDAVIT OF CHRISTOPHER M. FALLON

Christopher M. Fallon, being duly sworn, states that he is Vice President, Nuclear Development (Acting), Duke Energy Carolinas, LLC, that he is authorized on the part of said Company to sign and file with the U. S. Nuclear Regulatory Commission this combined license application for the William States Lee III Nuclear Station, and that all the matter and facts set forth herein are true and correct to the best of his knowledge.

Christopher M. Fallon

Christopher M. Fallon, Vice President
Nuclear Development (Acting)

Subscribed and sworn to me on March 28, 2012

Freda K. Crump
Notary Public

My commission expires: August 17, 2016

SEAL

FREDA K CRUMP
NOTARY
PUBLIC
LINCOLN COUNTY, NC

Lee Nuclear Station Response to Request for Additional Information (RAI)

RAI Letter No. 103

NRC Technical Review Branch: Evaluation of Potential Accidents

Reference NRC RAI Number(s): 02.02.03-008 (eRAI 6339)

NRC RAI:

RG 1.206 provides guidance regarding the information that is needed to ensure that the potential hazards in the vicinity of the site are identified and evaluated in order to meet the siting criteria in 10 CFR 100.20 and 10 CFR 100.21.

In William Lee Station (WLS) Units 1 and 2 COL FSAR Section 2.2.3.1.1.4, the applicant identified in FSAR Table 6.4-202, additional site specific chemicals that are outside the scope of DCD evaluations. The applicant also stated that "Based on the screening guidance provided in Regulatory Guide 1.78, none of the site-specific chemicals used were found to be a credible habitability threat to main control room occupants in case of a release." However, no discussion or justification is provided in making this conclusion. Additionally, in FSAR Section 2.2.3.1.3 the applicant stated that "Accidents involving the release of toxic chemicals from on-site facilities and nearby mobile and stationary sources are addressed in Section 6.4. For each postulated event, the concentration at the site is determined for use in evaluating the control room habitability." However, in Section 6.4 such evaluations are not presented, except for chlorine from truck transport. In addition, onsite site-specific chemical evaluations are not presented other than the reference of Table 6.4-202; therefore, the staff is not able to review the information and the screening analysis performed by the applicant in concluding that on-site chemicals do not pose a threat to control room habitability.

Based on the review of site-specific chemicals listed in Table 6.4-202, the consideration of Chemical Methoxypropylamine (MPA) by the Vogtle RCOLA, and on guidance within RG 1.78, the two site specific chemicals MPA, and Dimethylamine used by WLS were analyzed by the staff as confirmatory calculations. The respective concentrations from the staff's confirmatory analysis of these two chemicals, at the intake to the control room are found to exceed the IDLH (Immediate Danger to Life and Health) concentration. Therefore, they may have a potential to exceed the respective IDLH concentration in the control room.

Address the information, provide the rationale, analysis and discussion in connecting both the FSAR Sections consistently as appropriate to justify and present the conclusion. Also provide the proposed changes you intend to make to the FSAR.

Duke Energy Response:

Analysis of Methoxypropylamine (MPA)[1] and Dimethylamine (DMA)[2]

Duke Energy's letter to the NRC on February 11, 2011 (Reference 1) provided additional information pertaining to the analysis of methoxypropylamine (MPA) and dimethylamine (DMA).

[1] Methoxypropylamine has a Chemical Abstract Service (CAS) registry number of 5332-73-0 and is also known as 3-Methoxypropylamine.

[2] Dimethylamine has a CAS registry number of 124-40-3.

That letter (Reference 1) presented the screening methodology for chemicals stored and used onsite (FSAR Table 6.4-202). The listing includes chemicals suggested for use by Westinghouse for the standard AP1000 plant (and evaluated in the DCD) and site specific chemicals. That letter (Reference 1) described the screening methodology that was applied to the evaluation of site specific chemicals. As stated in Reference 1, the screening method first evaluated these chemicals based on chemical properties provided in each chemical's material safety data sheet (MSDS). Hazard classifications and associated criteria established by the National Fire Protection Association (NFPA) and the Hazardous Materials Identification System (HMIS) were obtained from each chemical's MSDS to support a screening evaluation. In general, screening sought to identify chemicals with NPFA 704 or HMIS Class 3 or Class 4 for further analysis and possible detailed dispersion model analysis.

Regulatory Guide 1.78, Revision 1, December 2001 (RG 1.78) and NUREG/CR-6624 (referenced in RG 1.78) provide levels based on the Immediately Dangerous to Life and Health concept, otherwise expressed as the IDLH level or limit. From RG 1.78 (Section B):

> The use of IDLH is considered appropriate since it provides an adequate margin of safety as long as control room operators use protective measures within 2 minutes after the detection of hazardous chemicals; they therefore would not be subjected to prolonged exposures at the IDLH concentration levels.

Note, RG 1.78 Table 1 does not provide an IDLH for either MPA or DMA. NUREG/CR-6624 (Appendix A, Line Item#135), referenced in RG 1.78, provides an IDLH for DMA at 500 ppm. No IDLH is provided in the NUREG for MPA, nor has the National Institute for Occupational Safety and Health (NIOSH) established a limit for this chemical. As discussed later in this response, the appropriate toxicity limit for MPA is set as 15 ppm based on the Workplace Environmental Exposure Level for an exposure over a 15 min period (Reference 4).

Duke Energy selected an appropriate dispersion model, SLAB (References 2 and 3), and conducted additional analyses to assess and confirm the hazard to control room personnel associated with MPA and DMA. As discussed in the modeling software's user manual (Reference 3), "the mathematical description of the physics of heavy gas dispersion (gravity spread, reduced turbulent mixing, etc.), as well as the description of the normal atmospheric advection and turbulent diffusion processes, are inherently included in the conservation equations." Key points considered in the selection of SLAB, as appropriate for these analyses, are the following:

- The source code, executable programs, and user manual are publicly available through the Environmental Protection Agency (EPA) (References 2 and 3).
- The model is developed specifically to deal with dispersion of dense gases.
- The model has the capability of predicting concentrations at a downwind, elevated receptor; therefore, the design of the elevated AP1000 control room intake can be considered in the analyses.

Note, the ALOHA code was considered for performing these analyses because it has the capability of analyzing dense gas behavior, using the DEGADIS model. However, ALOHA provides estimated concentrations at ground level receptors only, which leads to unnecessarily conservative results. The SLAB model was considered to offer a better overall alignment with analysis requirements.

Duke Energy made the following key assumptions and inputs when performing the analyses on these chemicals.

- Both chemicals are in aqueous solutions, 60% and 5% for MPA and DMA respectively. The mass of each chemical involved in the hypothetical spill was based on the mass fraction of 60% or 5%, as appropriate.
- The distance from the release point to the control room air intake is direct (i.e., an unobstructed, straight line path).
- MPA is stored as 330 gallons of 60% aqueous solution at ground level, 203 ft from the control room intake.
- DMA is stored as 330 gallons of 5% aqueous solution at ground level, 203 ft from the control room intake.
- The elevation of the control room intake is 19.9 meters, based on DCD Table 15A-7. A value of 17 meters is used in these analyses to reflect the elevation of the lower opening of the intake.
- Tables 1 and 2 of this response list key chemical properties of MPA and DMA used in these analyses and/or input to the SLAB model.
- Concentration averaging time (TAV)

The SLAB model, for a given set of input values, computes the maximum average concentration for a specified time duration (TAV) at a particular location (x,y,z). This input is referred to as the concentration averaging time. As discussed in the SLAB User's Manual (Reference 3), "the reason for time averaging is that safety levels for hazardous chemicals are generally expressed as a maximum allowable average concentration level for a given time of exposure."

<u>TAV for MPA.</u> The Workplace Environmental Exposure Level (WEEL) for MPA is given at 15 ppm for a short-term, time weighted average exposure over a 15 min period (Reference 4). The 15 ppm level is consistent with the Department of Energy maintained data set of Protective Action Criteria (PAC) values (Reference 5). The DOE PAC data base provides a convenient resource for exposure limits, including the EPA's Acute Exposure Guideline Levels (AEGLs). From the DOE PAC database, the various PAC levels (PAC-1, PAC-2, and PAC-3) for MPA are given at 15 ppm. Since the WEEL value is given as a 15 minute exposure time, the TAV input for MPA is appropriate for 15 minutes.

<u>TAV for DMA.</u> NUREG/CR-6624 (Appendix A, Line Item#135), referenced in RG 1.78, provides an IDLH for DMA at 500 ppm. A TAV value of 1 second was selected to estimate the peak instantaneous concentration.

Table 1: MPA Chemical Properties

Property	Value
Molecular Weight	89.14 g/mol
Vapor Heat Capacity at Constant Pressure	1.5 kJ/kg*K
Boiling Point Temperature	118.3°C
Heat of Vaporization	35.65 kJ/mol
Liquid Heat Capacity	225.52 J/mol*K at 298.15K
Liquid Density of Source Material	0.874 g/ml at 25°C
Vapor Pressure	20 mmHg at 30°C

Table 2: DMA Chemical Properties

Property	Value
Molecular Weight	45.0837 g/mol
Vapor Heat Capacity at Constant Pressure	1.532 kJ/kg*K
Boiling Point Temperature	7°C
Heat of Vaporization	26.4 kJ/mol
Liquid Heat Capacity	136.77 J/mol*K at 280.44K
Liquid Density of Source Material	0.68 g/ml at 20°C
Vapor Pressure	1277 mmHg at 20°C

Since evaporation is promoted by sunlight, warm air, and good mixing, the meteorological conditions to demonstrate worst case conditions would involve relatively high air temperatures (that is, 35°C) and unstable air (Stability Class A) with modest winds. To determine worst case conditions, sensitivity analyses were conducted with wind speeds at 1, 2, and 3 m/s at Stability Class A. The wind speed providing the highest concentration was then analyzed at Stability Classes B and D. More stable air classes, (i.e., Stability Classes E, F, and G) reflect more stable air and would result in less evaporation, therefore decreasing concentration at the control room intake.

Results of these analyses are presented in Table 3 of this response. In general, these results show that the worst case meteorological conditions are associated with Stability Class A and the lower wind speed of 1 m/s, for both MPA and DMA.

MPA. The appropriate exposure duration is 15 minutes and the exposure limit (PAC and WEEL) is 15 ppm. The maximum average concentration for a 15 minute duration of exposure for MPA is 2.64 ppm at the control room intake, below the limit of 15 ppm.

DMA. The SLAB analysis, using a duration of TAV = 1 second, provides a peak concentration of 28.5 ppm. This value is well below the IDLH value of 500 ppm, specified in NUREG/CR-6624, Appendix A.

Table 3: Summary of Results

Air Stability	Wind Speed (m/s)	MPA 15 Min Maximum Avg Concentration at Intake (ppm)	DMA Peak (1 sec) Concentration at Intake (ppm)
Class A	1	2.64	28.5
Class A	2	2.27	25.8
Class A	3	2.08	23.7
Class B	1	2.45	23.4
Class D	1	7.76E-09	1.00E-16

The analyses of MPA and DMA show concentrations to be below the exposure limits at the control room intake. Therefore, these two chemicals do not represent a toxic gas hazard to control room habitability.

Discussion of FSAR Changes

In response to the NRC RAI, the FSAR is revised as follows:

- FSAR Subsection 2.2.3.1.1.4 is updated to indicate that two chemicals required additional evaluation following the screening of site specific chemicals stored onsite. This subsection is also revised to include a reference to FSAR Section 6.4 for discussion of site specific chemicals requiring additional evaluation.
- FSAR Subsection 2.2.3.1.1.4 is revised to provide a brief summary of the AP1000 evaluation of onsite chemicals that are included in the DCD standard plant design and, therefore, evaluated for impacts to control room habitability in the DCD. This information is added to be consistent with the Vogtle Units 3 and 4 R-COLA FSAR Subsection 2.2.3.2.3.2.
- FSAR Subsection 2.2.3.1.3 is revised to state that the analysis of site specific chemicals (stored onsite) requiring further evaluation is presented in FSAR Section 6.4. Thus, with this clarification of scope, FSAR Subsection 2.2.3.1.3 addresses toxic chemicals only in terms of nearby mobile and stationary sources.
- FSAR Subsection 2.2.3.1.3.1 is revised to provide additional information on the screening process of toxic chemicals and on the setting of toxicity limits used in toxic gas evaluations.
- FSAR Subsection 6.4.4.2 to correct description of NIOSH.
- New FSAR Subsection 6.4.4.2.1 is added to provide a summary discussion of the evaluation and results of the analysis of MPA and DMA. FSAR Subsection 6.4.4.2.1 concludes that these chemicals do not represent a toxic hazard to the control room personnel.
- FSAR Table 6.4-202 is revised to indicate that the Main Control Room Habitability Impact Evaluation for MPA and DMA is "IH," meaning that the evaluation considered the design detail of the control room intake height.

References:

1. Letter from Bryan J. Dolan (Duke Energy) to NRC Document Control Desk, *Habitability Systems*, LTR# WLG2011.02-04, dated February 11, 2011 (ML110480148).
2. Environmental Protection Agency, Alternative Models, Technology Transfer Network, Support Center for Regulatory Atmospheric Modeling, Website http://www.epa.gov/scram001/dispersion_alt.htm, accessed March 15, 2012.
3. Ermak, Donald, L., "User's Manual For SLAB: An Atmospheric Dispersion Model for Denser-Than-Air Releases," UCRL-MA-105607, June 1990.
4. American Industrial Hygiene Association, AIHA Guideline Foundation, "Current WEEL Values (2011), Website, http://www.aiha.org/insideaiha/GuidelineDevelopment/weel/Documents/2011%20WEEL%20Values.pdf, Accessed 3/15/2012
5. Department of Energy, "Chemical Safety Program: PACs for Chemicals of Concern," Revision 27, February 2012, Website http://www.atlintl.com/DOE/teels/teel.html, Accessed March 14, 2012.

Associated Revisions to the Lee Nuclear Station Final Safety Analysis Report:

1. FSAR Subsection 2.2.3.1.1.4
2. FSAR Subsection 2.2.3.1.3
3. FSAR Subsection 2.2.3.1.3.1
4. FSAR Subsection 6.4.4.2
5. FSAR Subsection 6.4.4.2.1 (New)
6. FSAR Table 6.4-202.

Attachments:

1. Attachment 1 to Response for Request for Additional Information 02.02.03-008, Update to FSAR Chapter 2 Text.
2. Attachment 2 to Response for Request for Additional Information 02.02.03-008, Update to FSAR Chapter 6, Text and Table.

Attachment 1

Response for Request for Additional Information 02.02.03-008

Update to FSAR Chapter 2 Text

COLA Part 2, FSAR Chapter 2, Subsection 2.2.3.1.1.4, fifth paragraph is revised and a new last paragraph is added as follows:

Table 6.4-202, Part B, identifies additional site specific chemicals that are outside the scope of DCD evaluations. These site specific chemicals were screened for solid material explosion, confined and unconfined vapor explosion, flammability, and toxic gas release event hazards. These chemicals are not in solid state and are not flammable; therefore, solid material explosion hazard, confined and unconfined vapor explosion hazard, and flammability hazard evaluations are not required. Based on the screening guidance provided in Regulatory Guide 1.78, with two exceptions, none of the site-specific chemicals used were found to be a credible habitability threat to main control room occupants in case of a release. See Section 6.4 for analysis of site specific chemicals requiring additional evaluation.

Table 6.4-202, Part A, provides specific information about the chemicals described in DCD Table 6.4-1. This includes chemical names or limiting types and quantities. Except as noted, these chemicals have been suggested by Westinghouse for use in the AP1000 and have been evaluated in conjunction with AP1000 standard design and found not to present a hazard to the control room operators or to safety-related systems, structures, or components. No further evaluation or analysis regarding impact to control room habitability for these chemicals is required.

COLA Part 2, FSAR Chapter 2, Subsection 2.2.3.1.3, first paragraph is revised to read:

WLS COL 2.2-1 WLS COL 6.4-1 As stated in Subsection 2.2.3.1.1.4, analysis of site specific chemicals (stored on-site) requiring further evaluation is presented in Section 6.4. Accidents involving the release of toxic chemicals from ~~on-site storage facilities and~~ nearby mobile and stationary sources are addressed in this section. ~~Section 6.4. For each postulated event, the concentration at the site is determined for use in evaluating the control room habitability.~~

COLA Part 2, FSAR Chapter 2, Subsection 2.2.3.1.3.1, fifth paragraph is revised to read:

The screening criteria for airborne hazardous chemicals is established in Regulatory Guide 1.78, based on the National Institute for Safety and Health (NIOSH) Immediately Dangerous to Life and Health (IDLH) limits for 30 minute exposures. The criteria of Regulatory Guide 1.78 was supplemented in the screening assessment by considering chemical properties and health hazard classifications established by the National Fire Protection Association or Hazardous Materials Identification System. Per Regulatory Guide 1.78, the NIOSH IDLH values were utilized to ~~screen chemicals and to~~ evaluate concentrations of hazardous chemicals to determine their effect on control room habitability. For those cases in which neither Regulatory Guide 1.78 nor NUREG/CR-6624 establish an IDLH value, an appropriate toxicity limit was applied consistent with current industry standards.

Attachment 2

Response to Request for Additional Information 02.02.03-008

Update to FSAR Chapter 6 Text and Table

COLA Part 2, FSAR Chapter 6, Subsection 6.4.4.2, first paragraph is revised as follows:

6.4.4.2 Toxic Chemical Habitability Analysis

WLS COL 6.4-1 Regulatory Guide 1.78 establishes the ~~Occupational Safety and Health Association (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 Regulatory Guide 1.78, the NIOSH IDLH values were utilized to screen chemicals and to evaluate concentrations of hazardous chemicals to determine their effect on control room habitability.

COLA Part 2, FSAR Chapter 6 is revised to add the following new subsection:

6.4.4.2.1 Onsite Chemicals

Table 6.4-202, Part B, identifies site specific chemicals (stored onsite) that are outside the scope of DCD evaluations. For these site specific chemicals, this table presents the chemical name, evaluated (initial) state, maximum quantity, distance to the main control room, and the evaluation outcome per standard plant definitions in Note a of the table.

As stated in Subsection 2.2.3.1.1.4, the screening of these site specific chemicals identified two chemicals requiring further evaluation. Those chemicals are methoxypropylamine (MPA) and dimethylamine (DMA). While stored in aqueous solution form, the accidental spill of these liquids was evaluated as pools evaporating into the gaseous state. These two chemicals, when in gaseous state, are considered to be dense gases (more dense than air). Airborne concentrations associated with the accidental spill and dispersion of these chemicals is evaluated with an appropriate dense gas dispersion modeling software that is capable of determining gas concentrations at an elevated control room intake receptor location, consistent with the design of the AP1000 plant. This evaluation demonstrates that concentrations at the elevated control room intake do not represent a toxic hazard to control room personnel.

TABLE 6.4-202 (SHEET 2 OF 4)
MAIN CONTROL ROOM HABITABILITY EVALUATIONS OF ONSITE TOXIC CHEMICALS [a]

Evaluated Material	Evaluated State	Evaluated Maximum Quantity	Evaluated Minimum Distance to MCR Intake	Evaluated Location	MCR Habitability Impact Evaluation
A - STANDARD ONSITE TOXIC CHEMICALS					
Scale Inhibitor [Sodium Hexametaphosphate] [b]	Liquid	10,000 gal.	436 ft.	CWS area	S
Biocide/Disinfectant [Sodium hypochlorite]	Liquid	800 gal.	203 ft.	Turbine building	S
Biocide/Disinfectant [Sodium hypochlorite]	Liquid	10,000 gal.	436 ft.	CWS area	S
Algaecide [Ammonium comp. polyethoxylate] [b]	Liquid	800 gal.	203 ft.	Turbine building	S
Algaecide [Ammonium comp. polyethoxylate] [b]	Liquid	10,000 gal.	436 ft.	CWS area	S
B - SITE SPECIFIC ONSITE TOXIC CHEMICALS					
pH Addition [60% aqueous solution of Methoxypropylamine] ~~[c]~~	Liquid	330 gal.	203 ft.	Turbine building	~~S~~IH
pH Addition [5% aqueous solution of Dimethylamine] ~~[c]~~	Liquid	330 gal.	203 ft.	Turbine building	~~S~~IH
Oxygen Scavenger [20% aqueous solution of Carbohydrazide] [c]	Liquid	330 gal.	203 ft.	Turbine building	S
Corrosion Inhibitor [42% aqueous solution of Sodium Bisulfite] [c]	Liquid	330 gal.	203 ft.	Turbine building	S

WLS COL 6.4-1