TVA

Tennessee Valley Authority, 1101 Market Street, LP 5A, Chattanooga, Tennessee 37402-2801

June 29, 2009

10 CFR 52.79

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

In the Matter of)
Tennessee Valley Authority)

Docket No. 52-014 and 52-015

BELLEFONTE COMBINED LICENSE APPLICATION – RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION – EVALUATION OF POTENTIAL HAZARDS – IDLH CONCENTRATIONS

References:
1) Letter from Joseph Sebrosky (NRC) to Andrea L. Sterdis (TVA), Request for Additional Information Letter No. 132 Related to SRP Section 02.02.03 for the Bellefonte Units 3 and 4 Combined License Application, dated October 23, 2008.

2) Letter from Andrea L. Sterdis (TVA) to Document Control Desk (NRC), Request for Additional Information Letter No. 132 Supplement 1 Related to EVALUATION OF POTENTIAL HAZARDS – IDLH CONCENTRATIONS for the Bellefonte Units 3 and 4 Combined License Application, dated February 13, 2009.

This letter provides the Tennessee Valley Authority's (TVA) supplemental response to the Nuclear Regulatory Commission's (NRC) request for additional information (RAI) item in Reference 1.

The response to RAI number 02.02.03-08 is supplemented in the enclosure to replace the identified portions of the original submittal provided in Reference 2. This response also identifies associated changes to be made in a future revision of the BLN application.

This response is based on additional information pertaining to the evaluation of gasoline transportation accidents and the resulting impact to control room habitability discussions as included in Reference 2.

If you should have any questions, please contact Tom Spink at 1101 Market Street, LP5A, Chattanooga, Tennessee 37402-2801, by telephone at (423) 751-7062, or via email at tespink@tva.gov.

DO85
NRO

I declare under penalty of perjury that the foregoing is true and correct.

Executed on this 29th day of June, 2009.

Andrea L. Sterdis

Andrea L. Sterdis
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Nuclear Generation Development & Construction

Enclosure
cc: See Page 3

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Enclosure
TVA letter dated June 29, 2009
RAI Response

Responses to NRC Request for Additional Information letter No. 132 dated October 23, 2008
(6 pages, including this list)

Subject: Evaluation of Potential Hazards in the Final Safety Analysis Report

RAI Number	**Date of TVA Response**
02.02.03-08	February 13, 2009 supplemented in this letter – see following pages
02.02.03-09	November 24, 2008

Associated Additional Attachments / Enclosures	**Pages Included**
Attachment 02.02.03-08A	February 13, 2009
Attachment 02.02.03-08B	February 13, 2009
Attachment 02.02.03-08C	3 Pages

NRC Letter Dated: October 23, 2008

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.02.03-08

RG 1.206 provides guidance regarding the information that is needed to ensure potential hazards in the site vicinity are identified and evaluated to meet the siting criteria in 10 CFR 100.20 and 10 CFR 100.21. The IDLH concentrations of gasoline (300 ppm, 1227 mg/cu.m), ammonia (300 ppm, 209 mg/cu.m), and propylene oxide (400 ppm, 949 mg/cu.m) are lower than the applicant's screening criteria. Justify the use of the screening criteria with higher than IDLH concentrations and how they relate to control room habitability. In addition, based on the applicant's provided information (Tables 2.2-215 and 2.2-216), chemicals with IDLH concentrations considered for barge transport, styrene (2978 mg/cu.m), ethanol (6209 mg/cu.m), sodium hydroxide (10 mg/cu.m), pose a concern for control room habitability. The staff's independent analysis shows that the concentrations of these chemicals exceed the respective IDLH concentrations at the intake of the control room. Provide a basis for why these chemicals do not pose a potential control room habitability issue.

BLN RAI ID: 3457

BLN RESPONSE:

Because the response to this response provided in the first supplement was extensive, only the revised portion of the response is provided below. In particular, the portion related to the Roadway gasoline evaluation (and its associated Attachment) is replaced as indicated below.

Under ROADWAYS, the entire Supplement 1_Gasoline discussion is replaced with the following:

The previous response to RAI 02.02.03-08 (BLN-RAI-LTR-132 Supplement 1) determined an Immediately Dangerous to Life or Health (IDLH) value for gasoline since no published value could be identified. An IDLH value for gasoline was calculated as 780 ppm or 3,442.58 mg/m^3 (see Attachment 02.03.02-08C). This revised response utilizes an NRC suggested value of 300 ppm as the IDLH value for the analysis. Because this value is more conservative in relation to the calculated value, this re-evaluation is likewise considered to be more conservative.

Gasoline is a complex mixture of chemicals and does not have an IDLH value established by the National Institute for Occupational Safety and Health (NIOSH). In the absence of a regulatory IDLH value for gasoline, a conservative approach is used utilizing the minimum of the Temporary Emergency Exposure Limit (TEEL), Total Weighted Average exposure limit (TWA), Protective Action Criteria (PAC) or 10% Lower Explosive Limit (LEL) values obtainable from industry.

A time weighted average (TWA) exposure limit value of 300 ppm is used as a limiting value in the analysis to investigate gasoline release effects on the MCR habitability.

This analysis includes a sensitivity study which determines a worst case environmental conditions scenario. The sensitivity study included variation of ground temperatures, air temperatures, wind speeds, and stability classes. However, it is not possible to accurately determine the worst case environmental conditions from results of the HABIT V1.1. HABIT V1.1 internal programming causes the analysis to terminate prior to attaining peak concentrations. In order to determine the worst case environmental conditions and subsequently highest calculated chemical concentrations experienced by the main control room (MCR) operators, an alternate analysis was performed. To avoid early termination and extend the analysis to the peak MCR concentration time period of interest, the EXTRAN and CHEM source codes were translated into JAVA programming language and recompiled with a minimum of modification. The alternate analysis used the same toxic gas transport and dispersion modeling methods and properties as applied in the HABIT V1.1 code. The results of the alternative analysis were superimposed onto the representation of HABIT V 1.1 code in Figure A1 to confirm agreement.

The following are the inputs used for the EXTRAN module of HABIT V 1.1 code:

Release type: Liquid Tank Burst

Release height: 0 m

Storage temperature: 37.61 °C daytime; 21.89 °C nighttime

Air temperature: 37.61 °C daytime; 21.89 °C nighttime

Max Pool Radius: 0 m

Distance to intake: 2011 m (from FSAR Figure 2.2-201 the value is 1.5 miles, the value of 1.25 miles is used for conservatism.)

Intake height: 17 m

Atmospheric Pressure: 760 mmHg

Solar radiation: 1140 W/m^2 daytime; 0 W/m^2 nighttime

Cloud cover: 0

Ground temperature: 39.61 °C daytime; 21.89 °C nighttime

The chemical properties of gasoline vary with grade and composition. The Chemical Abstract Service (CAS) number is 8006-61-9 (<http://www.udec.cl/matpel/hazardous_materials/gasoline.pdf>). Using this information, the following properties were identified as reasonable values from industry sources.

Molecular weight: Average of 108 (<http://www.atsdr.cdc.gov/MHMI/mmg72.html>)

Boiling point: 50 °C (<http://www.atsdr.cdc.gov/MHMI/mmg72.html> provides a wide range; 50 °C selected to be above air temperature)

Liquid Heat Capacity: 2.22 kJ/kg*K (<http://www.engineeringtoolbox.com/specific-heat-fluids-d_151.html and http://www.engineeringtoolbox.com/fluids-evaporation-latent-heat-d_147.html>)

Heat of Vaporization: 318 kJ/kg (<http://www.engineeringtoolbox.com/specific-heat-fluids-d_151.html and http://www.engineeringtoolbox.com/fluids-evaporation-latent-heat-d_147.html>, Note heptanes data used)

Specific gravity: 0.8 (<http://www.atsdr.cdc.gov/MHMI/mmg72.html>)

With these data, HABIT V 1.1 code EXTRAN module and the Extended JAVA language code are used to find the maximum exterior concentrations for the variable meteorology conditions. The results of the JAVA language extended code are in Table A1.

Table A1: Results of Gasoline Plume analysis

Ground Temp (°C)	Air Temp (°C)	Wind Speed (m/sec)	Stability Class (A-G)	Solar Radiation (W/m2)	Max MCR HVAC Intake Exterior Concentration (PPM)	Max MCR Concentration (PPM)
39.61	37.61	1	E	1140	13	6.8
39.61	37.61	2	E	1140	16	5.9
39.61	37.61	3	E	1140	20	5.7
39.61	37.61	4	E	1140	23	5.5
39.61	37.61	5	E	1140	27	5.5
39.61	37.61	6	E	1140	30	5.4
39.61	37.61	7	E	1140	34	5.3
39.61	37.61	8	E	1140	37	5.2
39.61	37.61	9	D	1140	25	3.4
39.61	37.61	10	D	1140	26	3.2
21.89	21.89	1	G	0	7	4.3
21.89	21.89	2	G	0	10	4.4
21.89	21.89	3	G	0	13	4.6
21.89	21.89	4	F	0	14	4.2

Since under no condition is the exterior concentration above the IDHL value of 300 ppm, nearby transport of gasoline poses no threat to control room habitability. The limiting case for gasoline, 8 m/s Class E, is also run with the HABIT V 1.1 code. The results are identical, as seen in Figure A1.

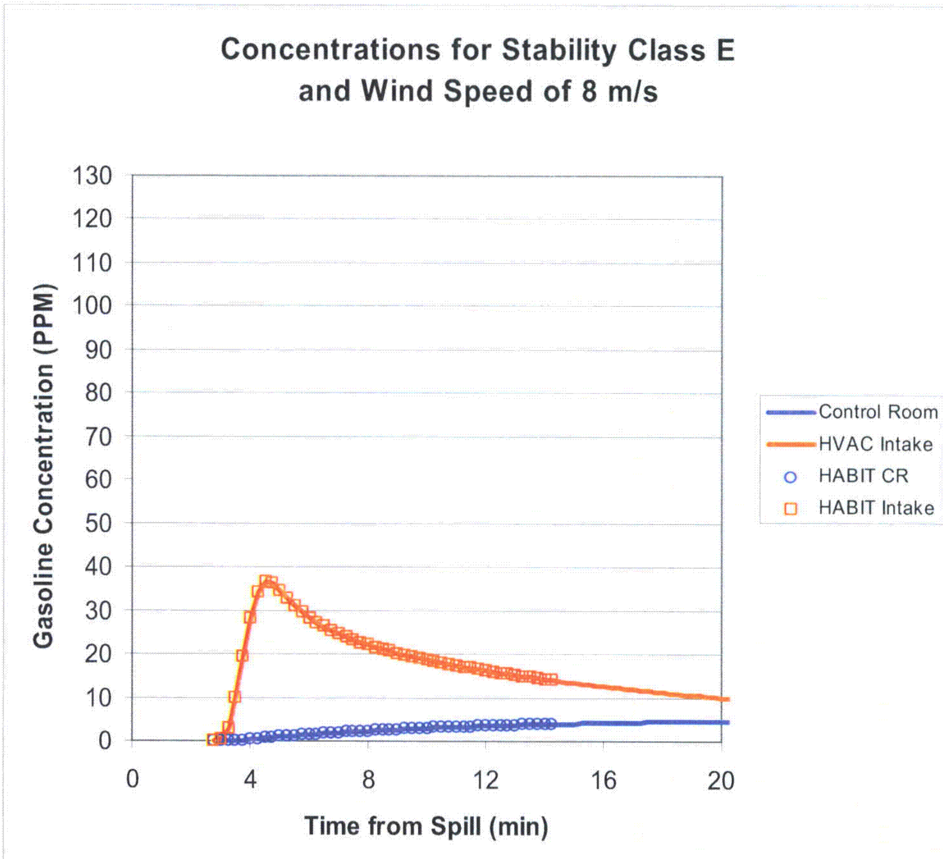

Figure A1: Limiting Case run with HABIT V 1.1 code and
the JAVA Language Extended version of HABIT

The Supplement 1 **ROADWAYS** discussions of Hydrogen and Nitrogen are unchanged.

The Supplement 1 **RAILROAD** discussion is unchanged.

The Supplement 1 **WATERWAYS** discussion is unchanged.

The Supplement 1 **Conclusion** discussion is unchanged.

This response is PLANT-SPECIFIC.

ASSOCIATED BLN COL APPLICATION REVISIONS:

The associated BLN COL Application Revisions 1 through 13 are unchanged.
Note, however, that Revision 10 is being revised by the response to BLN-RAI-LTR-159.

ASSOCIATED ATTACHMENTS/ENCLOSURES:

The Supplement 1Attachments 02.02.03-08A and 02.02.03-08B are unchanged.

The Supplement 1 Attachment 02.02.03-08C is replaced in its entirety with the Attachment 02.02.03-08C(R) provided with this supplement.

Attachment 02.02.03-08C(R)

Gasoline IDLH Determination

Gasoline IDLH Determination

Methodology 1: IDLH Weighted Average

Gasoline has a Lower Explosive Limit (LEL) of 1.4% which is converted to parts per million:

1.4%= 1.4 parts /100 parts= 14,000 parts/ 1,000,000 parts=14,000 ppm

OSHA considers a concentration in excess of 10% of the Lower Explosive Limit/Lower Flammability Limit (LEL/LFL) to be a hazardous atmosphere in confined spaces [29 CFR 1910.146(b)]. The 10% value of the LEL is used in place of IDLH value if this value is exceeded by the IDLH value. Therefore, the weighted average IDLH value of gasoline should not exceed 1,400 ppm which is the 10% of the LEL value.

The weighted average IDLH of Gasoline is determined to be 780 ppm hence this value will be used for further evaluation.

In order to convert toxicity limit from ppm units to mg/m^3 units, the Ideal Gas Law is used.

$$ppm(v) * AMU(g) / 24.47 = mg/m^3$$

Thus, gasoline with an average molecular weight of approximately 108 g/mol will have an IDLH of 3442.58 mg/m^3.

Following the guidance provided in Appendix A of Regulatory Guide 1.78, the following equation is evaluated:

CW = Table Mass * [AER / Actual AER] *[TL / 50 mg/m^3] * SCF

Where:

CW=	Chemical Weight (lb$_s$), [this is maximum potential release weight];
Table Mass=	Mass Taken from the Table of RG 1.78 Appendix A (lbs);
AER=	Air Exchange Rate of Control Room (AER);
Actual AER=	Actual Air Exchange Rate of Control Room (AER)**;
TL = IDLH =	Toxicity Limit (mg/m^3)
SCF =	Pasquill Stability Category (SCF)

Since the value of the CW is unknown, it is assumed that the chemical weight is the maximum capacity of a vessel used to transport it. For a liquid petroleum tank semi-trailer the capacity is 58,500 lbs of gasoline. This weight is viewed as a reasonable estimate of cargo capacity for a bulk liquid.

The volume of Control Room (CR) HVAC and the air intake flow are taken from AP1000 DCD Chapter 15, Table 15.6.5-2. The actual air exchange rate is calculated using these values.

Volume of HVAC total = 105,500 ft^3

Air Intake Flow = 1,925 ft^3/min

Thus:

Actual Air Exchange Rate (per hour) = (1,925 ft^3/min *60 min/1 hour) /105,500 ft^3
= 1.09 air volumes/hour.

**The values used in the development of the Table in Appendix A of Regulatory Guide 1.78 are based upon an assumption for Toxicity Limit (50 mg/m3) and Air Exchange Rate (1.2). Thus, to correct to actual conditions a simple ratio to 50 mg/m3 for TL and 1.2 air volumes/hour for AER is applied.

The Table Mass is taken from the Table in Appendix A of Regulatory Guide 1.78 by identifying the distance from the control room intake with an appropriate Air Exchange Rate (AER). From this, a Table Mass of 3,370 lbs is determined for a distance of 1.25 miles and an AER of 1.2 air volumes/hour.

Pasquill Stability Category (SCF) G, represents the worst 5th-percentile meteorology observed at the BLN site. Therefore, the SCF is 0.4.

Substituting the values above into the defining equation yields:

$$CW = 3{,}370 \text{ lbs} * [1.2/1.09] * [3442.58 \text{ mg/m}^3 / 50 \text{ mg/m}^3] * 0.4 = 102{,}178.3 \text{ lbs}$$

Since the calculated value of 102,178 lbs is greater than 58,500 lbs, which is maximum assumed capacity of a liquid petroleum tank semi-trailer, gasoline can be screened out based on its mass and does not require any further control room habitability analysis.

Methodology 2: Chemical Screening by Constituents

Material safety data sheets (MSDS) provided by four major gasoline manufacturers and distributors were used to gather data on chemical content of various gasoline mixtures. Using the methodology provided in Regulatory Guide 1.78, each of the chemical constituents of gasoline is then screened. Four gasoline mixes, their chemical component composition, and chemical component expected concentrations were evaluated. A review of the data shows that the values of chemical components' expected concentrations do not add up to 100%. This is because the data in the source material (MSDS) are the highest expected concentrations in percent mass. Toluene was selected for further evaluation because it is the most abundant chemical within the gasoline mixture. The toxicity limit of toluene is 500 ppm. The Ideal Gas Law is used to convert toxicity limit from ppm units to mg/m^3 units.

$$\text{ppm(v)} * \text{AMU(g)} / 24.47 = \text{mg/m}^3$$

The molecular weight of toluene is 92.13 g/mol, and so the toluene IDLH is 1882.51 mg/m^3.

Following guidance provided in Regulatory Guide 1.78 Appendix A, the following equation is evaluated:

$$CW = \text{Table Mass} * [\text{AER} / \text{Actual AER}] * [\text{TL} / 50 \text{ mg/m}^3] * \text{SCF}$$

Substituting the values into the equation yields:

$$CW = 3{,}370 \text{ lbs} * [1.2/1.09] * [1882.51 \text{ mg/m}^3 / 50 \text{ mg/m}^3] * 0.4 = 55{,}874.2 \text{ lbs}$$

Toluene constitutes a maximum of 30% by mass in the gasoline mixture. Therefore, the maximum weight of toluene in the liquid petroleum tank semi-trailer is 17,550 lbs (or 30% of 58,500 lbs.)

Since the calculated value of allowable mass (CW), 55,874.25 lbs, is greater than 17,550 lbs, toluene can be screened from further analysis.

This methodology was used for each of the chemical constituents within gasoline. Each of the chemical constituents in the gasoline mixture was determined to be screened out of further analysis. Therefore, gasoline is not considered for control room habitability analysis.