PMSTPCOL PEmails

From:	Scheide, Richard [rhscheide@STPEGS.COM]
Sent:	Thursday, October 29, 2009 4:16 PM
To:	Muniz, Adrian; Sosa, Belkys; Dyer, Linda; Wunder, George; Eudy, Michael; Plisco, Loren; Anand, Raj; Foster, Rocky; Joseph, Stacy; Govan, Tekia; Tai, Tom
Subject:	RAI Response
Attachments:	U7-C-STP-NRC-090180.pdf

All,

Attached is a copy of U7-C-STP-NRC-090180., Supplemental response to RAI 06.04-1.

Dick Scheide
Office: 361-972-7336
Cell: 479-970-9026

Hearing Identifier: SouthTexas34Public_EX
Email Number: 1834

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From: Scheide, Richard

Created By: rhscheide@STPEGS.COM

Recipients:
"Muniz, Adrian" <Adrian.Muniz@nrc.gov>
Tracking Status: None
"Sosa, Belkys" <Belkys.Sosa@nrc.gov>
Tracking Status: None
"Dyer, Linda" <lcdyer@STPEGS.COM>
Tracking Status: None
"Wunder, George" <George.Wunder@nrc.gov>
Tracking Status: None
"Eudy, Michael" <Michael.Eudy@nrc.gov>
Tracking Status: None
"Plisco, Loren" <Loren.Plisco@nrc.gov>
Tracking Status: None
"Anand, Raj" <Raj.Anand@nrc.gov>
Tracking Status: None
"Foster, Rocky" <Rocky.Foster@nrc.gov>
Tracking Status: None
"Joseph, Stacy" <Stacy.Joseph@nrc.gov>
Tracking Status: None
"Govan, Tekia" <Tekia.Govan@nrc.gov>
Tracking Status: None
"Tai, Tom" <Tom.Tai@nrc.gov>
Tracking Status: None

Post Office: exgmb2.CORP.STPEGS.NET

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Nuclear Operating Company

South Texas Project Electric Generating Station 4000 Avenue F – Suite A Bay City, Texas 77414

October 29, 2009
U7-C-STP-NRC-090180

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville MD 20852-2738

South Texas Project
Units 3 and 4
Docket Nos. 52-012 and 52-013
Supplemental Response to Request for Additional Information

Reference: Letter, Scott Head to Document Control Desk, " Response to Request for Additional Information" for the South Texas Combined License Application dated September 30, 2009 (U7-C-STP-NRC-0900138).

The referenced letter provided the response to Request for Additional Information (RAI) letter number 221 related to the STPNOC Combined Licensing Application (COLA) Part 2, Chapter 6. In response to RAI 06.04-1, STPNOC stated that a meteorological sensitivity analysis for the toxic gas evaluation was currently being performed and that the results of that analysis, including computer code inputs, methodology, assumptions, and basis would be provided to the NRC in a supplemental response to the referenced RAI by October 29, 2009.

The attachment includes the supplemental response to the RAI question listed below.

RAI 06.04-1

There are no commitments in this letter.

If you have any questions, please contact me at (361) 972-7136, or Bill Mookhoek at (361) 972-7274.

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

Executed on 10/29/09

Scott Head
Manager, Regulatory Affairs
South Texas Project Units 3 & 4

rhs

Attachment:

RAI 06.04-1 Supplemental Response

cc: w/o attachment except*
(paper copy)

Director, Office of New Reactors
U. S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

Regional Administrator, Region IV
U. S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 400
Arlington, Texas 76011-8064

Kathy C. Perkins, RN, MBA
Assistant Commissioner
Division for Regulatory Services
Texas Department of State Health Services
P. O. Box 149347
Austin, Texas 78714-9347

Alice Hamilton Rogers, P.E.
Inspections Unit Manager
Texas Department of State Health Services
P.O. Box 149347
Austin, TX 87814-9347

C. M. Canady
City of Austin
Electric Utility Department
721 Barton Springs Road
Austin, TX 78704

*Steven P. Frantz, Esquire
A. H. Gutterman, Esquire
Morgan, Lewis & Bockius LLP
1111 Pennsylvania Ave. NW
Washington D.C. 20004

*George F. Wunder
* Stacy Joseph
Two White Flint North
11545 Rockville Pike
Rockville, MD 20852

(electronic copy)

*George F. Wunder
*Stacy Joseph
Loren R. Plisco
U. S. Nuclear Regulatory Commission

Steve Winn
Eddy Daniels
Joseph Kiwak
Nuclear Innovation North America

Jon C. Wood, Esquire
Cox Smith Matthews

J. J. Nesrsta
R. K. Temple
Kevin Pollo
L. D. Blaylock
CPS Energy

RAI 06.04-1 – Supplement 1:

QUESTION:

The staff has the following questions related to the information provided by the applicant for COL License Information Item 6.8:

1) NRC Staff's confirmatory analysis of the STP 3&4 control room habitability showed that among the hazardous chemicals listed in Tables 2.2S of the FSAR; Acetic Acid (Water Transport), Gasoline (Water Transport), Sodium Hypochlorite (Onsite Storage), 1-Hexene (Offsite Storage), and Acetic Acid (Offsite Storage) posed toxic gas threat to the control room habitability. The NRC staff's computer simulations showed that an accidental release of these hazardous chemicals into the atmosphere could lead to the gas concentration exceeding the Immediately Dangerous to Life and Health (IDLH) level inside the control room (CR) after the resulting gas cloud reaches the CR intake. Provide details of the toxic gas evaluation (computer code inputs, results) to demonstrate that these chemical sources are not a threat to the STP 3&4 control room habitability.

2) Sodium Hypochlorite and Gasoline are not available in ALOHA computer code's chemicals database. How were they analyzed? Provide any additional physical properties of the chemicals specified outside the database.

3) Why is the IDLH of Sodium Hypochlorite provided as "10 ppm" of Chlorine in the FSAR? What is the physical process that would lead to the accumulation of chlorine inside the control room due to release of Sodium Hypochlorite in the atmosphere?

RESPONSE:

As discussed in the response to Item 1 in RAI 06.04-1 (STP Letter U7-C-STP-NRC-090138, dated September 30, 2009), a meteorological sensitivity analysis for the toxic gas evaluation has been performed to demonstrate that the following hazardous chemicals: Acetic Acid (Water Transport and Offsite Storage), Gasoline (Water Transport), Sodium Hypochlorite (Onsite Storage), and 1-Hexene (Offsite Storage) do not pose a toxic gas threat to the STP 3&4 control room habitability. The results of this analysis, including computer code inputs, methodology, assumptions and basis are provided below.

Table 1 provides the basis for the inputs to the ALOHA® program for performing a meteorological sensitivity analysis for the requested chemicals of concern. The first and second columns, Menu and Parameter, are menu inputs to ALOHA®; the third column, Input, is the data input to run the model; and, the last column, Basis, is the basis for the input/assumption.

Table 1: ALOHA Model Inputs/Assumptions

Menu	Parameter	Input	Basis
Site Atmospheric Data			
Site Data	Location	Galveston Texas	This is the geographically closest station to the STP nuclear facility in the ALOHA® database. ALOHA® uses the latitude, longitude, elevation, and time zone of the location of a chemical release in some of its computations – sun angle or solar radiation (latitude, longitude and time of day of calculation) and atmospheric pressure (determined by the location's elevation (Reference 1).
Site Data	Number of Air Exchanges	0.7063 air exchanges per hour	The number of air exchanges per hour (of outside air) for the control room is used by ALOHA® to estimate indoor pollutant concentrations (Reference 1).
Site Data	Date and Time	12:00 pm on July 1, 2006 and 5:00 am on July 1, 2006 was inputted only for Meteorological Classes E and F, and Class D with a wind speed of 3 m/s	The position of the sun for the date and time is used in determining the solar radiation. July 1, 2006 at 12:00 pm was chosen because temperatures are highest in the summer during midday. Higher temperatures lead to a higher evaporation rate and thus, a larger vapor cloud. ALOHA® calculates the amount of energy coming into the puddle from the atmosphere and from the ground—if the sun is high in the sky (around noon), the amount of energy coming into the puddle is greater than it would be in the early morning or late afternoon, when the sun is lower. The more energy coming in, the higher the evaporation rate. (Reference 1) 5:00 am on July 1, 2006, was selected to provide a realistic meteorological condition—ALOHA® requires manual override if noon is used with meteorological classes E and F, and D with a wind speed of 3 m/s. (Reference 1) Note: One run with F stability class at 12 noon and 1 m/sec was modeled for comparison purposes. Refer to Table 2: Meteorological Sensitivity Analysis.

Menu	Parameter	Input	Basis
Setup/Chemical	Chemical Library	A vapor cloud analysis was modeled for each chemical where a meteorological sensitivity analysis was requested.	1-Hexene (Offsite Storage), Acetic Acid (Offsite Storage), Acetic Acid (Water Transport) and Gasoline (modeled as n-Heptane) (Water Transport) were chosen from the chemical library to complete the meteorological sensitivity analysis. Sodium Hypochlorite (Onsite Storage) was added to the chemical library, see details on chemical properties below.
Setup/Atmospheric	Wind Speed	For each chemical a meteorological sensitivity analysis was performed at varying wind speeds and meteorological stability classes.	The ALOHA® model was run under a spectrum of meteorological conditions to determine the worst-case for each postulated event. This spectrum of meteorological conditions includes the most stable meteorological class, F, allowable with the ALOHA® model. The F stability class was modeled at 1, 1.5, 2, and 3 m/s (Reference 1). See Table 2: Meteorological Sensitivity Analysis for the specific inputs. The chosen wind speed inputs were based upon the defined Pasquill Stability Classes (Reference 4).
Setup/Atmospheric	Wind Direction	W	The wind direction determines which way a pollutant cloud will drift. (Reference 1) Note, that in the ALOHA® modeling runs conducted, the threat at point function was chosen which allows the user to set the receptor location directly downwind from the source for a worst-case determination—effectively negating the input for this menu item, i.e. the model will not take into account an entered value for wind direction.
Setup/Atmospheric	Wind Measurement Height	10 meters	ALOHA® calculates a wind profile based on where the meteorological data is taken. ALOHA® assumes that the meteorological (MET) station is at 10 meters. The National Weather Service usually reports wind speeds from a height of 10 meters. (Reference 1) Wind rose data for the STP COLA was also taken at a height of 10 meters. Additionally, the surface wind speeds for determining the Pasquill Stability Class are defined at 10 m. (Reference 4)
Setup/Atmospheric	Ground Roughness	“Open Country”	The degree of atmospheric turbulence influences how quickly a pollutant cloud moving downwind will mix with the air

Menu	Parameter	Input	Basis
			around it and be diluted. Friction between the ground and air passing over it is one cause of atmospheric turbulence. Because the air nearest the ground is slowed the most, eddies can develop. The rougher the ground surface, the greater the ground roughness (Z_0), and the greater the turbulence that develops. A chemical cloud generally travels farther across open country and open water than over an urban area or a forest. This is because it encounters fewer, smaller roughness elements to create turbulence. (Reference 1) "Open Country" is also the conservative selection when compared to the parameter selection requirements for the U.S. Environmental Protection Agency's (EPA) Risk Management Program "40 CFR 68.22 Offsite consequence analysis parameters. (e) Surface roughness. The owner or operator shall use either urban or rural topography as appropriate." (Reference 5) Selecting "open country" indicates that the terrain is generally flat and there are no obstructions to hinder the travel/dispersion of the vapor cloud—therefore more conservative distances are modeled. (Reference 1)
Setup/Atmospheric	Cloud Cover	The selection is dependent on the chosen meteorological stability class—Refer to Table 2: Meteorological Sensitivity Analysis	ALOHA® uses this value to estimate the amount of incoming solar radiation at the time of a chemical release. (Reference 1) There are defined cloud cover percentages for some of the Pasquill meteorological stability classes (Reference 4). Where a defined value is not present, the ALOHA® default value, 50% was chosen.
Setup/Atmospheric	Air Temperature	25ºC / 28.9ºC	Air temperature influences ALOHA®'s estimate of the evaporation rate from a puddle surface (the higher the air temperature, the more the puddle is warmed by the air above it, the higher the liquid's vapor pressure is, and the faster the substance evaporates). (Reference 1) Given that more stable meteorological classes such as E or F occur at night time, 25ºC is a conservative selection (Reference 4). (Generally, the more stable meteorological

Menu	Parameter	Input	Basis
			classes are the worst-case meteorological condition.) Note: for Gasoline modeled as n-Heptane (Water Transport) the air temperature used is 28.9°C which is the July mean temperature to be consistent with and allow for comparison with Gasoline modeled with the TOXDISP model.
Setup/Atmospheric	Stability Class	For each chemical, a meteorological sensitivity analysis was performed at varying wind speeds and meteorological stability classes.	The atmosphere may be more or less turbulent, depending on the amount of incoming solar radiation as well as other factors. Meteorologists have defined atmospheric stability classes, each representing a different degree of turbulence in the atmosphere. When moderate to strong incoming radiation heats air near the ground, causing it to rise and generate large eddies, the atmosphere is considered unstable (relatively turbulent). When solar radiation is weak or absent, air near the surface has a reduced tendency to rise, and less turbulence develops (stable atmospheres). Stability class has a large effect on ALOHA®'s prediction of the threat zone size for dispersion scenarios. Under unstable conditions, a dispersing gas mixes rapidly with the air around it and ALOHA® expects that the cloud will not extend as far downwind as it would under more stable conditions, because the pollutant is soon diluted. (Reference 1) A meteorological sensitivity analysis was performed for each chemical where a meteorological sensitivity analysis was requested. (Refer to Table 2: Meteorological Sensitivity Analysis)
Setup/Atmospheric	Inversion Height	None	An inversion is an atmospheric condition that serves to trap the gas below the inversion height thereby not allowing it to disperse normally. Inversion height has no affect on the heavy gas model. And, most inversions are at heights much greater than ground level. (Reference 4)
Setup/Atmospheric	Humidity	50%	ALOHA® uses the relative humidity values to estimate the atmospheric transmissivity value; estimate the rate of evaporation from

Menu	Parameter	Input	Basis
			a puddle; and make heavy gas dispersion computations. Atmospheric transmissivity is a measure of how much thermal radiation from a fire is absorbed and scattered by the water vapor and other atmospheric components. (Reference 1) The default value of 50% is selected because thermal radiation (heat flux) analyses are not included as part of this sensitivity analysis where it is expected to have the greatest impact.
Setup/Calculation Options	Calculation Options	"Let ALOHA® Decide"	It is assumed that all of the chemicals analyzed exhibit either neutral or heavy gas behavior. The dispersion model can be selected from the following options: "Let ALOHA® decide", "Use Gaussian dispersion only", or "Use Heavy gas dispersion only." Typically the option to "Let ALOHA® decide" is selected unless the chemical is known to behave as a heavy gas under certain conditions, then it may be necessary to select the "Use Heavy gas dispersion only" option.
For Liquid Releases:			
Setup/Source	Puddle	Puddle (For Liquid Releases)	In ALOHA®, the term source is used to describe the vessel or pool from which a hazardous chemical is released. ALOHA® can model four types of sources: (1) direct-chemical releases directly into the atmosphere; (2) puddle-chemical has formed a liquid pool; (3) tank-chemical is escaping from a tank; and (4) gas pipeline-chemical escaping from a ruptured gas pipeline. (Reference 1) Additionally, the selection of "puddle" is appropriate when one compares this selection to the parameter selection requirements for the U.S. EPA's Risk Management Program "40 CFR 68.25 Worst-case release scenario analysis. (d) (1) For regulated toxic substances that are normally liquids at ambient temperature, the owner or operator shall assume that the quantity in the vessel or pipe…is spilled instantaneously to form a liquid pool." (Reference 6) For liquids, assuming a puddle release is a conservative option especially when one considers that

Menu	Parameter	Input	Basis
			by choosing the puddle option, the total quantity of the vessel is assumed to be instantaneously spilled.
Setup/Source	Puddle	Type of Puddle/ Evaporating Puddle	As a toxic puddle evaporates, it forms a vapor cloud above the puddle, in order for ALOHA® to predict the concentration from this type of puddle option is chosen. (Reference 1)
Setup/Source	Puddle	Puddle Area and Volume	The puddle area strongly influences the evaporation rate. The larger the area of a puddle, the higher its evaporation rate (Reference 1). For sodium hypochlorite, the area of the puddle is conservatively estimated by taking the entire contents of the tank and assuming the quantity is spilled onto the ground with no containment or depressions in the ground, forming a 1 cm thick puddle (Reference 7). 1-Hexene is stored in a tank at the nearby OXEA industrial site surrounded by a berm with dimensions of 120 ft by 90 ft by 40 inches high. Since the berm will contain a spill from the 1-Hexene tank within its boundary, the puddle area was limited to the area of the berm --10,800 square feet. Due to the large quantities of Acetic Acid (Offsite Storage - 9,999,999 pounds), and (Water Transport - 500,000 gallons), a 1 cm thick puddle is not realistic. Spilling this large quantity over a 1 cm thick puddle would essentially diffuse the vapor cloud over a very large area for both scenarios. Thus, the maximum puddle area allowed by ALOHA® of 31,400 square meters was used in both cases. Additionally, because of the specific gravity of acetic acid, Acetic Acid (Water Transport) was conservatively assumed to spill onto the ground rather than into the water because acetic acid would sink. Due to the large quantity of gasoline (Water Transport - 1,680,000 gallons), again a 1 cm thick puddle is not realistic. Spilling this large quantity over a 1 cm thick puddle area would essentially have the spill of gasoline flowing miles down the river, thus essentially diffusing the vapor cloud over a very large area. Thus, the maximum puddle

Menu	Parameter	Input	Basis
			area allowed by ALOHA® of 31,400 square meters was used.
Setup/Source	Puddle/Ground Type	Soil/Water for Gasoline transported by barge	Ground type influences the amount of heat energy transferred from the ground to an evaporating puddle. ALOHA® assumes that the ground does not absorb any of the spilled chemical, and that none of the chemical spilled onto water dissolves into the water. ALOHA® expects the heat to be transferred most readily from default ground or concrete surfaces into a puddle, and least readily from sandy ground (Reference 1). Water is used for Gasoline (modeled as n-Heptane) since it is transported by barge. Acetic Acid (Water Transport) is modeled as ground because it has a higher specific gravity than water and would otherwise sink. Therefore, it is conservatively assumed that the entire quantity of acetic acid is spilled onto the deck of the barge/ground allowing the vapor cloud to form and travel towards the control room. This is extremely conservative as the confinement of the barge was also not accounted for in the scenario.
Setup/Source	Puddle/Input Ground Temperature	Air Temperature/ Water Temperature	Ground temperature influences the amount of heat transferred between the ground and the puddle. The warmer the ground, the warmer the puddle and the higher the evaporation rate. ALOHA® suggests using air temperature if the ground temperature is unknown (Reference 1). Given that more stable meteorological classes such as E or F occur at night time, 25ºC is a conservative selection (Reference 4). Note: for Gasoline modeled as n-Heptane (Water Transport) the air and water temperature used is 28.9°C, which is the July mean temperature, to be consistent with and allow for comparison with Gasoline modeled with the TOXDISP model. Note: this is conservative as the water temperature of the Colorado River is consistently cooler than the air or ground temperature (Reference 9).

Menu	Parameter	Input	Basis
Setup/Source	Puddle/Initial Puddle Temperature	Air Temperature	ALOHA® suggests selecting ambient air temperature if the initial puddle temperature is unknown. (Reference 1).
Toxicity Analysis:			
Display	Threat Zone	Toxic Area of Vapor Cloud	This option is chosen to determine the distance the vapor cloud will travel before the concentration of the hazardous chemical in the vapor cloud falls below the IDLH or other determined toxicity limit (Reference 1).
Display	Threat Zone/Level of Concern	Threat zone Red: IDLH or other determined toxicity limit of the chemical being analyzed	The red threat zone plot for the IDLH or other determined toxicity limit was chosen to determine the safe distance requirement in accordance with RG 1.78 (Reference 10).
Display	Threat at Point	Relative Coordinates	This option is chosen to obtain specific information about the hazard at a point of interest (Reference 1). By choosing this option, the hazard value expected if the wind were to carry the cloud of escaping gas directly toward the point of interest (STP Unit 3 Control Room intake) is determined. Note, the Unit 3 Control Room intake is closer to each postulated spill event than STP Unit 4 Control Room intake and is therefore used.
Display	Threat at Point	Input X, the downwind distance = the straight line distance from where the chemical is stored/transported to the control room. Input Y, the crosswind distance = 0 feet	In order to determine the hazard value expected if the wind were to carry the cloud directly toward the STP Unit 3 Control Room intake, the minimum distance from the stored chemical to the control room was entered with no cross wind distance. These results represent the worst-case hazard levels that could develop at that distance downwind of the source (Reference 1).

Table 2 provides a listing of the surface wind speed, temperature, cloud cover and date/time for each of the stability classes evaluated in the meteorological sensitivity analysis.

Table 2: Meteorological Sensitivity Analysis

Stability Class	Surface Wind Speed (m/s)	Temperature[1]	Cloud Cover	Date/Time
A	1.5	25°C/28.9°C	0%	July 1, 2006 12:00 PM
B	1.5	25°C/28.9°C	50%	July 1, 2006 12:00 PM
C	3	25°C/28.9°C	50%	July 1, 2006 12:00 PM
D	5.5	25°C/28.9°C	50%	July 1, 2006 12:00 PM
D	3	25°C/28.9°C	50%	July 1, 2006 5:00 AM
E	2	25°C/28.9°C	50%	July 1, 2006 5:00 AM
E	3	25°C/28.9°C	0%	July 1, 2006 5:00 AM
E	4	25°C/28.9°C	0%	July 1, 2006 5:00 AM
F	1	25°C/28.9°C	50%	July 1, 2006 12:00 PM
F	1	25°C/28.9°C	0%	July 1, 2006 5:00 AM
F [2]	1.5	25°C/28.9°C	0%	July 1, 2006 12:00 PM
F	1.5	25°C/28.9°C	0%	July 1, 2006 5:00 AM
F	2	25°C/28.9°C	0%	July 1, 2006 5:00 AM
F	3	25°C/28.9°C	0%	July 1, 2006 5:00 AM

Notes: [1] 28.9°C was used only for Gasoline modeled as n-Heptane (Water Transport) which is the July mean temperature to be consistent with and allow for comparison with Gasoline modeled with the TOXDISP model.

[2] F stability class at a wind speed of 1.5 m/s at 12:00 PM was only used for Gasoline modeled as n-Heptane (Water Transport) to match the conditions used to model Gasoline using TOXDISP allowing for a comparison between modeling Gasoline (using n-Heptane as a surrogate) using the ALOHA® model and modeling Gasoline using the TOXDISP model.

Chemical Selection:

Acetic Acid and 1-Hexene:

Acetic Acid and 1-Hexene are chemicals available in the ALOHA® chemical library and were thus selected for use in the sensitivity analyses conducted.

Sodium Hypochlorite:

Because Sodium Hypochlorite is not in ALOHA®'s chemical library, the following chemical properties were entered into the ALOHA® chemical library in order to add Sodium Hypochlorite as a new chemical.

Chemical Name:	Sodium Hypochlorite	
Molecular Weight:	74.44 g/mol	(Reference 11)
Normal Boiling Point:	373.15K	(Reference 12)
Normal Freezing Point:	270.15K	(Reference 12)

Critical Temperature:	417.15K (as chlorine)	(Reference 13)
Critical Pressure:	77.11 bar (as chlorine)	(Reference 14)

Heat Capacity (gas, const. pressure):
486.94 J/(kg K) at 293.15K and 101,325 Pa (as chlorine) (Reference 14)
Heat Capacity (liq., const. pressure):
946 J/(kg K) at 173.15K and 101,325 Pa (as chlorine) (Reference 14)

Properties:

Physical State:	Liquid	(Reference 11)
Vapor Pressure:	0.349124 Pa @ 293.15K	(Reference 13)
Toxicity Limit:	10 ppm as chlorine (IDLH)	(Reference 13)

Gasoline:
The included gasoline sensitivity analysis utilizes the ALOHA® model rather than the TOXDISP model, which was the analysis methodology previously used for gasoline as discussed in the response to RAI 02.02.03-4 (STP Letter No U7-STP-NRC-080065, ML083290340). In addition to providing the requested sensitivity analysis for gasoline, this will also allow for a limited comparison between modeling gasoline (using n-Heptane as surrogate) in the ALOHA® model and modeling gasoline using the TOXDISP model. Because solutions such as gasoline cannot be modeled in the current version of ALOHA®, gasoline was modeled for toxicity analysis by selecting n-Heptane as a surrogate for gasoline in ALOHA®'s chemical library. The selection of n-Heptane as a surrogate for gasoline is common in the determination of the octane rating of fuel as noted in a study, *The Oxidation of Gasoline Fuel Surrogate in the Negative Temperature Coefficient Region* (Reference 3). Additionally, in another study, *Evaporation of hydrocarbon compounds, including gasoline and diesel fuel, on heated metal surfaces* (Reference 2), the evaporation curves over a range of temperatures for n-Heptane and gasoline were shown to be similar and at temperatures below 80°C, the evaporation of n-Heptane occurred at a faster rate, reflecting the fact that gasoline has several components with higher boiling points. Therefore, it was conservatively assumed that the entire quantity of gasoline stored in a typical barge delivering gasoline to the Port of Bay City, 1,680,000 gallons (Reference 8), was modeled as n-Heptane, and therefore available to form a vapor cloud at the evaporation rate of n-Heptane.

Methodology:

The following chemicals were analyzed for potential toxic threats using the ALOHA® program: (1) Sodium Hypochlorite (Onsite Storage -7,200 gal); (2) 1-Hexene (Offsite Storage - 1,265,000 lbs); (3) Acetic Acid (Offsite Storage - 9,999,999 lbs); (4) Acetic Acid (Water Transport - 500,000 gal); and (5) Gasoline (Water Transport - 1,680,000 gal)

Results:

<u>Sodium Hypochlorite (Onsite Storage)</u>
A meteorological sensitivity study involving the release of 7,200 gallons of Sodium Hypochlorite was conducted to determine the effects of changing wind speed and stability. The results of the meteorological sensitivity analysis are presented in Table 3: Sodium Hypochlorite (Onsite Storage) Sensitivity Analysis.

<u>Storage:</u>
Storage location for modeling: Cooling Water Intake
Quantity: 7,200 gallons
Distance to Control Room: 2,559 feet
IDLH: 10 ppm as chlorine

<u>Puddle Area:</u>
7,200 gallons = 27,254,965 cm^3
27,254,965 $cm^3 = \pi * r^2 * h$ (h = 1 cm)
Area = 2,725.5 m^2

<u>ALOHA® synopsis (*refer to Table 3: Sodium Hypochlorite (Onsite Storage) Sensitivity Analysis)*</u>

Distance to IDLH: 177 feet (Pasquill Stability Class F @ 1 m/s)
Concentration in Control Room: 0.0450 ppm (Pasquill Stability Class F @ 1 m/s)

Table 3: Sodium Hypochlorite (Onsite Storage) Sensitivity Analysis

Stability Class	Wind Speed (m/s)	Cloud Cover	Time of Day	Temperature	Quantity Spilled (lbs)	Distance to Control Room (feet)	Toxicity Distance to IDLH (feet)	Concentration in Control Room (ppm)
A	1.5	0%	12:00 PM	25°C	7,200	2,559	96	No significant concentration
B	1.5	50%	12:00 PM	25°C	7,200	2,559	96	0.00149
C	3	50%	12:00 PM	25°C	7,200	2,559	96	0.00365
D	5.5	50%	12:00 PM	25°C	7,200	2,559	96	0.00888
D	3	50%	5:00 AM	25°C	7,200	2,559	96	0.00353
E	2	50%	5:00 AM	25°C	7,200	2,559	96	0.00848
E	3	0%	5:00 AM	25°C	7,200	2,559	96	0.00809
E	4	0%	5:00 AM	25°C	7,200	2,559	96	0.00796
F	1	50%	12:00 PM	25°C	7,200	2,559	177	0.0450
F	1	0%	5:00 AM	25°C	7,200	2,559	96	0.0209
F	1.5	0%	5:00 AM	25°C	7,200	2,559	96	0.0230
F	2	0%	5:00 AM	25°C	7,200	2,559	96	0.0238
F	3	0%	5:00 AM	25°C	7,200	2,559	96	0.0234

1-Hexene (Offsite Storage)
A meteorological sensitivity study involving the release of 1,265,000 pounds of 1-Hexene was conducted to determine the effects of changing wind speed and stability. The results of the meteorological sensitivity analysis are presented in Table 4: 1-Hexene (Offsite Storage) Sensitivity Analysis.

Storage:

Storage location for modeling:	OXEA Industrial Site
Quantity:	1,265,000 lbs.
Distance to Control Room:	22,841 feet
TLV-TWA:	30 ppm

Puddle Diameter (Chemical stored in bermed area):
Berm Dimensions = 120 feet x 90 feet x 40 inches high
Puddle area = 10,800 square feet

ALOHA® synopsis (*refer to Table 4: 1-Hexene (Offsite Storage) Sensitivity Analysis)*

Distance to TLV-TWA:	7,392 feet (Pasquill Stability Class E @ 4 m/s)
Concentration in Control Room:	1.36 ppm (Pasquill Stability Class E @ 4 m/s)

Table 4: 1-Hexene (Offsite Storage) Sensitivity Analysis

Stability Class	Wind Speed (m/s)	Cloud Cover	Time of Day	Temperature	Quantity Spilled (lbs)	Distance to Control Room (feet)	Toxicity Distance to IDLH (feet)	Concentration in Control Room (ppm)
A	1.5	0%	12:00 PM	25°C	1,265,000	22,841	3,693	>1 hr [1]
B	1.5	50%	12:00 PM	25°C	1,265,000	22,841	4,365	>1 hr [1]
C	3	50%	12:00 PM	25°C	1,265,000	22,841	5,034	0.409
D	5.5	50%	12:00 PM	25°C	1,265,000	22,841	5,808	0.896
D	3	50%	5:00 AM	25°C	1,265,000	22,841	5,808	0.631
E	2	50%	5:00 AM	25°C	1,265,000	22,841	5,808	>1 hr [1]
E	3	0%	5:00 AM	25°C	1,265,000	22,841	6,864	0.987
E	4	0%	5:00 AM	25°C	1,265,000	22,841	7,392 [2]	1.36
F	1	50%	12:00 PM	25°C	1,265,000	22,841	6,864	>1 hr [1]
F	1	0%	5:00 AM	25°C	1,265,000	22,841	6,864	>1 hr [1]
F	1.5	0%	5:00 AM	25°C	1,265,000	22,841	6,864	>1 hr [1]
F	2	0%	5:00 AM	25°C	1,265,000	22,841	7,392	>1 hr [1]
F	3	0%	5:00 AM	25°C	1,265,000	22,841	7,920	1.14

Notes: [1] ALOHA® does not model releases after one hour because meteorological conditions are likely to change after one hour, such as wind speed/wind direction are not likely to persist in a given sector for much more than one hour. However, it is reasonable to assume that the meteorological conditions have changed after one hour as suggested by the U.S. EPA and identified in RG 1.78 (Reference 10). Additionally, when other conservatisms are accounted for: (1) the model is run as a straight line release from the spill to the control room; and (2) after one hour, knowledge of the spill is likely and control room operators can take appropriate action.

[2] The worst-case meteorological conditions determined for each postulated event were based upon those meteorological conditions yielding the highest concentration in the control room.

Acetic Acid (Offsite Storage)

A meteorological sensitivity study involving the release of 9,999,999 pounds of Acetic Acid was conducted to determine the effects of changing wind speed and stability. The results of the meteorological sensitivity analysis are presented in Table 5: Acetic Acid (Offsite Storage) Sensitivity Analysis.

Storage:

Storage location for modeling:	OXEA Industrial Site
Quantity:	9,999,999 lbs.
Distance to Control Room:	22,841 feet
IDLH:	50 ppm

Puddle Diameter:

Due to the large quantity of Acetic Acid (Offsite Storage), 9,999,999 pounds, a 1 cm thick puddle is not realistic. Spilling this large quantity over a 1 cm thick puddle would essentially diffuse the vapor cloud over a very large area. Thus, the maximum puddle area allowed by ALOHA® of 31,400 square meters was used.

ALOHA® synopsis (*refer to Table 5: Acetic Acid (Offsite Storage) Sensitivity Analysis)*

Distance to IDLH:	7.392 feet (Pasquill Stability Class E @ 4 m/s)
Concentration in Control Room:	2.80 ppm (Pasquill Stability Class E @ 4 m/s)

Table 5: Acetic Acid (Offsite Storage) Sensitivity Analysis

Stability Class	Wind Speed (m/s)	Cloud Cover	Time of Day	Temperature	Quantity Spilled (lbs)	Distance to Control Room (feet)	Toxicity Distance to IDLH (feet)	Concentration in Control Room (ppm)
A	1.5	0%	12:00 PM	25°C	9,999,999	22,841	4,026	> 1 hr [1]
B	1.5	50%	12:00 PM	25°C	9,999,999	22,841	4,827	> 1 hr [1]
C	3	50%	12:00 PM	25°C	9,999,999	22,841	5,280	0.965
D	5.5	50%	12:00 PM	25°C	9,999,999	22,841	5,808	2.14
D	3	50%	5:00 AM	25°C	9,999,999	22,841	5,808	1.43
E	2	50%	5:00 AM	25°C	9,999,999	22,841	6,864	0.619
E	3	0%	5:00 AM	25°C	9,999,999	22,841	6,864	2.18
E	4	0%	5:00 AM	25°C	9,999,999	22,841	7,392 [2]	2.80
F	1	50%	12:00 PM	25°C	9,999,999	22,841	9,504	> 1 hr [1]
F	1	0%	5:00 AM	25°C	9,999,999	22,841	8,448	> 1 hr [1]

Stability Class	Wind Speed (m/s)	Cloud Cover	Time of Day	Temperature	Quantity Spilled (lbs)	Distance to Control Room (feet)	Toxicity Distance to IDLH (feet)	Concentration in Control Room (ppm)
F	1.5	0%	5:00 AM	25°C	9,999,999	22,841	8,448	> 1 hr [1]
F	2	0%	5:00 AM	25°C	9,999,999	22,841	8,448	0.497
F	3	0%	5:00 AM	25°C	9,999,999	22,841	8,448	2.68

Notes: [1] ALOHA® does not model releases after one hour because meteorological conditions are likely to change after one hour, such as wind speed/wind direction are not likely to persist in a given sector for much more than one hour. However, it is reasonable to assume that the meteorological conditions have changed after one hour as suggested by the U.S. EPA and identified in RG 1.78 (Reference 10). Additionally, when other conservatisms are accounted for: (1) the model is run as a straight line release from the spill to the control room; and (2) after one hour, knowledge of the spill is likely and control room operators can take appropriate action.

[2] The worst-case meteorological conditions determined for each postulated event were based upon those meteorological conditions yielding the highest concentration in the control room.

Acetic Acid (Water Transport)

A meteorological sensitivity study involving the release of 500,000 gallons of Acetic Acid was conducted to determine the effects of changing wind speed and stability. The results of the meteorological sensitivity analysis are presented in Table 6: Acetic Acid (Water Transport) Sensitivity Analysis.

Storage:

Storage location for modeling:	Barge Transport
Quantity:	500,000 gallons
Distance to Control Room:	15,974 feet
IDLH:	50 ppm

Puddle Diameter:

Due to the large quantity of Acetic Acid (Water Transport), 500,000 gallons, a 1 cm thick puddle is not realistic. Spilling this large quantity over a 1 cm thick puddle would essentially diffuse the vapor cloud over a very large area. Thus, the maximum puddle area allowed by ALOHA® of 31,400 square meters was used. Additionally, due to the specific gravity of acetic acid, it was conservatively assumed that the entire quantity was spilled onto the ground.

ALOHA® synopsis (*refer to Table 6: Acetic Acid (Water Transport) Sensitivity Analysis)*

Distance to IDLH:	8,448 feet (Pasquill Stability Class F @ 3 m/s)
Concentration in Control Room:	5.97 ppm (Pasquill Stability Class F @ 3 m/s)

Table 6: Acetic Acid (Water Transport) Sensitivity Analysis

Stability Class	Wind Speed (m/s)	Cloud Cover	Time of Day	Temperature	Quantity Spilled (gallons)	Distance to Control Room (feet)	Toxicity Distance to IDLH (feet)	Concentration in Control Room (ppm)
A	1.5	0%	12:00 PM	25°C	500,000	15,974	3,960	0.411
B	1.5	50%	12:00 PM	25°C	500,000	15,974	4,794	0.598
C	3	50%	12:00 PM	25°C	500,000	15,974	5,280	2.14
D	5.5	50%	12:00 PM	25°C	500,000	15,974	5,808	4.41
D	3	50%	5:00 AM	25°C	500,000	15,974	5,808	3.37
E	2	50%	5:00 AM	25°C	500,000	15,974	6,336	2.70
E	3	0%	5:00 AM	25°C	500,000	15,974	6,864	4.56
E	4	0%	5:00 AM	25°C	500,000	15,974	7,392	5.63
F	1	50%	12:00 PM	25°C	500,000	15,974	10,032	> 1 hr [1]
F	1	0%	5:00 AM	25°C	500,000	15,974	7,920	> 1 hr [1]
F	1.5	0%	5:00 AM	25°C	500,000	15,974	8,448	0.630
F	2	0%	5:00 AM	25°C	500,000	15,974	8,448	3.22
F	3	0%	5:00 AM	25°C	500,000	15,974	8,448 [2]	5.97

Notes: [1] ALOHA® does not model releases after one hour because meteorological conditions are likely to change after one hour, such as wind speed/wind direction are not likely to persist in a given sector for much more than one hour. However, it is reasonable to assume that the meteorological conditions have changed after one hour as suggested by the U.S. EPA and identified in RG 1.78 (Reference 10). Additionally, when other conservatisms are accounted for: (1) the model is run as a straight line release from the spill to the control room; and (2) after one hour, knowledge of the spill is likely and control room operators can take appropriate action.

[2] The worst-case meteorological conditions determined for each postulated event were based upon those meteorological conditions yielding the highest concentration in the control room.

Gasoline - modeled as n-Heptane (Water Transport)

A meteorological sensitivity study involving the release of 1,680,000 gallons of gasoline was conducted to determine the effects of changing wind speed and stability. The results of the meteorological sensitivity analysis are presented in Table 7: Gasoline (n-Heptane) (Water Transport) Sensitivity Analysis.

Storage:

Storage location for modeling: Barge Transport
Quantity: 1,680,000 gallons
Distance to Control Room: 15,974 feet
TLV-TWA: 300 ppm

Puddle Diameter:

Due to the large quantity of gasoline (Water Transport), 1,680,000 gallons, a 1 cm thick puddle is not realistic. Spilling this large quantity over a 1 cm thick puddle would essentially diffuse the vapor cloud over a very large area. Thus, the maximum puddle area allowed by ALOHA® of 31,400 square meters was used.

ALOHA® synopsis (*refer to Table 7: Gasoline (n-Heptane) (Water Transport) Sensitivity Analysis)*
Distance to TLV-TWA: 5,808 feet (Pasquill Stability Class F @ 3 m/s)
Concentration in Control Room: 13.8 ppm (Pasquill Stability Class F @ 3 m/s)

Table 7: Gasoline (n-Heptane) (Water Transport) Sensitivity Analysis

Stability Class	Wind Speed (m/s)	Cloud Cover	Time of Day	Temperature [1]	Quantity Spilled (gallons)	Distance to Control Room (feet)	Toxicity Distance to IDLH (feet)	Concentration in Control Room (ppm)
A	1.5	0%	12:00 PM	28.9°C	1,680,000	15,974	3,687	0.718
B	1.5	50%	12:00 PM	28.9°C	1,680,000	15,974	3,801	0.734
C	3	50%	12:00 PM	28.9°C	1,680,000	15,974	3,750	8.05
D	5.5	50%	12:00 PM	28.9°C	1,680,000	15,974	3,762	13.5
D	3	50%	5:00 AM	28.9°C	1,680,000	15,974	3,714	8.29
E	2	50%	5:00 AM	28.9°C	1,680,000	15,974	4,545	4.53
E	3	0%	5:00 AM	28.9°C	1,680,000	15,974	4,395	10.1
E	4	0%	5:00 AM	28.9°C	1,680,000	15,974	4,302	13.0
F	1	50%	12:00 PM	28.9°C	1,680,000	15,974	7,392	> 1 hr [2]
F	1	0%	5:00 AM	28.9°C	1,680,000	15,974	6,336	> 1 hr [2]
F	1.5	0%	12:00 PM	28.9°C	1,680,000	15,974	6,864	> 1 hr [2]
F	1.5	0%	5:00 AM	28.9°C	1,680,000	15,974	5,808	> 1 hr [2]
F	2	0%	5:00 AM	28.9°C	1,680,000	15,974	5,808	> 1 hr [2]
F	3	0%	5:00 AM	28.9°C	1,680,000	15,974	5,808 [3]	13.8

Notes: [1] 28.9°C was used only for Gasoline modeled as n-Heptane (Water Transport) to match the July mean temperature used to model Gasoline using TOXDISP allowing for a comparison between modeling Gasoline (using n-Heptane as a surrogate) using the ALOHA® model and modeling Gasoline using the TOXDISP model.

[2] ALOHA® does not model releases after one hour because meteorological conditions are likely to change after one hour, such as wind speed/wind direction are not likely to persist in a given sector for much more than one hour. However, it is reasonable to assume that the meteorological conditions have changed after one hour as suggested by the U.S. EPA and identified in RG 1.78 (Reference 10). Additionally, when other conservatisms are accounted for: (1) the model is run as a straight line release from the spill to the control room; and (2) after one hour, knowledge of the spill is likely and control room operators can take appropriate action.

[3] The worst-case meteorological conditions determined for each postulated event were based upon those meteorological conditions yielding the highest concentration in the control room.

The TOXDISP model predicted a toxicity distance to the IDLH of 6,433 feet. As presented in the response to RAI 06.04-1, TOXDISP inputs included meteorological stability class F with a wind speed of 1.5 m/s and a strong radiation value.

The ALOHA® comparison case (F stability class with a wind speed of 1.5 m/s at 12 noon) from the ALOHA® sensitivity analysis for n-Heptane as a surrogate for Gasoline results in a comparable but slightly more conservative distance than TOXDISP, 6,864 feet versus 6,433 feet. However, it should be noted that there were a few inputs that differed between the models, most notable was that the puddle size for TOXDISP was 55,741.8 square meters versus the 31,400 square meter puddle size utilized in ALOHA®.

References:

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2. Fardad, D. and N. Ladommatos, "Evaporation of hydrocarbon compounds, including gasoline and diesel fuel, on heated metal surfaces," Department of Mechanical Engineering, Brunel University, Uxbridge, UK, Proc Instn Mechanical Engineers Vol 213 Part D, 1999.

3. Lenhert, D.B, Cernansky, N.P, Miller, D.L., and K.G. Owens, "The Oxidation of a Gasoline Fuel Surrogate in the Negative Temperature Coefficient Region," July, 2004.

4. Seinfeld, J.H., "Atmospheric Chemistry and Physics of Air Pollution", John Wiley & Sons, Inc. 1986.

5. Code of Federal Regulations, Title 40 - – Protection of Environment Part 68 – Chemical Accident Prevention Provisions, Subpart B-Hazard Assessment, §68.22 Offsite consequence analysis parameters.

6. Code of Federal Regulations, Title 40 – Protection of Environment Part 68 – Chemical Accident Prevention Provisions, Subpart B-Hazard Assessment, §68.25 Worst-case release scenario analysis.

7. U.S. Nuclear Regulatory Commission, Wing, J., NUREG-0570, "Toxic Vapor Concentrations in the Control Room Following a Postulated Accidental Release," June 1979.

8. Letter from Evans, Terry of Gulfstream Terminals & Marketing, LLC to Wagner, David of Bechtel Power Corporation, entitled "Information you requested on the Port of Bay City," on January 10, 2007.

9. Lower Colorado River Authority. Colorado River Watch Network Water Quality Data, available online at: http://crwn.lcra.org/ , accessed February 1, 2007.

10. 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.

11. U.S. Coast Guard, Chemical Hazards Response Information System (CHRIS), June 1999.

12. Sciencelab.com, Inc., Material Safety Data Sheet Sodium Hypochlorite, 12% MSDS, last updated November 6, 2008.

13. U.S. Environmental Protection Agency and the National Oceanic and Atmospheric Administration's Office of Response and Restoration, *Computer-Aided Management of Emergency Operations*, accessed June 2008.

14. Yaws, C.L., *Chemical Properties Handbook.* McGraw-Hill, 1999.

FSAR Section 2.2S.3.1.3 and Table 2.2S-11 will be updated as shown below as a result of this RAI response:

The third paragraph of FSAR Section 2.2S.3.1.3 will be updated as follows:

The IDLH is defined by the National Institute of Occupational Safety and Health as a situation that poses a threat of exposure that is likely to cause death or immediate or delayed permanent adverse health effects, or one that could prevent escape from such an environment. The IDLHs determined by the National Institute of Occupational Safety and Health are established such that workers are able to escape such environments without suffering permanent health damage. Where an IDLH was unavailable for a toxic chemical, the time-weighted average (TWA) or threshold limit value (TLV), promulgated by the Occupational Safety and Health Administration or adopted by the American Conference of Governmental Hygienists, or the Temporary Emergency Exposure Limit, adopted by the U.S. Department of Energy, were used as the toxicity concentration level. Conservative meteorological assumptions were used: F (stable) stability class with a wind speed of one m/sec; ambient temperature of 25°C; relative humidity of 50%; cloud cover of 50%; and atmospheric pressure of one atmosphere. A Pasquill stability category "F" and a wind speed of one m/sec typically represent the worst five percent of meteorological conditions observed at a majority of nuclear plant sites (Reference 2.2S-42 and 2.2S-61). It was further assumed that the toxic vapor cloud traveled downwind directly toward the Control Room. Additionally, a meteorological sensitivity analysis was conducted using the ALOHA model for four of the toxic chemicals listed on Table 2.2S-11 involving five postulated events.

The first paragraph of FSAR Section 2.2S.3.1.3.3 will be updated as follows:

The STP 3 Control Room is located approximately 15,974 feet from the west bank of the Colorado River, a navigable waterway. The plausible chemicals transported on barges or chemical parcel tankers along the Colorado River identified for further analysis with regard to the potential of forming a toxic vapor cloud following an accidental release and traveling toward the Control Room are n-butanol, isobutanol, acetic acid, n-butyl acetate, vinyl acetate, and gasoline. An analysis was conducted for the identified hazardous materials. The conservative methodology outlined in Subsection 2.2S.3.1.3 was used to determine the concentration of a toxic chemical cloud as it disperses downwind toward the Control Room using the ALOHA or TOXDISP dispersion modeling. The maximum quantity of n-butanol, isobutanol, n-butyl acetate, and vinyl acetate assumed to be spilled on the waterway was 380,000 gallons. The quantity of acetic acid assumed to be spilled on the waterway was 500,000 gallons. For these cases, the maximum surface area of the spill that ALOHA would accommodate-31,400 m^2-was used. The maximum quantity of gasoline assumed to be spilled on the waterway was 1,680,000 gallons. Due to the immense volume of gasoline-1,680,000 gallons-the maximum spill area for a one-centimeter thick depth would require the gasoline to flow miles down the river away from STP 3 & 4. Therefore, the length of the spill area influencing the Control Room was assumed to be 1500 feet up and down the river from the spill site, the closest point from the river to STP 3 & 4, for a total of 3000 feet in river length. The Control Room concentrations of the selected hazardous materials never reach the IDLH or other established toxicity limits (Table 2.2S-11). The greatest distance to an IDLH for the selected hazardous materials was ~~acetic acid and~~ vinyl acetate, where its concentration~~s~~ in the air disperses to a level below ~~their respective~~ its IDLH limit~~s,~~ 10,032 feet from the spill site. Therefore, the formation of a toxic vapor cloud following an accidental release of the analyzed hazardous materials transported on the Colorado River would not adversely affect the safe operation or shutdown of STP 3 & 4.

A second paragraph will be added to FSAR Section 2.2S.3.1.3.3 as follows:

Additionally, a meteorological sensitivity analysis using ALOHA was performed for two of the chemicals transported by barge, acetic acid and gasoline. The ALOHA model was used to perform the meteorological sensitivity analysis for gasoline using n-Heptane as a surrogate for gasoline. The maximum surface area of the spill that ALOHA would accommodate for the gasoline sensitivity analysis-31,400 m^2-was used. The results of the gasoline sensitivity analysis indicate that under the determined worst case meteorological conditions, the distance to the TLV-TWA was 5,808 feet and the maximum concentration reached in the control room was 13.8 ppm.

The first paragraph of Section 2.2S.3.1.3.4 will be updated as follows:

The hazardous materials stored on site that were identified for further analysis with regard to the potential of the formation of toxic vapor clouds formed following an accidental release were Freon-11, Freon-12, gasoline (12,000 gallon above ground storage tank), Halon 1301, hydrogen (asphyxiant), sodium hypochlorite, monoethanolamine, hydrazine, nitrogen (asphyxiant), and liquid nitrogen (asphyxiant). As described in Subsection 2.2S.3.1.3, the identified hazardous materials were analyzed using the ALOHA dispersion model to determine whether the formed vapor cloud would reach the Control Room intake and what the concentration of the toxic chemical would be in the Control Room following an accidental release. Additionally, a meteorological sensitivity analysis was performed for sodium hypochlorite using the ALOHA model. Hydrogen, nitrogen, and liquid nitrogen concentrations were determined at the Control Room following a 10-minute release from the largest storage vessel. In each case, the concentration of these asphyxiants at the Control Room-1490 ppm hydrogen, 5540 ppm nitrogen, and 1390 ppm liquid nitrogen-would not displace enough oxygen for the Control Room to become an oxygen-deficient environment, nor would they be otherwise toxic at these concentrations (Reference 2.2S-63). The remaining chemical analyses indicate that the Control Room would remain habitable for the worst-case release scenario. (While, the distance to the selected toxicity limit for gasoline is greater than the distance to the STP 3 & 4 control room, the concentration inside the control room never reached the toxicity limit.) The worst-case release scenario in each of the analyses included the total loss of the largest vessel, resulting in an unconfined one-centimeter-thick puddle under stable atmospheric conditions (Table 2.2S-11). Therefore, the formation of a toxic vapor cloud following an accidental release of the analyzed hazardous materials stored onsite would not adversely affect the safe operation or shutdown of STP 3 & 4.

The first paragraph of Section 2.2S.3.1.3.5 will be updated as follows:

The OXEA Corporation, located approximately 22,841 feet, and the Port of Bay City, Gulfstream Terminal and Marketing LLC and GulfMark Energy facilities, located approximately 24,244 feet, from STP 3 & 4 operate within the vicinity of the STP site. The hazardous material stored at GulfMark Energy that was identified for further analysis with regard to the potential for forming a toxic vapor cloud following an accidental release and traveling to the Control Room was crude petroleum. (The gasoline storage at the Port of Bay City, Gulfstream Terminal and Marketing LLC, and GulfMark Energy is bounded by gasoline transport on the Colorado River.) The hazardous materials stored at OXEA Corporation that were identified for further analysis with regard to the potential for forming a toxic vapor cloud following an accidental release and traveling toward the Control Room were 1-hexene, 1-octene, 2-hexene, acetaldehyde, acetic acid, acetone, cyclohexylamine, dimethyl sulfide, hydrazine, sodium hypochlorite, carbon dioxide (asphyxiant), carbon monoxide (asphyxiant), ethyl acetate, ethylene (asphyxiant), hydrogen (asphyxiant), isobutanol, isobutyl acetate, isobutyraldehyde, methane (asphyxiant), n-butanol, n-butyl acetate, n-butyraldehyde, n-propyl acetate, n-propyl alcohol, propionaldehyde, nitrogen (asphyxiant), propylene (asphyxiant), and vinyl acetate. Additionally, a meteorological sensitivity analysis was performed for acetic acid and 1-hexene using the ALOHA model. Carbon dioxide, carbon monoxide, ethylene, hydrogen, methane, nitrogen and propylene concentrations were determined outside the Control Room following a 10-minute release from the largest storage vessel. In each case, the concentration of the asphyxiants at the Control Room would not displace enough oxygen for the Control Room to become an oxygen deficient environment, nor would it be otherwise toxic at these concentrations (Table 2.2S-11). The remaining chemical analyses indicate that the distance the vapor cloud could travel prior to falling below the selected toxicity limit was less than the distance to the Control Room. Therefore, the formation of a toxic vapor cloud following an accidental release of the analyzed hazardous materials stored offsite would not adversely affect the safe operation or shutdown of STP 3 & 4

Table 2.2S-11 will also be updated as shown below:

Table 2.2S-11 Design-Basis Events, Toxic Vapor Clouds

Source	Chemical	Quantity	IDLH	Distance to STP 3 & 4 Control Room	Distance to IDLH	Maximum Control Room Concentration
FM 521	Gasoline	9,000 gal	300 ppm TWA /500 ppm STEL	2,853 ft	2,034 ft	22.9 ppm
Waterway (Colorado River)	n-Butanol	380,000 gal	1,400 ppm	15,974 ft	1,974 ft	>1 hr [3]
	Isobutanol	380,000 gal	1,600 ppm		2,292 ft	> 1 hr [3]
	Acetic Acid	500,000 gal	50 ppm		~~10,032~~ 8,448 ft	~~>1 hr [3]~~ 5.97 ppm [7]
	n-Butyl Acetate	380,000 gal	1,700 ppm		2,205 ft	> 1 hr [3]
	Vinyl Acetate	380,000 gal	500 ppm		10,032 ft	>1 hr [3]
	Gasoline	1,680,000 gal	300 ppm TWA /500 ppm STEL		~~9,843~~ 6,433 ft [8]	Not applicable [4]
Onsite (Includes STP 1 & 2)	Freon-11	2,917 lbs	2,000 ppm	1,755 ft	651 ft	34.8 ppm
	Freon-12	55,200 lbs	15,000 ppm	1,755 ft	1,521 ft	653 ppm
	Gasoline	12,000 gal	300 ppm TWA /500 ppm STEL	1,976 ft	2,388 ft	110 ppm
	Halon 1301	9,150 lbs	40,000 ppm	2,032 ft	522 ft	154 ppm
	Hydrogen	80,000 ft3	Asphyxiant	1,668 ft	Not applicable [5]	1,490 ppm
	Sodium Hypochlorite	7,200 gal	10 ppm as Chlorine	2,559 ft	177 ft	0.045 ppm
	Monoethanolamine	15,100 gal	30 ppm	1,961 ft	867 ft	4.31 ppm
	Hydrazine	150 gal	50 ppm	2,671 ft	843 ft	1.84 ppm
	Nitrogen	20,000 lbs	Asphyxiant	1,613 ft	Not applicable [5]	5,540 ppm
	Liquid Nitrogen	92,400 lbs	Asphyxiant	1,613 ft	Not applicable [5]	1,390 ppm

Source	Chemical	Quantity	IDLH	Distance to STP 3 & 4 Control Room	Distance to IDLH	Maximum Control Room Concentration
Offsite (OXEA Corp.)	1-Hexene	1,265,000 lbs	30 ppm [1]	22,841 ft	6,864 [6] 7,392 ft [7]	>1 hr [3] 1.36 ppm [7]
	1-Octene	2,010,000 lb	250 mg/m3		8,976 ft	>1 hr [3]
	2-Hexene	3,861 lb	30 ppm		3,645 ft	>1 hr [3]
	Acetaldehyde	866,300 lbs	2,000 ppm		13,200 ft	>1 hr [3]
	Acetic Acid	9,999,999 lbs	50 ppm		9,504 7,392 ft [7]	>1 hr [3] 2.80 ppm [7]
	Acetone	4,400 lbs	2,500 ppm		399 ft	> 1 hr [3]
	Cyclohexylamine	4,000 lbs	30 ppm [1]		921 ft	>1 hr [3]
	Dimethyl Sulfide	10,000 lbs	2,000 ppm		1,083 ft	> 1 hr [3]
	Hydrazine	4,000 lbs	50 ppm		1,500 ft	>1 hr [3]
	Sodium Hypochlorite	30,000 lbs	10 ppm		114 ft	>1 hr [3]
	Carbon Dioxide	868,000 lbs	40,000 ppm		7,920 ft	>1 hr [3]
	Carbon Monoxide	868,000 lbs	1,200 ppm		10,660 ft [6]	[6]
	Ethyl Acetate	21,800 lbs	2,000 ppm		672 ft	>1 hr [3]
	Ethylene	470,000 lbs	15,000 ppm		11,616 ft	> 1 hr [3]
	Hydrogen	58,512 lbs	Asphyxiant		Not applicable [5]	> 1 hr [3]
	Isobutanol	3,455,333 lbs	1,600 ppm		1,377 ft	>1 hr [3]
	Isobutyl Acetate	9,999,999 lbs	1,300 ppm		1,956 ft	> 1 hr [3]
	Isobutyraldehyde	1,000,000 lbs	1,500 ppm [1]		6,336 ft	>1 hr [3]
	Methane	47,000 lbs	25,000 ppm [1]		4,392 ft	>1 hr [3]
	n-Butanol	16,921,268 lbs	1,400 ppm		777 ft	>1 hr [3]
	n-Butyl Acetate	9,999,999 lbs	1,700 ppm		1,380 ft	>1 hr [3]

Source	Chemical	Quantity	IDLH	Distance to STP 3 & 4 Control Room	Distance to IDLH	Maximum Control Room Concentration
Offsite (OXEA Corp.)	n-Butyraldehyde	3,300,000 lbs	2,000 ppm [1]	22,841 ft	4,563 ft	>1 hr [3]
	n-Propyl Acetate	9,999,999 lbs	1,700 ppm		2,451 ft	> 1 hr [3]
	n-Propyl Alcohol	9,999,999 lbs	800 ppm		2,637 ft	> 1 hr [3]
	Propionaldehyde	600,000 lbs	500 mg/m3		21,120 ft	> 1 hr [3]
	Nitrogen	9,999,999 lbs	Asphyxiant		Not applicable [5]	> 1 hr [3]
	Propylene	740,000 lbs	Asphyxiant		Not applicable [5]	> 1 hr [3]
	Vinyl Acetate	3,700,000 lbs	500 ppm [2]		8,448 ft	>1 hr [3]
Offsite (GulfMark)	Crude Petroleum	1,050,000 gal	The evaporation rate of crude petroleum is so low that a vapor cloud of substantial concentration is never reached.	24,244 ft	N/A-The evaporation rate of crude petroleum is so low that a vapor cloud of substantial concentration is never reached.	N/A- The evaporation rate of crude petroleum is so low that a vapor cloud of substantial concentration is never reached.

[1] Temporary Emergency Exposure Limits (TEEL).
[2] Emergency Response Planning Guideline (ERPG).
[3] ALOHA does not report values after 1 hour because it assumes that the weather conditions or other release circumstances are likely to change after an hour.
[4] Not applicable-The TOXDISP model was used to determine concentrations outside the control room intake. Because, the toxic concentrations had dissipated below the toxicity limit prior to reaching the control room intake, calculating the concentration inside the control room was not required.
[5] Not applicable-the material is an asphyxiant with no associated toxicity limit.
[6] The FLACS model was used to determine that the carbon monoxide plume travels to a maximum horizontal distance of 10,660 ft and rises vertically to 4,100 ft before concentrations are lowered to less than IDLH values.
[7] The worst-case meteorological conditions determined for each postulated event where a meteorological sensitivity analysis was performed was based upon the those meteorological conditions yielding the highest concentration in the control room.
[8] A comparison study was done using the ALOHA model with n-Heptane as a surrogate for gasoline. The following worst-case scenario was determined using the ALOHA model: F stability class at 3 m/s which yielded a distance to the IDLH of 5,808 ft with a maximum concentration reaching 13.8 ppm in the control room during the postulated scenario.