July 24, 2023

SUBMITTED VIA EMAIL: airpermits@azdeq.gov

Mr. Daniel Czecholinski
Air Quality Division Director
Arizona Department of Environmental Quality (ADEQ)
1110 W. Washington St.
Phoenix, AZ 85007

RE: **Air Quality Class II Permit Renewal and Minor Revision Application for Enterprise Products Operating LLC**
ADEQ Permit No. 73431
Adamana LPG Terminal
Navajo County, Arizona

Mr. Czecholinski:

Enterprise Products Operating LLC ("Enterprise") is submitting this Air Quality Class II Permit Renewal and Minor Revision application in accordance with the Arizona Administrative Code (AAC) Title 18 Chapter 2 for the Adamana LPG Terminal ("Adamana") in Navajo County to the Arizona Department of Environmental Quality (ADEQ) Air Quality Division (AQD). With this application, Enterprise seeks to Renew Air Permit No. 73431 expiring January 24, 2024, while also requesting the following updates to the permit:

- Update storage tank emission calculations to reflect current U.S. EPA AP-42 Chapter 7 - *Organic Liquid Storage Tanks* methodologies;
- Update tanker truck and railcar loading and unloading emissions to reflect more recent facility operating data; and
- Updated emissions from necessary sources to permit the handling of Refinery Grade Butane (RGB) and Butane/Pentane products.

The Adamana facility is located in Navajo County, Arizona, which is an attainment area for all criteria pollutants. The Adamana LPG Terminal is a minor source with respect to 40 CFR 52 PSD review. No new emission sources are being proposed and the updated facility emissions are less than the permitting exemption thresholds. Therefore, Minor NSR will not be triggered.

If you have questions or require additional information, please contact Ryan Anderson at (713) 381-4644 or by email at raanderson@eprod.com or Pranav Kulkarni at (713) 381-5830.

Thank you,
Enterprise Products Operating LLC

Ryan Anderson, P.E.
Engineer, Senior Environmental

Pranav Kulkarni, Ph.D.
Manager, Environmental Permitting

Attachments

ENTERPRISE PRODUCTS OPERATING LLC
ADAMANA LPG TERMINAL
Navajo County, Arizona

Air Quality Class II Permit Renewal & Minor Revision

JUNE 2023

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Tables

INTRODUCTION

In accordance with the requirements of Section R18-2-304 of the Arizona Administrative Code (A.A.C.), Enterprise Products Operating LLC (Enterprise) is submitting an Air Quality Class II Permit Renewal & Minor Revision application for the Adamana LPG Terminal located approximately 20 miles east-northeast of Holbrook in Navajo County, Arizona. This facility is currently authorized under Permit No. 73431 issued on January 25, 2019, and expiring on January 24, 2024. Enterprise is submitting this renewal application for Permit No. 73431 at least 6 months, but not more than 18 months, prior to the date of permit expiration, as required by A.A.C. R18-2-304.D.2.

The Adamana LPG Terminal stores and manages liquid propane and butane products or liquid petroleum gas (LPG) and consists of the following emissions sources:

- Degasser Flare;
- Loading Racks;
- Desiccant Dryers;
- Storage Tanks;
- Facility Flare;
- Coalescers;
- Vapor Recovery Compressors; and
- Equipment Leak Fugitives.

Enterprise is submitting this application to renew ADEQ Class II Air Permit 73431. Enterprise would also like to update tank emission calculations to reflect current AP-42 emission factors, update the truck & railcar loading & unloading emission calculations based on more recent operating data, and incorporate proposed new products to be handled at the facility. Thus, a Permit Renewal & Minor Revision Application is being submitted for this facility for these actions. No other equipment at the facility will change from what is authorized in the current permit, and no other facility modifications will occur.

The Adamana LPG Terminal is a minor source with respect to the A.A.C. Title 18, Chapter 2, Article 101(77) regarding Title V permitting. Thus, an Arizona Department of Environmental Quality (ADEQ) Class II Permit is required for the facility, which Enterprise has prepared.

This application will review operations of the facility and includes all equipment that is operated at the facility. The following sections are organized as follows:

- Attachment A provides the required Standard Application Form.
- Attachment B provides a detailed description of each process at the facility.
- Attachment C provides a flow diagram for all processes.
- Attachment D provides the Equipment List Form.
- Attachment E provides the Emission Source Form.
- Attachment F provides the emission calculations for all emission units at the facility and the supporting documents.
- Attachment G provides a determination of Minor NSR applicability.
- Attachment H provides a review of applicable air quality regulations.
- Attachment I provides the Application Administrative Completeness Checklist.

ATTACHMENT A – STANDARD APPLICATION FORM

SECTION 3.1

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Air Quality Division

1110 West Washington • Phoenix, AZ 85007 • Phone: (602) 771-2338

STANDARD CLASS II PERMIT APPLICATION FORM

(As required by A.R.S. § 49-426, and Chapter 2, Article 3, Arizona Administrative Code)

1. Permit to be issued to (Business license name of organization that is to receive permit): Enterprise Products Operating LLC

2. Mailing Address: P.O. Box 4324
   City: Houston State: Texas ZIP: 77210

3. Name (or names) of Responsible Official: Rodney M. Sartor, Senior Director
   Phone: 713-381-6595 Fax: Email: environmental@eprod.com

4. Facility Manager/Contact Person and Title: Ryan Anderson, P.E. Senior Environmental Engineer
   Phone: 713-381-4644 Fax: Email: raanderson@eprod.com

5. Facility Name: Adamana LPG Terminal
   Facility Location/Address (Current/Proposed): 113 County Road 7156
   City: Holbrook County: Navajo ZIP: 86025
   Indian Reservation (if applicable, which one): N/A
   Latitude/Longitude, Elevation: 34° 59' 10.12" N, 109° 49' 37.45" W; 5,410 ft

6. General Nature of Business: LPG Storage Terminal

7. Type of Organization:
   ☒ Corporation ☐ Individual Owner ☐ Partnership ☐ Government Entity ☐ LLC
   ☐ Other

8. Permit Application Basis: ☐ New Source ☒ Revision ☒ Renewal of Existing Permit
   For renewal or modification, include existing permit number (and exp. date): 73431 (01/24/2024)
   Date of Commencement of Construction or Modification:
   Primary Standard Industrial Classification Code: 5171

9. I certify that I have knowledge of the facts herein set forth, that the same are true, accurate and complete to the best of my knowledge and belief, and that all information not identified by me as confidential in nature shall be treated by ADEQ as public record. I also attest that I am in compliance with the applicable requirements of the Permit and will continue to comply with such requirements and any future requirements that become effective during the life of the Permit. I will present a certification of compliance to ADEQ no less than annually and more frequently if specified by ADEQ. I further state that

I will assume responsibility for the construction, modification, or operation of the source in accordance with Arizona Administrative Code, Title 18, Chapter 2 and any permit issued thereof.

Signature of Responsible Official: 

Printed Name of Signer/Official Title: Rodney M. Sartor, Senior Director

Date: 7/24/2023 Telephone Number: 713-381-6595

ATTACHMENT B – PROCESS DESCRIPTION

The Adamana LPG Terminal was constructed in 1973 and stores two million barrels per year of liquid propane and butane products, referred to as liquid petroleum gas (LPG). Tank truck and/or railcars unload LPG into pressurized bullet tanks using electric compressors. The facility is expected to experience 5,800 total loading and unloading events per year (Equipment ID: 2). From the bullet tanks, the LPG is pumped to be stored in underground salt caverns located at the facility, displacing brine from the caverns. Brine is sent to a degasification process once it is removed from a cavern to vaporize any remaining LPG from the brine. The vaporized product is sent to the brine degasser flare (Equipment ID: 1) with a maximum rating of 25,000 pounds per hour (lb/hr), including the pilot gas. Once degasification is complete, the brine is stored in ponds at the facility until it is needed in the caverns.

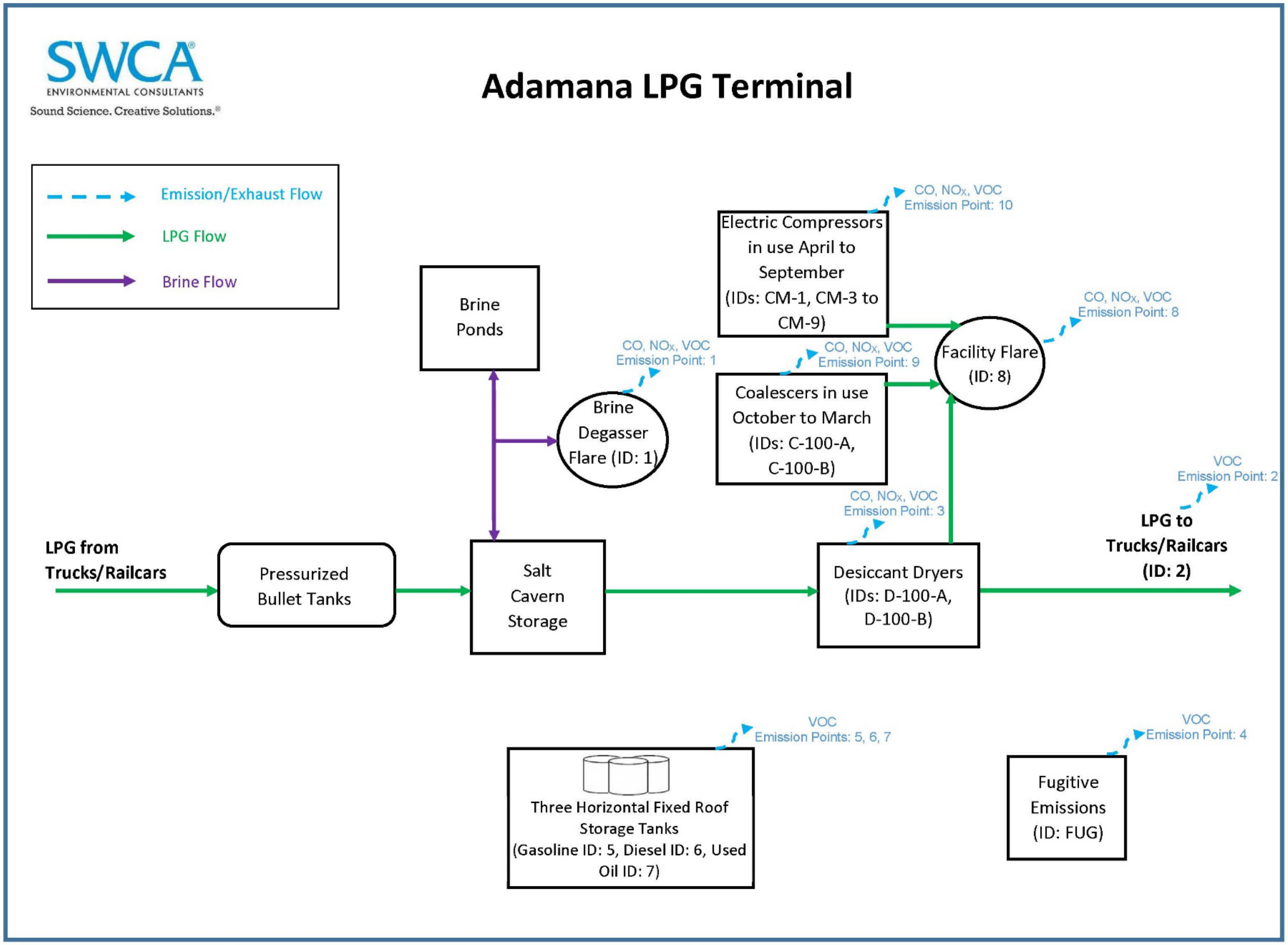
To withdraw product from the caverns, brine is injected into the caverns to displace the LPG. The LPG product then moves through a desiccant bed to remove any water and is loaded into tank trucks and/or railcars (Equipment ID: 2) to be transported from the facility, with the facility experiencing 5,800 loading and unloading events per year. The desiccant bed is then flushed with pressurized LPG to capture any water from the bed, and a sight glass is used to monitor the removal of water from the bed. The pressurized product, along with any water that is captured from the bed, is emitted from the bed. The facility flare (Equipment ID: 8) is used to control emissions from the desiccant dryers (Equipment IDs: D-100-A, D-100-B). The facility flare handles a maximum of 2,195 lb/hr of gas, with a 32 standard cubic feet per hour (scf/hr) pilot.

There are three horizontal fixed roof storage tanks permitted and located at the facility. One 1,000-gallon tank stores gasoline (Equipment ID: 5), one 320-gallon tank stores diesel (Equipment ID: 6), and one 1,160-gallon tank stores used oil (Equipment ID: 7). The process flow diagram for this facility is provided as Attachment C.

The flare also controls two coalescers (Equipment ID: C-100-A, C-100-B), two 300-gallon electric vapor recovery compressors (Equipment IDs: CM-5 and CM-6), and six 200-gallon electric vapor recovery compressors (Equipment IDs: CM-1, CM-3, CM-4, CM-7, CM-8, and CM-9). The coalescers are only used in October through March, the out-haul season, for about 50% of the time as the desiccant dryers. The compressors are only used from April to October, during the in-haul season, and are operated 3 to 4 times per day. Typically, only 5 of the compressors are operated at any given time, although the number of compressors in use is not limited by the permit.

Tank emissions were formerly calculated using EPA TANKS 4.09d, however it is no longer acceptable to use this software for tank emissions estimations. Therefore, tank emissions were calculated using AP-42 Chapter 7 *Organic Liquid Storage Tanks* emission factors and calculation methodology. The revised estimated tank Potential To Emit (PTE) values are included in this application. Tank truck and railcar loading and unloading emissions have also been updated. Lastly, Enterprise wishes to store a new material consisting primarily of pentanes, and potential emissions from this material were also incorporated into the loading / unloading calculations.

ATTACHMENT C – PROCESS FLOW DIAGRAM


SWCA
ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.
Adamana LPG Terminal
Emission/Exhaust Flow
LPG Flow
Brine Flow
Electric Compressors in use April to September (IDs: CM-1, CM-3 to CM-9)
CO, NOx, VOC Emission Point: 10
Brine Ponds
CO, NOx, VOC Emission Point: 1
Brine Degasser Flare (ID: 1)
CO, NOx, VOC Emission Point: 9
Coalescers in use October to March (IDs: C-100-A, C-100-B)
Facility Flare (ID: 8)
CO, NOx, VOC Emission Point: 8
VOC Emission Point: 2
CO, NOx, VOC Emission Point: 3
LPG from Trucks/Railcars
Pressurized Bullet Tanks
Salt Cavern Storage
Desiccant Dryers (IDs: D-100-A, D-100-B)
LPG to Trucks/Railcars (ID: 2)
VOC Emission Points: 5, 6, 7
Three Horizontal Fixed Roof Storage Tanks (Gasoline ID: 5, Diesel ID: 6, Used Oil ID: 7)
VOC Emission Point: 4
Fugitive Emissions (ID: FUG)

ATTACHMENT D – EQUIPMENT LIST FORM

Section 3.5 - Equipment List

Type of Equipment	Maximum Rated Capacity [1]	Make	Model	Serial Number	Date of Manufacture	Equipment ID Number
No New Equipment						

[1} For generator sets, enter the maximum rated capacity of the engine rather than the maximum rated capacity of the generator.

All relevant equipment utilized at the facility should be included in the equipment list. Please complete all fields.
The date of manufacture must be included in order to determine applicability of regulations.
Indicate the units (tons/hour, horsepower, etc.) when recording the maximum rated capacity.
Make additional copies of this form if necessary.
***Submit photographs of the faceplates for all engines listed above.**
***If an engine is certified, please also include a copy of the engine certification with the application.**
***For any newly added equipment, include a copy of the specification sheet.**
***These documents will be used to verify equipment information and determine applicable regulations.**

ATTACHMENT E – EMISSION SOURCE FORM

SECTION 3.6 - EMISSION SOURCE FORM

Emission Point		Regulated Air Pollutant Name	PTE		USE THIS SECTION FOR MODIFICATIONS ONLY: PTE AFTER MODIFICATION		CHANGE IN PTE
Number	Name		lbs/hr	tons/yr	lbs/hr	tons/yr	tons/yr
2	Loading	VOC	12.06	4.37	15.13	5.49	1.12
3	Desiccant Dryers	VOC	0.193	0.084	0.22	0.09	0.01
		NOx	0.030	0.010	0.03	0.01	0.00
		CO	0.100	0.500	0.12	0.05	-0.45
5	Gasoline Storage Tank	VOC	13.08	1.04	14.53	0.52	-0.52
6	Diesel Storage Tank	VOC	0.01	<0.01	0.02	<0.01	0.00
7	Used Oil Storage Tank	VOC	8.27	0.26	12.05	0.53	0.27
9	Coalescers	VOC	0.068	0.030	0.08	0.03	<0.01
		NOx	0.010	<0.01	0.01	0.00	<0.01
		CO	0.040	0.020	0.04	0.02	<0.01
10	Vapor Recovery Compressor Blowdowns	VOC	0.220	0.070	0.21	0.06	-0.01
		NOx	0.03	0.01	0.03	0.01	<0.01
		CO	0.12	0.04	0.12	0.04	<0.01

****Submit emission calculations spreadsheet with your application****

ATTACHMENT F – EMISSION CALCULATIONS

Potential emissions (taking into account the maximum capacity of the equipment) were estimated as described in the sections below. The emission calculations for Liquid Petroleum Gas Loading and Storage Tanks are being modified as part of this Permit Renewal & Minor Revision application.

Brine Degassing Flare (Emission Point: 1)

Enterprise operates the degassing flare to control vapors from the brine degasification process with 98% control efficiency. The flare is operated for 8,760 hours per year. The maximum design rating of the flare is 2.3 MMBtu/hr, and the waste gas has a heat content of 2,332 Btu/scf. Waste gas is sent to the flare at a rate of 115.4 lb/hr, including pilot gas.

NO_X and CO emission factors were determined from the Texas Commission on Environmental Quality (TCEQ) *Air Permit Division's Technical Guidance for Flares and Vapor Oxidizers*, dated October 2000.

Liquid Petroleum Gas Loading (Emission Point: 2)

Liquid Petroleum Gas (LPG) is loaded out of the facility via truck and railcar. Enterprise proposes handling and storing Refinery Grade Butane (RGB) and Butane Pentane Mix in addition to currently permitted products. The uncoupling of the hose causes fugitive emissions from the connection section. The emission calculations were determined using the liquid densities and percentages of the chemicals that make up each product.

The facility is expected to experience 5,800 total loading and unloading events per year, with a maximum of 8 loads per hour, as limited by the permit. The VOC emissions were estimated using a 1-inch connection radius with 2 feet between the connection valves. The volume released from the valve disconnection is multiplied by the material density and the number of loads to obtain VOC emissions.

Emissions were estimated under three scenarios where each scenario assumed one (and only one) of the products were used all year round. Then the worst-case scenario of emissions were reported in the site-wide emissions summary, which represents maximum potential to emit (PTE) values. PTE emissions will increase less than one ton per year.

Desiccant Dryer (Emission Point: 3)

The desiccant dryer is used during propane truck and railcar loadings with 50% opening of the valve. The gallons of propane per load value was calculated using “The Omega Method for Discharge Rate Evaluation” by J.C. Leung, adapted for subcooled inlet piping. It was assumed that propane would be released from the valve for two seconds per load. The calculations were based on 2,000 truckloads per year and 1,500 railcar loads per year of LPG, with 0.57 gallons of LPG released per load. Desiccant dryer emissions are controlled by the facility flare with 98% combined capture and destruction efficiency.

Fugitive Emissions (Emission Point: 4)

Fugitive emissions from flanges, connectors, open-ended lines, pump seals, valves, and other equipment in light liquid service, and from pressure relief valves in gas service, were included in the emission calculations. Emission factors were obtained from Table 2-3 of *Protocol for Equipment Leak Emission Estimates* (EPA Document, EPA-453/R-95-017, November 1995). The fugitive emissions are represented as uncontrolled.

Storage Tanks (Emission Points: 5, 6, and 7)

The Adamana LPG Terminal consists of the following storage tanks permitted at the facility:

- One (1) x 1,000-gallon Gasoline Tank;
- One (1) x 320-gallon Diesel Tank; and
- One (1) x 1,160-gallon Used Oil Tank.

The gasoline storage tank has a maximum fill rate of 1,000 gallons per hour with a throughput of 10,000 gallons per year. The diesel storage tank has a maximum fill rate of 320 gallons per hour with a throughput of 5,000 gallons per year. The used oil tank has a maximum fill rate of 1,160 gallons per hour with a throughput of 116 gallons per year.

Working and breathing emissions for the tanks were calculated using emission factors and calculation methodology from the EPA's AP-42 *Compilation of Air Emission Factors* Ch 7 *Organic Liquid Storage Tanks* (updated June 2020). Emissions from the storage tanks are uncontrolled. Hourly loading emissions were calculated using the following equation:

$$L_T = L_S + L_W$$

Where:

L_T = total routine losses, lb/yr
L_S = standing losses, lb/yr
L_W = working losses, lb/yr

Which, this equation can be further broken down for standing and working losses:

$$L_S = 365\, V_V\, W_V\, K_E\, K_S$$

Where:

L_S = standing losses, lb/yr
V_V = vapor space volume, ft^3
W_V = stock vapor density, lb/ft^3
K_E = vapor space expansion factor, per day
K_S = vented vapor saturation factor, dimensionless
365 = constant, the number of daily events in a year, (days/year)

And:

$$L_W = V_Q\, K_N\, K_P\, W_V\, K_E$$

Where:

L_W = working loss, lb/yr
V_Q = net working loss throughput, ft^3/yr
K_N = working loss turnover (saturation) factor, dimensionless
K_P = working loss product factor, dimensionless
W_V = stock vapor density, lb/ft^3
K_E = vapor space expansion factor, per day

Complete tanks emissions calculations are provided at the end of this section.

Facility Flare (Emission Point: 8)

Enterprise operates a second flare to control the emissions from the desiccant dryers, coalescers and compressor blowdowns with 98% control efficiency. The facility flare is operated for 8,760 hours per year. The fuel for the pilot flame of the flare is propane (2,315 Btu/scf) that is used at a rate of 32 scf an hour (scfh).

The heat released from the desiccant dryers was estimated from the propane heating value and the volumetric flow rate of the desiccant dryer vapors sent to flare. The heat released from the coalescers was estimated from the propane heating value and the volumetric flow rate of the coalescer vapors sent to flare. The heat released from the compressors was estimated from the propane heating value and the annual mass flow rate from compressor purges. The calculated annual heat rate inputs of the desiccant dryer, coalescer, and compressor vapors were added to the pilot gas flow rate.

NO_X and CO emission factors were determined from the Texas Commission on Environmental Quality (TCEQ) *Air Permit Division's Technical Guidance for Flares and Vapor Oxidizers*, dated October 2000. VOC emissions due to the pilot flame were estimated at 0.091 lb/hr and 0.400 tpy.

Coalescers (Emission Point: 9)

The coalescers are blown down during propane truck and railcar loadings with 50% opening of the valve, and are used approximately 50% of the time as the dryers. The gallons of propane per load value was calculated using “The Omega Method for Discharge Rate Evaluation” by J.C. Leung, adapted for subcooled inlet piping. It was assumed that propane would be released from the valve for two seconds per load. The calculations were based on 2,000 truckloads per year and 1,500 railcar loads per year of propane with 0.20 gallons of propane released per load, assuming 50% usage of the dryer equivalent. Coalescer emissions are controlled by the facility flare with 98% combined capture and destruction efficiency.

Compressor Blowdowns (Emission Point: 10)

Emissions from compressor blowdowns are estimated for the electric compressors. Typically, the 8 compressors are operated from April to September each year and are turned on average of 3 to 4 times per day. Emissions are estimated for 2 railcar loading area compressors at 3/4” diameter LPG service, 4 railcar loading area compressors at 3/8” diameter LPG service, and 3 truck loading area compressors at 3/8” diameter LPG service.

Emission estimates are based on a volume derived from “The Omega Method for Discharge Rate Evaluation” by J.C. Leung. The compressor blowdown emissions are calculated for a maximum blowdown time of 4 seconds.

Emission Summary

Calculated emissions of regulated air pollutants for the facility are summarized in Table 1. The facility emissions demonstrate the facility remains a minor source as the PTE is less than 100 tpy of criteria pollutants.

Table 1. Summary of Emission

Emission Point	Emission Source	VOC		NOx		CO	
		lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
1	Brine Degasser Flare	2.308	10.109	0.317	1.390	1.264	5.537
2	Loading Racks	9.323	3.380	-	-	-	-
3	Desiccant Dryers	0.193	0.084	0.026	0.011	0.102	0.045
4	Fugitives	0.096	0.422	-	-	-	-
5	Gasoline Storage Tank	14.530	0.518	-	-	-	-
6	Diesel Storage Tank	0.20	<0.001	-	-	-	-
7	Used Oil Storage Tank	12.050	1.581	-	-	-	-
8	Facility Flare Pilot	0.091	0.400	0.010	0.045	0.041	0.178
9	Coalescers	0.068	0.030	0.009	0.004	0.036	0.016
10	Vapor Recovery Compressor Blowdowns	0.208	0.064	0.028	0.009	0.111	0.034
	Total	**38.888**	**16.588**	**0.390**	**1.459**	**1.555**	**5.810**

As shown in Table 1, no modifications to the facility are being requested as part of this Permit Renewal & Minor Revision application, and the emissions will not change from what is represented in the existing permit.

Enterprise Products Operating LLC
Adamana LPG Terminal
Emission Calculations
Summary of Facility Potential to Emit

Table 1. - Summary of Single Unit Emissions and Facility Potential-to-Emit

Emission Point	Emission Source	VOC		NOx		CO	
		lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
1	Brine Degasser Flare	2.308	10.109	0.317	1.390	1.265	5.541
2	Loading Racks	15.133	5.486	-	-	-	-
3	Desiccant Dryers	0.216	0.094	0.031	0.013	0.122	0.053
4	Fugitives	0.096	0.422	-	-	-	-
5	Gasoline Storage Tank	14.530	0.518	-	-	-	-
6	Diesel Storage Tank	0.020	0.000	-	-	-	-
7	Used Oil Storage Tank	12.050	0.528	-	-	-	-
8	Facility Flare Pilot	0.091	0.400	0.010	0.045	0.041	0.178
9	Coalescers	0.077	0.034	0.011	0.005	0.043	0.019
10	Vapor Recovery Compressor Blowdowns	0.207	0.063	0.030	0.009	0.120	0.037
Total		**44.727**	**17.654**	**0.399**	**1.462**	**1.591**	**5.828**

Enterprise Products Operating LLC
Adamana LPG Terminal
Emission Calculations
Loading (Emission Point: 2)

Material A: Butane/Pentane Mix

Table 2.a. General Values - Butane/Pentane Loading

Property & Variable		Value & Units		Basis/Calculations/Notes
Loading Arm and Connection Volume	V_V	0.05	scf	Equipment design
Initial Pressure During Purge	P_I	210	psig	Conservative estimate (email 2/15)
		224.7	psia	$= P_I + 14.7$ psia
Final Pressure During Venting	P_F	14.7	psia	Atmospheric pressure
Process Temperature	T_I	69.6	°F	AP-42, Chapter 7, avg. maximum monthly ambient temperature for Prescott, AZ
Volume of Material Vented	V_V	0.65	scf/arm	$= (V_V * P_I/P_S * T_S/T_I) - (V_V * P_F/P_S * T_S/T_I)$
Liquid Volume Remaining After Purge	V_L	0.340	gal	Conservative estimate of 100% residual liquid
Frequency per Year	F_{ANN}	5,800	loads/yr	Conservative estimate - Used in previous applications
Maximum Rate of Activity	D_A	8	loads/hr/bay	Conservative estimate - Used in previous applications
Loading Arms per Bay	A	1	arms	
Number of Trucks/Railcars Bays	B	1	bays	
Density	D	5.2	lb/gal	Density of Product. Obtained from Marathon MSDS
Standard Molar Volume	MV	385	ft^3/lb-mol	Molar volume at standard conditions
Vapor Molecular Weight	MW	72	lb/lb-mol	Calculated - Chemical Molecular Weights obtained from https://www.engineeringtoolbox.com/molecular-weight-gas-vapor-d_1156.html
Vapor VOC Content	W_{NG}	100	wt%	Vapor is assumed to contain 100 % VOC. (Tank Vapor Space)
Hexane Content in Product	W_H	3	wt%	
Propane Content in Product	W_{PR}	1	wt%	
Butane Content in Product	W_B	3	wt%	
Pentane Content in Product	W_{PE}	93	wt%	
VOC Weight Content	W_{VOC}	100	wt%	

Table 2.b. Calculated Values (Vapors Routed to Combustion Unit) - Butane/Pentane Loading

Property & Variable		Value & Units		Basis/Calculations/Notes
Amount Vapor Released per Arm	R_{VA}	0.12	lb/arm	$= V_V / MV * MW$
Amount Vapor Released per Vehicle	R_{VT}	0.12	lb/vehicle	$= R_{VA} * A$
Amount Liquid Released per Arm	R_{LA}	1.77	lb/arm	$= V_L * D$
Amount Liquid Released per Vehicle	R_{LT}	1.77	lb/vehicle	$= R_{LA} * A$
Mass per Vehicle	M_T	1.89	lb/vehicle	$= R_{VT} + R_{LT}$
VOC Mass per Vehicle	M_{VOC}	1.89	lb/vehicle	$= (R_{VT} * W_{NG}) + (R_{LT} * W_{VOC})$
Hexane Mass per Vehicle	M_H	0.05	lb/vehicle	$= (R_{LT} * W_H)$
Propane Mass per Vehicle	M_{PR}	0.14	lb/vehicle	$= (R_{VT} * W_{NG}) + (R_{LT} * W_{PR})$
Butane Mass per Vehicle	M_B	0.05	lb/vehicle	$= (R_{LT} * W_B)$
Pentane Mass per Vehicle	M_{PE}	1.65	lb/vehicle	$= (R_{LT} * W_{PE})$
Mass per Hour	M_{THR}	15.13	lb/hr	$= M_T * D_A * B$
VOC Mass per Hour	M_{HR}	15.13	lb/hr	$= M_{VOC} * D_A * B$
Hexane Mass per Hour	M_{HHR}	0.43	lb/hr	$= M_H * D_A * B$
Propane Mass per Hour	M_{PRHR}	1.11	lb/hr	$= M_{PR} * D_A * B$
Butane Mass per Hour	M_{BHR}	0.43	lb/hr	$= M_B * D_A * B$
Pentane Mass per Hour	M_{PEHR}	13.18	lb/hr	$= M_{PE} * D_A * B$
Mass per Year	M_{TANN}	5.49	tpy	$= (M_T + M_{EM}) * F_{ANN}$
VOC Mass per Year	M_{ANN}	5.49	tpy	$= (M_{VOC} + M_{EM}) * F_{ANN}$
Hexane Mass per Year	M_{HANN}	0.15	tpy	$= M_H * F_{ANN}$
Propane Mass per Year	M_{PRANN}	0.40	tpy	$= M_{PR} * F_{ANN}$
Butane Mass per Year	M_{BANN}	0.15	tpy	$= M_B * F_{ANN}$
Pentane Mass per Year	M_{PEANN}	4.78	tpy	$= M_{PE} * F_{ANN}$

Material B: LPG (Propane)

Table 2.c. General Values - LPG Loading

Property & Variable		Value & Units		Basis/Calculations/Notes
Loading Arm and Connection Volume	V_V	0.05	scf	Equipment design
Initial Pressure During Purge	P_I	210	psig	Conservative estimate (email 2/15)
		224.7	psia	$= P_I + 14.7$ psia
Final Pressure During Venting	P_F	14.7	psia	Atmospheric pressure
Process Temperature	T_I	69.6	°F	AP-42, Chapter 7, avg. maximum monthly ambient temperature for Prescott, AZ
Volume of Material Vented	V_V	0.65	scf/arm	$= (V_V * P_I/P_S * T_S/T_I) - (V_V * P_F/P_S * T_S/T_I)$
Liquid Volume Remaining After Purge	V_L	0.340	gal	Conservative estimate of 100% residual liquid
Frequency per Year	F_{ANN}	5,800	loads/yr	Conservative estimate - Used in previous applications
Maximum Rate of Activity	D_A	8	loads/hr/bay	Conservative estimate - Used in previous applications
Loading Arms per Bay	A	1	arms/truck	
Number of Trucks/Railcars Bays	B	1	bays	
Density	D	4.2	lb/gal	Density of Product
Standard Molar Volume	MV	385	ft^3/lb-mol	Molar volume at standard conditions
Vapor Molecular Weight	MW	43	lb/lb-mol	Calculated - Chemical Molecular Weights obtained from https://www.engineeringtoolbox.com/molecular-weight-gas-vapor-d_1156.html
Vapor VOC Content	W_{NG}	100	wt%	Vapor is assumed to contain 100 % VOC. (Tank Vapor Space)
Propylene Content in Product	W_{PL}	5	wt%	
Propane Content in Product	W_{PR}	90	wt%	
Butane Content in Product	W_B	5	wt%	
VOC Weight Content	W_{VOC}	100	wt%	$= W_P + W_B$

Table 2.d. Calculated Values (Vapors Routed to Combustion Unit) - LPG Loading

Property & Variable		Value & Units		Basis/Calculations/Notes
Amount Vapor Released per Arm	R_{VA}	0.07	lb/arm	$= V_V / MV * MW$
Amount Vapor Released per Vehicle	R_{VT}	0.07	lb/vehicle	$= R_{VA} * A$
Amount Liquid Released per Arm	R_{LA}	1.44	lb/arm	$= V_L * D$
Amount Liquid Released per Vehicle	R_{LT}	1.44	lb/vehicle	$= R_{LA} * A$
Mass per Vehicle	M_T	1.51	lb/vehicle	$= R_{VT} + R_{LT}$
VOC Mass per Vehicle	M_{VOC}	1.51	lb/vehicle	$= (R_{VT} * W_{NG}) + (R_{LT} * W_{VOC})$
Propylene Mass per Vehicle	M_{PL}	0.07	lb/vehicle	$= (R_{LT} * W_{PL})$
Propane Mass per Vehicle	M_{PR}	1.37	lb/vehicle	$= (R_{VT} * W_{NG}) + (R_{LT} * W_{PR})$
Butane Mass per Vehicle	M_B	0.07	lb/vehicle	$= (R_{LT} * W_B)$
Mass per Hour	M_{THR}	12.10	lb/hr	$= M_T * D_A * B$
VOC Mass per Hour	M_{HR}	12.10	lb/hr	$= M_{VOC} * D_A * B$
Propylene Mass per Hour	M_{PLHR}	0.58	lb/hr	$= M_{PL} * D_A * B$
Propane Mass per Hour	M_{PRHR}	10.95	lb/hr	$= M_{PR} * D_A * B$
Butane Mass per Hour	M_{BHR}	0.58	lb/hr	$= M_B * D_A * B$
Mass per Year	M_{TANN}	4.39	tpy	$= (M_T + M_{EM}) * F_{ANN}$
VOC Mass per Year	M_{ANN}	4.39	tpy	$= (M_{VOC} + M_{EM}) * F_{ANN}$
Propylene Mass per Year	M_{PLANN}	0.21	tpy	$= M_{PL} * F_{ANN}$
Propane Mass per Year	M_{PRANN}	3.97	tpy	$= M_{PR} * F_{ANN}$
Butane Mass per Year	M_{BANN}	0.21	tpy	$= M_B * F_{ANN}$

Material C: Refinery Grade Butane (RGB)

Table 2.e. General Values - RGB Mix Loading

Property & Variable		Value & Units		Basis/Calculations/Notes
Loading Arm and Connection Volume	V_V	0.05	scf	Equipment design
Initial Pressure During Purge	P_I	210	psig	Conservative estimate (email 2/15)
		224.7	psia	= P_I + 14.7 psia
Final Pressure During Venting	P_F	14.7	psia	Atmospheric pressure
Process Temperature	T_I	69.6	°F	AP-42, Chapter 7, avg. maximum monthly ambient temperature for Prescott, AZ
Volume of Material Vented	V_V	0.65	scf/arm	= (V_V * P_I/P_S * T_S/T_I) - (V_V * P_F/P_S * T_S/T_I)
Liquid Volume Remaining After Purge	V_L	0.340	gal	Conservative estimate of 100% residual liquid
Frequency per Year	F_{ANN}	5,800	loads/yr	Conservative estimate - Used in previous applications
Maximum Rate of Activity	D_A	8	loads/hr/bay	Conservative estimate - Used in previous applications
Loading Arms per Bay	A	1	arms/truck	
Number of Trucks/Railcars Bays	B	1	bays	
Density	D	4.9	lb/gal	Density of Product.
Standard Molar Volume	MV	385	ft^3/lb-mol	Molar volume at standard conditions
Vapor Molecular Weight	MW	59	lb/lb-mol	Calculated - Chemical Molecular Weights obtained from https://www.engineeringtoolbox.com/molecular-weight-gas-vapor-d_1156.html
Vapor VOC Content	W_{NG}	100	wt%	Vapor is assumed to contain 100 % VOC. (Tank Vapor Space)
Olefins	W_O	2	wt%	
Propane Content in Product	W_{PR}	3	wt%	
Butane Content in Product	W_B	87	wt%	
Pentane Content in Product	W_{PE}	8	wt%	
VOC Weight Content	W_{VOC}	100	wt%	= W_P + W_B

Table 2.f. Calculated Values (Vapors Routed to Combustion Unit) - RGB Mix Loading

Property & Variable		Value & Units		Basis/Calculations/Notes
Amount Vapor Released per Arm	R_{VA}	0.10	lb/arm	= V_V / MV * MW
Amount Vapor Released per Vehicle	R_{VT}	0.10	lb/vehicle	= R_{VA} * A
Amount Liquid Released per Arm	R_{LA}	1.65	lb/arm	= V_L * D
Amount Liquid Released per Vehicle	R_{LT}	1.65	lb/vehicle	= R_{LA} * A
Mass per Vehicle	M_T	1.75	lb/vehicle	= R_{VT} + R_{LT}
VOC Mass per Vehicle	M_{VOC}	1.75	lb/vehicle	= (R_{VT} * W_{NG}) + (R_{LT} * W_{VOC})
Olefins Mass per Vehicle	M_O	0.03	lb/vehicle	= (R_{LT} * W_O)
Propane Mass per Vehicle	M_{PR}	0.15	lb/vehicle	= (R_{VT} * W_{NG}) + (R_{LT} * W_{PR})
Butane Mass per Vehicle	M_B	1.44	lb/vehicle	= (R_{LT} * W_B)
Pentane Mass per Vehicle	M_{PE}	0.13	lb/vehicle	= (R_{LT} * W_{PE})
Mass per Hour	M_{THR}	14.02	lb/hr	= M_T * D_A * B
VOC Mass per Hour	M_{HR}	14.02	lb/hr	= M_{VOC} * D_A * B
Olefins Mass per Hour	M_{OHR}	0.26	lb/hr	= M_O * D_A * B
Propane Mass per Hour	M_{PRHR}	1.19	lb/hr	= M_{PR} * D_A * B
Butane Mass per Hour	M_{BHR}	11.51	lb/hr	= M_B * D_A * B
Pentane Mass per Hour	M_{PEHR}	1.06	lb/hr	= M_{PE} * D_A * B
Mass per Year	M_{TANN}	5.08	tpy	= (M_T + M_{EM})* F_{ANN}
VOC Mass per Year	M_{ANN}	5.08	tpy	= (M_{VOC} + M_{EM}) * F_{ANN}
Olefins Mass per Year	M_{OANN}	0.10	tpy	= M_O * F_{ANN}
Propane Mass per Year	M_{PRANN}	0.43	tpy	= M_{PR} * F_{ANN}
Butane Mass per Year	M_{BANN}	4.17	tpy	= M_B * F_{ANN}
Pentane Mass per Year	M_{PEANN}	0.38	tpy	= M_{PE} * F_{ANN}

Max PTE from Loading & Unloading		
Compound	**lb/hr**	**TPY**
Hexane	0.43	0.15
Propylene	0.58	0.21
Olefins	0.26	0.10
Propane	10.95	3.97
Butane	11.51	4.17
Pentane	13.18	4.78
Total VOC	15.13	5.49

1 Obtained from Enterprise Products Operating LLC - Exhibit B: Adamana Propane Specification issued March 19, 2018.

2 Obtained from Mont Belvieu Caverns, LLC - Exhibit B: Product Specifications Butane/Pentane Mix

3 Obtained from Mont Belvieu Caverns, LLC - Exhibit B: Product Specifications Refinery Grade Butane (RGB)

Enterprise Products Operating LLC
Adamana LPG Terminal
Emission Calculations
Fugitive Component Emissions (Emission Point: 4)

Table 3. - Fugitive Emissions

				VOC		
Equipment Type	**Count**	**Emission factor [1] (kg/hr/source)**	**Emission factor [1] (lb/hr/source)**	**Wt. %**	**Emissions (lb/hr)**	**Emissions (tpy)**
Gas						
Valves	0	1.30E-05	2.87E-05	100%	0.00	0.00
PRVs	9	1.30E-05	2.87E-05		0.00	0.00
Others	0	1.20E-04	2.65E-04		0.00	0.00
Connectors	0	4.20E-05	9.26E-05		0.00	0.00
Flanges	0	4.20E-05	9.26E-05		0.00	0.00
Open-ended lines	0	1.20E-04	2.65E-04		0.00	0.00
Pump Seals	0	6.50E-05	1.43E-04		0.00	0.00
Subtotal					0.00	0.00
Light Liquid						
Valves	650	4.30E-05	9.48E-05	100%	0.06	0.27
PRVs	50	4.30E-05	9.48E-05		0.00	0.02
Others	9	1.30E-04	2.87E-04		0.00	0.01
Connectors	0	8.00E-06	1.76E-05		0.00	0.00
Flanges	600	8.00E-06	1.76E-05		0.01	0.05
Open-ended lines	0	1.30E-04	2.87E-04		0.00	0.00
Pump Seals	14	5.40E-04	1.19E-03		0.02	0.07
Subtotal					0.10	0.42
Total =					0.10	0.42

[1] Factors are taken from Table 2-3 of "Protocol for Equipment Leak Emission Estimates" (EPA Document, EPA-453/R-95-017, November 1995).

[2] Continuous operations for 8,760 hours was assumed.

Adamana LPG Terminal
Emission Calculations
Summary of Facility Potential to Emit
Tanks Emissions

Emission Point	Name	VOC Emissions (lb/hr)	VOC Emissions (lb/yr)	VOC Emissions (TPY)
5	Gasoline Storage Tank	14.53	1,035.06	0.51753
6	Diesel Storage Tank	0.02	0.33	0.000165
7	Used Oil Storage Tank	12.05	1,056.09	0.528045

Enterprise Products Operating LLC
Adamana LPG Terminal
Emission Calculations
Brine Degassing Flare - Combustion Products (Emission Point: 1)

Table 7.a. - Process Flare - Pilot Fuel Information

Parameter	Value
Waste Gas Heat Value, Btu/scf	2,332
Maximum Design Rating, MMBtu/hr	2.30

Note: Process flare based on a maximum design rating of 2.3 MMBtu/hr operated 8,760 hours per year.

Table 7.b. - Process Flare - Criteria Pollutant Emissions

Component	Mass Flow Rate to Flare, lb/hr [1]	Emission Factor, lb/MMBtu [2]	Emission Rate, lb/hr	Emission Rate, tpy
NO_X	-	0.138	0.32	1.39
CO	-	0.550	1.27	5.54
VOC	115.4	-	2.31	10.11

[1] Based on EPA AP-42, Section 1.4, Natural Gas Combustion (Tables 1.4-1 and 1.4-2).
[2] NO_X and CO emission factors for Flares from TCEQs Air Permit Division's Technical Guidance for Flares and Vapor Oxidizers, RG-109 dated October 2000.

Enterprise Products Operating LLC
Adamana LPG Terminal
Emission Calculations
Facility Flare - Combustion Products (Emission Point: 8)

Table 8.a. - Process Flare - Pilot Fuel Information

Parameter	Value
Propane Gas Usage, Pilot (scfh)	32
Propane Gas Pilot Fuel (Btu/scf)	2,315
Pilot Fuel (MMBtu/hr)	0.074

Table 8.b. - Process Flare - Criteria Pollutant Emissions

Component	Emission Factor, lb/MMBtu [2]	Emission Rate, lb/hr	Emission Rate, tpy
VOC		0.09	0.40
NO_X	0.138	0.01	0.04
CO	0.550	0.04	0.18

[1] VOC emissions based on 32 scfh pilot fueled by propane and assuming 98% DRE.

[2] NO_X and CO emission factors for Flares from TCEQs Air Permit Division's Technical Guidance for Flares and Vapor Oxidizers, RG-109 dated October 2000.

Enterprise Products Operating LLC
Adamana LPG Terminal
Emission Calculations
Flare Combustion Products (Emission Point: 8)

Table 9.a. - Stream Information and Mass Flow Rates of Vapors

Stream Sent to Flare	Desiccant Dryer	Coalescer	Compressor Blowdowns
Mass flow rate of VOC sent to Flare (lb/hr)	10.79	3.83	10.34
Mass flow rate of VOC sent to Flare (tpy)	4.72	1.68	3.16
Emissions to Atmosphere (lb/hr) [1]	0.22	0.08	0.21
Emissions to Atmosphere (tpy) [1]	0.09	0.03	0.06
Flow Rate to Flare (lb/hr) [1]	10.57	3.75	10.13
Flow Rate to Flare (tpy) [1]	4.62	1.64	3.10
Heat Content of Stream (Btu/lb) [2,3]	20,908.00	20,908.00	21,564.00
Maximum Hourly Heat Input (MMBtu/hr)	0.22	0.08	0.22
Annual Heat Input (MMBtu/yr)	193.39	68.67	133.72

[1] Flare has a combined capture and control efficiency of 98%.

[2] Based on worst-case emitting product for each stream. Dessicant Dryer and Coalescer assume pentane, while compressor blowdowns assume propane.

[3] Gross heating value obtained from The Engineering ToolBox (2005). Fuel Gases - Heating Values. Available at: https://www.engineeringtoolbox.com/heating-values-fuel-gases-d_823.html

Table 9.b. - Short-Term Controlled Emissions

Component	Emission Factors		Short-Term Emissions (lb/hr)		
	Emission Factor, DRE [1]	Emission Factor, lb/MMBtu [2]	Desiccant Dryer	Coalescer	Compressor Blowdowns
NO_X	-	0.138	0.031	0.011	0.030
CO	-	0.550	0.122	0.043	0.120
VOC	0.98	-	0.216	0.077	0.207

[1] VOC emissions are based on a flare control efficiency of 98%.
[2] NO_X and CO emission factors for Flares from TCEQs Air Permit Division's Technical Guidance for Flares and Vapor Oxidizers, RG-109 dated October 2000.

Table 9.c. - Annual Controlled Emissions

Component	Emission Factors		Annual Emissions (TPY)			
	Emission Factor, DRE [1]	Emission Factor, lb/MMBtu [2]	Desiccant Dryer	Coalescer	Compressor Blowdowns	Total Emissions
NO_X	-	0.138	0.013	0.005	0.009	0.027
CO	-	0.550	0.053	0.019	0.037	0.109
VOC	0.98	-	0.094	0.034	0.063	0.191

[1] VOC emissions are based on a flare control efficiency of 98%.
[2] NO_X and CO emission factors for Flares from TCEQs Air Permit Division's Technical Guidance for Flares and Vapor Oxidizers, RG-109 dated October 2000.

Enterprise Products Operating LLC
Adamana LPG Terminal
Emission Calculations
Desiccant Dryer Emissions (Emission Point: 3)

Table 10.a. - Desiccant Dryer Emissions - Propane

Equipment Type	Loads/hr	Loads/yr	gal/load [1]	gal/hr	gal/yr	Uncontrolled VOC Emissions lb/hr	Uncontrolled VOC Emissions tpy	Controlled VOC Emissions lb/hr	Controlled VOC Emissions tpy
Trucks	2	2,000	0.57	1.15	1,146.75	4.86	2.43	0.10	0.05
Railcars	2	1,500	0.57	1.15	860.06	4.86	1.82	0.10	0.04
Total	**4**	**3,500**	**1**	**2.29**	**2,006.80**	**9.73**	**4.26**	**0.19**	**0.09**

[1] Gallon per load emission factor calculated using "The Omega Method for Discharge Rate Evaluation" by J.C. Leung. Assumes 50% opening of the valve per load with a two-second release of propane from the valve.

Table 10.b. - Input Data - The Omega Method

Subcooled Liquid - Propane

Parameter	Input	SI Conversion	Unit
Inlet liquid density, lb/ft^3	31.73	507.84	kg/m^3
Liquid Specific Heat, BTU/lb-°F	0.64	2,698.26	J/kg-K
Inlet Temperature, °F	70.00	294.44	K
Saturation Vapor Pressure, psia	111.80	770,831.93	N/m^2
Vapor Specific Volume, ft^3/lb	0.698	0.044	m^3/kg
Liquid Specific Volume, ft^3/lb	0.032	0.002	m^3/kg
Overall Specific Volume, ft^3/lb	0.032	0.002	m^3/kg
Inlet Pressure, psia	185.00	1,275,526.90	N/m^2
Latent Heat of Vaporization, Btu/lb	149.70	348,193.22	J/kg

Vapor Specific Volume	0.697564	ft3/lb
ρ	22.96342 L/g	1.433561 lb/ft^3
P	12.5885	atm
M	44.097	g/mol
R	0.0821	L·atm/mol·K
T	294.44	K

Hole Diameter, in	0.89
K-factor (fL/D)	52

Calculated Values

Specific Volume difference v_{vlo}, ft^3/lb	0.666	0.042	M^3 / Kg
Omega, w_s		4.43	
Transition Saturation Pressure ratio , n_{st}		0.143	
$n_s = P_s/P_o$		0.604	

<u>If n_s is less than n_{st} then no vapor is formed until valve exit. Flash occurs in pipe. (Subcooled doesn't work)</u>

Omega, w		25.184	
$G_c/(P_o p_{lo})$^0.5	0.18		
Critical mass flux, G_{oc}, lb/in^2-hr	23,457.716	4581.227	kg/M^2-sec
Actual Relief Area - in^2	0.622		
Valve Capacity, lb/hr	14,593.41		
Valve Emissions, gpm	57		
G_c/G_{oc}	0.3		
Critical mass flux, G_c, lb/in^2-hr	7,037.31		
Pipe Capacity, lb/hr	4,378.02		
Pipe Emissions, gpm	**17.20**		

The valve used in this service is a 2", 4500 class threaded ball valve with a carbon-steel body and 316 stainless-steel ball with a Teflon seat. Based on the actual ball valve bore inner diameter of 0.89 inches.

Enterprise Products Operating LLC
Adamana LPG Terminal
Emission Calculations
Desiccant Dryer Emissions (Emission Point: 3)

Table 10.c. - Desiccant Dryer Emissions - Butane

						Uncontrolled VOC Emissions		Controlled VOC Emissions	
Equipment Type	**Loads/hr**	**Loads/yr**	**gal/load [1]**	**gal/hr**	**gal/yr**	**lb/hr**	**tpy**	**lb/hr**	**tpy**
Trucks	2	2,000	0.54	1.07	1,070.37	5.21	2.61	0.10	0.05
Railcars	2	1,500	0.54	1.07	802.78	5.21	1.95	0.10	0.04
Total	**4**	**3,500**	**1**	**2.14**	**1,873.16**	**10.42**	**4.56**	**0.21**	**0.09**

[1] Gallon per load emission factor calculated using "The Omega Method for Discharge Rate Evaluation" by J.C. Leung. Assumes 50% opening of the valve per load with a two-second release of butane from the valve.

Table 10.d. - Input Data - The Omega Method

Subcooled Liquid - Butane

Parameter	Input	SI Conversion	Unit
Inlet liquid density, lb/ft^3	36.42	582.90	kg/m^3
Liquid Specific Heat, BTU/lb-°F	0.57	2,396.18	J/kg-K
Inlet Temperature, °F	70.00	294.44	K
Saturation Vapor Pressure, psia	31.60	217,873.78	N/m^2
Vapor Specific Volume, ft^3/lb	0.529	0.033	m^3/kg
Liquid Specific Volume, ft^3/lb	0.027	0.002	m^3/kg
Overall Specific Volume, ft^3/lb	0.027	0.002	m^3/kg
Inlet Pressure, psia	185.00	1,275,526.90	N/m^2
Latent Heat of Vaporization, Btu/lb	146.45	340,631.54	J/kg

Vapor Specific Volume		0.529258	ft3/lb
ρ	30.26587 L/g	1.889438	lb/ft^3
P	12.5885 atm		
M	58.12 g/mol		
R	0.0821 L·atm/mol·K		
T	294.44 K		

Hole Diameter, in	0.89
K-factor (fL/D)	52

Calculated Values

Specific Volume difference v_{vlo}, ft^3/lb	0.502	0.031	M^3 / Kg
Omega, w_s		0.76	
Transition Saturation Pressure ratio , n_{st}		0.028	
$n_s = P_s/P_o$		0.171	

If n_s is less than n_{st} then no vapor is formed until valve exit. Flash occurs in pipe. (Subcooled doesn't work)

Omega, w		19.076	
$G_c/(P_o p_{lo})$^0.5	0.18		
Critical mass flux, G_{oc}, lb/in^2-hr	25,131.406	4908.094	kg/M^2-sec
Actual Relief Area - in^2	0.622		
Valve Capacity, lb/hr	15,634.63		
Valve Emissions, gpm	54		
G_c/G_{oc}	0.3		
Critical mass flux, G_c, lb/in^2-hr	7,539.42		
Pipe Capacity, lb/hr	4,690.39		
Pipe Emissions, gpm	**16.06**		

The valve used in this service is a 2", 4500 class threaded ball valve with a carbon-steel body and 316 stainless-steel ball with a Teflon seat. Based on the actual ball valve bore inner diameter of 0.89 inches.

Enterprise Products Operating LLC
Adamana LPG Terminal
Emission Calculations
Desiccant Dryer Emissions (Emission Point: 3)

Table 10.e. - Desiccant Dryer Emissions - Pentane

						Uncontrolled VOC Emissions		Controlled VOC Emissions	
Equipment Type	**Loads/hr**	**Loads/yr**	**gal/load [1]**	**gal/hr**	**gal/yr**	**lb/hr**	**tpy**	**lb/hr**	**tpy**
Trucks	2	2,000	0.52	1.03	1,034.22	5.39	2.70	0.11	0.05
Railcars	2	1,500	0.52	1.03	775.67	5.39	2.02	0.11	0.04
Total	**4**	**3,500**	**1**	**2.07**	**1,809.89**	**10.79**	**4.72**	**0.22**	**0.09**

[1] Gallon per load emission factor calculated using "The Omega Method for Discharge Rate Evaluation" by J.C. Leung. Assumes 50% opening of the valve per load with a two-second release of pentane from the valve.

Table 10.f. - Input Data - The Omega Method

Subcooled Liquid - Pentane

Parameter	Input	SI Conversion	Unit
Inlet liquid density, lb/ft^3	39.010	624.36	kg/m^3
Liquid Specific Heat, BTU/lb-°F	0.56	2,326.30	J/kg-K
Inlet Temperature, °F	70.00	294.44	K
Saturation Vapor Pressure, psia	9.94	68,533.72	N/m^2
Vapor Specific Volume, ft^3/lb	0.426	0.027	m^3/kg
Liquid Specific Volume, ft^3/lb	0.026	0.002	m^3/kg
Overall Specific Volume, ft^3/lb	0.026	0.002	m^3/kg
Inlet Pressure, psia	185.00	1,275,526.90	N/m^2
Latent Heat of Vaporization, Btu/lb	157.00	365,172.58	J/kg

Hole Diameter, in	0.89
K-factor (fL/D)	52

Calculated Values

Specific Volume difference v_{vlo} - ft^3/lb	0.401	0.025	M^3 / Kg
Omega, w_s		0.14	
Transition Saturation Pressure ratio , n_{st}		0.005	
$n_s = P_s/P_o$		0.054	

If n_s is less than n_{st} then no vapor is formed until valve exit. Flash occurs in pipe. (Subcooled doesn't work)

Omega, w		15.662	
$G_c/(P_o p_{lo})$^0.5	0.18		
Critical mass flux, G_{oc} - lb/in^2-hr	26,009.899	5079.662	kg/M^2-sec
Actual Relief Area - in^2	0.622		
Valve Capacity, lb/hr	16,181.16		
Valve Emissions, gpm	52		
G_c/G_{oc}	0.3		
Critical mass flux, G_c - lb/in^2-hr	7,802.97		
Pipe Capacity, lb/hr	4,854.35		
Pipe Emissions, gpm	**15.51**		

The valve used in this service is a 2", 4500 class threaded ball valve with a carbon-steel body and 316 stainless-steel ball with a Teflon seat. Based on the actual ball valve bore inner diameter of 0.89 inches.

Vapor Specific Volume			0.426341	ft3/lb
ρ	37.57197	L/g	2.345543	lb/ft^3
P	12.5885	atm		
M	72.15	g/mol		
R	0.0821	L·atm/mol·K		
T	294.44	K		

Enterprise Products Operating LLC
Adamana LPG Terminal
Emission Calculations
Coalescer Emissions (Emission Point: 9)

Table 11.a. - Coalescer Emissions

Equipment Type	Loads/hr	Loads/yr[1]	gal/load[2]	gal/hr[3]	gal/yr	Uncontrolled VOC Emissions		Controlled VOC Emissions	
						lb/hr	tpy	lb/hr	tpy
Trucks	2	2,000	0.20	0.41	407.17	1.73	0.86	0.03	0.02
Railcars	2	1,500	0.20	0.41	305.38	1.73	0.65	0.03	0.01
Total	**4**	**3,500**	**0.41**	**0.81**	**712.55**	**3.45**	**1.51**	**0.07**	**0.03**

[1] Coalescers are only used from October to March.
[2] From Omega Method for 0.75" hole diameter at 50% opening of valve. Coalescers have 50% usage of the dryers.
[3] Assumes a two-second release of propane when valve is opened.

Table 11.b. - Input Data - The Omega Method

Subcooled Liquid - Propane

Parameter	Input	SI Conversion	Unit
Inlet liquid density, lb/ft^3	31.73	507.84	kg/m^3
Liquid Specific Heat, BTU/lb-°F	0.64	2,698.26	J/kg-K
Inlet Temperature, °F	70.00	294.44	K
Saturation Vapor Pressure, psia	111.80	770,831.93	N/m^2
Vapor Specific Volume, ft^3/lb	0.698	0.044	m^3/kg
Liquid Specific Volume, ft^3/lb	0.032	0.002	m^3/kg
Overall Specific Volume, ft^3/lb	0.032	0.002	m^3/kg
Inlet Pressure, psia	185.00	1,275,526.90	N/m^2
Latent Heat of Vaporization, Btu/lb	149.70	348,193.22	J/kg

Vapor Specific Volume		0.697564	ft3/lb
ρ	22.96342 L/g	1.433561	lb/ft^3
P	12.5885 atm		
M	44.097 g/mol		
R	0.0821 L·atm/mol·K		
T	294.44 K		

Hole Diameter, in	0.75
K-factor (fL/D)	52

Calculated Values

Specific Volume difference v_{vlo}, ft^3/lb	0.666	0.042	M^3 / Kg
Omega, w_s		4.43	
Transition Saturation Pressure ratio , n_{st}		0.143	
$n_s = P_s/P_o$		0.604	

If n_s is less than n_{st} then no vapor is formed until valve exit. Flash occurs in pipe. (Subcooled doesn't work)

Omega, w		25.184	
$G_c/(P_o p_{lo})$^0.5	0.18		
Critical mass flux, G_{oc}, lb/in^2-hr	23,457.716	4581.227	kg/M^2-sec
Actual Relief Area - in^2	0.442		
Valve Capacity, lb/hr	10,363.33		
Valve Emissions, gpm	41		
G_c/G_{oc}	0.3		
Critical mass flux, G_c, lb/in^2-hr	7,037.31		
Pipe Capacity, lb/hr	3,109.00		
Pipe Emissions, gpm	**12.22**		

Each coalescer is 3/4 inch

Enterprise Products Operating LLC
Adamana LPG Terminal
Emission Calculations
Coalescer Emissions (Emission Point: 9)

Table 11.c. - Coalescer Emissions

Equipment Type	Loads/hr	Loads/yr[1]	gal/load[2]	gal/hr[3]	gal/yr	Uncontrolled VOC Emissions		Controlled VOC Emissions	
						lb/hr	tpy	lb/hr	tpy
Trucks	2	2,000	0.19	0.38	380.06	1.85	0.93	0.04	0.02
Railcars	2	1,500	0.19	0.38	285.04	1.85	0.69	0.04	0.01
Total	**4**	**3,500**	**0.38**	**0.76**	**665.10**	**3.70**	**1.62**	**0.07**	**0.03**

[1] Coalescers are only used from October to March.
[2] From Omega Method for 0.75" hole diameter at 50% opening of valve. Coalescers have 50% usage of the dryers.
[3] Assumes a two-second release of butane when valve is opened.

Table 11.d. - Input Data - The Omega Method

Subcooled Liquid - Butane

Parameter	Input	SI Conversion	Unit
Inlet liquid density, lb/ft^3	36.419	582.90	kg/m^3
Liquid Specific Heat, BTU/lb-°F	0.57	2,396.18	J/kg-K
Inlet Temperature, °F	70.00	294.44	K
Saturation Vapor Pressure, psia	31.6	217,873.78	N/m^2
Vapor Specific Volume, ft^3/lb	0.529	0.033	m^3/kg
Liquid Specific Volume, ft^3/lb	0.027	0.002	m^3/kg
Overall Specific Volume, ft^3/lb	0.027	0.002	m^3/kg
Inlet Pressure, psia	185.00	1,275,526.90	N/m^2
Latent Heat of Vaporization, Btu/lb	146.45	340,631.54	J/kg

Vapor Specific Volume		0.529258	ft3/lb
ρ	30.26587 L/g	1.889438	lb/ft^3
P	12.5885 atm		
M	58.12 g/mol		
R	0.0821 L·atm/mol·K		
T	294.44 K		

Hole Diameter, in	0.75
K-factor (fL/D)	52

Calculated Values

Specific Volume difference v_{vlo} - ft^3/lb	0.502	0.031	M^3 / Kg
Omega, w_s		0.76	
Transition Saturation Pressure ratio , n_{st}		0.028	
$n_s = P_s/P_o$		0.171	

<u>If n_s is less than n_{st} then no vapor is formed until valve exit. Flash occurs in pipe. (Subcooled doesn't work)</u>

Omega, w		19.076	
$G_c/(P_o p_{lo})$^0.5	0.18		
Critical mass flux, G_{oc} - lb/in^2-hr	25,131.406	4908.094	kg/M^2-sec
Actual Relief Area - in^2	0.442		
Valve Capacity, lb/hr	11,102.74		
Valve Emissions, gpm	38		
G_c/G_{oc}	0.3		
Critical mass flux, G_c - lb/in^2-hr	7,539.42		
Pipe Capacity, lb/hr	3,330.82		
Pipe Emissions, gpm	**11.40**		

Each coalescer is 3/4 inch

Enterprise Products Operating LLC
Adamana LPG Terminal
Emission Calculations
Coalescer Emissions (Emission Point: 9)

Table 11.e. - Coalescer Emissions

Equipment Type	Loads/hr	Loads/yr[1]	gal/load[2]	gal/hr[3]	gal/yr	Uncontrolled VOC Emissions		Controlled VOC Emissions	
						lb/hr	tpy	lb/hr	tpy
Trucks	2	2,000	0.18	0.37	367.22	1.92	0.96	0.04	0.02
Railcars	2	1,500	0.18	0.37	275.42	1.92	0.72	0.04	0.01
Total	**4**	**3,500**	**0.37**	**0.73**	**642.64**	**3.83**	**1.68**	**0.08**	**0.03**

[1] Coalescers are only used from October to March.
[2] From Omega Method for 0.75" hole diameter at 50% opening of valve. Coalescers have 50% usage of the dryers.
[3] Assumes a two-second release of pentane when valve is opened.

Table 11.f. - Input Data - The Omega Method

Subcooled Liquid - Pentane

Parameter	Input	SI Conversion	Unit
Inlet liquid density, lb/ft^3	39.010	624.36	kg/m^3
Liquid Specific Heat, BTU/lb-°F	0.56	2,326.30	J/kg-K
Inlet Temperature, °F	70.00	294.44	K
Saturation Vapor Pressure, psia	9.94	68,533.72	N/m^2
Vapor Specific Volume, ft^3/lb	0.426	0.027	m^3/kg
Liquid Specific Volume, ft^3/lb	0.026	0.002	m^3/kg
Overall Specific Volume, ft^3/lb	0.026	0.002	m^3/kg
Inlet Pressure, psia	185.00	1,275,526.90	N/m^2
Latent Heat of Vaporization, Btu/lb	157.00	365,172.58	J/kg

Vapor Specific Volume		0.426341	ft3/lb
ρ	37.57197 L/g	2.345543	lb/ft^3
P	12.5885 atm		
M	72.15 g/mol		
R	0.0821 L·atm/mol·K		
T	294.44 K		

Hole Diameter, in 0.75
K-factor (fL/D) 52

Calculated Values

Specific Volume difference v_{vlo} - ft^3/lb	0.401	0.025	M^3 / Kg
Omega, w_s		0.14	
Transition Saturation Pressure ratio , n_{st}		0.005	
$n_s = P_s/P_o$		0.054	

If n_s is less than n_{st} then no vapor is formed until valve exit. Flash occurs in pipe. (Subcooled doesn't work)

Omega, w		15.662	
$G_c/(P_o p_{lo})$^0.5	0.18		
Critical mass flux, G_{oc} - lb/in^2-hr	26,009.899	5079.662	kg/M^2-sec
Actual Relief Area - in^2	0.442		
Valve Capacity, lb/hr	11,490.85		
Valve Emissions, gpm	37		
G_c/G_{oc}	0.3		
Critical mass flux, G_c - lb/in^2-hr	7,802.97		
Pipe Capacity, lb/hr	3,447.25		
Pipe Emissions, gpm	**11.02**		

Each coalescer is 3/4 inch

Enterprise Products Operating LLC
Adamana LPG Terminal
Emission Calculations
MSS Compressor Emissions (Emission Point: 10)

Table 12.a. - MSS Emissions: Compressor Blowdowns

Event Type	Estimated Maximum Number of Events [1]	Number of Compressors	Propane Volume Releases [2]		Gas Volume Releases [2]		Uncontrolled VOC Emissions		Controlled VOC Emissions	
	(events/year/compressor)	(Compressors)	(gal/min/event/unit)	4 Second Blowdown (gal/event/unit)	(gal/event)	(lb/event)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
Railcar Compressors - 3/4" diameter	612	2	10.55	0.70	1.41	5.91	5.91	1.81	0.12	0.04
Railcar Compressors - 3/8" diameter	612	3	2.64	0.18	0.53	2.22	2.22	0.68	0.04	0.01
Truck Loading Compressors - 3/8" diameter	612	3	2.64	0.18	0.53	2.22	2.22	0.68	0.04	0.01
TOTAL	**-**	**8**	**-**	**-**	**-**	**-**	**10.34**	**3.16**	**0.21**	**0.06**

Uncontrolled Emissions = **10.34** **3.16**

[1] Compressors operate approximately 5 months per year (153 days/year) with 4 purges per day.
[2] Volume releases calculated using "The Omega Method for Discharge Rate Evaluation" by J.C. Leung. Assumes a maximum blowdown duration of 4 seconds.

Table 12.b. - Input Data - The Omega Method

Subcooled Liquid - Propane

Parameter	Input	SI Conversion	Unit
Inlet liquid density, lb/ft^3	31.73	507.84	kg/m^3
Liquid Specific Heat, BTU/lb-°F	0.64	2,698.26	J/kg-K
Inlet Temperature, °F	70.00	294.44	K
Saturation Vapor Pressure, psia	111.80	770,831.93	N/m^2
Vapor Specific Volume, ft^3/lb	0.935	0.058	m^3/kg
Liquid Specific Volume, ft^3/lb	0.032	0.002	m^3/kg
Overall Specific Volume, ft^3/lb	0.032	0.002	m^3/kg
Inlet Pressure, psia	138.00	951,474.12	N/m^2
Latent Heat of Vaporization, Btu/lb	149.70	348,193.22	J/kg

Vapor Specific Volume 0.935139923 ft3/lb

ρ	17.12947214	L/g	1.069358686	lb/ft^3
P	9.39034302	atm		
M	44.097	g/mol		
R	0.0821	L·atm/mol·K		
T	294.44	K		

Hole Diameter, in 0.375
K-factor (fL/D) 52

Calculated Values

Specific Volume difference v_{vlo} - ft^3/lb	0.904	0.056	M^3 / Kg
Omega, w_s		8.16	
Transition Saturation Pressure ratio , n_{st}		0.235	
$n_s = P_{s/}P_o$		0.810	

<u>If n_s is less than n_{st} then no vapor is formed until valve exit. Flash occurs in pipe. (Subcooled doesn't work)</u>

Omega, w		36.283	
$G_c/(P_o p_{lo})$^0.5	0.18		
Critical mass flux, G_{oc} - lb/in^2-hr	20,259.999	3956.722	kg/M^2-sec
Actual Relief Area - in^2	0.110		
Valve Capacity, lb/hr	2,237.65		
Valve Emissions, gpm	9		
G_c/G_{oc}	0.3		
Critical mass flux, G_c - lb/in^2-hr	6,078.00		
Pipe Capacity, lb/hr	671.30		
Pipe Emissions, gpm	**2.64**		

Hole Diameter, in 0.75
K-factor (fL/D) 52 process software - piping specs, fittings - 2" pipe

Calculated Values

Specific Volume differen	0.904	0.056	M^3 / Kg
Omega, w_s		8.16	
Transition Saturation Pressure ratio , n_{st}		0.235	
$n_s = P_{s/}P_o$		0.810	

<u>If n_s is less than n_{st} then no vapor is formed until valve exit. Flash occurs in pipe. (Subcooled doesn't work)</u>

Omega, w		36.283	
$G_c/(P_o p_{lo})$^0.5	0.18		
Critical mass flux, G_{oc} - lb	20,259.999	3956.722	kg/M^2-sec
Actual Relief Area - in^2	0.442		
Valve Capacity, lb/hr	8,950.61		
Valve Emissions, gpm	35		
G_c/G_{oc}	0.3		
Critical mass flux, G_c - lb/	6,078.00		
Pipe Capacity, lb/hr	2,685.18		
Pipe Emissions, gpm	**10.55**		

Compressors are electric and therefore do not genrate combustion emissions. Compressors in propane service are operated at 138 psia.
Blowdown from the compressors is subjective and vary as this is a manual operation controlled by the Enterprise technician loading the trucks/rail cars. Compressor blowdowns are in the range of 1 to 4 seconds in duration. Emissions are based on a 4 second blowdown to purge water and LPG as a result of truck and/or rail car loading.

Enterprise Products Operating LLC
Adamana LPG Terminal
Emission Calculations
MSS Compressor Emissions (Emission Point: 10)

Table 12.c. - MSS Emissions: Compressor Blowdowns

Event Type	Estimated Maximum Number of Events [1]	Number of Compressors	Butane Volume Releases [2]		Butane Gas Volume Releases [2]		Uncontrolled VOC Emissions		Controlled VOC Emissions	
	(events/year/compressor)	(Compressors)	(gal/min/event/unit)	4 Second Blowdown (gal/event/unit)	(gal/event)	(lb/event)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
Railcar Compressors - 3/4" diameter	612	2	6.10	0.41	0.81	3.96	3.96	1.21	0.08	0.02
Railcar Compressors - 3/8" diameter	612	3	1.53	0.10	0.31	1.49	1.49	0.45	0.03	0.01
Truck Loading Compressors - 3/8" diameter	612	3	1.53	0.10	0.31	1.49	1.49	0.45	0.03	0.01
TOTAL	-	**8**	-	-	-	-	**6.93**	**2.12**	**0.14**	**0.04**

Uncontrolled Emissions = **6.93** **2.12**

[1] Compressors operate approximately 5 months per year (153 days/year) with 4 purges per day.
[2] Volume releases calculated using "The Omega Method for Discharge Rate Evaluation" by J.C. Leung. Assumes a maximum blowdown duration of 4 seconds.

Table 12.d. - Input Data - The Omega Method

Subcooled Liquid - Butane

Parameter	Input	SI Conversion	Unit
Inlet liquid density, lb/ft^3	36.419	582.90	kg/m^3
Liquid Specific Heat, BTU/lb-°F	0.57	2,396.18	J/kg-K
Inlet Temperature, °F	70.00	294.44	K
Saturation Vapor Pressure, psia	31.6	217,873.78	N/m^2
Vapor Specific Volume, ft^3/lb	1.847	0.115	m^3/kg
Liquid Specific Volume, ft^3/lb	0.027	0.002	m^3/kg
Overall Specific Volume, ft^3/lb	0.027	0.002	m^3/kg
Inlet Pressure, psia	53.00	365,421.22	N/m^2
Latent Heat of Vaporization, Btu/lb	146.45	340,631.54	J/kg

Vapor Specific Volume		1.847409847	ft3/lb
ρ	8.670763167 L/g	0.541298403	lb/ft^3
P	3.606436087 atm		
M	58.12 g/mol		
R	0.0821 L·atm/mol·K		
T	294.44 K		

Hole Diameter, in 0.375
K-factor (fL/D) 52

Calculated Values

Specific Volume difference v_{vlo} - ft^3/lb	1.820	0.114	M^3 / Kg
Omega, w_s		9.97	
Transition Saturation Pressure ratio , n_{st}		0.273	
$n_s = P_s/P_o$		0.596	

<u>If n_s is less than n_{st} then no vapor is formed until valve exit. Flash occurs in pipe. (Subcooled doesn't work)</u>

Omega, w		76.422	
$G_c/(P_o p_{lo})$^0.5	0.18		
Critical mass flux, G_{oc} - lb/in^2-hr	13,451.443	2627.030	kg/M^2-sec
Actual Relief Area - in^2	0.110		
Valve Capacity, lb/hr	1,485.67		
Valve Emissions, gpm	5		
G_c/G_{oc}	0.3		
Critical mass flux, G_c - lb/in^2-hr	4,035.43		
Pipe Capacity, lb/hr	445.70		
Pipe Emissions, gpm	**1.53**		

Hole Diameter, in 0.75
K-factor (fL/D) 52 process software - piping specs, fittings - 2" pipe

Calculated Values

Specific Volume differen	1.820	0.114	M^3 / Kg
Omega, w_s		9.97	
Transition Saturation Pressure ratio , n_{st}		0.273	
$n_s = P_s/P_o$		0.596	

<u>If n_s is less than n_{st} then no vapor is formed until valve exit. Flash occurs in pipe. (Subcooled doesn't work)</u>

Omega, w		76.422	
$G_c/(P_o p_{lo})$^0.5	0.18		
Critical mass flux, G_{oc} - lb	13,451.443	2627.030	kg/M^2-sec
Actual Relief Area - in^2	0.442		
Valve Capacity, lb/hr	5,942.68		
Valve Emissions, gpm	20		
G_c/G_{oc}	0.3		
Critical mass flux, G_c - lb/	4,035.43		
Pipe Capacity, lb/hr	1,782.80		
Pipe Emissions, gpm	**6.10**		

Compressors are electric and therefore do not genrate combustion emissions. Compressors while in butane service are operated at 53 psia.
Blowdown from the compressors is subjective and vary as this is a manual operation controlled by the Enterprise technician loading the trucks/rail cars. Compressor blowdowns are in the range of 1 to 4 seconds in duration. Emissions are based on a 4 second blowdown to purge water and LPG as a result of truck and/or rail car loading.

Enterprise Products Operating LLC
Adamana LPG Terminal
Emission Calculations
MSS Compressor Emissions (Emission Point: 10)

Table 12.e. - MSS Emissions: Compressor Blowdowns

Event Type	Estimated Maximum Number of Events [1] (events/year/compressor)	Number of Compressors (Compressors)	Pentane Volume Releases [2] (gal/min/event/unit)	Pentane Volume Releases [2] 4 Second Blowdown (gal/event/unit)	Pentane Gas Volume Releases [2] (gal/event)	Pentane Gas Volume Releases [2] (lb/event)	Uncontrolled VOC Emissions (lb/hr)	Uncontrolled VOC Emissions (tpy)	Controlled VOC Emissions (lb/hr)	Controlled VOC Emissions (tpy)
Railcar Compressors - 3/4" diameter	612	2	3.62	0.24	0.48	2.52	2.52	0.77	0.05	0.02
Railcar Compressors - 3/8" diameter	612	3	0.91	0.06	0.18	0.94	0.94	0.29	0.02	0.01
Truck Loading Compressors - 3/8" diameter	612	3	0.91	0.06	0.18	0.94	0.94	0.29	0.02	0.01
TOTAL	-	**8**	-	-	-	-	**4.41**	**1.35**	**0.09**	**0.03**

Uncontrolled Emissions = **4.41** **1.35**

[1] Compressors operate approximately 5 months per year (153 days/year) with 4 purges per day.
[2] Volume releases calculated using "The Omega Method for Discharge Rate Evaluation" by J.C. Leung. Assumes a maximum blowdown duration of 4 seconds.

Table 12.f. - Input Data - The Omega Method

Subcooled Liquid - Pentane

Parameter	Input	SI Conversion	Unit
Inlet liquid density, lb/ft^3	39.010	624.36	kg/m^3
Liquid Specific Heat, BTU/lb-°F	0.56	2,326.30	J/kg-K
Inlet Temperature, °F	70.00	294.44	K
Saturation Vapor Pressure, psia	9.94	68,533.72	N/m^2
Vapor Specific Volume, ft^3/lb	3.944	0.246	m^3/kg
Liquid Specific Volume, ft^3/lb	0.026	0.002	m^3/kg
Overall Specific Volume, ft^3/lb	0.026	0.002	m^3/kg
Inlet Pressure, psia	20.00	137,894.80	N/m^2
Latent Heat of Vaporization, Btu/lb	157.00	365,172.58	J/kg

Hole Diameter, in	0.375	
K-factor (fL/D)	52	

Calculated Values

Specific Volume difference v_{vlo} - ft^3/lb	3.918	0.245	M^3 / Kg
Omega, w_s		13.15	
Transition Saturation Pressure ratio , n_{st}		0.332	
$n_s = P_s/P_o$		0.497	

<u>If n_s is less than n_{st} then no vapor is formed until valve exit. Flash occurs in pipe. (Subcooled doesn't work)</u>

Omega, w		164.937	
$G_c/(P_o p_{lo})$^0.5	0.18		
Critical mass flux, G_{oc} - lb/in^2-hr	8,552.002	1670.182	kg/M^2-sec
Actual Relief Area - in^2	0.110		
Valve Capacity, lb/hr	944.54		
Valve Emissions, gpm	3		
G_c/G_{oc}	0.3		
Critical mass flux, G_c - lb/in^2-hr	2,565.60		
Pipe Capacity, lb/hr	283.36		
Pipe Emissions, gpm	**0.91**		

Vapor Specific Volume			3.94365031	ft3/lb
ρ	4.061834088	L/g	0.253572178	lb/ft^3
P	1.360919278	atm		
M	72.15	g/mol		
R	0.0821	L·atm/mol·K		
T	294.44	K		

Hole Diameter, in	0.75	
K-factor (fL/D)	52	process software - piping specs, fittings - 2" pipe

Calculated Values

Specific Volume differen	3.918	0.245	M^3 / Kg
Omega, w_s		13.15	
Transition Saturation Pressure ratio , n_{st}		0.332	
$n_s = P_s/P_o$		0.497	

<u>If n_s is less than n_{st} then no vapor is formed until valve exit. Flash occurs in pipe. (Subcooled doesn't work)</u>

Omega, w		164.937	
$G_c/(P_o p_{lo})$^0.5	0.18		
Critical mass flux, G_{oc} - lt	8,552.002	1670.182	kg/M^2-sec
Actual Relief Area - in^2	0.442		
Valve Capacity, lb/hr	3,778.17		
Valve Emissions, gpm	12		
G_c/G_{oc}	0.3		
Critical mass flux, G_c - lb/	2,565.60		
Pipe Capacity, lb/hr	1,133.45		
Pipe Emissions, gpm	**3.62**		

Compressors are electric and therefore do not genrate combustion emissions. Compressors while in pentane service are operated at 20 psia.
Blowdown from the compressors is subjective and vary as this is a manual operation controlled by the Enterprise technician loading the trucks/rail cars. Compressor blowdowns are in the range of 1 to 4 seconds in duration. Emissions are based on a 4 second blowdown to purge water and LPG as a result of truck and/or rail car loading.
The compressor blowdowns are controlled by the Facility Flare.

Emission Point 5

Enterprise

Tank Indentification and Physical Characteristics

Identification

Identification No.	Emission Point 5
Description	Gasoline Tank
State	Arizona
City	Holbrook
Nearest Major City	Prescott, AZ
Company	Enterprise

Physical Characteristics - Tank Characteristics

Diameter	4.6	ft		
Shell Length/Height	12.6	ft		
Maximum Liquid height	3.612831552	ft		
Avg. Liquid height	1.806415776	ft		
Minimum Liquid height	0	ft		
Tank Volume	1,000	gal		
Maximum short-term filling rate	1,000	gal/hr		
Worst Case liquid Surface Temp	95	°F		
Net annual throughput	10,000	gal/yr		
Net Throughput January	849	gal/mo	**Turnovers**	0.54
Net Throughput February	767	gal/mo	**Turnovers**	0.49
Net Throughput March	849	gal/mo	**Turnovers**	0.54
Net Throughput April	822	gal/mo	**Turnovers**	0.52
Net Throughput May	849	gal/mo	**Turnovers**	0.54
Net Throughput June	822	gal/mo	**Turnovers**	0.52
Net Throughput July	849	gal/mo	**Turnovers**	0.54
Net Throughput August	849	gal/mo	**Turnovers**	0.54
Net Throughput September	822	gal/mo	**Turnovers**	0.52
Net Throughput October	849	gal/mo	**Turnovers**	0.54
Net Throughput November	822	gal/mo	**Turnovers**	0.52
Net Throughput December	849	gal/mo	**Turnovers**	0.54
Tank Type	Horizontal			
Paint Color/Shade	Gray Medium			
Paint Condition	Average			

Physical Characteristics - Roof Characteristics

Roof Type		
Breather vent pressure setting	0.03	psia
Breather vent vacuum setting	-0.03	psia
Tank has Flash?	N	DO NOT LEAVE BLANK

Emission Point 5
Enterprise
Liquid Contents of Storage Tank

Chemical Category of Liquid	Petroleum_Liquid	
Single/Multiple	[redacted]	
Chemical subtype	Motor Gasoline RVP 10	
Vapor Pressure Calculation Method	Table 7.1-2	
Chemical Name	Gasoline	
Average Liquid Surface Temperature, T_{LA}	64.52	F
Vapor Pressure at Liquid Surface Temperature	5.857	psia
Liquid Molecular Weight Default	92.000	lb/lb-mole
Vapor Molecular Weight Default	66.000	lb/lb-mole
Liquid Density Default	5.60	lb./gal
Liquid Molecular Weight User Input		lb/lb-mole
Vapor Molecular Weight User Input		lb/lb-mole
Liquid Density User Input		lb./gal
RVP		

Mixture Properties

Compound	Mole Fraction	A	B	C	Mi	M_L

Results Summary - Gasoline Emissions

Month	Standing lb/month	Working lb/month	Total lb/month	Vapor Pressure @ Daily Average Surface Temp	Average Liquid Surface Temp °F	Liquid Bulk Temp °F
January	21.54	5.18	26.72	3.76	43.84	41.19
February	25.01	5.05	30.05	4.09	47.96	44.60
March	42.21	6.33	48.53	4.70	54.93	50.36
April	63.18	7.05	70.24	5.50	63.06	57.24
May	107.28	8.74	116.02	6.75	73.91	67.39
June	167.02	9.83	176.85	7.98	83.16	76.23
July	178.30	10.76	189.06	8.50	86.73	80.87
August	134.39	10.21	144.60	8.01	83.39	78.25
September	98.54	8.96	107.50	7.17	77.26	72.39
October	56.30	7.46	63.75	5.63	64.26	60.23
November	30.50	5.79	36.29	4.40	51.66	48.61
December	20.34	5.10	25.44	3.69	43.00	40.57
Total Annual lb or avg parameter	944.60	90.46	1035.06	5.86	64.52	59.91
Ozone Season lb or Ozone Season average param.	685.52	48.50	734.02	7.68	80.90	75.04
Ozone Season lb/day	4.48	0.32	4.80	-	-	-

Worst Case Hourly Emissions	lb/hr
Gasoline	14.53

Enterprise
Emission Point 5

Tank No.	**Emission Point 5**	**Tank type**	**Horizontal**
Material stored	**Gasoline**	**Company**	**Enterprise**
City	**Prescott, AZ**	**State**	**Arizona**
Description	**Gasoline Tank**		

Annual Losses

Parameter	Symbol	January	February	March	April	May	June	July	August	September	October	November	December	Units
Molecular Weight														
Molecular weight (vapor)	Mv	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00	Lb/lb-mole
Tank design data														
Shell length	Hs	12.60	12.60	12.60	12.60	12.60	12.60	12.60	12.60	12.60	12.60	12.60	12.60	ft
Diameter	D	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	ft
Effective Tank Diameter (Eq. 1-14)	D_E	8.59	8.59	8.59	8.59	8.59	8.59	8.59	8.59	8.59	8.59	8.59	8.59	ft
Liquid height	H_{LX}	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	ft
Avg. Liquid height	H_L	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	ft
Effective height (Eq. 1-15)	H_E	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	ft
vapor space outage (Eq. 1-16, 1-17, and 1-19)	Hvo	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	ft
Tank volume		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	gallons
Turnovers	N	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Net throughput	Q	849	767	849	822	849	822	849	849	822	849	822	849	gallons/mo
Tunover factor	K_N	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Working loss product factor	K_P	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Meteorological data - Prescott, AZ														
Daily ave. ambient temp. (Eq. 1-30)	T_{AA}	39.10	41.95	46.75	52.65	62.25	70.75	76.25	74.20	68.55	57.05	46.20	38.65	°F
Daily max. ambient temp.	T_{AX}	51.40	54.40	60.00	66.40	76.50	85.60	89.20	86.50	82.20	71.40	60.10	51.10	°F
Daily min. ambient temp.	T_{AN}	26.80	29.50	33.50	38.90	48.00	55.90	63.30	61.90	54.90	42.70	32.30	26.20	°F
Daily ambient temp. range (Eq. 1-11)	DT_A	24.60	24.90	26.50	27.50	28.50	29.70	25.90	24.60	27.30	28.70	27.80	24.90	°F
Tank paint solar absorptance	α	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	
Daily total insolation factor	I	982	1245	1694	2156	2415	2571	2171	1903	1805	1493	1130	901	Btu/ft2-day
Liquid bulk temperature (Eq. 1-31)	T_B	41.19	44.60	50.36	57.24	67.39	76.23	80.87	78.25	72.39	60.23	48.61	40.57	°F
Daily vapor temp. range (Eq. 1-7)	DTv	31.16	35.11	42.60	49.87	54.24	57.30	48.96	44.24	44.74	41.29	35.51	30.22	°F
Average vapor temperature (Eq. 1-33)	Tv	46.00	50.70	58.66	67.80	79.23	88.82	91.51	87.58	81.24	67.54	54.14	44.98	°F
Daily ave. liquid surface temp. (Eq. 1-28)	T_{LA}	43.84	47.96	54.93	63.06	73.91	83.16	86.73	83.39	77.26	64.26	51.66	43.00	°F
Daily max. liquid surface temp.	T_{LX}	51.63	56.74	65.58	75.53	87.47	97.49	98.97	94.45	88.45	74.58	60.53	50.56	°F
Daily min. liquid surface temp.	T_{LN}	36.05	39.18	44.28	50.59	60.35	68.84	74.49	72.33	66.08	53.94	42.78	35.44	°F
VP @ daily ave. liquid surf. temp. (Eq. 1-25)	P_{VA}	3.76	4.09	4.70	5.50	6.75	7.98	8.50	8.01	7.17	5.63	4.40	3.69	psia
VP @ daily max. liquid surf. temp.	P_{VX}	4.40	4.87	5.78	6.95	8.61	10.22	10.48	9.71	8.75	6.83	5.24	4.31	psia
VP @ daily min. liquid surf. temp.	P_{VN}	3.19	3.41	3.79	4.31	5.22	6.14	6.82	6.55	5.83	4.61	3.67	3.15	psia
Daily vapor pressure range (Eq. 1-9)	DP_V	1.21	1.46	1.99	2.64	3.38	4.08	3.66	3.15	2.92	2.22	1.57	1.16	psia
Breather vent pressure setting range (Eq. 1-10)	DP_B	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	psia
Atmospheric pressure	P_A	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	psia
Breather vent pressure setting	P_{BP}	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	psia
Breather vent vacuum setting	P_{BV}	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	psia
Standing Losses														
Tank vapor space volume (Eq. 1-3)	V_V	104.70	104.70	104.70	104.70	104.70	104.70	104.70	104.70	104.70	104.70	104.70	104.70	ft3
Vapor density (Eq. 1-22)	W_V	0.0457	0.0492	0.0557	0.0642	0.0770	0.0894	0.0948	0.0900	0.0816	0.0657	0.0527	0.0450	lb/ft3
Vapor space expansion factor (Eq. 1-5)	K_E	0.1976	0.2410	0.3382	0.4786	0.7065	1.0485	1.0509	0.8128	0.6487	0.4064	0.2620	0.1886	
Vented vapor saturation factor (Eq. 1-21)	K_S	0.7356	0.7188	0.6897	0.6549	0.6075	0.5670	0.5515	0.5660	0.5928	0.6497	0.7035	0.7389	
Standing losses - Eq. 1-2	L_S	21.54	25.01	42.21	63.18	107.28	167.02	178.30	134.39	98.54	56.30	30.50	20.34	lb/mo
Working Losses														
Working losses - Eq. 1-35	L_W	5.18	5.05	6.33	7.05	8.74	9.83	10.76	10.21	8.96	7.46	5.79	5.10	lb/mo
Total Losses														
TOTAL LOSSES - Eq. 1-1	L_T	**26.72**	**30.05**	**48.53**	**70.24**	**116.02**	**176.85**	**189.06**	**144.60**	**107.50**	**63.75**	**36.29**	**25.44**	lb/mo

Maximum Hourly Losses

Parameter	Symbol	Value	Units
Molecular weight (vapor)	M_V	66.00	Lb/lb-mole
Worst Case Liquid Surface Temperature	T	95.00	°F
Vapor Pressure at worst case temperature	P_{VA}	9.80	psia
Maximum Filling Rate	FR_M	1000.00	gal/hr
Total Losses			
TOTAL LOSSES	L_{MAX}	14.53	lb/hr

Emission Point 6

Enterprise

Tank Indentification and Physical Characteristics

Identification

Identification No.	Emission Point 6
Description	Diesel Tank
State	Arizona
City	Holbrook
Nearest Major City	Prescott, AZ
Company	Enterprise

Physical Characteristics - Tank Characteristics

Diameter	3	ft		
Shell Length/Height	10.08	ft		
Maximum Liquid height	2.35619449	ft		
Avg. Liquid height	1.178097245	ft		
Minimum Liquid height	0	ft		
Tank Volume	320	gal		
Maximum short-term filling rate	320	gal/hr		
Worst Case liquid Surface Temp	95	°F		
Net annual throughput	5,000	gal/yr		
Net Throughput January	425	gal/mo	**Turnovers**	0.80
Net Throughput February	384	gal/mo	**Turnovers**	0.72
Net Throughput March	425	gal/mo	**Turnovers**	0.80
Net Throughput April	411	gal/mo	**Turnovers**	0.77
Net Throughput May	425	gal/mo	**Turnovers**	0.80
Net Throughput June	411	gal/mo	**Turnovers**	0.77
Net Throughput July	425	gal/mo	**Turnovers**	0.80
Net Throughput August	425	gal/mo	**Turnovers**	0.80
Net Throughput September	411	gal/mo	**Turnovers**	0.77
Net Throughput October	425	gal/mo	**Turnovers**	0.80
Net Throughput November	411	gal/mo	**Turnovers**	0.77
Net Throughput December	425	gal/mo	**Turnovers**	0.80
Tank Type	Horizontal			
Paint Color/Shade	Gray Medium			
Paint Condition	Average			

Physical Characteristics - Roof Characteristics

Roof Type	[redacted]

Breather vent pressure setting	0.03	psia
Breather vent vacuum setting	-0.03	psia
Tank has Flash?	N	DO NOT LEAVE BLANK

Emission Point 6
Enterprise
Liquid Contents of Storage Tank

Chemical Category of Liquid	Petroleum_Liquid	
Single/Multiple		
Chemical subtype	No. 2 Fuel Oil (Diesel)	
Vapor Pressure Calculation Method	Table 7.1-2	
Chemical Name	Diesel	
Average Liquid Surface Temperature, T_{LA}	64.52	F
Vapor Pressure at Liquid Surface Temperature	0.008	psia
Liquid Molecular Weight Default	188.000	lb/lb-mole
Vapor Molecular Weight Default	130.000	lb/lb-mole
Liquid Density Default	7.10	lb./gal
Liquid Molecular Weight User Input		lb/lb-mole
Vapor Molecular Weight User Input		lb/lb-mole
Liquid Density User Input		lb./gal
RVP		

Mixture Properties

Compound	Mole Fraction	A	B	C	Mi	M_L

Results Summary - Diesel Emissions

Month	Standing lb/month	Working lb/month	Total lb/month	Vapor Pressure @ Daily Average Surface Temp	Average Liquid Surface Temp °F	Liquid Bulk Temp °F
January	0.01	0.01	0.01	0.00	43.84	41.19
February	0.01	0.01	0.01	0.00	47.96	44.60
March	0.01	0.01	0.02	0.01	54.93	50.36
April	0.02	0.01	0.03	0.01	63.06	57.24
May	0.02	0.01	0.04	0.01	73.91	67.39
June	0.03	0.02	0.05	0.01	83.16	76.23
July	0.03	0.02	0.05	0.02	86.73	80.87
August	0.03	0.02	0.04	0.01	83.39	78.25
September	0.02	0.01	0.04	0.01	77.26	72.39
October	0.01	0.01	0.02	0.01	64.26	60.23
November	0.01	0.01	0.01	0.00	51.66	48.61
December	0.01	0.00	0.01	0.00	43.00	40.57
Total Annual lb or avg parameter	0.20	0.13	0.33	0.01	64.52	59.91
Ozone Season lb or Ozone Season average param.	0.13	0.08	0.21	0.01	80.90	75.04
Ozone Season lb/day	0.00	0.00	0.00	-	-	-

Worst Case Hourly Emissions	lb/hr
Diesel	0.02

Enterprise
Emission Point 6

Tank No.	**Emission Point 6**	**Tank type**	**Horizontal**
Material stored	**Diesel**	**Company**	**Enterprise**
City	**Prescott, AZ**	**State**	**Arizona**
Description	**Diesel Tank**		

Annual Losses

Parameter	Symbol	January	February	March	April	May	June	July	August	September	October	November	December	Units
Molecular Weight														
Molecular weight (vapor)	Mv	130.00	130.00	130.00	130.00	130.00	130.00	130.00	130.00	130.00	130.00	130.00	130.00	Lb/lb-mole
Tank design data														
Shell length	Hs	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08	ft
Diameter	D	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	ft
Effective Tank Diameter (Eq. 1-14)	D_E	6.21	6.21	6.21	6.21	6.21	6.21	6.21	6.21	6.21	6.21	6.21	6.21	ft
Liquid height	H_{LX}	2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.36	ft
Avg. Liquid height	H_L	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	ft
Effective height (Eq. 1-15)	H_E	2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.36	ft
vapor space outage (Eq. 1-16, 1-17, and 1-19)	Hvo	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	ft
Tank volume		320	320	320	320	320	320	320	320	320	320	320	320	gallons
Turnovers	N	0.8	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
Net throughput	Q	425	384	425	411	425	411	425	425	411	425	411	425	gallons/mo
Tunover factor	K_N	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Working loss product factor	K_P	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Meteorological data - Prescott, AZ														
Daily ave. ambient temp. (Eq. 1-30)	T_{AA}	39.10	41.95	46.75	52.65	62.25	70.75	76.25	74.20	68.55	57.05	46.20	38.65	°F
Daily max. ambient temp.	T_{AX}	51.40	54.40	60.00	66.40	76.50	85.60	89.20	86.50	82.20	71.40	60.10	51.10	°F
Daily min. ambient temp.	T_{AN}	26.80	29.50	33.50	38.90	48.00	55.90	63.30	61.90	54.90	42.70	32.30	26.20	°F
Daily ambient temp. range (Eq. 1-11)	ΔT_A	24.60	24.90	26.50	27.50	28.50	29.70	25.90	24.60	27.30	28.70	27.80	24.90	°F
Tank paint solar absorptance	α	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	
Daily total insolation factor	I	982	1245	1694	2156	2415	2571	2171	1903	1805	1493	1130	901	Btu/ft2-day
Liquid bulk temperature (Eq. 1-31)	T_B	41.19	44.60	50.36	57.24	67.39	76.23	80.87	78.25	72.39	60.23	48.61	40.57	°F
Daily vapor temp. range (Eq. 1-7)	ΔTv	31.16	35.11	42.60	49.87	54.24	57.30	48.96	44.24	44.74	41.29	35.51	30.22	°F
Average vapor temperature (Eq. 1-33)	Tv	46.00	50.70	58.66	67.80	79.23	88.82	91.51	87.58	81.24	67.54	54.14	44.98	°F
Daily ave. liquid surface temp. (Eq. 1-28)	T_{LA}	43.84	47.96	54.93	63.06	73.91	83.16	86.73	83.39	77.26	64.26	51.66	43.00	°F
Daily max. liquid surface temp.	T_{LX}	51.63	56.74	65.58	75.53	87.47	97.49	98.97	94.45	88.45	74.58	60.53	50.56	°F
Daily min. liquid surface temp.	T_{LN}	36.05	39.18	44.28	50.59	60.35	68.84	74.49	72.33	66.08	53.94	42.78	35.44	°F
VP @ daily ave. liquid surf. temp. (Eq. 1-25)	P_{VA}	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.00	0.00	psia
VP @ daily max. liquid surf. temp.	P_{VX}	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.00	psia
VP @ daily min. liquid surf. temp.	P_{VN}	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	psia
Daily vapor pressure range (Eq. 1-9)	ΔP_V	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	psia
Breather vent pressure setting range (Eq. 1-10)	ΔP_B	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	psia
Atmospheric pressure	P_A	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	psia
Breather vent pressure setting	P_{BP}	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	psia
Breather vent vacuum setting	P_{BV}	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	psia
Standing Losses														
Tank vapor space volume (Eq. 1-3)	V_V	35.63	35.63	35.63	35.63	35.63	35.63	35.63	35.63	35.63	35.63	35.63	35.63	ft3
Vapor density (Eq. 1-22)	W_V	0.0001	0.0001	0.0001	0.0002	0.0002	0.0003	0.0003	0.0003	0.0003	0.0002	0.0001	0.0001	lb/ft3
Vapor space expansion factor (Eq. 1-5)	K_E	0.0572	0.0645	0.0782	0.0910	0.0975	0.1016	0.0856	0.0773	0.0791	0.0743	0.0648	0.0554	
Vented vapor saturation factor (Eq. 1-21)	K_S	0.9998	0.9997	0.9997	0.9996	0.9994	0.9992	0.9991	0.9992	0.9993	0.9995	0.9997	0.9998	
Standing losses - Eq. 1-2	L_S	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.02	0.01	0.01	0.01	lb/mo
Working Losses														
Working losses - Eq. 1-35	L_W	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.00	lb/mo
Total Losses														
TOTAL LOSSES - Eq. 1-1	L_T	**0.01**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.05**	**0.04**	**0.04**	**0.02**	**0.01**	**0.01**	lb/mo

Maximum Hourly Losses

Parameter	Symbol	Value	Units
Molecular weight (vapor)	M_V	130.00	Lb/lb-mole
Worst Case Liquid Surface Temperature	T	95.00	°F
Vapor Pressure at worst case temperature	P_{VA}	0.02	psia
Maximum Filling Rate	FR_M	320.00	gal/hr
Total Losses			
TOTAL LOSSES	L_{MAX}	0.02	lb/hr

Hourly Losses - Mixture Components

Compound	CAS Registry	Value	Units

Emission Point 7
Enterprise
Tank Indentification and Physical Characteristics

Identification

Identification No.	Emission Point 7
Description	Used Oil Tank
State	Arizona
City	Holbrook
Nearest Major City	Prescott, AZ
Company	Enterprise

Physical Characteristics - Tank Characteristics

Diameter	19	ft		
Shell Length/Height	3.58	ft		
Maximum Liquid height	2.58	ft		
Avg. Liquid height	1.29	ft		
Minimum Liquid height	1	ft		
Tank Volume	1,160	gal		
Maximum short-term filling rate	1,160	gal/hr		
Worst Case liquid Surface Temp	95	°F		
Net annual throughput	116	gal/yr		
Net Throughput January	10	gal/mo	**Turnovers**	0.01
Net Throughput February	9	gal/mo	**Turnovers**	0.01
Net Throughput March	10	gal/mo	**Turnovers**	0.01
Net Throughput April	10	gal/mo	**Turnovers**	0.01
Net Throughput May	10	gal/mo	**Turnovers**	0.01
Net Throughput June	10	gal/mo	**Turnovers**	0.01
Net Throughput July	10	gal/mo	**Turnovers**	0.01
Net Throughput August	10	gal/mo	**Turnovers**	0.01
Net Throughput September	10	gal/mo	**Turnovers**	0.01
Net Throughput October	10	gal/mo	**Turnovers**	0.01
Net Throughput November	10	gal/mo	**Turnovers**	0.01
Net Throughput December	10	gal/mo	**Turnovers**	0.01
Tank Type	Horizontal			
Paint Color/Shade	Gray Medium			
Paint Condition	Average			

Physical Characteristics - Roof Characteristics

Roof Type	

Breather vent pressure setting	0.03	psia
Breather vent vacuum setting	-0.03	psia
Tank has Flash?	N	DO NOT LEAVE BLANK

Emission Point 7
Enterprise
Liquid Contents of Storage Tank

Chemical Category of Liquid	Petroleum_Liquid	
Single/Multiple		
Chemical subtype	Motor Gasoline RVP 7	
Vapor Pressure Calculation Method	Table 7.1-2	
Chemical Name	Used Oil	
Average Liquid Surface Temperature, T_{LA}	64.57	F
Vapor Pressure at Liquid Surface Temperature	3.972	psia
Liquid Molecular Weight Default	92.000	lb/lb-mole
Vapor Molecular Weight Default	68.000	lb/lb-mole
Liquid Density Default	5.60	lb./gal
Liquid Molecular Weight User Input		lb/lb-mole
Vapor Molecular Weight User Input		lb/lb-mole
Liquid Density User Input		lb./gal
RVP		

Mixture Properties

Compound	Mole Fraction	A	B	C	Mi	M_L

Results Summary - Used Oil Emissions

Month	Standing lb/month	Working lb/month	Total lb/month	Vapor Pressure @ Daily Average Surface Temp	Average Liquid Surface Temp °F	Liquid Bulk Temp °F
January	35.06	0.04	35.10	2.48	43.84	41.19
February	39.22	0.04	39.26	2.71	47.96	44.60
March	61.86	0.05	61.91	3.14	54.93	50.36
April	84.63	0.06	84.69	3.71	63.06	57.24
May	123.83	0.07	123.91	4.59	73.91	67.39
June	161.95	0.08	162.03	5.48	83.16	76.23
July	158.07	0.09	158.16	5.85	86.73	80.87
August	129.51	0.09	129.59	5.50	83.39	78.25
September	107.43	0.08	107.51	4.90	77.26	72.39
October	74.25	0.06	74.31	3.80	64.26	60.23
November	46.17	0.05	46.22	2.93	51.66	48.61
December	33.35	0.04	33.39	2.44	43.00	40.57
Total Annual lb or avg parameter	1055.34	0.75	1056.09	3.97	64.57	59.96
Ozone Season lb or Ozone Season average param.	680.79	0.41	681.20	5.26	80.89	75.03
Ozone Season lb/day	4.45	0.00	4.45	-	-	-

Worst Case Hourly Emissions	lb/hr
Used Oil	12.05

Enterprise
Emission Point 7

Tank No.	**Emission Point 7**	**Tank type**	**Horizontal**
Material stored	**Used Oil**	**Company**	**Enterprise**
City	**Prescott, AZ**	**State**	**Arizona**
Description	**Used Oil Tank**		

Annual Losses

Parameter	Symbol	January	February	March	April	May	June	July	August	September	October	November	December	Units
Molecular Weight														
Molecular weight (vapor)	Mv	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	Lb/lb-mole
Tank design data														
Shell length	Hs	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	ft
Diameter	D	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	ft
Effective Tank Diameter (Eq. 1-14)	D_E	9.31	9.31	9.31	9.31	9.31	9.31	9.31	9.31	9.31	9.31	9.31	9.31	ft
Liquid height	H_{LX}	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	ft
Avg. Liquid height	H_L	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	ft
Effective height (Eq. 1-15)	H_E	14.92	14.92	14.92	14.92	14.92	14.92	14.92	14.92	14.92	14.92	14.92	14.92	ft
vapor space outage (Eq. 1-16, 1-17, and 1-19)	Hvo	7.46	7.46	7.46	7.46	7.46	7.46	7.46	7.46	7.46	7.46	7.46	7.46	ft
Tank volume		1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160	gallons
Turnovers	N	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Net throughput	Q	10	9	10	10	10	10	10	10	10	10	10	10	gallons/mo
Tunover factor	K_N	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Working loss product factor	K_P	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Meteorological data - Prescott, AZ														
Daily ave. ambient temp. (Eq. 1-30)	T_{AA}	39.10	41.95	46.75	52.65	62.25	70.75	76.25	74.20	68.55	57.05	46.20	38.65	°F
Daily max. ambient temp.	T_{AX}	51.40	54.40	60.00	66.40	76.50	85.60	89.20	86.50	82.20	71.40	60.10	51.10	°F
Daily min. ambient temp.	T_{AN}	26.80	29.50	33.50	38.90	48.00	55.90	63.30	61.90	54.90	42.70	32.30	26.20	°F
Daily ambient temp. range (Eq. 1-11)	DT_A	24.60	24.90	26.50	27.50	28.50	29.70	25.90	24.60	27.30	28.70	27.80	24.90	°F
Tank paint solar absorptance	α	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	
Daily total insolation factor	I	982	1245	1694	2156	2415	2571	2171	1903	1805	1493	1130	901	Btu/ft2-day
Liquid bulk temperature (Eq. 1-31)	T_B	41.19	44.60	50.36	57.24	67.39	76.23	80.87	78.25	72.39	60.23	48.61	40.57	°F
Daily vapor temp. range (Eq. 1-7)	DTv	31.16	35.11	42.60	49.87	54.24	57.30	48.96	44.24	44.74	41.29	35.51	30.22	°F
Average vapor temperature (Eq. 1-33)	Tv	46.00	50.70	58.66	67.80	79.23	88.82	91.51	87.58	81.24	67.54	54.14	44.98	°F
Daily ave. liquid surface temp. (Eq. 1-28)	T_{LA}	43.84	47.96	54.93	63.06	73.91	83.16	86.73	83.39	77.26	64.26	51.66	43.00	°F
Daily max. liquid surface temp.	T_{LX}	51.63	56.74	65.58	75.53	87.47	97.49	98.97	94.45	88.45	74.58	60.53	50.56	°F
Daily min. liquid surface temp.	T_{LN}	36.05	39.18	44.28	50.59	60.35	68.84	74.49	72.33	66.08	53.94	42.78	35.44	°F
VP @ daily ave. liquid surf. temp. (Eq. 1-25)	P_{VA}	2.48	2.71	3.14	3.71	4.59	5.48	5.85	5.50	4.90	3.80	2.93	2.44	psia
VP @ daily max. liquid surf. temp.	P_{VX}	2.93	3.26	3.90	4.74	5.93	7.11	7.30	6.73	6.04	4.65	3.52	2.87	psia
VP @ daily min. liquid surf. temp.	P_{VN}	2.09	2.24	2.51	2.87	3.51	4.16	4.65	4.46	3.94	3.08	2.43	2.06	psia
Daily vapor pressure range (Eq. 1-9)	DP_V	0.84	1.02	1.40	1.87	2.42	2.95	2.65	2.28	2.10	1.58	1.10	0.80	psia
Breather vent pressure setting range (Eq. 1-10)	DP_B	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	psia
Atmospheric pressure	P_A	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	psia
Breather vent pressure setting	P_{BP}	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	psia
Breather vent vacuum setting	P_{BV}	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	psia
Standing Losses														
Tank vapor space volume (Eq. 1-3)	V_V	507.52	507.52	507.52	507.52	507.52	507.52	507.52	507.52	507.52	507.52	507.52	507.52	ft3
Vapor density (Eq. 1-22)	W_V	0.0311	0.0337	0.0384	0.0446	0.0540	0.0633	0.0673	0.0637	0.0574	0.0457	0.0362	0.0306	lb/ft3
Vapor space expansion factor (Eq. 1-5)	K_E	0.1420	0.1699	0.2296	0.3077	0.4104	0.5322	0.4949	0.4104	0.3611	0.2586	0.1811	0.1360	
Vented vapor saturation factor (Eq. 1-21)	K_S	0.5046	0.4824	0.4460	0.4054	0.3550	0.3159	0.3017	0.3150	0.3404	0.3996	0.4629	0.5092	
Standing losses - Eq. 1-2	L_S	35.06	39.22	61.86	84.63	123.83	161.95	158.07	129.51	107.43	74.25	46.17	33.35	lb/mo
Working Losses														
Working losses - Eq. 1-35	L_W	0.04	0.04	0.05	0.06	0.07	0.08	0.09	0.09	0.08	0.06	0.05	0.04	lb/mo
Total Losses														
TOTAL LOSSES - Eq. 1-1	L_T	**35.10**	**39.26**	**61.91**	**84.69**	**123.91**	**162.03**	**158.16**	**129.59**	**107.51**	**74.31**	**46.22**	**33.39**	lb/mo

Maximum Hourly Losses

Parameter	Symbol	Value	Units
Molecular weight (vapor)	M_V	68.00	Lb/lb-mole
Worst Case Liquid Surface Temperature	T	95.00	°F
Vapor Pressure at worst case temperature	P_{VA}	6.80	psia
Maximum Filling Rate	FR_M	1160.00	gal/hr
Total Losses			
TOTAL LOSSES	L_{MAX}	12.05	lb/hr

Hourly Losses - Mixture Components

Compound	CAS Registry	Value	Units

ATTACHMENT G – MINOR NSR APPLICABILITY DETERMINATION

As outlined in the *Arizona Department of Environmental Quality – Application Packet for Class II Permit* (December 3, 2015), Minor NSR Requirements apply to each regulated minor NSR pollutant for which the facility-wide PTE emissions are greater than or equal to the permitting exemption threshold. The permitting exemption thresholds are listed in Table G-1.

Table G-1. Permitting Exemption Thresholds

Pollutant	Emission Rate
$PM_{2.5}$	5 tpy
PM_{10}	7.5 tpy
SO_2	20 tpy
NO_X	20 tpy
VOCs	20 tpy
CO	50 tpy
Lead	0.3

The facility emissions are less than the permitting exemption threshold, therefore the Adamana LPG Terminal is not subject to the Minor NSR Requirements.

ATTACHMENT H – REGULATORY ANALYSIS

The following section describes the potentially applicable state and federal air quality regulations and whether the facility is subject to such requirements. A brief discussion of certain state and federal requirements and their applicability is included below.

State Regulations

Arizona Department of Environmental Quality – Air Pollution Control Regulations

The ADEQ Air Pollution Control Regulations are codified at Title 18, Chapter 2 of the Arizona Administrative Code (A.A.C.). Table H-1 identifies whether a regulation under 18 A.A.C. 2 is applicable to the facility. Furthermore, Table H-1 provides an explanation of compliance for the facility.

Table H-1. ADEQ Air Pollution Control Regulations Applicability Determination

Article	Subject	Applicability	Compliance Explanation
3	Permits and Permit Revisions	Yes	R18-2-302 – A Class II permit is required for a person to begin actual construction of or operate any stationary source that emits, or has the maximum capacity to emit with any elective limits, any regulated NSR pollutant in an amount greater than or equal to the significant level. This facility is a minor source, and thus qualifies for a Class II permit. R18-2-304 – Enterprise complies will all permit requirements and has provided the necessary information to obtain a Permit Renewal & Minor Revision. R18-2-306 – This facility complies with all emission limitations and standards, as described in this Permit Renewal & Minor Revision application. The facility complies with all testing and monitoring requirements and keeps records of any such activities. Reports of any required monitoring are submitted at least once per year. All records, analyses and reports shall be retained for a minimum of five years from the date of generation. The required fees have been provided with this application. R18-2-309 – Enterprise shall submit an annual compliance certification to the Director which describes the compliance status of the source with respect to each permit condition. R18-2-310.01 – Enterprise shall report to the Director any emissions in excess of the limits established by this Chapter or the applicable permit. R18-2-312 – Enterprise will conduct performance testing as required by the Director. R18-2-322 – Enterprise is submitting this timely Permit Renewal & Minor Revision application not later than six months before expiration of the registration's term, in accordance with R18-2-304. R18-2-327 – Enterprise shall complete and submit to the Director an annual emissions inventory questionnaire by March 31 or 90 days after the Director makes the inventory form available, whichever occurs later, and shall include emission information for the previous calendar year.
6	Emissions from Existing and New Nonpoint Sources	Yes	Enterprise will minimize fugitive dust emissions.

Article	Subject	Applicability	Compliance Explanation
7	Existing Stationary Source Performance Standards	Yes	R18-2-702 – General Provisions: The opacity of any plume or effluent shall not be greater than 20% in an area that is attainment or unclassifiable for each particulate matter standard. R18-2-710 – Standards of Performance for Existing Storage Vessels for Petroleum Liquids: Enterprise does not store any petroleum liquid in a tank having a capacity of 40,000 or more gallons. Any other petroleum liquid storage tank shall be equipped with a submerged filling device, or acceptable equivalent, for the control of hydrocarbon emissions. The gasoline storage tank at the facility is subject to these requirements. All pumps and compressors which handle volatile organic compounds shall be equipped with mechanical seals or other equipment of equal efficiency to prevent the release of organic contaminants into the atmosphere. Enterprise complies with the recordkeeping requirements of this section. R18-2-730 – Standards of Performance for Unclassified Sources: This facility complies with all emission limitations and standards in this section, and will maintain control of emissions from the degasser, desiccant dryers, coalescers, compressors and associated flares.
8	Emissions from Mobile Sources	Yes	The tank trucks at the facility will not emit smoke or dust the opacity of which exceeds 40%.
9	New Source Performance Standards	No	The provisions of this regulation incorporate by reference specified 40 CFR 60 NSPS regulations. There are currently no applicable part 60 NSPS regulations for the Adamana LPG Terminal.
11	Federal Hazardous Air Pollutants	Yes	The provisions of this regulation incorporate by reference specified 40 CFR 63 NESHAP regulations. The gasoline storage tank at the facility is subject to 40 CFR 63 Subpart CCCCCC: National Emission Standards for Hazardous Air Pollutants for Source Category: Gasoline Dispensing Facilities.
12	Emissions Bank	No	The Adamana LPG Terminal is not claiming credit for emission reductions.
13	State Implementation Plan Rules for Specific Locations	No	Enterprise does not own or operate any of the listed locations.
16	Visibility; Regional Haze	No	This facility does not cause or contribute to visibility impairment in any mandatory Federal Class I area.

Federal Regulations

Prevention of Significant Deterioration (PSD)

The emission threshold for “major stationary sources” varies under PSD according to the type of facility. As defined by 40 CFR Part 52.21(b)(1)(i), a facility is considered major under PSD if it has the potential to emit 250 tpy of any criteria pollutant, or 100 tpy for specified source categories.

The Adamana LPG Terminal is not a specified source category. Therefore, the PSD threshold for the facility is 250 tpy. The facility emissions do not exceed the specified PSD thresholds. Therefore, PSD review is not required for the Adamana LPG Terminal.

Nonattainment New Source Review (NNSR)

The federal pre-construction review for a new or modified major source located in a nonattainment area is commonly referred to as Nonattainment New Source Review (NNSR). NNSR only applies to major sources of the pollutants that are classified as nonattainment; therefore, a new or modified facility could potentially undergo both types of review, depending on the emission of the various pollutants and their respective attainment status.

Navajo County is currently classified as being in attainment or unclassified with respect to the National Ambient Air Quality Standards (NAAQS) for CO, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), ozone (O_3), and lead (Pb). Additionally, this facility is not undergoing any modifications. Therefore, the Adamana LPG Terminal is not subject to nonattainment new source review.

New Source Performance Standards

Section 111 of the Clean Air Act authorized the EPA to develop technology-based standards that apply to specific categories of stationary sources. These standards are referred to as New Source Performance Standards (NSPS) and are found in Tile 40 Code of Federal Regulations (CFR) Part 60. NSPS applies to new, modified, and reconstructed affected facilities in specific source categories. The Adamana LPG Terminal is not a specific source category listed in 40 CFR 60 and is not subject to the NSPS requirements.

National Emission Standards for Hazardous Air Pollutants

National Emission Standards for Hazardous Air Pollutants (NESHAPs) are stationary source standards for HAPs. The NESHAPs promulgated after the 1990 Clean Air Act Amendments are found in 40 CFR 63. These standards require application of technology-based emissions standards referred to as Maximum Achievable Control Technology (MACT). Because of this, these post-1990 NESHAPs are also referred to as MACT standards. Table H-2 lists the subparts of 40 CFR 63 that are potentially applicable to the Adamana LPG Terminal and notes whether a requirement is or is not applicable. Applicable citations are listed in Table H-2.

Table H-2. National Emission Standards for Hazardous Air Pollutants Applicability Determination

Subpart	Subject	Applicability
A	General Provisions	Yes
CCCCCC	National Emission Standards for Hazardous Air Pollutants for Source Category: Gasoline Dispensing Facilities	Yes

Subpart A contains general requirements for notification, testing, and reporting for the NESHAPs program. The subpart applies to each project that has an affected source as defined under another subpart. As the facility has units subject to one or more standards under 40 CFR 63, Subpart A applies to the project.

Subpart CCCCCC applies to gasoline storage tanks at gasoline dispensing facilities that are an area source of HAP emissions. The Adamana LPG Terminal limits the monthly throughput of gasoline to less than 10,000 gallons of gasoline and will comply with the requirements in 40 CFR 63.11116 and maintain records of gasoline throughput.

ATTACHMENT I – APPLICATION ADMINISTRATIVE COMPLETENESS CHECKLIST

SECTION 5.0 -APPLICATION ADMINISTRATIVE COMPLETENESS CHECKLIST

	REQUIREMENT	MEETS REQUIREMENTS			COMMENT
		YES	NO	N/A	
1	Has the standard application form been completed?	X			
2	Has the responsible official signed the standard application form?	X			
3	Has a process description been provided?	X			
4	Are the facility's emissions documented with all appropriate supporting information?	X			
5	Is the facility subject to Minor NSR requirements? If the answer is "YES" , answer 6a, 6b and 6c as applicable. If the answer is "NO", skip to 7.		X		
6.a	If the facility chooses to implement RACT, is the RACT determination included for the affected pollutants for all affected emission units?			X	
6.b	If the facility chooses to demonstrate compliance with NAAQS by screen modeling, is the modeling analysis included?				
6.c	If refined modeling has been conducted, is a comprehensive modeling report along with all modeling files included?				
7	Does the application include an equipment list with the type, name, make, model, serial number, maximum rated capacity, and date of manufacture?	X			
8	Does the application include an identification and description of Pollution Controls? (if applicable)	X			
9	For any application component claimed as confidential, are the requirements of AR.S. 49-432 and A.A.C. R18-2-305 addressed?			X	
10	For any current non-compliance issue, is a compliance schedule attached?			X	
11	For minor permit revision that will make a modification upon submittal of application, has a suggested draft permit been attached?	X			The additional products stored do not require any changes to the specific conditions. However, Enterprise requests the facility description be updated to name these additional products.