Construction Permit
Source Analysis & Technical Review

Company	**Port Arthur LNG LLC**	Permit Numbers	**158420, PSDTX1572, and GHGPSDTX198**
City	**Port Arthur**	Project Number	**306843**
County	**Jefferson**	Regulated Entity Number	**RN104517826**
Project Type	**Initial**	Customer Reference Number	**CN604794834**
Project Reviewer	**Benjamin Hansen, Ph.D., P.E.**	Received Date	**September 12, 2019**
Site Name	**Port Arthur LNG**		

Project Overview

Port Arthur LNG, LLC (PALNG) proposes to construct and operate a natural gas liquefaction and export terminal near Port Arthur, Jefferson County and the Sabine Pass in Southeast Texas. The proposed liquefaction plant will consist of four liquefaction trains, each capable of producing 6.76 million metric tonnes per annum of liquefied natural gas (LNG). Each LNG train will consist of one propane and one mixed refrigeration compression turbine and an Acid Gas Removal Unit (AGRU). Pipeline quality natural gas will be delivered from interconnecting intrastate pipeline systems. The natural gas will be treated to remove acid gases (carbon dioxide and sulfur compounds) with an amine treatment process. Emissions from the AGRU will be controlled with a thermal oxidizer. Water, mercury, and heavy hydrocarbons will also be removed from the natural gas. The treated natural gas is then sent to the liquefaction process where the gas is cooled to become a liquid. The LNG will then be stored in one of three LNG storage tanks and loaded onto a marine vessel for export at the marine berthing area. Emissions from routine maintenance, startup, and shutdown (MSS) activities are included in the permit application and have been reviewed.

The proposed project will include the following new emission points:

- Eight GE Frame 7EA gas-fired refrigeration compressor turbines, four with waste heat recovery
- Nine GE PGT25+G4 simple cycle gas-fired combustion turbine electric generating units
- One marine flare
- One ground flare
- Two gas-fired fuel pre-heaters
- Four thermal oxidizers
- Four diesel-fired engine standby generators
- Two diesel-fired engine fire water pumps
- Seven diesel storage tanks
- Two amine storage tanks
- Two oil storage tanks
- Fugitive emissions

Emission Summary

The table below summarizes proposed maximum annual emissions in tons per year (TPY) for the project, including routine MSS emissions. These emissions include nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compounds (VOC), particulate matter (PM), PM less than 10 microns in average diameter (PM_{10}), PM less than 2.5 microns in average diameter ($PM_{2.5}$), sulfur dioxide (SO_2), sulfuric acid (H_2SO_4) mist, ammonia (NH_3), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), carbon dioxide (CO_2) and the carbon dioxide equivalent (CO_2e) of all greenhouse gases (GHG) emitted. The pollutants NO_x, CO, PM_{10}, $PM_{2.5}$, and SO_2 are criteria pollutants, for which a national ambient air quality standard (NAAQS) has been promulgated. In addition, NO_x and VOC are regulated as criteria pollutants for the NAAQS pollutant ozone, which forms in the atmosphere as a reaction of NO_x and VOC emissions.

Table 1. PALNG Project Emission Summary

Air Contaminant	Proposed Allowable Emission Rates (tpy)
VOC	206.06
NO_x	1,895.02
SO_2	63.02
CO	3,195.85
$PM/PM_{10}/PM_{2.5}$	428.41
H_2SO_4	7.59
NH_3	187.05
CO_2	7,699,960
CH_4	1,480.4
SF_6	0.01
N_2O	10.7
CO_2 Equivalents (CO_2e)	7,741,044

CO_2e -carbon dioxide equivalents based on global warming potentials of CH_4 = 25, N_2O = 298, SF_6=22,800.
PM, PM_{10}, and $PM_{2.5}$ emissions include filterable and condensable particulate matter.

Table 2. PSD Pollutant Applicability to PALNG Project Emission Summary

Pollutant	Project Emissions (tpy)	Major Source Trigger (tpy)	PSD Significant Emission Rate (tpy)	PSD Triggered Y/N
VOC	206.06	250	40	Y
NO_x	1,895.02	250	40	Y
SO_2	63.02	250	40	Y
CO	3,195.85	250	100	Y
PM	428.41	250	25	Y
PM_{10}	428.41	250	15	Y
$PM_{2.5}$	428.41	250	10	Y
H_2SO_4	7.59	250	7	Y
CO_2e	7,741,044	--	75,000	Y

Compliance History Evaluation - 30 TAC Chapter 60 Rules

A compliance history report was reviewed on:	April 24, 2020
Site rating & classification:	Unclassified
Company rating & classification:	Unclassified
Has the permit changed on the basis of the compliance history or rating?	NA
Did the Regional Office have any comments? If so, explain.	No

Public Notice Information

Requirement	**Date**
Legislator letters mailed	9/26/2019
Date 1st notice published	10/09/2019
Publication Name: (Port Arthur) *The News*	
Pollutants: NO_x, CO, VOC, PM, PM_{10}, $PM_{2.5}$, SO_2, H_2SO_4, NH_3, and greenhouse gases	
Date 1st notice Alternate Language published	10/13/2019
Publication Name (Alternate Language): *El Perico*	
1st public notice tearsheet(s) received	10/21/2019, 10/23/2019
1st public notice affidavit(s) received	10/21/2019
1st public notice certification of sign posting/application availability received	11/20/2019
SB709 Notification mailed	3/6/2020
Date 2nd notice published	6/17/2020
Publication Name: The Port Arthur News	
Pollutants: NO_x, CO, VOC, PM, PM_{10}, $PM_{2.5}$, SO_2, H_2SO_4, NH_3, and greenhouse gases	
Date 2nd notice published (Alternate Language)	6/21/2020
Publication Name (Alternate Language): El Perico	
2nd public notice tearsheet(s) received	6/22/2020
2nd public notice affidavit(s) received	6/22/2020
2nd public notice certification of sign posting/application availability received	10/22/2020

Public Interest

Number of comments received	1
Number of meeting requests received	1
Number of hearing requests received	3
Date meeting held	9/15/2020
Date response to comments filed with OCC	3/19/2021
Date of SOAH hearing	11/16/2021

Federal Rules Applicability

Requirement	
Subject to NSPS?	**Yes**
Subparts **Subparts A & Kb, VV, NNN, KKKK, IIII**	
Subject to NESHAP?	**No**
Subparts &	
Subject to NESHAP (MACT) for source categories?	**Yes**
Subparts **A & ZZZZ, EEEE, YYYY**	
Nonattainment review applicability:	**No**
PSD review applicability: **See Table 2 above for PSD applicability by pollutant**	**Yes**

Title V Applicability - 30 TAC Chapter 122 Rules

Requirement
Title V applicability: . Title V applies because the site is a major source of a non-GHG pollutant, as well as a major source of GHG.
Periodic Monitoring (PM) applicability: Periodic monitoring is applicable because the site is a major source subject to 30 TAC Chapter 122. The permit contains the following requirements that satisfy periodic monitoring: CEMS for NO_x and CO on the turbines used for refrigeration compression, quarterly visible emission/opacity observations from combustion sources, quarterly monitoring of sulfur content upstream and downstream of the thermal oxidizers, and fuel usage monitoring of turbines, pre-heaters. Engines will have run-time meters.
Compliance Assurance Monitoring (CAM) applicability: CAM is applicable because the site is major and facilities are equipped with control devices. The turbines used in electrical power generation will be monitored with NO_x, NH_3, and CO CEMS. Flares will have flow meters. Thermal oxidizers will have temperature and oxygen monitors.

Process Description

The PALNG terminal will have an export capacity of 27.04 million tonnes per annum of LNG. Natural gas will arrive at the site by pipeline and will be treated to remove acid gases (carbon dioxide and sulfur compounds) with an amine treatment process. Emissions from the AGRU and H_2S scavenger unit will be controlled with a thermal oxidizer. Water, mercury, and heavy hydrocarbons will also be removed from the natural gas. The treated natural gas is then sent to the liquefaction process where PALNG will utilize a proprietary liquefaction process from Air Products to cool the natural gas and convert it to a liquid. The LNG will then be stored in one of three LNG storage tanks and loaded onto a marine vessel for export at the marine berthing area. Other support facilities at the site include the following activities: condensate recovery, electric power generation, fuel gas generation and distribution, flare relief system to dispose of vapors released during operations, fire water pump engines and emergency generator engines in the event of emergencies.

Best Available Control Technology

Emission sources for the proposed project consist of: eight GE Frame 7EA gas-fired refrigeration compressor turbines (four with waste heat recovery), nine GE PGT25+G4 simple cycle gas-fired combustion turbine electric generating units, one marine flare, one ground flare, two gas-fired fuel pre-heaters, four thermal oxidizers, four diesel-fired engine standby generators, two diesel-fired engine fire water pumps, seven diesel storage tanks, two amine storage tanks, two oil storage tanks, and fugitives sources from natural gas and ammonia piping, and circuit breakers. As part of the best available control technology (BACT) review process, the Texas Commission on Environmental Quality (TCEQ) evaluates information from the Environmental Protection Agency's (EPA's) RACT/BACT/LAER Clearinghouse (RBLC), on-going permitting in Texas and other states, and the TCEQ's continuing review of emissions control developments.

The TCEQ performed an analysis of the applicant's proposed BACT for each emission source. The record of these BACT determinations is in the Preliminary Determination Summary (PDS) that is a part of the record for this permit. PALNG used EPA's "top-down" and the TCEQ's three tier BACT process to evaluate BACT for the emission sources identified above.

In addition to a review of control technology for steady state operations, the BACT analyses include MSS emissions and the numerical emission limits and work practices in the draft permit reflect this analysis. BACT for each pollutant include the numerical limits in the Maximum Allowable Emission Rate Table (MAERT).

Source Name	**EPN**	**Best Available Control Technology Description**
Combustion turbines for refrigeration compression	CT-COMP-1 through CT-COMP-8	Good combustion practices Minimize startup/shutdown duration NO_x - Dry low NO_x (DLN) burners to 9.0 ppmvd @ 15% O_2 (24-hour rolling). CO - 25.0 ppmvd @ 15% O_2 (3-hour rolling). VOC - 2.0 ppmvd @ 15% O_2 (3-hour rolling). $PM/PM_{10}/PM_{2.5}$, H_2SO_4 and SO_2 - low sulfur gas GHG - use of low carbon fuels, turbine design, and operational energy efficiency combustion practices
Combustion turbines for electric power generation	CT-GEN -1 through CT-GEN-9	Good combustion practices Minimize startup/shutdown duration NO_x - DLN burners and SCR to 5.0 ppmvd @ 15% O_2 (24-hour rolling). CO – Oxidation catalyst to 9.0 ppmvd @ 15% O_2 (3-hour rolling). VOC - 2.0 ppmvd @ 15% O_2 (3-hour rolling). $PM/PM_{10}/PM_{2.5}$, H_2SO_4 and SO_2 - low sulfur gas NH3 - 10 ppmvd @ 15% O_2 GHG - use of low carbon fuels, turbine design, and operational energy efficiency combustion practices
Natural gas-fired fuel gas preheaters	HTR-1 and HTR-2	Good combustion practices NO_x – Low-NOx burners to 0.049 lb/MMBtu $PM/PM_{10}/PM_{2.5}$, H_2SO_4 and SO_2 - low sulfur gas GHG - use of low carbon fuels, efficient design, operational energy efficiency, combustion practices
Thermal Oxidizers	TO-1 through TO-4	Good combustion practices VOC, H_2SO_4 and SO_2 - 99.9% destruction and removal efficiency (DRE) NO_x – Low-NOx burners to 0.053 lb/MMBtu within BACT $PM/PM_{10}/PM_{2.5}$, H_2SO_4 and SO_2 - low sulfur gas GHG – efficient design, operational energy efficiency, combustion practices

Flares (Ground Flare and Marine Flare)	G-FLARE and M-FLARE	Good combustion practices Comply with 40 CFR §60.18 GHG – good design and operating practices, low-carbon fuel for pilots
Diesel-fired emergency engines (Standby Generators}	ENG-GEN-1 through ENG-GEN-4	Good combustion practices Comply with NSPS IIII Limited hours: 24 hours non-emergency per year NO_x – NO_x plus non-methane hydrocarbon (NMHC) limited to 9.8 g/kW-hr CO – 5.0 g/kW-hr $PM/PM_{10}/PM_{2.5}$ – 0.5 g/kW-hr VOC - 9.8 g/kW-hr SO_2 - low sulfur fuel GHG - good design and operating practices
Diesel-fired emergency engines (Firewater Pumps)	ENG-FWP-1 and ENG-FWP-2	Good combustion practices Comply with NSPS IIII Limited hours: 39 hours non-emergency per year NO_x – NO_x plus non-methane hydrocarbon (NMHC) limited to 6.4 g/kW-hr CO – 5.0 g/kW-hr $PM/PM_{10}/PM_{2.5}$ – 0.2 g/kW-hr VOC – 6.4 g/kW-hr SO_2 - low sulfur fuel GHG - good design and operating practices
Equipment Leak Fugitives	FUGITIVES	VOC - 28VHP LDAR 97% control efficiency for valves 85% control efficiency for pumps and compressors
Storage Tanks	TK-DSLF-1 and TK-DSLF-2; TK-DSLG-1 through TK-DSLG-4; TKDSL-1	VOC - Submerged fill White paint or aluminum (except for firewater pump tanks, which will be painted red)
Condensate Truck Loading	TRK-LOAD-1 and TRK-LOAD-2	VOC - Closed vent system and ground flare

Impacts Evaluation

Was modeling conducted? **Yes** Type of Modeling: **Refined: AERMOD**

Is the site within 3,000 feet of any school? **No**

Additional site/land use information: **Area is undeveloped/industrial**

TCEQ Air Dispersion Modeling Team (ADMT) concluded that the applicant's Air Quality Analysis is acceptable for all review types and pollutants. The audit memo dated April 16, 2020 is filed as GroupWise document number 627414.

TCEQ Toxicology division reviewed an instance of exceedance of the effective screening level for diesel fuel 1-hour, and in their memo dated April 27, 2020, concluded "we do not anticipate any short- or long-term adverse health effects to occur to the general public."

Therefore, all criteria pollutants are predicted not to cause or contribute to an exceedance of the NAAQS. All non-criteria pollutants are predicted not to cause an adverse impact on human health or welfare.

9/12/2022			9/17/2022
Project Reviewer	Date	Team Leader	Date
Benjamin Hansen, Ph.D., P.E.		Matthew Ray	