Federal Energy Regulatory Commission
Office of Energy Projects, Division of Gas-Environment & Engineering

ENVIRONMENTAL ASSESSMENT REPORT

Name of Applicant: Cameron LNG, LLC (Cameron)

Date Filed: September 28, 2015	**Docket No:** CP15-560-000
Type: Section 3(a)	**Cost:** N/A

Facilities:

Cameron would construct two liquefaction trains (Trains 4 and 5) each with a maximum LNG production capacity of 4.985 million metric tonnes per year and a new 160,000 cubic meter full containment LNG storage tank (Tank 5) at its existing LNG liquefaction facility in Cameron and Calcasieu Parishes, Louisiana. Additionally, Cameron would install a low pressure flare, two boil-off gas compressor units, one condensate storage tank, one diesel storage tank, two liquid nitrogen storage tanks, and miscellaneous piping. All construction would occur within the existing disturbed land for the Liquefaction Project (CP13-25-000). Additionally, no new LNG vessel transit along the Calcasieu Shipping Channel would occur as a result of this project.

Environmental Impact -- Conclusions:

___ **Categorical Exclusion**

___ **Environment Not Involved**

_X_ **Environment Complete**

___ **Deficiency Letter Required**

___ **EA/EIS Required**

___ **No NOI Required**

___ **NOI Required**

Environmental Considerations or Comments:

See attached EA.

Prepared by: /s/ Danny Laffoon	**Date:** 2/12/2016	**Approved by Branch Chief:** /s/ Shannon Jones	**Date:** 2/12/2016

Federal Energy Regulatory Commission

Office of Energy Projects

February 2016

Cameron LNG, LLC

Docket No. CP15-560-000

Cameron LNG Expansion Project

Environmental Assessment

Cooperating Agencies:

U.S. Department of Energy
U.S. Department of Transportation

Washington, DC 20426

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Abbreviations and Technical Acronyms

AEGL	Acute Exposure Guidance Levels
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
amsl	above mean sea level
AQCR	Air Quality Control Region
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
BACT	Best Available Control Technology
Bcf/d	Billion cubic feet per day
BLEVE	boiling-liquid-expanding-vapor explosion
BOG	boil-off gas
$BTU/ft^2/hr$	British thermal units per square foot per hour
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
Cameron LNG	Cameron LNG, LLC
CO	carbon monoxide
CO_2	carbon dioxide
CO_{2e}	carbon dioxide equivalents
COE	U.S. Army Corps of Engineers
Commission	Federal Energy Regulatory Commission
dB	decibels
dBA	A-weighted scale decibels
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EA	environmental assessment
EI	environmental inspector
Entergy	Entergy Louisiana LLC
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ERP	Emergency Response Plan
ERPG	Emergency Response Planning Guidelines
ESA	Endangered Species Act
ESD	emergency shutdown
FE	Office of Fossil Energy
FEED	front-end engineering design
FERC	Federal Energy Regulatory Commission
FWS	U.S. Fish and Wildlife Service

GHGs	greenhouse gases
GIS	Geographic Information System
GIWW	Gulf Intercoastal Coastal Waterway
gpm	gallons per minute
GWP	global warming potential
HAP	Hazardous Air Pollutant
HAZOP	Hazard and Operability Review
ICE	internal combustion engine
IPCC	Intergovernmental Panel on Climate Change
kV	Kilovolt
LDEQ	Louisiana Department of Environmental Quality
Ldn	day-night noise level
LDNR	Louisiana Department of Natural Resources
LDWF	Louisiana Department of Wildlife and Fisheries
LFL	lower flammability limit
LNG	liquefied natural gas
LNHP	Louisiana Natural Heritage Program
L_{eq}	equivalent sound level
MBTA	Migratory Bird Treaty Act
MR	mixed refrigerants
MRL	mixed refrigerant liquid
MSL	mean sea level
Mtpy	metric tonnes per year
MW	megawatt
m^3	cubic meters
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAP	National Emission Standard for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NGA	Natural Gas Act of 1938
NGL	natural gas liquids
NMFS	National Marine Fisheries Service
NOI	notice of intent
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxide
NSA	noise-sensitive area
NSPS	New Source Performance Standards
N_2O	nitrous oxide
O_3	ozone
OCM	Office of Coastal Management

OEP	Office of Energy Projects
OSHA	Occupational Safety and Health Administration
P&ID	Piping and Instrument Diagrams
PHMSA	Pipeline Hazardous Materials Safety Administration
Plan	Upland Erosion Control, Revegetation, and Maintenance Plan
PM	particulate matter
$PM_{2.5}$	PM less than 2.5 microns in aerodynamic diameter
PM_{10}	PM less than 10 microns in aerodynamic diameter
ppb	parts per billion
Procedures	Wetland and Waterbody Construction and Mitigation Procedures
PSD	Prevention of Significant Deterioration
psi	pounds per square inch
RICE	reciprocating internal combustion engine
RPT	rapid phase transition
RRF	relative response factor
SIP	State Implementation Plan
SIL	significant impact level
SONRIS	Strategic Online Natural Resources Information System
SO_2	sulfur dioxide
SPCC	Spill Prevention Control and Countermeasure Plan
tpy	tons per year
Secretary	Secretary of the Commission
UFL	Upper flammability limit
USCG	U.S. Coast Guard
USGCRP	United States Global Change Research Program
U.S.C.	Unites States Code
VOC	volatile organic compound
WSA	Water Suitability Assessment
$\mu g/m^3$	micrograms per cubic meter

1. PROPOSED ACTION

1.1 Introduction

On September 28, 2015, (Cameron LNG, LLC) Cameron LNG filed an application in Docket No. CP15-560-000 with the Federal Energy Regulatory Commission (FERC or Commission) pursuant to Section 3(a) of the Natural Gas Act (NGA) and Part 157 of the Commission's regulations. Cameron LNG requests authorization to expand its existing liquefied natural gas (LNG) Terminal[1] in Cameron and Calcasieu Parishes, Louisiana, by siting, constructing, and operating additional LNG facilities within the LNG Terminal property. This proposal is referred to as the Expansion Project. The Expansion Project would increase the terminal's capability to liquefy natural gas for export by 515 billion cubic feet per year, equivalent to 9.97 million metric tonnes per year (Mtpy). The Expansion Project would increase the Terminal's total liquefaction capacity from 14.95 million Mtpy to 24.92 million Mtpy.

The staff of the Commission has prepared this environmental assessment (EA) to address the potential environmental impacts of Cameron LNG's Expansion Project in compliance with National Environmental Policy Act of 1969 (NEPA), requirements and regulations issued by the Council on Environmental Quality (CEQ) at Title 40 of the Code of Federal Regulations (CFR) 1500-1508 (40 CFR 1500-1508), and the Commission's regulations implementing NEPA at 18 CFR 380. The FERC is the federal agency responsible for approving the siting of LNG facilities under the NGA, and is the lead federal agency for the preparation of this EA in compliance with the requirements of NEPA.

The U.S. Department of Energy (DOE) and the U.S. Department of Transportation (DOT) are cooperating agencies in the preparation of this EA. Cooperating agencies have jurisdiction by law or special expertise with respect to environmental impacts involved with a proposal. The roles of the FERC, DOE, and DOT in the Expansion Project review process are described in section 1.2. Our[2] EA is an integral part of the Commission's decision on whether to issue Cameron LNG authorization to construct and operate the facilities described in section 1.5 below.

Our principal purposes in preparing this EA are to:

- identify and assess potential impacts on the natural and human environment that would result from implementation of the proposed action;

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[1] The Cameron LNG Terminal was previously evaluated and assessed by the FERC for various project components in FERC Docket Nos. CP02-374-000 (Cameron LNG Terminal and Cameron Interstate Pipeline), CP06-422-001 (Cameron LNG Terminal Expansion), and CP13-25-000 (Cameron LNG Liquefaction and Cameron Interstate Pipeline Expansion Project). Cameron LNG's Liquefaction Project (Docket No. CP13-25-000) was approved by the Commission on June 19, 2014. This authorization included a fourth full containment LNG storage tank (T-204) and three systems for liquefying natural gas (Trains 1, 2, and 3) including the associated natural gas pre-treatment equipment, to produce up to 14.95 million Mtpy of LNG for export. The Liquefaction Project is currently under construction.

[2] "We," "us," and "our" refer to the environmental staff of the Commission's Office of Energy Projects.

- assess reasonable alternatives to the proposed action that would avoid or minimize adverse effects to the environment; and
- identify and recommend specific mitigation measures, as necessary, to minimize environmental impacts.

1.2 Scope of this Environmental Assessment

The topics addressed in this EA include geology; groundwater; surface waters; wildlife and aquatic resources; migratory birds; land use and visual resources; socioeconomics (including transportation and traffic); cultural resources; air quality and noise; reliability and safety; cumulative impacts; and alternatives. This EA describes the affected environment as it currently exists, discusses the environmental consequences of the Expansion Project, and compares the Expansion Project's potential impact with that of various alternatives. This EA also presents our recommended mitigation measures. The following resources would not be affected by the Expansion Project and, therefore, are not discussed further in this EA:

- mineral resources;
- oil and gas resources;
- soils;
- essential fish habitat;
- vegetation;
- wetlands;
- paleontological resources;
- agriculture; and
- residential housing and businesses.

When considering the environmental consequences of constructing and operating the Expansion Project, the duration and significance of any potential impacts are described according to the following four levels:

- temporary impacts - generally occur during construction, with the resources returning to preconstruction conditions almost immediately;
- short-term impacts - continue for approximately 3 years following construction;
- long-term impacts - require more than 3 years to recover, but eventually would recover to pre-construction conditions; and
- permanent impacts - occur as a result of activities that modify resources to the extent that they do not return to pre-construction conditions during the life of the project, such as with the construction of an aboveground facility.

<u>Cooperating Agencies</u>

U.S. Department of Energy

The DOE authorizes the import and export of natural gas, including LNG, unless it finds that the proposed import or export will not be consistent with the public interest. The DOE's authority to regulate exports of natural gas, including LNG, is explained by Section 3(c) of the

NGA, as amended by section 201 of the Energy Policy Act of 1992 (Public Law 102-486). This authority has been delegated to the Assistant Secretary for the Office of Fossil Energy (FE) in Redelegation Order No. 00-002.04F, issued July 11, 2013. On February 23, 2015 and May 28, 2015, Cameron LNG filed applications with the DOE FE for authorization to export up to 9.97 million Mtpy of domestically produced LNG from its LNG Terminal. Cameron LNG requested authorization for a 20-year term, commencing the earlier of either the date of first export or 7 years from the date of issuance of the requested authorization. FE Docket No. 15-36-LNG seeks to export LNG from the Cameron LNG Terminal to any country with which the United States has, or in the future may have, a free trade agreement requiring national treatment for trade in natural gas and that has, or in the future develops, the capacity to import LNG. FE Docket No. 15-90-LNG seeks to export LNG from the Cameron LNG Terminal to any country (1) with which the United States does not have a free trade agreement requiring the national treatment for trade in natural gas and LNG; (2) with which trade is not prohibited by United States law or policy; and (3) that has, or in the future develops, the capacity to import LNG. FE Docket No. 15-36-LNG was approved and Order No. 3680 was issued by the DOE on July 10, 2015. FE Docket No. 15-90-LNG is still under DOE review.

U.S. Department of Transportation

The DOT has the authority to enforce safety regulations and design standards for LNG terminals. The DOT has prescribed the minimum federal safety standards for onshore LNG facilities in compliance with Title 49 of the Unites States Code (U.S.C.), Chapter 60101. Those standards are codified in 49 CFR 193 and apply to siting, construction, operation, and maintenance of onshore LNG facilities. The National Fire Protection Association (NFPA) Standard 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas*, is incorporated into these requirements by reference, with regulatory preemption in the event of conflict. The DOT is a cooperating agency with the FERC, serving as a subject matter expert on its federal safety standards for siting, construction, operation, and maintenance of onshore LNG facilities codified in 49 CFR 193. The DOT, as a cooperating agency, assists FERC staff in evaluating whether an applicant's proposed design would meet the DOT siting requirements.

1.3 Purpose and Need

The purpose of the Expansion Project is to increase the Cameron LNG Terminal's maximum natural gas liquefaction capabilities and to export LNG to free trade agreement and non-free trade agreement countries, consistent with DOE authorizations and applications. The Expansion Project would increase the Terminal's LNG production capacity by 9.97 million Mtpy, equivalent to 515 billion cubic feet per year. Cameron LNG claims that the Expansion Project will enable Cameron LNG to meet the demonstrated market demand for liquefaction and export of domestic natural gas.

Section 3 of the NGA, as amended, requires that authorization be obtained from the DOE prior to importing or exporting natural gas, including LNG, from or to a foreign country. For applicants that have, or intend to have, a signed gas purchase or sales agreement/contract for a period of time longer than two (2) years, long-term authorization is required. Under Section 3 of the NGA, FERC considers, as part of its decision to authorize natural gas facilities, all factors bearing on the public interest. Specifically, regarding whether to authorize natural gas facilities for importation or exportation, the FERC shall authorize the proposal unless it finds that the proposed facilities would not be consistent with the public interest.

1.4 Public Review and Comment

On March 2, 2015, we granted Cameron LNG's request to use the pre-filing process and assigned Docket No. PF15-13-000 to the Expansion Project. Cameron LNG hosted, and we participated in, an open house information session for landowners, agencies, and other interested stakeholders on May 14, 2015, in Sulphur, Louisiana. The open house provided stakeholders an opportunity to learn about the Expansion Project and ask questions in an informal setting. Notifications of the open house were mailed by Cameron LNG to stakeholders and published in local newspapers. Cameron LNG also established a webpage and a telephone hotline for the Expansion Project.

On June 18, 2015, we issued a *Notice of Intent to Prepare an Environmental Assessment for the Planned Cameron LNG Expansion Project and Request for Comments on Environmental Issues* (NOI).[3] This NOI, which identified a 30-day public comment period and instructed interested parties on how to comment on the Expansion Project, was mailed to federal, state, and local government representatives and agencies; elected officials; Native American tribes; and other interested individuals and groups.

During the review process, we received no comments about the Expansion Project from the public. One letter was received from the Louisiana Department of Wildlife and Fisheries (LDWF) stating no objection to the Expansion Project. Another letter was received from the U.S. Environmental Protection Agency (EPA) that included comments and recommendations pertaining to the information to be provided in the EA. Finally, the U.S. Department of Defense stated that the Expansion Project would have minimal impacts on training and operations. Table 1.4-1 lists the concerns identified during the public comment process that are within the scope of the environmental analysis, and identifies the applicable sections of this EA that address each issue.

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[3] On June 24, 2015 the NOI was published in the Federal Register (FR) at 80 FR 36332.

TABLE 1.4-1 Issues Identified During Scoping	
Issue	**EA Section Where Addressed**
GENERAL	
Purpose and Need	1.2
Indirect Impacts and Cumulative Impacts	2.8
Fugitive Dust, Mobility and Stationary Source and Administrative Control Measures	2.6.1
WATER RESOURCES	
Surface Water Quality	2.2.1
Water Supply Quality and Reliability	2.2.1.1
Groundwater Quality and Quantity and Mitigation Measures to Prevent Adverse Impacts	2.2.1.1
Stormwater Pollution Prevention and Mitigation Measures	2.2.1.2 and 2.2.1.3
AIR RESOURCES	
Air Quality	2.6.1
Greenhouse Gas and Methane Leakage	2.6.1
SOCIOECONOMICS	
Effects on Environmental Justice Populations	2.4.6
Effects on Land Use Plans in the Local Area	2.4
WILDLIFE AND VEGETATION	
Impacts and Avoidance of Species and Mitigation Efforts	2.2.1, 2.2.2, and 2.2.3
CULTURAL RESOURCES	
Tribal Government Coordination	2.5
Cultural and Historic Sites	2.5
ALTERNATIVES	
Description of Alternatives and Analysis	3.0

In addition, Magnolia LNG, LLC and Lake Charles LNG, LLC commented in their requests for intervention that increased shipping could impact their respective projects; however, we note that no increase in LNG vessel traffic or size of vessels would occur as a result of the Expansion Project. Therefore, this is not discussed further in this EA.

1.5 Proposed Facilities

The Cameron LNG Expansion Project facilities are described below and depicted in figures 1 and 2.

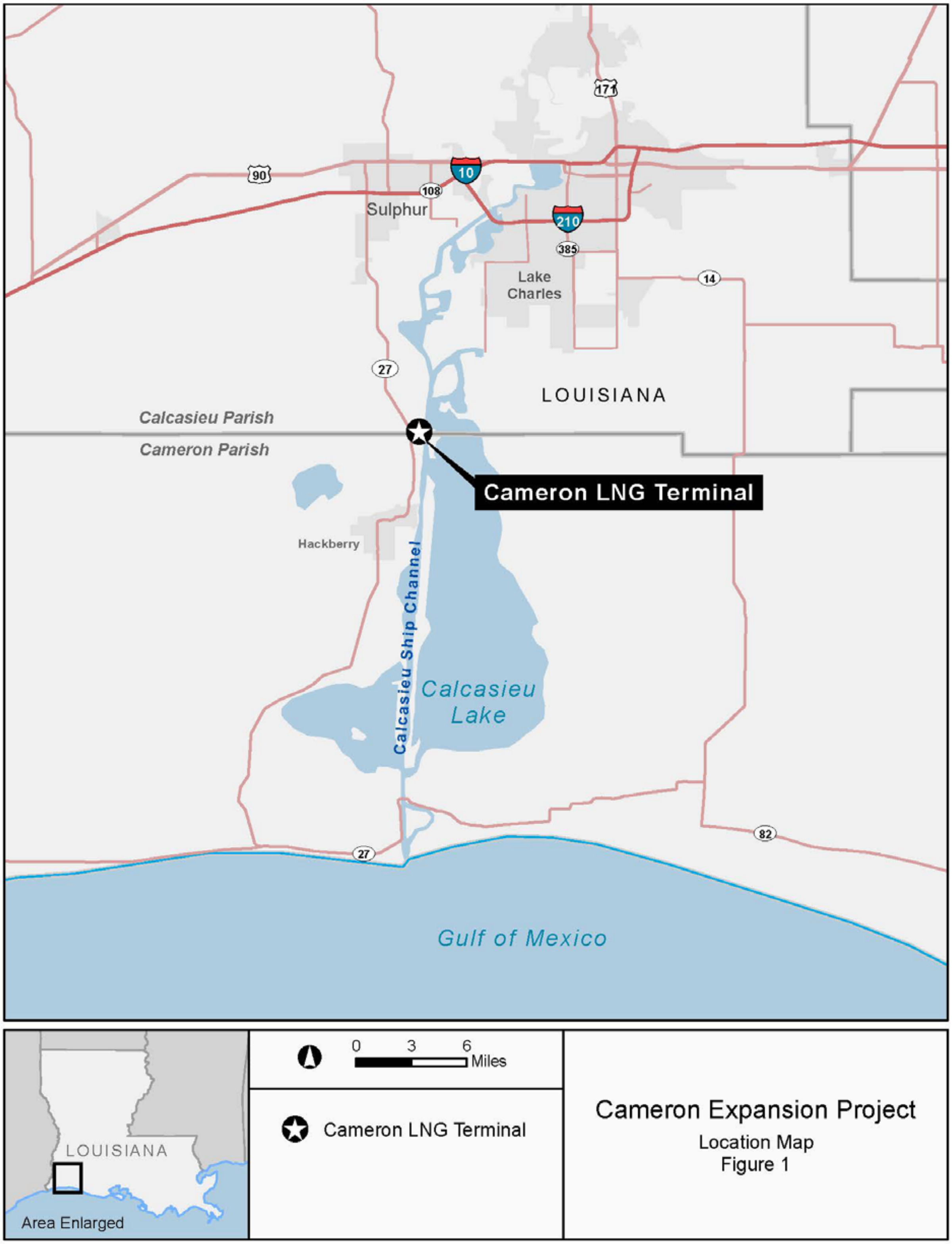
Cameron LNG Expansion Project

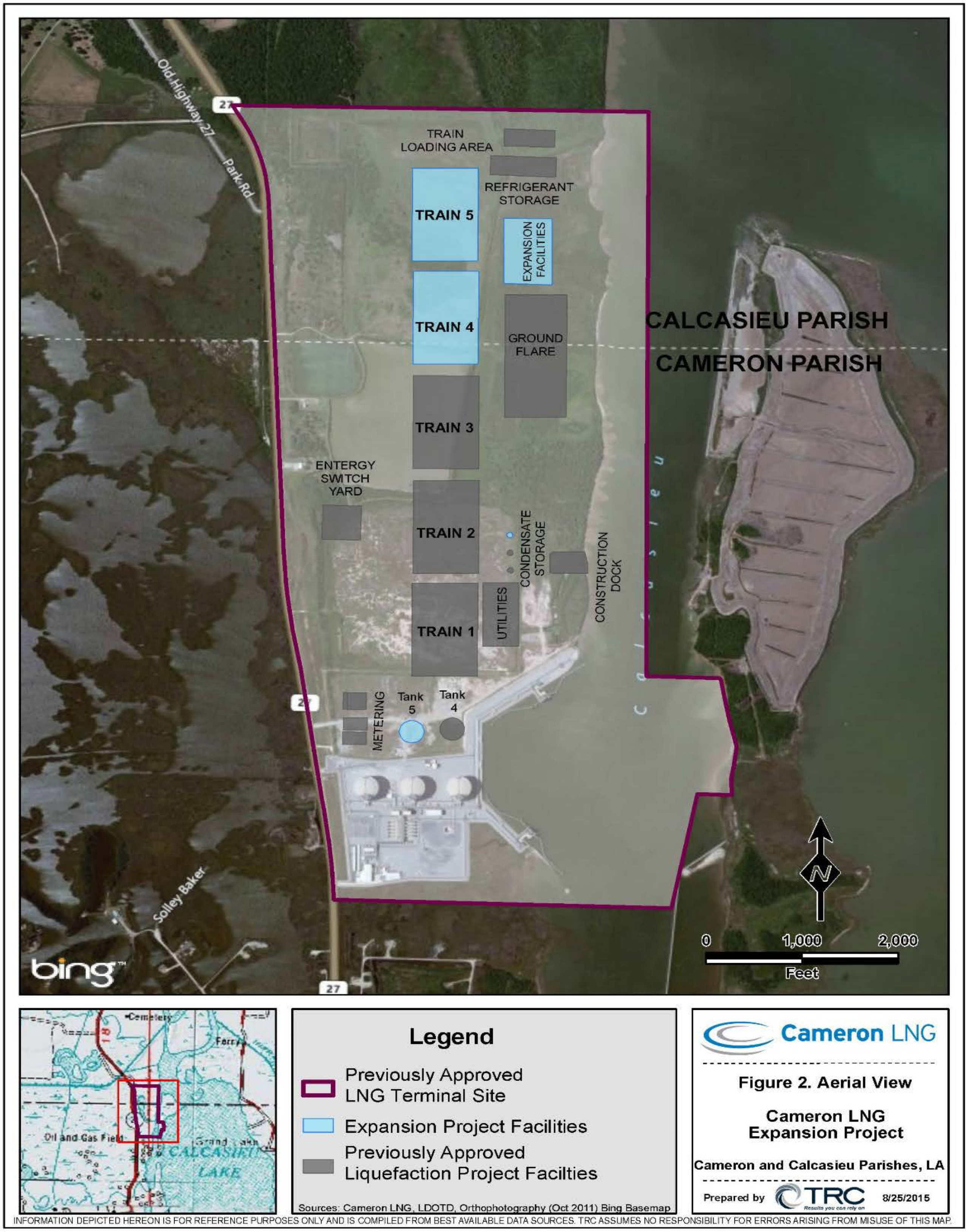
The Cameron LNG Expansion Project facilities would receive natural gas via existing natural gas pipelines at the LNG Terminal and pipelines being constructed as part of the Liquefaction Project. The natural gas would be pre-treated to remove contaminants (mercury, hydrogen sulfide, carbon dioxide, water) and heavy hydrocarbons then liquefied using liquefaction units. The liquefied gas would be stored as LNG in a new LNG storage tank or sent to existing LNG storage tanks. The LNG would be transferred from the new and existing LNG storage tanks and would be loaded onto ships berthed at the terminal's existing marine facility. The Expansion Project facilities would be constructed and operated on about 60 acres entirely within the previously authorized Terminal site, as shown on figure 2. The Expansion Project includes the following key facilities:

- two liquefaction trains (Trains 4 and 5) each with a maximum LNG production capacity of 4.985 million Mtpy (9.97 Mtpy total). Each liquefaction train would be composed of a feed gas treatment unit consisting of a mercury adsorber; hydrogen sulfide scavenger bed to remove hydrogen sulfide; amine unit to remove carbon dioxide; a dehydration unit to remove water; a heavy hydrocarbon removal unit to remove isopentane and heavier hydrocarbons and a liquefaction unit consisting of main cryogenic heat exchanger, refrigeration system and end flash drum.
- one 160,000 cubic meter (m^3) full containment LNG storage tank (T-205);
- one new low pressure elevated flare; new flare knockout drums;
- two new boil-off gas (BOG) compressor units to compress BOG and deliver as fuel to gas turbine;
- one 1,070,000 gallon capacity low pressure condensate storage tank;
- three 2.5 megawatt (MW) capacity diesel powered standby generators;
- one 54,100 gallon capacity diesel storage tank containment;
- two liquid nitrogen storage drawers
- modifications and additions to existing utilities, fire and gas detection systems, control system, firewater system, spill containment, tertiary berm and infrastructure needed to accommodate the two additional liquefaction trains.

The new facilities proposed in the Expansion Project would be consistent with the existing LNG Terminal and Liquefaction Project facilities and would replicate the design of liquefaction Trains 1, 2, and 3 that are currently under construction and the existing LNG storage tanks. The condensate storage tanks would also be identical to those previously approved. The project would not add new refrigerant storage vessels.

The Expansion Project would not require any additional marine facilities. Cameron LNG would not modify the LNG loading arms, berthing equipment, basin, or other portions of the marine terminal. The number and size of ships using the LNG Terminal would not increase from the number and size of ships previously authorized by the U.S. Coast Guard (USCG) Water Suitability Assessment (WSA) for the LNG Terminal. Because the loading rates proposed for the Expansion Project would be the same as the unloading rates for the LNG Terminal, there would be no increase in the previously analyzed ship traffic.


171
90
10
108
Sulphur
210
385
Lake
Charles
14
27
LOUISIANA
Calcasieu Parish
Cameron Parish
Cameron LNG Terminal
Hackberry
Calcasieu Ship Channel
Calcasieu
Lake
82
27
Gulf of Mexico
LOUISIANA
Area Enlarged
0 3 6
Miles
Cameron LNG Terminal
Cameron Expansion Project
Location Map
Figure 1



TRAIN LOADING AREA
REFRIGERANT STORAGE
TRAIN 5
EXPANSION FACILITIES
TRAIN 4
GROUND FLARE
CALCASIEU PARISH
CAMERON PARISH
TRAIN 3
ENTERGY SWITCH YARD
TRAIN 2
CONDENSATE STORAGE
CONSTRUCTION DOCK
TRAIN 1
UTILITIES
METERING
Tank 5
Tank 4
Old Highway 27
Park Rd
Solley Baker
27
0
1,000
2,000
Feet
Legend
Previously Approved LNG Terminal Site
Expansion Project Facilities
Previously Approved Liquefaction Project Facilties
Sources: Cameron LNG, LDOTD, Orthophotography (Oct 2011) Bing Basemap
Cameron LNG
Figure 2. Aerial View
Cameron LNG Expansion Project
Cameron and Calcasieu Parishes, LA
Prepared by TRC 8/25/2015
INFORMATION DEPICTED HEREON IS FOR REFERENCE PURPOSES ONLY AND IS COMPILED FROM BEST AVAILABLE DATA SOURCES. TRC ASSUMES NO RESPONSIBILITY FOR ERRORS ARISING FROM MISUSE OF THIS MAP.

Cameron LNG anticipates beginning construction of the Expansion Project in June 2016, subject to receipt of the Commission's authorization and all other required permits and approvals, and expects liquefaction Trains 4 and 5 to be in operation by year's end 2019.

1.6 Non-jurisdictional Facilities

Occasionally, proposed projects have associated facilities that do not come under the jurisdiction of the FERC. These non-jurisdictional facilities may be integral to the project (e.g., an electrical switch yard for an LNG terminal) or they may be minor, non-integral components of the jurisdictional facilities that would be constructed and operated as a result of the project.

In its application, Cameron LNG identified plans for Entergy Louisiana, LLC (Entergy) to build a new transmission line in Calcasieu and Cameron Parishes as well as a new switch yard on the west side of the LNG Terminal. The new transmission line that would be constructed for the Project would include a 15.9-mile-long 230 kilovolt (kV) transmission line and a 500/230 kV bulk power substation east of Carlyss substation near Sulphur, Louisiana. Entergy would design, permit, construct, own, operate, and maintain the new powerline. Further, Entergy would consult with the appropriate state and federal resource agencies to obtain the required permits or authorizations, including: United States Army Corps of Engineers (COE) (Section 10/404 Permit); Louisiana Department of Natural Resources (LDNR) Office of Coastal Management (OCM) (Coastal Use Permit); and LDWF (Habitat Evaluation). The preliminary route for the new powerline would parallel an existing 69 kV line for about 7 miles and parallel another proposed power line for 2 miles. The remaining length would follow existing roadways back to Carlyss. We have included this non-jurisdictional facility in our cumulative impacts analysis (refer to section 2.8).

1.7 Construction, Operation, and Maintenance Procedures

Cameron LNG would design, construct, operate, and maintain the Expansion Project facilities to conform to, or exceed, federal standards that are intended to adequately protect the public by preventing or mitigating LNG failures or accidents and ensure safe operation of the facilities. The liquefaction facilities would be constructed according to the standards outlined by the DOT's *Federal Safety Standards for Liquefied Natural Gas Facilities* in 49 CFR 193 and the NFPA's *Standards for the Production, Storage, and Handling of LNG* (NFPA 59A).

Cameron LNG has adopted, in whole without changes, the FERC's 2013 *Upland Erosion Control, Revegetation, and Maintenance Plan* (Plan) and *Wetland and Waterbody Construction and Mitigation Procedures* (Procedures)[4] into its Environmental Plan. We previously reviewed

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[4] The FERC Plan and Procedures are a set of construction and mitigation measures that were developed in collaboration with other federal and state agencies and the natural gas pipeline industry to minimize the potential environmental impacts of the construction of projects. Copies of our Plan and Procedures may be accessed on our website (http://www.ferc.gov/industries/gas/enviro/guidelines.asp) or obtained through our Office of External Affairs at 1-866-208-3372.

and approved use of Cameron LNG's Environmental Plan for the Liquefaction Project, which is currently under construction. Cameron LNG is not proposing to modify its Environmental Plan for the Expansion Project and therefore, we find it acceptable.

1.7.1 Construction Procedures

For purposes of quality assurance and compliance with mitigation measures, other applicable regulatory requirements, and other project specifications, Cameron LNG would employ at least one environmental inspector (EI). Cameron LNG would require its contractors to observe and comply with all federal, state, and local construction laws, ordinances, and regulations that apply and would provide environmental training to all construction personnel. The level of training would be appropriate for the duties performed. Training would be provided before the start of construction and throughout the construction process, as needed. The environmental training program would include the measures outlined in Cameron LNG's Environmental Plan, job-specific permit conditions, company policies, and any other project requirements.

Site Preparation

The Expansion Project would involve modifications to the existing LNG Terminal facilities and the construction of new infrastructure. The construction area for the new facilities would be entirely within the previously authorized Terminal and would not require any new construction infrastructure (i.e., roads or docks) or modifications. No wetlands would be affected by the construction of the Expansion Project.

Site Grade and Fill

The Expansion Project process area would be north of existing liquefaction Trains 1, 2, and 3, but would not require additional clearing or grubbing. Onsite material would be used as structural backfill material when applicable. If onsite material is determined to be insufficient or unsuitable for the intended application, clean structural backfill material would be imported from existing local borrow areas.

Cameron LNG would increase the Expansion Project process area to a minimum grade elevation of +11.5 mean sea level (MSL) (+12.6 feet North American Vertical Datum of 1988 (NAVD88)) and the new LNG storage tank (T-205) minimum grade elevation would be +5 feet MSL (+6.1 feet NAVD88). Foundations for the associated structures would consist of pile supports and spread footings. Critical equipment and infrastructure such as process equipment and pipe racks would have their foundations supported by piles. The foundations would be constructed of reinforced concrete and designed according to standard engineering practices. Concrete would be delivered to the Expansion Project site either from an existing Gulf Intracoastal Coastal Waterway (GIWW) batch plant near the Expansion Project site or the Engineering, Procurement, and Construction contractor may utilize an onsite concrete batch plant. If the existing GIWW batch plant would be used, an existing GIWW barge dock and lay down area, adjacent to the batch plant, would be used for delivery of aggregate and concrete piles during construction. No improvements to the GIWW dock would be required for its use.

Materials and Equipment Delivery

Construction traffic would access the site from Louisiana State Highway (LA) 27 and use the same entrances already approved for access to the Terminal. Cameron LNG would deliver material by barge to the maximum extent practical utilizing the existing construction barge dock at the LNG Terminal, previously constructed as part of the Cameron LNG's Liquefaction Project. There would be some material delivery by truck by using LA 27. Bulk materials and equipment would be delivered via LA 27 or by barge.

1.7.2 Operating Procedures

Natural gas would be delivered to the existing terminal via the Cameron Interstate Pipeline and the Cameron Access Project Pipeline. The gas would be metered and enter the gas pre-treatment section of the liquefaction facilities to remove components in the gas stream in preparation for liquefaction. The removed components include solids, CO_2, hydrogen, sulfur, water, and mercury.

The dry gas would feed to the heavy hydrocarbon removal unit to remove pentane and heavier hydrocarbons (stabilized condensate product) to prevent freeze-out in the liquefaction unit and meet the LNG product specification. The purified natural gas would be pre-cooled using propane before entering the liquefaction systems where it would be put in contact with progressively cooler refrigerants, consisting of mixed refrigerants (MR) which consist of nitrogen, methane (CH_4), ethylene, and propane. The LNG would then be pumped to the LNG storage system.

The LNG Terminal's Operations Manual would include additional operating procedures for the new liquefaction facilities. Cameron LNG would train the Expansion Project's additional 90 operations personnel in accordance with the DOT minimum federal safety standards specified in 49 CFR 192 and 193.

1.7.3 Maintenance Procedures

Cameron LNG would conduct facility maintenance in accordance with 49 CFR 193, Subpart G. All current manuals would be updated, as necessary, to include the expanded terminal operations and Cameron LNG would file amendments with the agencies prior to commissioning the Expansion Project facilities. Cameron LNG would train all operations and maintenance personnel to safely perform their jobs prior to commissioning the proposed facility. Operators would meet all the training requirements of USCG, DOT, local fire departments, and other regulatory entities.

1.8 Land Requirements

The Expansion Project would not require any additional land for construction or operation. This project would affect about 141 acres within the previously authorized terminal site during construction. A total of 60 acres would be permanently affected by the Expansion

Project, but is currently affected by the Liquefaction Project. All facility access and egress would be through existing highway access locations.

1.9 Consultations, Approvals, and Permits for the Expansion Project

Table 1.9-1 lists the federal, state, and local regulatory agencies that have permit or approval authority or consultation requirements and the status of that review for the Expansion Project. Cameron LNG is responsible for obtaining all necessary permits, licenses, and approvals for the Expansion Project, regardless of whether they are listed in table 1.9-1.

TABLE 1.9-1

Permits and Consultations for the Expansion Project

Agency	Permit/Consultation	Status
Federal		
FERC	Section 3 of the Natural Gas Act	Application Filed September 28, 2015
DOE	Application for Long Term, Multi-Contract Authorization to Export Natural Gas to Free Trade Agreement Countries	Order Received July 10, 2015
	Application for Long Term, Multi-Contract Authorization to Export Natural Gas to Non-Free Trade Agreement Countries	Application Filed May 28, 2015
USCG	Letter of Intent and Update/Preliminary Waterway Suitability Assessment Waiver	Concurrence Letter Received February 3, 2015
COE	Section 404 (Clean Water Act) Section 10 (Rivers and Harbors Act)	Approval of Permit (MVN-2012-03266-WII) Modification Received June 22, 2015
U.S. Fish and Wildlife Service	Section 7 of Endangered Species Act Consultation Migratory Bird Treaty Act	Concurrence Letter Received August 8, 2015
National Marine Fisheries Service	Section 7 of Endangered Species Act Consultation Magnuson-Stevens Fishery Management and Conservation Act Essential Fish Habitat Consultation Marine Mammal Protection Act Consultation	Cameron LNG Filed a concurrence Letter with NMFS on May 19, 2015
State		
LDNR – Office of Coastal Management	Coastal Use Consistency Determination	Amended Coastal Use Permit (P20121194) Authorization Received June 21, 2015

TABLE 1.9-1

Permits and Consultations for the Expansion Project

Agency	Permit/Consultation	Status
Louisiana Department of Environmental Quality (LDEQ) Air Quality Division	Prevention of Significant Deterioration (PSD) and Title V Air Permits (modify existing permits)	Application to Modify Existing Permits (0560-00184-V6 and PSD-LA-766(M1)) Filed May 14, 2015
LDEQ Water Quality Division	Hydrostatic Test Water Discharge General Permit	Permit Received September 17, 2014
	Water Quality Certification	Certification (020809-08) Received October 24, 2012
LDWF	State Threatened and Endangered Species Consultation	Concurrence Letter Filed May 19, 2015
Louisiana State Historic Preservation Office	Section 106 Consultation	Concurrence Received July 17, 2015
Local		
Cameron Parish Police Jury	Building Permit	Application Anticipated to be Filed April 2016; as Needed
Cameron Parish Coastal Use Consistency	Letter of No Objection	Approval Received July 20, 2015
Calcasieu Parish Police Jury	Building Permit	Application Anticipated to be Filed April 2016; as Needed
Calcasieu Parish Coastal Use Consistency	Letter of No Objection	Approval Received July 22, 2015

2. ENVIRONMENTAL ANALYSIS

2.1 Geology, Foundations, and Natural Hazards

2.1.1 Geology

The Expansion Project is within the West Gulf Coastal Plain geomorphic province (Hunt, 1974), in southwestern Louisiana just west of Calcasieu Lake on the Calcasieu Ship Channel. Much of the site is covered with dredged soil from the maintenance dredging of the Calcasieu Ship Channel conducted by the COE.

Blasting

The geotechnical studies conducted to date by Cameron LNG, and recent work at the Cameron LNG Terminal indicate that there is no bedrock near the surface of the LNG Terminal site that would require blasting for removal. Should Cameron LNG require blasting for construction of the Expansion Project, it would file a blasting plan with the Commission.

2.1.2 Foundation Conditions

Cameron LNG's geotechnical investigation indicated that the surficial conditions at the Expansion Project site primarily consist of recently deposited very soft to firm, high plasticity cohesive soils to depths ranging from about 20 to 30 feet below grade. However, at several locations the surficial conditions consisted of existing fill materials or cohesionless/granular soils. These surficial soils were underlain by alternating strata of firm to stiff, cohesive soils and loose to medium-dense cohesionless soils to a depth of about 40 feet below grade. Below depths of 40 feet, very stiff Pleistocene aged cohesive deposits along with occasional stratums of medium-dense to very dense cohesionless soil were encountered.

The results of the geotechnical investigation (Fugro, 2015a) indicate that subsurface conditions at the site are generally suitable for the Expansion Project facilities, provided that adequate site preparation and foundation design and construction methods are implemented. Cameron LNG would support all settlement sensitive structures on deep foundations. Lightly loaded structures or equipment insensitive to settlement may be supported on concrete pads.

Due to raising the site grade up to 11.5 feet above mean sea level (amsl), settlement of the soft soils would continue for a long time and create downdrag on piles. Therefore, piles would be designed for downdrag loads. The foundations would be supported on 14- or 18-inch-square prestressed or auger cast concrete piles designed for downdrag.

Cameron LNG's Expansion Project would be constructed to satisfy the design requirements of 49 CFR 193, NFPA 59A-2001, 2006 International Building Code, and American Society of Civil Engineer (ASCE) 7-05. For seismic design, the facility would also be designed to satisfy the requirements of NFPA 59A-2006 and ASCE 7-05.

No significant impacts on site topography would occur during construction of the Expansion Project facilities. The proposed facilities would be constructed within areas of the ongoing Liquefaction Project that have been previously cleared, grubbed, filled, and brought to grade. In addition, primary surface drainage features have already been constructed for the Liquefaction Project site; therefore, only minor topography changes are anticipated for the Expansion Project facilities.

Construction and operation of the Expansion Project would not materially alter the geologic conditions of the site and the Expansion Project would not affect mining resources during construction or operation. Based on Cameron LNG's proposal, including implementation of its Environmental Plan, we conclude that impacts on geologic resources would be adequately minimized and would not be significant.

The design of the facility is currently at the front-end engineering design (FEED) level of completion. Cameron LNG has proposed a feasible design, and it has committed to conducting a significant amount of detailed design work if the Expansion Project is authorized by the Commission. Information regarding the development of the final design would need to be reviewed by FERC staff in order to ensure that the final design addresses the requirements identified in the FEED. Therefore, **we recommend that:**

- **Cameron LNG should file with the Secretary of the Commission (Secretary) the following information, stamped and sealed by a professional engineer-of-record licensed in Louisiana:**

  a. quality control procedures that will be used for design and construction prior to initial site preparation.
  b. site preparation drawings and specifications prior to construction of the final design;
  c. LNG storage tank and foundation design drawings and calculations prior to construction of the final design;
  d. LNG liquefaction structures and foundation design drawings and calculations prior to their construction of the final design; and
  e. seismic specifications used in conjunction with the procuring equipment prior to construction of the final design.

  In addition, Cameron LNG should file, in its Implementation Plan, the schedule for producing this information.

2.1.3 Natural Hazards

Geologic hazards that could potentially affect the Expansion Project site include earthquake ground motions and faulting, soil liquefaction, landslides, and subsidence. Other natural hazards of concern include hurricane winds as well as storm surge-related flooding.

Earthquake Ground Motions and Liquefaction

The proposed Expansion Project is in an area of low seismicity. Earthquakes have occurred in Louisiana, but their occurrence has been infrequent, with most having a magnitude too low to be felt by people or to have caused serious damage to property or structures (U.S. Geological Survey [USGS], 2001).

The expected peak ground acceleration in the Expansion Project area on rock site conditions, expressed as a percentage of the acceleration of gravity, is 4 percent for a 10 percent probability of exceedance in 50 years and 4 percent for a 2 percent probability of exceedance in 50 years (USGS, 2008). These peak ground accelerations for rock sites can be amplified by factors of two or more on soft soil sites, which are typical of those in the vicinity of the Expansion Project.

The seismic design of the Expansion Project's Category I items, including the new LNG tank, are based on site-specific Safe Shutdown Earthquake (SSE) and Operating Basis Earthquake (OBE) ground motions developed by Fugro (2012c). The site-specific SSE is a ground motion which has a 2 percent probability of exceedance in 50 years while the OBE has a 10 percent probability of exceedance in 50 years. The site-specific peak ground and spectral acceleration values of the SSE and OBE are provided in table 2.1-1.

TABLE 2.1-1

Probability of Seismic Hazards at the Expansion Project[(a)]

Probability/Return Period	Peak Ground Acceleration (g)	Spectral Acceleration at 0.2 Second (g)	Spectral Acceleration at 1 Second (g)
10 percent in 50/475 years	0.041	0.121	0.072
2 percent in 50 /2475 years	0.121	0.292	0.230

(a) From Tables 4.2-2b and 4.2-3b of Fugro (2015b) Maximum Rotated Component for Train 4 and Tank T-205.
g = acceleration of gravity

The facility structures and systems, other than the LNG tank and associated safety systems, are being designed to the seismic design ground motion as specified in ASCE 7-05.

Fugro (2015b) performed a site-specific Probabilistic Seismic Hazard Analysis for the Expansion Project to determine the ". . . location, size, and resulting shaking intensity of future earthquakes . . ." and ". . . [a] description of the distribution of future shaking that may occur at a site" based on Baker (2008). The results of the analysis are presented in table 2.1-1. The predicted ground accelerations are relatively low compared to other locations in the United States.

While some soils and surficial sediments within the Expansion Project are susceptible to liquefaction, the low peak ground acceleration indicates a low liquefaction potential. Therefore, earthquakes and liquefaction are not likely to affect construction or operation of the Expansion Project.

Faulting

A detailed geologic fault detection study (Fugro, 2015c) was submitted by Cameron LNG to document the presence/absence of surface faulting at the site. Based on the study, it was concluded that there are no surface faults present at the terminal site, even though areas in close proximity of the Hackberry Salt Dome have a higher risk for surface faulting (i.e., radial faults extending from the dome) and the project is proximal to the coast (i.e., regional faults trending approximately parallel to the coast). We conclude that faulting is not likely to affect construction or operation of the Expansion Project.

Ground Subsidence

Subsidence is downward movement of near-surface material as a result of geologic or manmade-induced processes. Typical causes of localized subsidence include karst-related voids or sinkholes, underground mines, groundwater or other subsurface gas or fluid withdrawal, and dewatering and resettlement of recent deposits. There are no karst features within the Expansion Project site. All key Expansion Project facilities would be installed on piles at depths such that the facilities would not be susceptible to subsidence, as described in section 2.1.2 of this EA. Additionally, Cameron LNG would monitor foundations and other critical facilities to ensure that they remain within acceptable limits. We conclude subsidence is not likely to affect construction or operation of the Expansion Project.

Landslides

The ground surface in this part of the gulf coast region is relatively flat with very little grade change. Therefore, landslides are not expected on or in the area of the Expansion Project.

Wind

The Expansion Project would be designed to satisfy the design wind speed requirements in 49 CFR 193.2067; therefore, we do not consider that construction or operation of the Expansion Project would be significantly impacted by wind speed.

Flooding

Cameron LNG considered the potential threat of storm surge associated with hurricane winds in its facility design. The Expansion Project's Storm Surge Study (Moffat and Nichol 2012) indicated that the 500-year still water level with sea level rise for the Expansion Project site is 12.4 feet amsl. Sea level rise includes subsidence and global sea level rise of 0.5 foot over the 20 year design life of the facility. Based on this, the minimum point of support elevation for equipment would be set at 12.5 feet amsl, and the LNG tank T-205 top of pile cap elevation will be set at 14.0 feet amsl.

The proposed Expansion Project site is subject to flooding from hurricanes, tropical storms, and other weather systems. Cameron LNG's design considers a hurricane storm surge with a 500-year return period. When subsidence and the rise in sea level are considered, the resulting design elevation to be resisted is several feet greater than the 100-

year base flood map elevations provided in the Federal Emergency Management Agency Flood Risk Insurance Maps.

We conclude that construction and operation of the Expansion Project would not likely be adversely affected by flooding.

2.2 Water Resources, Fisheries, and Wildlife

2.2.1 Water Resources

Groundwater

Geographic Information System (GIS) electronic records obtained from the LDNR Strategic Online Natural Resources Information System (SONRIS) and review of the Louisiana Groundwater Law indicated that the previously authorized Cameron LNG Terminal site was not within an "Area of Groundwater Concern" or "Critical Area of Groundwater Concern" (LDNR, 2012). The Expansion Project would be wholly within the limits of the LNG Terminal site and utilize the same groundwater sources.

There are no springs within 150 feet of the proposed construction area. No blasting activities are anticipated during construction.

Local surficial groundwater sources consist of discontinuous beds of sand near the surface, which provide small quantities of groundwater for domestic use. Depth to groundwater within the Cameron and Calcasieu Parish surficial water bearing zones typically ranges from 2 to 10 feet with water-bearing zones being present at roughly 10, 20, and 50 feet, depending on local geology. Permeability within the surficial geology varies, but is less than that of the Chicot Aquifer (USGS, 1998).

There are a total of three water wells (1 active, 1 inactive, 1 abandoned) on the Cameron LNG Terminal site and would be within 150 feet of the Expansion Project (LDNR, 2012). Two of these wells were drilled for use during the construction of the original LNG Terminal. One well is active and would be used during construction of the Expansion Project, the other has been plugged and abandoned. The third well (number 019-51042) within the LNG Terminal site is an inactive domestic water supply well, as described in LDEQ records, previously drawing water from the 200-foot sand of the Lake Charles Area.

During construction of the Expansion Project, water would be supplied from the existing on-site water well described above, totaling approximately 68.5 million gallons of water. Approximate water use would be as follows:

- 30 million gallons for hydrostatic testing of the LNG storage tank;
- 10 million gallons for hydrostatic testing of the piping;
- 28 million gallons for dust control; and
- 560 thousand gallons for the concrete batch plant operations.

No chemicals would be added to the hydrostatic test water before or after testing. All hydrostatic test water would be sampled, tested, and discharged in accordance with Louisiana General Permit LAG67000 for discharge of hydrostatic test wastewater discharges. As allowed by permit, discharges would be either through internal or external outfalls. All test water discharges would be conducted in accordance with the Cameron LNG Environmental Plan. We conclude that effects from hydrostatic testing at the LNG Terminal would be negligible and temporary.

There are a total of two water wells (1 active, 1 abandoned) on properties adjacent to the existing LNG Terminal. These wells (numbers 023-216 and 023-217) are part of a rural public water supply system operated by Cameron Parish Waterworks, Water Supply District 10. Well 023-217 is an active well drawing water from the 500-foot sand of the Lake Charles Area. Well 023-216 is an abandoned well installed by the Water Supply District as a test hole for well number 023-217. Both wells are in a small fenced parcel of property owned by Cameron Parish Waterworks that is bound on three sides by the existing Cameron LNG Terminal property. These wells are not within 150 feet of Expansion Project construction activities.

No significant impacts are expected to occur on groundwater resources from construction or operation of the Expansion Project. Potential impacts on groundwater resources would be avoided or minimized by the use of both standard and specialized construction techniques. Specifically, with regard to the Cameron Parish Waterworks well, Cameron LNG would not conduct construction activities within 150 feet of this well. In addition, no refueling activities would be allowed within 400 feet of the well.

Some groundwater withdrawals (such as dewatering for foundation construction) would be required, but these withdrawals would only potentially affect the surficial aquifer and not the deeper aquifers that are used for potable water supply. No significant withdrawals from the surficial aquifer would be required for the operation or maintenance of the Expansion Project. Therefore, we do not anticipate the Expansion Project to permanently affect the surficial aquifer.

No adverse effects on groundwater resources are anticipated from the placement of foundations for the Expansion Project facilities. The deepest structures for the Expansion Project would be the piles used for the LNG storage tank (T-205). The outer piles would be driven to a depth of approximately 110 feet and the inner piles to a depth of 95 feet. These piles and all other foundations and piles would be above the water table of the shallowest aquifer, the 200-foot sand aquifer.

If contaminated groundwater is encountered, Cameron LNG would immediately discontinue any activities that may be using such water and any activities which could potentially be causing contamination. Cameron LNG would investigate the situation to determine if construction activities are the cause of the contamination and would properly dispose of any water collected at a state approved facility.

No significant groundwater drawdowns from the deeper aquifers (200-foot and 500-foot sand aquifers) are anticipated due to the use of the on-site well for the hydrostatic testing or dust control, as none were observed by Cameron LNG during the hydrostatic testing of the three previously constructed LNG storage tanks.

Water supply to the Cameron LNG Terminal for operations is through an existing 10-inch-diameter pipeline from the City of Hackberry. The same water supply would be used for operations of the Expansion Project.

Cameron LNG would use its Spill Prevention Control and Countermeasures Plan (SPCC Plan) during construction and operation of the Expansion Project to prevent spills, leaks, or other releases of hazardous materials that could adversely impact groundwater quality from entering groundwater. We conclude that Cameron LNG's proposed mitigation, and use of the Cameron LNG SPCC Plan would minimize effects on groundwater from construction and operation of the Expansion Project. Cameron LNG's SPCC Plan is contained within the Environmental Plan.

Surface Water

The Expansion Project facilities would be constructed completely within the existing LNG Terminal site but away from the perimeter edges. No additional work would be conducted to maintain the marine basin or the construction dock at the LNG Terminal site; therefore, construction activities would not directly affect the Calcasieu River-Calcasieu Ship Channel. Land disturbing activities required for the construction of the Expansion Project would be confined to the existing graded portions of the existing Cameron LNG Terminal site with no grubbing or clearing and minimal grading and soil disturbance to raise the surface elevations under some proposed aboveground structures. Cameron LNG would implement its Environmental Plan to minimize the impacts of erosion and sedimentation on surface waters. Accordingly, Cameron LNG would install erosion and sedimentation control structures as needed.

Cameron LNG would implement its SPCC Plan during construction to prevent spills, leaks, or other releases of hazardous materials from adversely impacting water quality. No additional stormwater accumulation or stormwater outfalls would be required. Stormwater and other discharges from operation of the LNG Terminal would be in accordance with the existing Cameron LNG Terminal's Louisiana Pollutant Discharge Elimination System permit for stormwater and industrial wastewater.

The number of ships traveling to and from the existing LNG Terminal would not increase beyond the number of vessels previously approved by the USCG for the existing terminal. No increase in ballast or cooling water intake or discharge is expected.

Barge traffic would be consistent with the existing construction traffic at the LNG Terminal to and from the construction dock and would be associated with the transportation of construction equipment and supplies. Barge traffic would occur primarily during the construction period and would have only temporary effects, which may include suspension of sediment from tug propeller wash or unintentional groundings in the dock area.

We conclude there would be no significant impacts on or modifications of surface water quality due to temporary barge traffic, or overall Expansion Project construction and operation.

Floodplain Management

Executive Order (EO) 11988: Floodplain Management requires federal agencies to avoid adverse effects on the 100-year floodplain, when possible. The Expansion Project would not be constructed within a 100-year floodplain. In addition, Cameron LNG would use and maintain appropriate erosion and sedimentation measures to prevent the movement of disturbed materials off the right-of-way. These measures would minimize impacts on adjacent floodplains. We conclude that construction and operation of the Expansion Project would comply with EO 11988.

2.2.2 Fisheries

There are no waterbodies within the existing Cameron LNG Terminal, although the terminal is adjacent to the Calcasieu River-Ship Channel. It is classified as a warm water marine or estuarine waterbody. While there would be no direct in-water impacts associated with the Expansion Project, a temporary increase in barge traffic to and from the construction dock (consistent with the barge traffic associated with the Liquefaction Project) would be associated with the transportation of construction equipment and supplies. While barge traffic may temporarily increase disturbance to the water column and disturb sediment in the vicinity of the construction dock, these impacts are consistent with the active shipping areas.

The number and size of LNG ships traveling to and from the existing Cameron LNG Terminal would not increase beyond what is currently authorized.

After testing, hydrostatic test water would be discharged in accordance with LDEQ permit conditions and Cameron LNG's Environmental Plan. Impacts associated with hydrostatic testing are expected to be temporary and negligible.

Based on the characteristics of the identified fisheries, our review of hydrostatic test water withdrawal and discharge methods, and implementation of impact minimization methods (e.g., installation of erosion controls to keep sediment on-site), we have determined that constructing and operating the Expansion Project would not significantly affect fisheries.

2.2.3 Wildlife

Impacts on wildlife from construction of the Expansion Project would be temporary and considered not significant because construction would occur within the disturbed/graveled and mostly fenced LNG Terminal site. The existing disturbance and constructed fence would exclude wildlife from the project area. The Expansion Project would add additional light and noise to the LNG Terminal, but the amounts would not be appreciable. Mobile wildlife species could be temporarily displaced from adjacent to the Expansion Project to surrounding habitats. However, similar habitats as those adjacent to the Expansion Project are plentiful in coastal Louisiana. Therefore, there is an abundance of suitable habitat for wildlife species. Because of the minimal impacts on habitat, we conclude that the Expansion Project would not significantly affect wildlife.

Migratory Birds

Migratory birds are protected under the Migratory Bird Treaty Act of 1918 ([MBTA] -16 U.S. C.703-711) and Bald and Golden Eagles are additionally protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d). EO 13186 (66 Federal Register 3853) directs federal agencies to identify where unintentional take is likely to have a measurable negative effect on migratory bird populations and to avoid or minimize adverse impacts on migratory birds through enhanced collaboration with the U.S. Fish and Wildlife Service (FWS). EO 13186 states that emphasis should be placed on special species of concern, priority habitats, and key risk factors, and that particular focus should be given to addressing population-level impacts.

As the Expansion Project site is graded and graveled, there is minimal migratory bird habitat at the site. Further, Cameron LNG received concurrence from FWS for the Expansion Project that no mitigation for migratory birds was required for the Expansion Project. Therefore, we conclude impacts on migratory birds would be minimal and not significant.

2.2.4 Special Status Species

Federal agencies are required by Section 7 of the Endangered Species Act (ESA) to consult with the FWS and National Marine Fisheries Service (NMFS) to ensure that any action they authorize, fund, or carry out would not jeopardize the continued existence of a federally listed threatened or endangered species, its critical habitat, or species proposed for listing. As the lead federal agency, the FERC is responsible for the Section 7 consultation with the FWS and NMFS. Cameron LNG, acting as FERC's non-federal representative, conducted informal consultations with the FWS and NMFS about species under their jurisdictions that would be potentially affected by the Expansion Project. In addition, Cameron LNG also consulted with the LDWF.

Through consultation with the FWS, Lafayette Office, and the LDWF, ten federally listed species were identified as potentially occurring in the Expansion Project area. These species include five federally listed endangered species (red-cockaded woodpecker, West Indian manatee, hawksbill sea turtle, leatherback turtle, Kemp's Ridley sea turtle), four federally listed threatened species (gulf sturgeon, piping plover, green sea turtle, loggerhead sea turtle), and one federal candidate species (Sprague's pipit). Table 2.2-1 lists the special status wildlife species that may occur in the Expansion Project area and the potential effects the Expansion Project poses to each species.

The Expansion Project would be constructed entirely within the Cameron LNG Terminal site. The Louisiana Natural Heritage Program (LNHP) previously provided concurrence, on September 25, 2012, indicating that based on review of their database, no impacts on rare, threatened, or endangered species or critical habitats are anticipated for the Liquefaction Project. Based on the proposed location of the Expansion Project activities (existing graveled area) and that there is no suitable habitat for any of the identified species, we conclude that the Expansion Project would have *no effect* on any federally listed species. Therefore, our ESA consultation is complete.

TABLE 2.2-1 Federal and State-Listed Species Potentially Occurring in the Project Area				
Common Name	**Federal Status**	**State Status**	**Suitable Habitat**	**Effects**
Fish				
Gulf Sturgeon	Threatened	Threatened	No Suitable Habitat	*No Effect*
Birds				
Piping Plover	Threatened	Threatened/ Endangered	No Suitable Habitat	*No Effect*
Red-cockaded Woodpecker	Endangered	Endangered	No Suitable Habitat	*No Effect*
Sprague's Pipit	Candidate	Not Listed	No Suitable Habitat	*No Effect*
Mammal				
West Indian Manatee	Endangered	Endangered	No Suitable Habitat	*No Effect*
Reptiles				
Hawksbill Sea Turtle	Endangered	Endangered	No Suitable Habitat	*No Effect*
Green Sea Turtle	Threatened	Threatened	No Suitable Habitat	*No Effect*
Leatherback Turtle	Endangered	Endangered	No Suitable Habitat	*No Effect*
Kemps' Ridley Sea Turtle	Endangered	Endangered	No Suitable Habitat	*No Effect*
Loggerhead Turtle	Threatened	Threatened	No Suitable Habitat	*No Effect*

2.3 Land Use, Recreation, and Visual Resources

2.3.1 Land Use

The Expansion Project would affect 141 acres during construction and 60 acres during operations, all entirely within Cameron LNG Terminal site. The land use within the Cameron LNG Terminal site is classified as Industrial, High Intensity.

<u>Coastal Zone Management</u>

Section 307(c) (3) of the Coastal Zone Management Act requires that all federally licensed and permitted activities be consistent with approved state Coastal Zone Management Programs. The LDNR's OCM, administers the state's Coastal Zone Management Program and is the lead state agency that performs federal consistency reviews. The Expansion Project is within the coastal zone boundary, which is defined by the area south of the Gulf Intracoastal Waterway with the exception of areas above the 5-foot-contour. Although the Expansion Project facilities would be constructed in areas well above the five foot contour, the Expansion Project was designed and developed in consultation with LDNR and in compliance with Louisiana Coastal Zone consistency guidelines. On June 21, 2015, the LDNR OCM, Permits/Mitigation Division, issued an Amended Coastal Use Permit/Consistency Determination (P20121194) for the Expansion Project. Subsequently, the COE issued an amended Section 404 of the Clean Water Act Permit (MVN-2002-3266-WII) for the Expansion Project.

2.3.2 Recreation and Public Interest Areas

The Expansion Project would be within the footprint of the existing Cameron LNG Terminal site and would not cross public or conservation lands. The Creole Nature Trail, which is designated an All American Road and a Louisiana State Scenic Byway, includes the portion of LA 27 that passes along the west side of the existing Cameron LNG Terminal where the Expansion Project would be located. LA 27 would be the primary access for workers and material transport, and construction activities may delay or temporarily affect vehicular traffic during peak hours. Cameron LNG would implement their Traffic Management Plan[5] to alleviate congestion on LA 27. Because the Expansion Project would be within the existing Terminal site, and consistent with the visual characteristics of the LNG Terminal, we conclude that operational impacts on the Creole Nature Trail would be minimized.

Designated natural and recreational areas in the vicinity of the Expansion Project include the Sabine National Wildlife Refuge (about 8 miles south of Hackberry, Louisiana) and Cameron Prairie National Wildlife Refuge (about 25 miles southeast of Lake Charles, Louisiana). The nearest marina is about 2 miles to the south of the Liquefaction Project site, near Hackberry. Because of the distance to the proposed project, we conclude that construction and operation of the Expansion Project would not affect these recreational resources.

2.3.3 Visual Resources

The majority of the construction activities for the Expansion Project would take place concurrently with the activities for the Liquefaction Project and delay the end of construction by approximately 12 – 18 months. Construction of all facilities associated with the Expansion Project would result in temporary visual impacts on the immediate area consistent with that of the LNG Liquefaction Project. Therefore, the level of temporary (construction) visual impacts on the immediate area would remain essentially unchanged, but the duration of those visual impacts would be extended.

The construction of the Expansion Project's liquefaction Trains 4 and 5 and the new LNG storage tank (T-205) would result in a permanent change in the visual resources. However, construction would be within the Cameron LNG Terminal site that is already part of the visual environment. Liquefaction Trains 4 and 5 would be installed adjacent to liquefaction Trains 1 through 3, which are under construction at the Cameron LNG Terminal, and would be constructed and lit in the same manner. Intermittent views of the facility would be available to

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[5] Cameron LNG filed the Traffic Management Plan for the Cameron LNG Terminal Liquefaction Project under FERC Docket No. CP13-25-000 (Accession Number 20141031-5092).

boaters in the Calcasieu River- Ship Channel and motorists using LA 27. The visual impact of the construction and operation of the Expansion Project would be relatively minor because the Expansion Project would be within an existing, similar industrial facility and construction of liquefaction Trains 4 and 5 and the new LNG storage tank (T-205) would be consistent with the existing viewshed. Therefore, we do not believe there would be a significant visual resources impact.

2.4 Socioeconomics

Socioeconomics is an evaluation of the basic conditions (attributes and resources) associated with the human environment, particularly the population and economic activity within a region. This section addresses several different factors that could affect the quality of life and economy in the area surrounding the Expansion Project where employees might live, shop, and use public resources. These factors include public services such as fire, police, and medical facilities; educational facilities; and environmental justice. This analysis includes portions of Cameron and Calcasieu Parishes where construction would take place.

2.4.1 Population and Demographics

Table 2.4-1 provides a summary of selected population and demographic information for the area in and around the Expansion Project area.

TABLE 2.4-1

Existing Population and Demographics

State/ Parish	Population			Population Density (per square mile)	
	1990[a]	2000[a]	2014 (est.)[a]	2000[a][b]	2014[a][b]
Louisiana	4,219,976	4,468,976	4,649,676	103.4	107.6
Cameron	9,260	9,991	6,679	7.8	5.2
Calcasieu	168,134	183,577	197,204	172.5	185.4

(a) U.S. Census Bureau, State and County *Quick Facts*
(b) Persons per square mile, based on population and area size: Louisiana (43,203.9 sq. mi.), Calcasieu Parish (1063.7 sq. mi.), Cameron Parish (1,284.9 sq. mi).

2.4.2 Employment and Income

Table 2.4-2 provides a summary of selected employment and income statistics for the area in and around the Expansion Project site.

TABLE 2.4-2 Existing Socioeconomic Conditions				
State/ Parish	**Per Capita Income 2014 [(a)]**	**Labor Force 2014[(c)]**	**Unemployment Rate (percent) 2014 [(c)]**	**Top Major Industries 2013 [(b)]**
Louisiana	$24,442	2,159,000	6.4	1. Manufacturing 2. Construction
Cameron	$29,559	3,510	4.8	1. Sales & Office 2. Production & Transportation 3. Management & Professional
Calcasieu	$24,355	94,601	5.9	1. Management & Professional 2. Sales & Office Service

(a) U.S. Census Bureau, State and County *Quick Facts*
(b) Louisiana Works Department of Labor, *Louisiana Workforce at a Glance*
(c) U.S. Department of Labor, Bureau of Labor Statistics, *Local Unemployment Statistics, Labor Force Data by County 2014.*

2.4.3 Housing

With an increase in non-local workers during both construction and operation, housing becomes an important socioeconomic factor. Table 2.4-3 provides a summary of the housing characteristics for the area in and around the Expansion Project site.

TABLE 2.4-3 2013 Housing Characteristics in Affected Parishes[(a)]				
State/Parish	**Owner Occupied (percent)**	**Renter Occupied (percent)**	**Owner Vacancy Rate (percent)**	**Rental Vacancy Rate (percent)**
Louisiana	67.0	33.0	1.9	8.2
Cameron	90.0	10.0	3.6	10.3
Calcasieu	70.6	29.4	1.9	9.9

(a) U.S. Census Bureau; 2009-2013 American Community Survey 5-year Estimates, Selected Housing Characteristics, Table DP04; American Fact Finder; <http://factfinder2.census.gov>; (26 May 2015).

The Expansion Project would utilize the construction workforce hired for the ongoing Liquefaction Project. Cameron LNG anticipates adding about 90 permanent staff positions to operate the Expansion Project facilities.

Due to the adequate availability of housing in the Expansion Project area for both the construction and operational workforces and the fact that construction at the site would not be significantly increased from what is required for the ongoing Liquefaction Project, we conclude that no negative impacts on housing resources are anticipated during the construction or operation of the Expansion Project.

2.4.4 Public Services

This section describes the community and public services available within the Expansion Project, including schools, emergency response protocol and medical facilities, and fire and police protection.

Education and School System

Cameron Parish has five public schools with a 2013 enrollment of 1,279 (Louisiana Department of Education [LDE], 2014). There are 58 primary and secondary public schools in Calcasieu Parish, with a 2013 enrollment of 32,271 students (LDE, 2014). Based on the analysis completed for the Cameron LNG Liquefaction Project (Docket No. CP13-25-000), the Liquefaction Project will result in a 0.08-percent increase in school enrollment in these parishes. The Expansion Project would utilize the same construction workforce, so the impact on school enrollment would be a continuation of the Liquefaction Project. Based on current census data, the average family size in Calcasieu Parish is 2.57, and in Cameron Parish is 2.67 (U.S. Census Bureau, 2015a). Using a conservative estimate that the proposed additional 90 permanent operational employees for the Expansion Project do not currently live in the area and would have to relocate and that each family has 2 children, the result would be an additional 180 children to be accommodated by the parish school systems or a 0.5 percent increase in enrollment. Therefore, we conclude that impacts from the addition of 90 full-time workers on the local school system would be negligible.

Health Care

There is one hospital in Cameron Parish with a total of 33 beds (Louisiana Department of Health and Hospitals [LDHH], 2007) and ten hospitals located in Calcasieu Parish with a combined total of 1,540 beds (LDHH, 2007). Health care demands during the construction phase are expected to include emergency medical services to treat injuries resulting from construction accidents. Medical facilities within the Expansion Project area are sufficient to absorb any increase in demand by the temporary construction workforce, with minimal cost to the local governments. Ultimately, we conclude that impacts on the local hospitals would be minimal. The addition of about 90 full-time permanent workers at the Cameron LNG Terminal would have a negligible effect on hospitals.

Police and Fire Services

Cameron Parish has a sheriff's department and nine volunteer fire protection districts (Cameron Parish Police Jury, 2012). Calcasieu Parish has a sheriff's office, six police departments, and nine fire protection districts (Calcasieu Parish, 2012).

Construction-related demands on local agencies could include increased enforcement activities associated with issuing permits for vehicle load and width limits, local police assistance during construction at road crossings to facilitate traffic flow, and emergency medical services to treat injuries resulting from construction accidents. Police and fire departments within the Expansion Project area can absorb any increase in demand by the temporary construction workforce with minimal cost to the local governments. Further, the existing Cameron LNG Terminal has 24-hour on-site security, which would minimize reliance on local law enforcement. The existing LNG Terminal also has an on-site firewater pond and pumps with sufficient capacity to respond to fires. We conclude that construction of the Expansion Project would have only minor and temporary negative impacts on the local police and fire services. The addition of about 90 full-time permanent workers at the Cameron LNG Terminal would have a negligible effect on police and fire services.

2.4.5 Transportation

Existing public road, LA 27, would be used to transport construction equipment, materials, and workers to the Expansion Project site. LA 27 runs north-south adjacent to the west side of the Expansion Project site. The Expansion Project would utilize the already existing and approved entrances on LA 27 to the Cameron LNG Terminal. Parking for construction would be both at on-site and at off-site locations with bus transportation. Material deliveries to the site will occur throughout the construction phase. Off-site locations are existing graveled or paved areas that would require no upgrades.

Neel-Schaffer, Inc. conducted a traffic study of LA 27 adjacent to the Liquefaction Project site for the Liquefaction Project on April 24, 2013. That study was filed with the Commission on April 26, 2013, and a Traffic Management Plan was subsequently developed by Cameron LNG and filed with the Commission on October 30, 2014 (Docket No. CP13-25-000). In the Final Environmental Impact Statement prepared for the Liquefaction Project, we concluded that, with the implementation of the Traffic Management Plan, there would be no significant impacts on existing traffic conditions during construction or operation of the Liquefaction Project. The plan is currently in use for the Liquefaction Project and would be utilized for the Expansion Project.

Barges would deliver the majority of large equipment and materials, such as soil and rock fill, to the work dock during construction. This would reduce the number of truck trips to and from the Expansion Project site as well as the potential for damage to local roadways and traffic congestion. The Expansion Project would not significantly increase the barge traffic currently planned for the Liquefaction Project. Based on the insignificant increase in barge traffic and Cameron LNG's continued use of its approved Traffic Management Plan, we conclude that impacts on traffic would not be significant.

2.4.6 Environmental Justice

In 1994, EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, was issued to focus the attention of federal agencies on human health and environmental conditions in minority and low-income communities (The White House, 1994). In 1997, EO 13045, Protection of Children from Environmental Health Risks and Safety Risks, expanded the focus to include children populations. The EOs require that impacts on minority or low-income populations and children be taken into account when preparing environmental and socioeconomic analysis of projects or programs that are proposed, funded, or licensed by federal agencies.

The Expansion Project would be within the Cameron LNG Terminal site and not near any low-income or minority population areas. Therefore, there would not be any disproportionately high or adverse environmental and human health impacts on low-income and minority populations. During operation, the Expansion Project would have positive socioeconomic effects on minority and economically disadvantaged populations as well as the general population in the Expansion Project area through job creation, economic activity, and continuing tax payments. Construction and operation of the Expansion Project would not generate significant levels of air quality emissions (either nuisance or human health hazards) off-site. Additionally, no significant impacts on water quality or noise are expected to affect the health or welfare of the populations living in the Expansion Project area. The minor impacts that would occur would be temporary or similar to the existing noise conditions in the area (see section 2.6.2).

We conclude that construction and operation of the Expansion Project would not disproportionately affect any population group, and no environmental justice or protection of children issues would occur as a result of construction or operation of the Expansion Project.

2.5 Cultural Resources

All construction activities would take place in areas previously approved under Docket No. CP13-25-000. Cultural resources/Section 106 review and tribal consultation completed under that docket concluded that no historic properties would be affected.

Cameron LNG would implement the Unanticipated Discoveries Plan approved under Docket No. CP13-25-000. In addition, Cameron LNG re-contacted the Louisiana State Historic Preservation Office regarding the current Expansion Project activities. On July 17, 2015, the State Historic Preservation Office indicated that "no known historic properties will be affected by this undertaking." We agree.

2.6 Air Quality and Noise

2.6.1 Air Quality

Air quality would be affected by construction and operation of the Expansion Project. Although air emissions would be generated by equipment operations during construction of the Expansion Project, most air emissions associated with the Expansion Project would result from the long-term operation of liquefaction Trains 4 and 5 and associated facilities proposed by Cameron LNG.

Existing Environment

The general area of the Expansion Project has a modified marine climate which can be influenced by a predominant onshore flow of tropical marine air from the Gulf of Mexico. During onshore flow events, the area experiences a subtropical humid climate. In summer, sea breezes help decrease temperatures. Based on data from the National Climatic Data Center's Climatology of the United States No. 20 , which provides data from 1971 to 2000, maximum and minimum temperatures at the Port Arthur Airport in Beaumont, Texas (the data collection point that is closest to the proposed Expansion Project) usually occur in July and January, respectively (National Climatic Data Center, 2010).

Mean annual precipitation at the Port Arthur Airport is 59.9 inches, while monthly average precipitation is from 3.35 inches in February to 6.58 inches in June. Thunderstorms occur in the area approximately 60 days per year and the average annual snowfall is 0.3 inch.

Winds speeds in the area are generally around 9 miles per hour. Wind direction can vary by season; spring winds are from the south through southeast, summer winds are from the south and west-southwest; fall winds are from the north clockwise through south; and in winter, winds are from the north. Winds from the southwest through north-northwest are quite rare.

Ambient Air Quality

The EPA has established National Ambient Air Quality Standards (NAAQS) for seven air contaminants designated "criteria pollutants," which are nitrogen dioxide (NO_2), carbon monoxide (CO), ozone, sulfur dioxide (SO_2), lead, particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}), and particulate matter with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$). The NAAQS were established under the Clean Air Act of 1970, as amended in 1977 and 1990 (CAA), to protect human health (primary standards) and public welfare (secondary standards).

Each state is required to implement and enforce air quality control regulations, known as State Implementation Plans (SIP), to ensure that air quality in the state meets the NAAQS. Individual states are allowed to establish their own air quality standards; however, these standards cannot be less stringent than the NAAQS. Louisiana has established the LDEQ to administer its SIP. The current NAAQS and LDEQ standards for these criteria pollutants are summarized in table 2.6-1.

On December 7, 2009, the EPA defined air pollution to include six greenhouse gases (GHGs), CO_2, CH_4, nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, finding that the presence of these GHGs in at the atmosphere endangers public health and public welfare through climate change. As with any fossil-fuel fired project or activity, the Expansion Project would contribute GHG emissions. The principal GHGs that would be produced are CH_4, CO_2, and N_2O. No fluorinated gases would be emitted.

TABLE 2.6-1 National Ambient Air Quality Standards				
Air Contaminant	**NAAQS**		**LDEQ**	**Averaging Time**
	Primary	**Secondary**	**Primary**	
CO	35 ppm	NA	35 ppm	1-hour
	9 ppm	NA	9 ppm	8-hour
Pb	0.15 µg/m^3	0.15 µg/m^3	1.5 µg/m3	3-month (NAAQS) Calendar Quarter (LDEQ)
NO_2	100 ppb	NA	NA	1-hour
	53 ppb	53 ppb	0.05 ppm	Annual
O_3	0.075 ppm	0.075 ppm	0.08 ppm	8-hour
$PM_{2.5}$	35 µg/m^3	35 µg/m^3	35 µg/m^3	24-hour
	12 µg/m^3	15 µg/m^3	15 µg/m^3	Annual
PM_{10}	150 µg/m^3	150 µg/m^3	150 µg/m^3	24-hour
SO_2	75 ppb	NA	NA	1-hour
	NA	0.5 ppm	NA	3-hour
	NA	NA	0.14 ppm	24-hour
	NA	NA	0.03 ppm	Annual

Source: EPA 2014, LDEQ Title 33, Part III, Chapter 7, Section 711 (July 2014)

Abbreviations:

PM_{10} = particulate matter less than 10 microns
$PM_{2.5}$ = particulate matter less than 2.5 microns
SO_2 = sulfur dioxide
CO = carbon monoxide
NO_2 = nitrogen dioxide
O_3 = ozone
Pb = lead

NA = not applicable

mg = milligram(s)
µg = microgram(s)
m^3 = cubic meter(s)
ppm = part(s) per million
ppb = part(s) per billion

Emissions of GHGs are quantified in terms of carbon dioxide equivalents (CO_2e) by multiplying emissions of each GHG by its respective global warming potential (GWP). The GWP is a ratio relative to CO_2 that is based on the properties of a GHG's ability to absorb solar radiation as well as its residence time in the atmosphere. Thus, CO_2 has a GWP of 1, CH_4 has a GWP of 25, and N_2O has a GWP of 298.[6] To obtain the CO_2e quantity, the mass of the

[6] U.S. EPA, 40 CFR 98, Subpart A, 79 FR 73779, Dec 11, 2014.

particular chemical is multiplied by the corresponding GWP, the product of which is the CO_2e for that chemical. The CO_2e value for each of the GHG chemicals is summed to obtain the total CO_2e GHG emissions. There are no federal regulations at this time limiting the emissions of CO_2. Also, CO_2 reporting requirements for stationary sources do not apply to construction emissions. However, in compliance with EPA's definition of air pollution to include GHGs, we have provided estimates of GHG emissions for construction and operation, as discussed throughout this section. The EPA did not establish NAAQS for any listed GHGs as their impact is on a global basis and not a local/regional basis. Impacts from GHG emissions (climate change) are described in more detail in section 2.6.1.4.

Air Quality Control Regions (AQCR) were established in accordance with Section 107 of the CAA as a way to implement the CAA and to comply with the NAAQS through state implementation plans. The AQCRs are intra- and interstate regions such as large metropolitan areas where the improvement of the air quality in one portion of the AQCR requires emission reductions throughout the AQCR. Each AQCR, or portion thereof, is designated as attainment, unclassifiable, maintenance, or nonattainment for each of the six criteria pollutants. Areas where an ambient air pollutant concentration is determined to be below the applicable NAAQS are designated attainment. Areas where no data are available are designated unclassifiable and are treated as attainment areas for the purpose of permitting a stationary source of pollution. Areas where the ambient air concentration is greater than the applicable NAAQS are designated nonattainment. Areas that previously were designated nonattainment that are now meeting the NAAQS are designated maintenance for that pollutant. The Project area encompasses Cameron, Calcasieu, Beauregard, Allen, and Evangeline Parishes, all of which are classified as attainment for all six of the criteria pollutants.

Regulatory Requirements

The CAA is the basic federal statute governing air pollution. The provisions of the CAA that are potentially relevant to the Expansion Project include the following:

- Prevention of Significant Deterioration (PSD)/Nonattainment New Source Review;
- Title V Operating Permits;
- New Source Performance Standards;
- National Emission Standard for Hazardous Air Pollutants for Source Categories;
- General Conformity; and
- GHG Reporting Rule.

Prevention of Significant Deterioration/Nonattainment New Source Review

Separate procedures have been established for federal pre-construction review of certain large proposed projects in attainment areas versus nonattainment areas. Federal pre-construction review for affected sources in nonattainment areas is commonly referred to as Nonattainment New Source Review. This process is intended to keep new or modified major air emission sources from causing existing air quality to deteriorate beyond acceptable levels. Federal pre-construction review for affected sources in attainment areas is formally called the PSD. The

Cameron LNG Terminal is in an attainment area and is, therefore, potentially subject to PSD regulations.

The PSD regulations under 40 CFR 52.21 define a major source as any source type belonging to a list of 28 sources categories which emits or has the potential to emit 100 tons per year (tpy) or more of any pollutant regulated under the CAA, or any other source type which emits or has the potential to emit regulated pollutants in amounts greater than 250 tpy [40 CFR 52.21(b)]. The Expansion Project does not fall under a listed source category, but it is considered a major source because it has the potential to emit more than 250 tpy of a pollutant regulated under the CAA. Major source emission thresholds are included in table 2.6-2.

TABLE 2.6-2

Major Stationary Source/Major Modification Emission Thresholds for NAAQS Attainment Areas

Pollutant	Major Stationary Source Threshold Level (tons/year)	Major Modification Significant Net Increase (tons/year)
Ozone (as VOC or NO_x)	250	40
CO	250	100
SO_2	250	40
PM	250	25
PM_{10}	250	15
$PM_{2.5}$	250	10
Lead	250	0.6
GHG	100,000 tpy of CO_2e and 250 tpy of GHGs[a]	75,000 tpy of CO_2e and >0 tpy of GHGs [b]

[a] A facility is considered a major stationary source if the potential-to-emit is greater than 100,000 tons/year (tpy) of CO_2e and greater than 250 tpy of GHG (sum of six GHGs on a mass basis).
[b] A major modification must meet both conditions of greater than 75,000 tpy of CO_2e and exceed 0 tpy of GHG (sum of six GHGs on a mass basis).
NO_x : nitrogen oxides

There are three air quality classifications within each of the AQCRs of the U.S.: Class I areas are designated as pristine natural areas or areas of natural significance and receive special protections under the CAA based on good air quality. Class III areas are heavily-industrialized zones that are established only on request and must meet all requirements outlined in 40 CFR 51.166. The remainder of the U.S. is designated as Class II. If a new source or major modification of an existing source is subject to the PSD program requirements and is within 62 miles (100 kilometers [km]) of a Class I area, the facility is required to notify the appropriate federal officials and assess the impacts of the proposed project on the Class I area. The closest designated Class I area to the Cameron LNG Terminal is Breton National Wildlife Refuge, approximately 238 miles from the proposed site, and therefore a PSD Class I analysis is not required for the Expansion Project.

On May 13, 2010, the EPA issued the PSD GHG Tailoring Rule. After July 1, 2011, the PSD major source threshold of 100,000 tpy of CO_2e became effective for new sources. For existing PSD major sources, the threshold for a modification is 75,000 tpy CO_2e.

The Cameron LNG Terminal is an existing PSD major source, and the Expansion Project would be a major modification. As shown in table 2.6-2, the net emissions increase requires a PSD review for PM_{10}, $PM_{2.5,}$ NO_2, CO, and volatile organic compounds (VOCs). Cameron LNG filed its revised PSD permit application with the LDEQ in May 2015.

The May 2015 permit application addresses emissions associated with the two additional liquefaction trains and the new LNG storage tank (T-205) associated with the Expansion Project and updated permitted equipment for liquefaction Trains 1 through 3. Changes to liquefaction Trains 1 through 3 reflect updates to the engineering design basis for those units. The sum of the changes from the revised application are reflected in the emission totals shown in this section.

Table 2.6-3 provides a summary of the potential-to-emit as a result of the new equipment associated with the Expansion Project.

TABLE 2.6-3

Expansion Project Potential to Emit Summary

Emission Unit	Pollutant Emissions (tpy)						
	Nitrogen Oxides (NO_x)	CO	SO_2	PM_{10}	VOC	VOC TAPs	CO_2e
Refrigeration Compressor Turbines (4)	1023.82	623.28	3.24	146.08	35.02	19.53	2,178,200
Thermal Oxidizer CAP (Trains 4 & 5)	29.99	24.59	5.72	2.26	22.77	3.06	999,370
Low Pressure Flare	8.17	44.43	0.07	0.89	0.65	0.01	14,163
Ground Flare	10.84	58.99	0.10	1.19	4.45	0.34	19,652
Emergency Generators (3)	5.28	2.88	0.03	0.18	5.28	0.12	576
Emergency Fire Water Pumps (3)	0.45	0.39	0.03	0.03	0.45	0.12	78
Condensate Loading	-	-	-	-	0.89	-	-
Diesel Storage Tanks (2)	-	-	-	-	0.02	-	-
Fugitives	-	-	-	-	0.96	0.96	96
SSM Emissions	121.50	538.50	0.44	14.05	11.55	-	234,672
Total Facility	**1,200.05**	**1293.06**	**9.63**	**164.68**	**82.04**	**24.14**	**3,446,807**

NO_x : nitrogen oxides

Table 2.6-4 provides a summary of the total emissions for the existing Cameron LNG Terminal including the ongoing Liquefaction Project.

Facilities can trigger additional review by the EPA if emissions exceed the PSD major source thresholds and if project-associated emissions exceed the PSD significant emission rate for existing facilities defined as a PSD major source. The revised air permit application and addendum is still under LDEQ's review. Cameron LNG would be subject to the emissions limitations, monitoring requirements, and other conditions set forth in the permit.

On June 23, 2014 the U.S. Supreme Court issued a decision addressing the application of stationary source permitting requirements to GHG. The Supreme Court stated that the EPA may not treat GHG as an air pollutant for purposes of determining whether a source is a major source required to obtain a PSD or Title V permit. The Supreme Court also stated that the EPA could continue to require PSD permits, otherwise required based on emissions of other criteria pollutants, containing limitations on GHG emissions based on the application of Best Available Control Technology (BACT). The EPA in its memorandum dated July 24, 2014, states that it intends to continue applying the PSD BACT requirement to GHG emissions if the source emits or has the potential to emit 75,000 tpy or more of GHG on a CO_2e basis.[7] Projected CO_2e emissions for the Expansion Project are above the 75,000 tpy CO_2e threshold; thus it is subject to the GHG BACT requirements that may be contained in its PSD permit.

TABLE 2.6-4

Existing Cameron LNG Terminal and Liquefaction Project Facilities Currently Authorized Facilities Emissions Summary

Emission Unit	Pollutant Emissions (tpy)						
	NO_x	CO	SO_2	PM_{10}	VOC	VOC TAPs	CO_2e
Submerged Combustion Vaporizer CAP	230.0	182.65	3.16	33.60	24.32	0.37	527,665
Fuel Gas Heater	1.40	0.88	0.01	0.12	0.09	0.04	1,947
Emergency Generators (2)	3.08	1.68	0.02	0.10	3.08	0.08	334
Emergency Fire Water Pumps (3)	0.75	0.24	0.03	0.03	0.75	0.12	48
Emergency River Water Pumps (2)	0.26	0.12	0.02	0.02	0.26	0.08	18
Diesel Storage Tank	-	-	-	-	0.01	-	-
Fugitives	-	-	-	-	1.11	0.02	164

[7] U.S. EPA, "Next Steps and Preliminary Views on the Application of Clean Air Act Permitting Programs to Greenhouse Gases Following the Supreme' Court's Decision in the *Utility Air Regulatory Group v. Environmental Protection Agency"*, July 24, 2014.

TABLE 2.6-4

Existing Cameron LNG Terminal and Liquefaction Project Facilities Currently Authorized Facilities Emissions Summary

Emission Unit	Pollutant Emissions (tpy)						
	NO_x	CO	SO_2	PM_{10}	VOC	VOC TAPs	CO_2e
Flare	12.19	66.31	0.11	1.34	0.97	0.01	21,279
Refrigeration Compressor Turbines (6)	1,535.73	934.92	4.86	219.12	52.53	29.30	3,267,300
Thermal Oxidizer CAP	44.98	36.89	8.59	3.37	34.15	4.58	1,499,055
Ground Flare	16.26	88.48	0.14	1.78	6.67	0.52	29,478
Emergency Generators (3)	5.28	2.88	.03	0.18	5.28	0.12	576
Emergency Fire Water Pumps (3)	0.45	0.39	0.03	0.03	0.45	0.12	78
Emergency River Water Pumps (2)	0.30	0.26	0.02	0.02	0.30	0.08	52
Condensate Loading	-	-	-	-	1.33	-	-
Fugitives (Trains 1-3)	-	-	-	-	1.44	1.43	144
SSM Emissions	121.50	538.50	0.44	14.05	11.55	-	234,672
Total Facility	**1,972.18**	**1,854.20**	**17.46**	**273.76**	**144.29**	**36.88**	**5,582,810**

NO_x : nitrogen oxides

Title V Operating Permit

The Title V Operating Permit program requires major stationary sources of air emissions to obtain an operating permit within one year of initial facility startup. The major source threshold levels for determining the need for a Title V Operating Permit are a potential to emit 100 tpy or more of any criteria pollutant, 10 tpy of any individual Hazardous Air Pollutant (HAP), or 25 tpy of any combination of HAPs.

On May 13, 2010, the EPA issued the GHG Tailoring Rule to address the inclusion of GHG emission into the PSD and Title V permitting programs. The EPA currently believes it is still appropriate for a Title V permit to incorporate and assure compliance with GHG BACT limits that remain applicable requirements under a PSD permit issued to a facility.

The Cameron LNG Terminal is considered an existing Title V major source and currently operates under Title V permit number 0560-00184-V6 issued by the LDEQ on June 26, 2014. The permit includes provisions allowing operation as both an export and import facility, with no restrictions on simultaneous operation of export and import equipment (i.e., bi-directional operation). Cameron LNG applied to the LDEQ to modify its existing Title V permit to include the facilities associated with the Expansion Project and submitted a Major Modification Application in May 2015.

New Source Performance Standards

The New Source Performance Standards (NSPS) include emission limits, monitoring, reporting, and record keeping for new or significantly modified sources. The following NSPS requirements were identified as potentially applicable to the Expansion Project.

Condensate Storage Tanks - NSPS Subpart Kb, "Standards of Performance for Volatile Organic Liquid Storage Vessels, (Including Petroleum Liquid Storage Vessels)" applies to storage vessels that are constructed, reconstructed, or modified after July 23, 1984, with a capacity more than 75 cubic meters (19,800 gallons) that store volatile organic liquids. Therefore, the condensate storage tanks are required to comply with NSPS Subpart Kb. Cameron LNG states that it would comply with NSPS Subpart Kb.

Emergency Generators, Emergency Fire Water Pumps, and Emergency River Water Pumps - NSPS Subpart IIII, "Standards of Performance for Stationary Compression Ignition Internal Combustion Engines", applies to certain stationary compression ignition internal combustion engines (ICE). The Expansion Project includes three standby generator diesel engines and three emergency fire water pumps which would be subject to Subpart IIII. These engines must meet the applicable emission standards in effect for the model year and type of engine installed. Cameron LNG states it would comply with the emission and monitoring limitations of Subpart IIII. Additionally, Subpart IIII limits operation of emergency stationary ICE for the purpose of maintenance checks and readiness testing to 100 hours per year unless operation beyond 100 hours per year is required by other federal, state, or local standards. NSPS Subpart JJJJ, "Standards of Performance for Stationary Spark Ignition Internal Combustion Engines (ICEs)," does not apply to the Expansion Project because no spark ignition engines would be installed.

Refrigeration Compression Turbines - NSPS Subpart KKKK, "Standards of Performance for Stationary Combustion Turbines," applies to manufacturers and owner/operators of gas turbines manufactured after the applicability date stated in the rule for the particular type and size gas turbine. Subpart KKKK regulates emissions of nitrogen oxides (NO_x) and SO_2. The proposed gas turbines to drive refrigeration compressors and electrical generators would be subject to NSPS Subpart KKKK. The turbines at both locations must meet the applicable emission limits and operational requirements, as well as the record-keeping and reporting requirements of this subpart.

All NSPS requirements would be defined in the PSD and Title V air permits issued by LDEQ for the Cameron LNG Terminal.

National Emission Standards for Hazardous Air Pollutants

The National Emission Standards for Hazardous Air Pollutants (NESHAP), codified in 40 CFR 61 and 63, regulate the emissions of HAPs from existing and new sources. Part 61 was promulgated prior to the 1990 CAA Amendments and regulates eight types of hazardous substances: asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. The Expansion Project will not operate processes that are regulated by Part 61.

The 1990 CAA Amendments established a list of 189 HAPs, resulting in the promulgation of Part 63. Part 63, also known as the Maximum Achievable Control Technology standards, regulates HAP emissions from major sources of HAP emissions, and specific source categories that emit HAPs. Some NESHAP standards may apply to non-major sources (area sources) of HAPs. The major source thresholds for the purpose of NESHAP applicability are 10 tpy of any single HAP or 25 tpy of all HAPs in aggregate. The existing Cameron LNG Terminal (export facilities and liquefaction Trains 1 through 3) is a major HAP emitter. The existing LNG Terminal would continue to be a major source of HAP emissions after completion of the Expansion Project.

NESHAP standards for marine tank vessel-loading operations were promulgated under Subpart Y and apply to marine vessel loading operations at facilities that are considered major sources of HAPs. Although the Expansion Project would be considered a major source of HAPs, this subpart does not apply to emissions resulting from marine tank vessel-loading operations of commodities with vapor pressures less than 10.3 kilopascals at standard conditions. Therefore, this subpart does not apply to the Expansion Project.

NESHAP standards for stationary combustion turbines (such as refrigeration compression turbines) were promulgated under Subpart YYYY. The natural gas-fired refrigeration compressor turbines proposed for the Expansion Project qualify as new stationary combustion turbines under Subpart YYYY. The EPA issued a stay of standards for natural gas-fired units; therefore, the units are only required to comply with the initial notification requirements set forth in section 63.6145.

NESHAP for reciprocating internal combustion engines (RICE) were promulgated under subpart ZZZZ. The Expansion Project would have emergency generators, emergency fire water pumps, and emergency river water pumps, all of which are classified as RICE. Subpart ZZZZ exempts new emergency stationary RICE that are subject to NSPS Subpart IIII, as long as the RICE has a site rating of less than or equal to 500 brake horsepower (BHP). The three fire water pumps would be rated at 460 BHP, less than 500 BHP, and therefore, exempt from the requirements of subpart ZZZZ, including initial notification. The three emergency generators are also subject to NSPS subpart IIII, but with ratings of 3,353 BHP each, cannot take the exemption and must meet the requirements of subpart ZZZZ.

General Conformity

The General Conformity Rule was designed to require federal agencies to ensure that federally-funded or federally-approved projects conform to the applicable SIP. Section 176(c) of the CAA prohibits federal actions in nonattainment or PSD maintenance areas that do not conform to the SIP for the attainment and maintenance of NAAQS. General Conformity regulations apply to project-wide emissions of pollutants for which the project areas are designated as nonattainment (or, for ozone, its regulated precursor emission NO_x and VOC) that are not subject to Nonattainment New Source Review and that are greater than the significance thresholds established in the General Conformity regulations, or 10 percent of the total emissions budget for the entire nonattainment area. Federal agencies are able to make a positive conformity determination for a proposed project if any of several criteria in the General Conformity Rule are met. These criteria include:

- emissions from the project that are specifically identified and accounted for in the SIP attainment or maintenance demonstration; or
- emissions from the action that are fully offset within the same area through a revision to the SIP, or a similarly enforceable measure that creates emissions reductions so there is no net increase in emissions of that pollutant.

The Expansion Project is within an attainment area; therefore, General Conformity would not apply for construction of the Project. Similarly, operating emissions from the expanded Cameron LNG Terminal would occur entirely within an attainment area and would be subject to PSD permitting, and therefore, are not subject to General Conformity Regulations. Cameron LNG, however, stated that some tug vessel and barge transport used to deliver equipment and materials during construction of the Project would originate at the Port of Houston, which is in Houston-Galveston-Brazoria, Texas, 8-hour severe attainment area. Construction emissions, including barge/vessel transport, would be subject to General Conformity Regulations for any emissions that occur in the Beaumont-Port Arthur ozone maintenance area or the Houston-Galveston-Brazoria non-attainment area. Vessels would impact the Beaumont-Port Arthur area when traveling through Jefferson and Orange Counties, Texas when traveling to and from the Port of Houston. Vessels/Barges traveling along the Gulf Intracoastal Waterway in Louisiana would remain outside of the Baton Rouge nonattainment area (i.e., the parishes of Ascension, East Baton Rouge, Iberville, Livingston, and West Baton Rouge). Cameron LNG's vessel/barge emissions estimates within the nonattainment and maintenance areas are provided in table 2.6-9 in section 2.6.1.4.

The maximum annual emission rates due to barge/vessel transport in the Houston-Galveston-Brazoria Area are below the *de minimis* emission rates for NO_x and VOCs of 25 tpy for severe ozone nonattainment areas. Similarly, the maximum annual emission rates due to construction in the Beaumont-Port Arthur Area are also below the *de minimis* emission rate for NO_x and VOCs of 100 tpy for moderate ozone maintenance areas. Therefore, the Expansion Project's construction emissions would be below the General Conformity Applicability threshold, and a General Conformity Determination is not required for the Expansion Project.

Greenhouse Gas Reporting Rule

In September 2009, EPA issued the final Mandatory Reporting of Greenhouse Gases Rule, requiring reporting of GHG emissions from suppliers of fossil fuels and facilities that emit greater than or equal to 25,000 metric tpy of GHG (reported as CO_2e). In November 2010, EPA signed a rule finalizing GHG reporting requirements for the petroleum and natural gas industry in 40 CFR 98, Subpart W. The industry separates LNG storage facilities from LNG import and export equipment because the former are considered part of the source category regulated by Subpart W. The rule does not apply to construction emissions.

The new facilities associated with the Expansion Project would potentially be subject to the GHG Mandatory Reporting Rule. The rule establishes reporting requirements based on actual emissions; however, it does not require emission controls. Cameron LNG would monitor emissions in accordance with the reporting rule. If actual emissions exceed the 25,000 tpy CO_2e reporting threshold, Cameron LNG would be required to report its GHG emissions to EPA.

EPA provided a comment recommending that FERC consider potential BMPs to reduce leakage of methane associated with operation of the Cameron LNG Terminal. The GHG emissions associated with the construction and the operation of the Expansion Project are identified here in this section. Cameron LNG prepared a GHG BACT analysis in its PSD permit has been performed for the LNG terminal; proposed GHG BACT for the LNG terminal includes use of low carbon fuels, combustion equipment (turbines, thermal oxidizers, emergency back-up and firewater pump engines) designed as operational energy efficient in accordance with the EPA GHG BACT guidance, and a leak detection and repair program for monitoring piping and storage tank components to limit the impact of methane emissions. Cameron LNG would need to comply with LDEQ's imposed conditions associated with any PSD permit that the LDEQ would issue, including BMPs for reducing methane leakages. With regard to specific mitigation technology, FERC staff defers to the agencies with particular technical expertise over the resource. In this case, the LDEQ has federally delegated authority to enforce the CAA and ensure that emission sources, such as the Cameron LNG Terminal, comply with the CAA.

Applicable State Air Quality Requirements

The LDEQ is the lead air permitting authority for the Cameron LNG Terminal. The Expansion Project must obtain an air quality permit prior to initiating construction. The Expansion Project facilities would be subject to state standards, codified in Louisiana Administrative Code, Title 33, Part III. Facilities also trigger review by other states if the project is within 50 miles of an adjacent state's border. The Cameron LNG Terminal is within 25 miles of the Texas state line; therefore, the TCEQ will have the opportunity to review and comment on the application and subsequent permits.

In addition to the federal regulations identified above, the state requirements potentially applicable to the Expansion Project are listed below.

- Chapter 5 – Permit Procedures applies to any operation which emits or has the potential to emit any air contaminant in the state of Louisiana.

- Chapter 9 – General Regulations on Control of Emissions and Emission Standards. This Chapter contains requirements to submit an air emissions inventory and report unauthorized discharges.
- Chapter 11 – Control of Air Pollution from Smoke establishes opacity limits for combustion units, prohibits open burning and impairment of visibility on public roads.
- Chapter 13 – Emission Standards for Particulate Matter apply to any operation, process, or activity from which PM is emitted and requires that all reasonable precautions be taken to minimize PM emissions from fugitive sources. Fuel burning equipment is limited to 0.6 pounds per 1 million British thermal units of PM emissions.
- Chapter 21 – Control of Emission of Organic Compounds, subchapter A, section 2111 requires that pumps and compressors handling VOCs with a true vapor pressure greater than 1.5 pounds per square inch absolute at handling conditions to be equipped with mechanical seals or other equivalent equipment approved by the administrative authority. Section 2113 requires best practical housekeeping and maintenance practices must be maintained at highest possible standards to minimize the quantity of organic compound emissions.
- Chapter 29 – Odor Regulations require that a facility be operated such that off-site odors do not cause a nuisance.
- Chapter 51 – The Comprehensive Toxic Air Pollutant Emission Control Program applies to major sources of toxic air pollutants. Operations at major sources subject to a Federal Maximum Achievable Control Technology standard are exempt; however, all other operations are included.
- Chapter 56 – Prevention of Air Pollution Emergency Episodes requires any person responsible for operation of a listed source to prepare a standby plan for the reduction of emissions, and activate the plan when LDEQ declares an Air Pollution Alert, Air Pollution Warning and Air Pollution Emergency.

Impacts and Mitigation

The Expansion Project would produce air pollutant emissions during construction and operation. Although many construction activities for the projects would be considered temporary, construction at the Cameron LNG Terminal would occur over a 4-year period (2016 to 2019) in one location. Following construction, air quality near the Cameron LNG Terminal would not revert to previous conditions but would transition to operational-phase emissions after commissioning and initial startup of liquefaction Trains 4 and 5.

Construction Emissions

Air emissions during the construction of the Expansion Project would consist of tailpipe emissions (due to fossil fuel combustion from equipment, vehicles, and vessels) and fugitive dust (ground and roadway dust).

The quantity of fugitive dust generated by construction-related activities depends on several factors, including the size of area disturbed, the nature and intensity of construction activity, surface properties (such as the silt and moisture content of the soil), wind speed, and the speed, weight, and volume of vehicular traffic. Cameron LNG would limit or mitigate fugitive dust emissions if necessary, by spraying water to dampen the surfaces of dry work areas and/or by the application of calcium chloride or other dust suppressants as needed. Table 2.6-5 provides estimates of fugitive dust emissions associated with construction activities and assumes a dust suppressant control efficiency of 50 percent.

TABLE 2.6-5

Construction Fugitive Dust Emissions From Expansion Project

Year	Land Affected (acres)	Duration (months)	PM_{10} (tons)	$PM_{2.5}$ (tons)
2016	141	6	34.95	3.59
2017	141	12	69.90	7.18
2018	141	12	69.90	7.18
2019	141	10	58.25	5.99

Note:
Emission factors used are most applicable to a semi-arid climate. The Expansion Project site is in a wetter marine climate; therefore, actual emissions are expected to be less than the calculated emissions.

Emissions of NO_x, CO, PM_{10}/$PM_{2.5}$, SO_2, VOCs, and GHGs from non-road equipment engines, on-road vehicles, and tugs were estimated for the Expansion Project construction activities. The estimates are based on the vehicles and equipment expected to be used. Emission factors for non-road construction equipment were obtained from the EPA NONROAD 2008 program. Tug vessels and barges used to deliver equipment and material during construction would originate from the Ports of New Orleans, Houston, and Lake Charles. Therefore, emissions from tug vessel and barge activity are included in the construction emission estimates. Emissions were estimated using the methods described in the EPA publication *Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories* (ICF International, April 2009) and travel distances obtained from the National Oceanic and Atmospheric Administration (NOAA) publication *Distances Between United States Ports, 12th Edition*.

Tables 2.6-6, 2.6-7, and 2.6-8 summarize the non-road construction equipment emissions, the on-road vehicle construction equipment, and the tug vessel emissions estimates by year for construction.

TABLE 2.6-6 Construction Emissions of Non-Road Construction Equipment							
Year	Annual Emissions (tons)						
	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2e
2016	32.16	59.77	0.07	5.35	3.43	3.43	10,510
2017	72.27	124.06	0.23	14.08	7.00	7.00	34,494
2018	56.05	92.08	0.21	12.41	4.85	4.85	32,652
2019	31.93	58.29	0.24	8.80	2.96	2.96	24,646

TABLE 2.6-7 Construction Worker and Materials Transport On-Road Vehicle Emissions							
Year	Annual Emissions (tons)						
	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2e
2016	21.42	12.87	0.06	0.95	0.56	0.54	5,994
2017	42.37	27.94	0.14	2.00	1.25	1.21	13,256
2018	38.89	21.41	0.13	1.56	0.90	0.87	12,254
2019	16.18	4.55	0.05	0.41	0.17	0.16	3,845

Construction activities would result in temporary emissions of air pollutants that would be restricted to the construction period. Construction equipment would be operated primarily on an as-needed basis during daylight hours. The emissions from gasoline and diesel engines would be minimized because the engines must be built to meet the standards for mobile sources established by the EPA mobile source emission regulations. The construction equipment would be powered by fossil fuel engines and would be equipped with typical control equipment. Once construction activities are completed, fugitive dust and construction equipment emissions would subside. In its comment letter, the EPA recommended that Cameron LNG be required to adopt certain mitigation measures as part of a Construction Emissions Mitigation Plan for construction of the project. Many of these mitigation measures included in EPA's comment letter, such as stabilizing disturbed soils and preventing soils from the construction workspaces onto public roads, are already included in Cameron LNG's Environmental Plan which incorporates FERC's Plan and Procedures. Based on the project's limited construction footprint all within the existing Cameron LNG Terminal and the mitigation measures included in Cameron LNG's Environmental Plan, we find that a separate Construction Emissions Mitigation Plan is not warranted.

TABLE 2.6-8 Tug Vessel Construction Equipment and Material Transport Emissions							
Year	**Annual Emissions (tons)**						
	CO	**NO_x**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2e**
Attainment / Unclassifiable Areas							
2016	18.37	96.66	9.96	2.07	2.40	2.40	5,350
2017	19.70	103.46	10.61	2.20	2.53	2.53	5,696
2018	3.32	17.40	1.77	0.37	0.42	0.42	951
2019	2.07	10.85	1.10	0.23	0.26	0.26	592
Houston-Galveston-Brazoria, TX 1-Hr O_3 Severe 17 / 8-Hr O_3 Standard Severe 15 Nonattainment Area							
2016	0.63	3.28	0.33	0.07	0.08	0.08	178
2017	1.15	6.01	0.61	0.13	0.14	0.14	326
2018	0.94	4.92	0.50	0.10	0.12	0.12	266
2019	0.58	3.01	0.30	0.06	0.07	0.07	163
Beaumont - Port Arthur, TX 1-Hr O_3 Serious / 8-Hr O_3 Moderate Nonattainment							
2016	0.29	1.50	0.15	0.03	0.04	0.04	81
2017	0.53	2.75	0.28	0.06	0.06	0.06	149
2018	0.43	2.25	0.23	0.05	0.05	0.05	122
2019	0.26	1.38	0.14	0.03	0.03	0.03	75

Operational Emissions

The Expansion Project includes the following stationary point sources of air pollutants for liquefaction Trains 4 and 5:

- four refrigeration turbines;
- two amine units controlled by a thermal oxidizer;
- three emergency generators;
- three emergency firewater pumps;
- one low pressure flare;
- one diesel storage tank;
- one condensate storage tank;
- condensate loading; and
- fugitive emission sources (valves, flanges, connectors, and pump seals).

Potential emissions for the Expansion Project are contained in table 2.6-3 and for the existing Cameron LNG Terminal (excluding the Expansion Project) in table 2.6-4. The existing Cameron LNG terminal consists of the original import terminal and liquefaction Trains 1 through 3. The emission data are based on the *Title V Major Modification/PSD Application* submitted by Cameron LNG to the LDEQ on May 14, 2015.

As part of the air permit application process for the Expansion Project, a BACT analysis was prepared for the stationary gas turbine and emergency engine emission sources. Methods for reducing emissions of NO_x, CO, $PM_{10}/PM_{2.5}$, and VOCs for each of these emission sources were evaluated based on technical feasibility.

Through this process and review by the LDEQ, Cameron LNG would reduce emissions of NO_x for the turbines by using dry-low NO_x combustion. Emission rates of CO and VOC would be maintained by using good combustion practices. Cameron LNG is proposing a $PM_{10}/PM_{2.5}$ BACT emission limitation of 7.6 x 10^{-3} pounds/million British terminal units based on manufacturer provided data for each proposed gas driven refrigeration compressor.

For the internal combustion engines, Cameron LNG is proposing the use of ultra-low sulfur fuel, good combustion practices, and compliance with NSPS subpart IIII as BACT for reducing NO_x, CO, and VOC emissions.

Air Modeling

A thorough examination of the potential impacts on air quality is necessary to evaluate the Expansion Project. An air quality modeling analysis that quantifies the impacts of the Expansion Project is required as part of the air quality permit application process and has been submitted. Therefore, we have used those analyses for our evaluation of the Expansion Project's stationary source impacts. The analyses included the following:

- preconstruction monitoring and significant impact analyses;
- cumulative impact analysis;
- additional impacts analysis; and
- Class I area analysis.

Dispersion Modeling

Dispersion modeling of operational emissions followed EPA PSD modeling requirements to evaluate potential air quality impacts within an area extending out to at least 50 kilometers from the facility. Dispersion modeling was performed using American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) version 14134 and various AERMOD system processors. Data sets input to this model include emission source parameter values (stack height and diameter, stack exhaust temperature and gas flow, and emission rate), building dimensions, receptor locations, terrain elevation data, and meteorological data.

Preconstruction Monitoring and Significant Impact Analyses

According to PSD rules, if a modeled result (i.e., maximum predicted ambient impact) does not exceed the applicable significant impact level (SIL), no additional modeling is required. If a modeled result exceed the applicable SIL, a full impact analysis, including the Expansion Project other nearby sources, is required.

For the preconstruction monitoring analysis, modeled results are compared to monitoring *de minimis* levels specified in the PSD regulation. If the modeled result exceeds the applicable monitoring *de minimis* level, then one year of preconstruction ambient air pollutant monitoring must be conducted for the applicable pollutant. If the modeled result does not exceed the *de minimis* level, preconstruction monitoring is not required.

The emissions of each pollutant proposed to be emitted above the significant emission rate defined in the PSD regulation (NO_x, CO, PM_{10}, and $PM_{2.5}$), were modeled to determine whether any of the predicted maximum ambient impacts were greater than the applicable SIL or monitoring *de minimis* concentration. Five years (2010 through 2014) of surface and upper air meteorological data from the Lake Charles, Louisiana station (National Weather Service Facility 03937) were used. The meteorological data was processed using the AERMET, AERMINUTE, and AERSURFACE programs. Boundary layer parameters required as input to AERMET using AERSURFACE were calculated based on the albedo, Bowen ratio, and surface roughness parameters. The rural dispersion coefficients were employed, and the Regulatory Default option was chosen (except for the 1-hour NO_2 analysis). The results are summarized in table 2.6-9, and show that only the 1-hour NO_2 predicted impact exceeds its associated SIL, and none of the predicted impacts exceed their associated monitoring *de minimis* levels. Therefore, a cumulative impacts analysis was required only for the 1-hour NO_2 NAAQS, and preconstruction monitoring of the ambient air quality was not required.

TABLE 2.6-9

Expansion Project Significant Impact Analysis Summary

Pollutant	Averaging Period	Year[1]	Predicted Impact (μg/m^3)	SIL (μg/m^3)	Monitoring *De Minimis* Level (μg/m^3)
CO	1-hour	2014	176	2,000	575
CO	8-hour	2010	70	500	NA
NO_2	1-hour	2010 - 2014	19.2	7.5	NA
NO_2	Annual	2011	0.65	1	14
PM_{10}	24-hour	2012	1.38	5	10
PM_{10}	Annual	2011	0.11	1	NA
$PM_{2.5}$	24-hour	2010 - 2014	1.07[2]	1.2	NA
$PM_{2.5}$	Annual	2011	0.11	0.3	NA

(1) Meteorological data year when the maximum impact was predicted to occur
(2) Includes primary and secondary $PM_{2.5}$

Cumulative Modeling Impact Analysis

A cumulative modeling impact analysis was performed for the 1-hour NO_2 NAAQS because the predicted 1-hour NO_2 impact exceeded its associated SIL. The key analysis assumptions were as follows:

- The plume volume molar ratio method was used to model atmospheric chemistry (i.e., the oxidation of NO to NO_2 during plume expansion) as an exhaust plume travels downwind. Five years (2010 through 2014) of ozone concentration data from the Carlyss, Louisiana and Vinton, Louisiana monitoring station were input to the model.
- For the refrigeration turbines, an NO_2/NO_x in-stack ratio of 0.15 was used based on data provided by the manufacturer, General Electric.
- Data for off-site sources were obtained from the LDEQ permit inventory.
- Background NO_2 concentration data from the Westlake, Louisiana monitoring station (located 23 kilometers from the Expansion Project) were added to the modeled NO_2 impacts in accordance with EPA guidance.[8] Based on this guidance, background data was input to the modeling runs by season and hour-of-day using the 3rd highest value for each season and hour-of-day combination.

Data for off-site sources were obtained from the LDEQ permit inventory, and adjusted as follows:

- Any source more than 10 kilometers from Cameron LNG with emission rate less than 0.1 pound/hour was considered insignificant and omitted from the inventory.
- Emergency equipment and sources permitted to operate less than 500 hours per year were considered to be intermittent sources per EPA guidance[9] and modeled with the permitted annual emission rates averaged over 8,760 hours.
- Per EPA guidance[9], an ISR of 0.2 was used for off-site sources more than 1 kilometer from Cameron LNG.
- Stack heights were adjusted to a maximum of 65 meters.
- Sources within 6 kilometers of the Westlake monitor (from which the background NO_2 concentration were obtained) were omitted from the inventory because the contributions of these sources to the ambient 1-hour NO_2 impacts are accounted for in the background NO_2 data.

The results of the cumulative modeling impacts analysis were as follows:

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[8] http://www.epa.gov/region07/air/nsr/nsrmemos/appwno2_2.pdf accessed September 2, 2015.
[9] http://www.epa.gov/sites/production/files/2015-07/documents/appwno2_2.pdf accessed January 19, 2016.

- The maximum predicted 1-hour NO_2 concentration (the 8^{th} highest of the daily maximum 1-hour values over a year, a surrogate for the 98^{th} percentile) predicted by AERMOD was 705 micrograms per cubic meters ($\mu g/m^3$), exceeding the NAAQS of 188 $\mu g/m^3$. However, Cameron LNG's contribution to this total was only 0.00004 $\mu g/m^3$.
- The maximum contribution by Cameron LNG to any predicted violation of the 1-hour NO_2 was 5.05 $\mu g/m^3$, which is less than the SIL of 7.5 $\mu g/m^3$.

These results indicate that the Expansion Project would not significantly contribute to any NAAQS violation.

Additional Impacts Analysis

To obtain a PSD permit, Cameron LNG was required to conduct analyses demonstrating that:

- The industrial, commercial, and residential source growth associated with the Expansion Project would not cause or contribute to a violation of any applicable NAAQS or PSD increment. Excluded from consideration as associated sources are mobile and temporary sources.
- The proposed emissions increases associated with the Expansion Project would not adversely affect soils or vegetation.
- The proposed emissions increases associated with the Expansion Project would not impair visibility.

The growth analysis indicated that no significant commercial, residential, or industrial growth is expected as a result of construction of the facility due to a combination of factors, including only modest job growth (approximately 50 new permanent employees).

Secondary ambient air quality standards are set under the CAA for the protection of soils, water, vegetation, animals, and other public welfare impacts. Cameron LNG's air quality analysis demonstrated that no secondary ambient air quality standards would be violated. Therefore, any impacts on soils, vegetation, animals, and other public welfare concerns would not be significant.

Visibility impacts were evaluated using the visibility screening model, VISCREEN. Visibility impacts were assessed using a Level I screening analysis, followed by a refined analysis. The refined analysis was necessary because the visibility impacts determined via the Level I screening analysis was found to be above critical screening criteria. The refined analysis is more rigorous because it includes the use of regional meteorological data, annual PM and NO_x emission rates, a background ozone concentration value, geometric data defining the orientation of a hypothetical plume relative to the Class II area and a hypothetical observer. The results of the refined analysis show that the Expansion Project would not result in adverse visibility impacts in the Class II area.

Class I Area Analysis

If a proposed major source or major modification is within 100 kilometers of a Class I area, the federal PSD regulations require that the reviewing authority provide written notification of any such proposed source to the federal land manager with jurisdiction for that area. The permitting authority should also notify the federal land manager of "very large sources" with the potential to impact a Class I area within their jurisdiction, even if the facility is beyond 100 kilometers from the Class I area. In practice, all sources within 200 (and sometimes 300) kilometers are included in the review because the term "very large sources" is not defined in the Clean Air Act. The nearest Class I area, Breton National Wildlife Refuge, is 415 kilometers east of Cameron LNG. Therefore, no Class I modeling analysis was necessary.

Photochemical Modeling

The Expansion Project would be in Calcasieu and Cameron Parishes, which are designated as attainment areas for the 2008 8-hour ozone (O_3) NAAQS. However, it is near the Baton Rouge area (Ascension, East Baton Rouge, Iberville, Livingston, and West Baton Rouge Parishes), which EPA has proposed to re-designate as attainment for the 2008 8-hour O_3 NAAQS[10], and the Houston - Galveston - Brazoria area, which is designated as marginal non-attainment for the 2008 8-hour O_3 NAAQS. Due to the Expansion Project's potential emissions of O_3 precursor pollutants, photochemical grid modeling was performed to assess its potential impacts on ambient O_3 concentrations in the Calcasieu – Cameron, Baton Rouge and Houston - Galveston - Brazoria areas. Photochemical grid modeling was performed to evaluate the impacts of the Expansion Project on regional ambient air quality with respect to the 8-hour average O_3 concentration.

EPA has not issued formal guidance for conducting photochemical grid ozone modeling or interpreting the results. Therefore, this evaluation was performed in accordance with EPA guidance on the use of photochemical models[11] and the suggestions of EPA Region 6 and the attainment demonstration performed in support of the Louisiana SIP for the 2008 8-hour O_3.[12] This analysis does not supersede air dispersion modeling performed for PSD permitting, and was not performed in lieu of modeling that may be required in the future for other reasons.

The Comprehensive Air Quality Model with Extensions (CAMx)[13] was used for the analysis. Two benchmarking cases, a 2010 base case and a 2017 future case were run to check that the model duplicated previous LDEQ CAMx results. The benchmarking cases reproduced the results of the previous analyses to within O_3 concentrations of 1×10^{-6} parts per billion (ppb).

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10 80 FR 51992 - 52002, August 17, 2015.

11 Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze, EPA-454/B-07-002, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. April 2007.

12 Technical Support Document Photochemical Modeling for the Louisiana 8-Hour Ozone State Implementation Plan, ENVIRON International Corporation and Eastern Research Group, Inc., April 2013 http://www.deq.louisiana.gov/portal/Portals/0/AirQualityAssessment/Engineering/Ozone/LDEQ_TSD_4Oct13.pdf (accessed 09/19/2015)

13 http://www.camx.com/files/camxusersguide_v6-10.pdf (accessed 09/19/2015)

This confirmed that transfer of the CAMx modeling platform from one computer cluster to another would not affect the analyses described herein.

The modeling concept to evaluate the Cameron LNG Facility (i.e., the combined Liquefaction Project and Expansion Project) was to re-model a previous attainment demonstration based on a known ozone episode (August 17 to October 31, 2010) with the Cameron LNG Facility NO_x and VOC emissions from Trains 1 through 5 added to the projected emission inventory. The inventory included the following:

- ten refrigeration compressor turbines;
- four thermal oxidizers;
- eight flares;
- six emergency generators;
- eight emergency water pumps;
- two diesel storage tanks;
- LNG loading operations; and
- fugitive sources.

This is an unlikely operating scenario because it assumes the simultaneous operation of normal operating, spare, and emergency equipment, which would not normally occur. The results from the modeling likely overestimate the impacts on ambient O_3 from the Cameron LNG Facility. NO_x and VOC emission were processed using the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system[14] based on a 90 percent NO and 10 percent NO_2 speciation.

The impact of the Cameron LNG Facility was evaluated using the Relative Response Factor (RRF) and absolute model predicted impact methods. An RRF is the ratio of the O_3 design concentration in a future year (or a project impact case) to the current or baseline year concentrations near a monitor site. Future O_3 concentrations are estimated at existing monitoring sites by multiplying a RRF at locations near each monitor by the observation-based, monitor-specific, "baseline" design value. The resulting predicted future concentrations are compared to the NAAQS. In the absolute model predicted impact method, the O_3 impacts predicted by the model are compared directly to the NAAQS. In general, EPA recommends the RRF method rather than the absolute model predicted impact method because the latter does not account for model biases.[15] The results of both analysis methods are summarized for completeness.

Over 90 monitor locations in Texas, Louisiana, Mississippi, and Florida were evaluated using the RRF method. The predicted peak O_3 impact for the liquefaction facilities was 0.4 ppb greater than the baseline at a single monitor in Calcasieu Parish in Louisiana, and at two

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14 https://cmascenter.org/smoke/ (accessed 09/20/15)

15 Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze, EPA-454/B-07-002, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. April 2007. See Section 2.

monitors in Orange County in Texas. At approximately 90 percent of these monitor locations, the predicted peak O_3 impact exceeds the baseline by 0.1 ppb or less. At areas removed from the monitors, the predicted peak O_3 impact exceeds the baseline by 0.7 ppb or less.[16]

Using the EPA Region 6 absolute basis metrics at monitors, the Cameron LNG Facility is estimated to impact the maximum 8-hour average O_3 concentrations at locations estimated to be over 70 ppb by a maximum of 1.73 ppb.

We conclude that the emissions from the Expansion Project, as simulated by the photochemical modeling, would not cause or contribute to any violation of the 2008 8-hour O_3 NAAQS.

2.6.2 Noise

Construction and operation of the Expansion Project would affect the local noise environment. The ambient sound level of a region is defined by the total noise generated within the specific environment and comprises sounds from both natural and artificial sources. At any location, both the magnitude and frequency of environmental noise may vary considerably throughout the day and week, in part due to changing weather conditions and the impacts of seasonal vegetative cover.

Two measurements used by some federal agencies to relate the time-varying quality of environmental noise to its known effects on people are the equivalent sound level (L_{eq}) and the day-night sound level (L_{dn}). The L_{eq} is a sound level containing the same sound energy as the instantaneous sound levels measured over a specific time period. Noise levels are perceived differently, depending on length of exposure and time of day. The L_{dn} takes into account the duration and time the noise is encountered. Specifically, in the calculation of the L_{dn}, late night to early morning (10:00 p.m. to 7:00 a.m.) noise exposures are penalized +10 decibels (dB), to account for people's greater sensitivity to sound during the nighttime hours. The A-weighted scale (dBA) is used because human hearing is less sensitive to low and high frequencies than mid-range frequencies. For an essentially steady sound source that operates continuously over a 24-hour period, the L_{dn} is approximately 6.4 dB above the measured L_{eq}.

In 1974, the EPA published its *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. This document provides information for state and local governments to use in developing their own ambient noise standards. The EPA has indicated that an L_{dn} of 55 dBA protects the public from indoor and outdoor activity interference. We have adopted this criterion and use it to evaluate the potential noise impacts from the Expansion Project at noise-sensitive areas (NSAs) such as residences, schools, or hospitals. Because of the 10 dBA nighttime penalty added before calculating the L_{dn}, for a facility to meet the L_{dn} 55 dBA limit, it must be

[16] As a point of reference, the O_3 NAAQS is 75 ppb, based on the annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years. The modeling results are conservatively presented as the highest maximum 8-hour impact, which overstates their effect relative to the NAAQS

designed such that actual constant noise levels on a 24-hour basis do not exceed 48.6 dBA L_{eq} at any NSA. Also, in general, a person's threshold of perception for a perceivable change in loudness on the A- weighted sound level is about 3 dBA, whereas a 5 dBA change is clearly noticeable, and a 10 dBA change is perceived as either twice or half as loud.

The State of Louisiana and Cameron Parish do not have noise regulations or ordinances applicable to the Expansion Project.

Existing Noise Conditions

The Expansion Project facilities would be within the Cameron LNG Terminal site. Cameron LNG identified two NSAs in the vicinity of the site. The nearest NSA is a rural residence approximately 5,200 feet northwest of the approximate acoustic center of the Expansion Project. The next nearest NSA (NSA 2) to the proposed Expansion Project is just northwest of NSA 1, approximately 6,000 feet northwest of the approximate acoustic center of the facility.

Existing ambient noise levels in the vicinity of NSA 1 and NSA 2 were based on the previous noise survey conducted by Cameron LNG for the previously authorized Cameron LNG Terminal Expansion Project (FERC Docket CP13-25-000). All of the NSAs are in similar land use areas, and are therefore anticipated to experience similar ambient noise levels.

Construction Noise Impacts and Mitigation

Construction activity and associated noise levels would vary depending on the construction phase in progress at any given time. Generally, construction would take place during daylight hours (7:00 a.m. to 7:00 p.m.) and would include the following major phases: site preparation, excavation, installation of pipeline and/or aboveground facilities, and site cleanup and restoration. The construction equipment would differ from phase to phase but would include dozers, cranes, cement mixers, dump trucks, and loaders. Noise generated during construction is primarily from the diesel engines that power the equipment. Exhaust noise is usually the predominant source of diesel engine noise. Equipment used is not generally operated continuously, nor is the equipment always operated simultaneously. Typically, the highest site average sound levels (89 dBA at 50 feet) are associated with excavation and finishing activities.

Measures to mitigate construction noise include complying with federal regulations limiting noise from trucks and ensuring that equipment and sound-muffling devices provided by the manufacturer are kept in good working condition.

Cameron LNG's analysis indicated that given the large distance to the nearest NSA (5,200 feet), maximum construction-related noise levels would be low (about 38 dBA). Pile driving for the new tank foundation would produce peak levels of about 95 dBA at 50 feet. Estimated pile driving noise levels at the nearest NSA would be approximately 46 dBA. Cameron LNG would develop mitigation measures to minimize nighttime noise impacts if pile driving is required at night.

Construction would occur during daylight hours; however, in some cases to avoid delays, some activities such as unloading/staging materials, barge unloading, welding activities, may require working during non-daylight hours. Construction noise levels for these activities would be minimal. Cameron LNG would provide alternative accommodations for the residents during these activities should the noise levels be greater than anticipated and a nuisance to the nearby residents.

Operation Noise Impacts and Mitigation

The proposed Expansion Project would include two liquefaction Trains (Trains 4 and 5). Liquefaction Trains 1 through 3, previously authorized under FERC Docket No. CP 13-25-000, are currently under construction. Cameron LNG used the commercially available CadnaA model developed by DataKustik GmBH to conduct a noise analysis for the Expansion Project. The software has the ability to take into account spreading losses, ground and atmospheric effects, shielding from barriers and buildings, and reflections from surfaces. Cameron LNG's noise analysis included an evaluation of noise from the proposed Expansion Project, noise from the previously authorized Cameron LNG Liquefaction Project, and expected noise levels for the liquefaction Trains 1 through 5. The analysis also included a comparison to measured ambient noise levels.

The major noise producing equipment associated with the proposed Expansion Project for liquefaction Trains 4 and 5 combined include:

- two air compressors;
- two boil-off gas compressors;
- two residue gas compressors;
- two drier regeneration gas compressors;
- two EFG compressors;
- two expander compressors;
- one hundred eighty fin fan gas coolers;
- four GE 7EA combustion turbines;
- four GE 7EA cooling water modules;
- two HP MR compressors;
- two LP MR compressors;
- two MP MR compressors;
- two propane compressors;
- miscellaneous pumps; and
- above ground piping.

Each liquefaction train is identical and would contain the same noise generating components, with the exception that all of the BOG compressors would be at the south end of the previously authorized Liquefaction Project, and the two air compressors for liquefaction Trains 4 and 5 would be immediately to the west of and in between liquefaction Trains 4 and 5.

Cameron LNG's noise analysis conducted for the previously authorized Cameron LNG Terminal liquefaction Trains 1 through 3 identified operational noise levels from the

Liquefaction Project to be an L_{dn} of 53.8 dBA at NSA 1. The analysis utilized estimated source noise level data and a conceptual design. Cameron LNG indicated that since that analysis was conducted, they were able to obtain vendor specific data for all of the proposed fans and for the BOG compressors. Cameron LNG noted that the vendor supplied data revealed that these source noise levels are significantly lower than the estimated source noise levels utilized in that the previous noise analysis. Additionally, fewer fans would be present than was assumed in the original noise analysis. Cameron LNG therefore revisited the noise modeling analysis for liquefaction Trains 1 through 3, revised the number of fans and their associated sound levels, and the sound levels for the BOG compressors. Cameron LNG's noise analysis for the proposed Expansion Project therefore, contains the results of the revised noise modeling for the previously authorized Cameron LNG Liquefaction Project (Trains 1 through 3), the results for the proposed Expansion Project (Trains 4 and 5), and the total modeled sound level for the liquefaction Trains 1 through 5.

These noise levels were evaluated against the existing baseline L_{dn} noise levels and our impact criterion to determine potential noise impacts at the nearby NSAs. The calculated noise levels, as well as the existing ambient sound level and the future sound levels for the nearest NSAs are presented in table 2.6-10.

The noise analysis for the proposed Expansion Project incorporated specific noise mitigation measures to reduce potential noise impacts, such as enclosures, exhaust silencers, and air intake silencers. Cameron LNG indicated that these measures were incorporated to their analysis in order to achieve the levels presented.

TABLE 2.6-10

Operational Noise Impacts Results

NSA	Cameron LNG Terminal Project Ldn (1) (dBA)	Liquefaction Expansion Project Ldn (2) (dBA)	Full Project Ldn (3) (dBA)	Existing Ldn with no Project (dBA)	Future Ldn (Existing Plus Full Project) (dBA)	Expected Increase Over Ambient (dBA)
NSA 1	48.7	51.0	53.2	50.9	55.2	4.3
NSA 2	47.2	49.2	51.5	50.9	54.2	3.3

(1) Trains 1 through 3
(2) Trains 4 and 5
(3) Trains 1 through 5 (full Project)

As shown in table 2.6-10, the noise level at NSA 1 attributable to the Expansion Project is estimated to be 51.0 dBA L_{dn} and the noise level at this NSA attributable to the entire Cameron LNG liquefaction facilities is expected to be 53.2 dBA L_{dn}. Hence, operation of the Cameron LNG Terminal is estimated to meet our noise criterion of 55 dBA L_{dn} at all NSAs. Increases of 3 dBA or less are considered to be barely perceptible. The increase in noise levels at the NSAs would be approximately at the threshold of a perceptible change. Therefore, noise impacts from operation of the Cameron LNG Project are not projected to be significant. To ensure that NSAs are not significantly impacted by the operation of the expanded Cameron LNG Terminal, **we recommend that:**

- **Cameron LNG should file a full load noise survey with the Secretary <u>no later than 60 days</u> after placing the Expansion Project (Trains 4 and 5) into service. If a full load noise survey is not possible, Cameron LNG should provide an interim survey at the maximum possible load and provide the full load survey <u>within 6 months</u>. If the noise attributable to operation of all the equipment at the Cameron LNG Terminal, under interim or full load conditions, exceeds an L_{dn} of 55 dBA at any nearby NSA, Cameron LNG should file a report on the changes that are needed and should install the additional noise controls to meet the level <u>within one year</u> of the in-service date. Cameron LNG should confirm compliance with the above requirement by filing a second noise survey with the Secretary <u>no later than 60 days</u> after it installs the additional noise controls.**

2.7 Safety

2.7.1 Regulatory Agencies

Multiple federal agencies share regulatory authority over the siting, design, construction, and operation of LNG import and export terminals. The safety, security, and reliability of the Cameron LNG Expansion Project would be governed by the FERC, the DOT, and the Coast Guard.

The FERC authorizes the siting and construction of LNG import and export facilities under the NGA and delegated authority from the DOE. As part of the review required for FERC authorization, we assess whether or not a facility would have a public safety impact.

The DOT establishes federal safety standards for siting, construction, operation, and maintenance of onshore LNG facilities, as well as for the siting of marine cargo transfer systems at waterfront LNG plants. Those regulations are codified in 49 CFR 193. As a cooperating agency, the DOT assists FERC staff in evaluating whether an applicant's proposed siting meets the DOT requirements. If a facility is constructed and becomes operational, the facility would be subject to the DOT's inspection program. Final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by DOT staff.

The Coast Guard has authority over the safety of an LNG facility's marine transfer area and LNG marine traffic, as well as over security plans for the entire LNG facility and LNG marine traffic. The Coast Guard regulations over LNG facilities are codified in 33 CFR 105 and 127. In accordance with 33 CFR 127, the Coast Guard has reviewed the proposed Expansion Project and stated that a Letter of Intent or a revision to the WSA is not required for the Expansion Project because the proposed modifications lie outside the Marine Transfer Area. A copy of the correspondence between Cameron LNG and the Coast Guard is included in Appendix A.11 of the application.

2.7.2 LNG Facility Hazards

Before liquefaction, Cameron LNG would pre-treat the feed gas for the removal of mercury, hydrogen sulfide, carbon dioxide, water vapor, and heavier hydrocarbons. The hazards associated with the removal of these substances from the feed gas stream result from the physical and chemical properties, flammability, and toxicity of mercury, hydrogen sulfide, and amine.

Mercury in the feed gas would be removed by adsorption in the mercury removal units. Cameron LNG would replace the mercury removal beds by the end of their service life. Maintenance and safety procedures would cover the proper replacement and disposal of these beds and would not pose a significant safety hazard to the public.

Hydrogen sulfide would be removed by permanently bonding to scavenger beds. Cameron LNG would replace the scavenger beds by the end of their service life. Maintenance and safety procedures would cover the proper replacement and disposal of these beds and would not pose a significant safety hazard to the public.

Carbon dioxide would be removed from the feed gas by an amine unit using a solution of activated methyl-diethanol-amine (a-MDEA). The amine solution would be handled at temperatures below the point at which it could produce enough vapors to form a flammable mixture Also, the Amine Units would be located within the curbed area of the new liquefaction trains. Any amine releases would be contained within the spill containment system and would not pose a significant safety hazard to the public, which would have no access to the on-site areas.

Water would be removed from the feed gas by a dehydration unit using regenerative molecular sieve beds. The water would be recycled to the Amine unit for water makeup purposes and would not pose a significant safety hazard to the public.

Heavier hydrocarbons would be removed from the feed gas by a heavy removal unit and fractionation system. During this removal process, natural gas liquid (NGL) and heavier hydrocarbons would be extracted. The feed gas would be fractionated into off gas, which consists primarily of methane and ethane, liquefied propane gas (LPG), which consists primarily of propane and butane, and stabilized condensate, which consists primarily of pentane and heavier hydrocarbons, including benzene, toluene, ethylbenzene, and xylenes (BTEX). The off gas would be recycled to the fuel gas and the LPG would be recycled back to the feed gas inlet. The stabilized condensate would be stored on-site at ambient pressure and temperature for removal by truck. A release of off gas or LPG would result primarily in a vapor release and the ability to produce damaging overpressures. Due to the temperature and pressure conditions under which the stabilized condensate would be stored and handled, a loss of containment would primarily result in a liquid release. The liquid spill would be contained in impoundments, as discussed under “Impoundment Sizing” in section 2.7.5. The principal hazards associated with the off gas, LPG, and condensate would result from loss of containment and the flammability and toxicity of the substances used or produced in the heavy hydrocarbon removal system. Hazard modeling associated with these hazards are discussed in section 2.7.5

After removal of the heavy hydrocarbon components, the feed gas stream would be precooled by thermal exchange with the propane loop and subsequently liquefied in the main cryogenic heat exchanger by thermal exchange with a mixed refrigerant that includes methane, ethylene, propane, and nitrogen. The principal hazards associated with a release of LNG or refrigerants would be the potential for flammable vapor dispersion, radiant heat from a fire, and the ability to produce damaging overpressures. Hazard modeling associated with these hazards are discussed in section 2.7.5

Hazardous Release

A release of hazardous fluid from piping or equipment is the initial event that results in all other potential hazards. This initial loss of containment can produce a liquid and/or gaseous release with the formation of vapor at the release location, as well as from any liquid that pooled. The fluid released may present low or high temperature hazards, and may result in the formation of toxic and flammable vapors. The extent of the hazard will depend on the material released, the storage and process conditions, and the volumes released.

Cameron LNG would store the following on-site: LNG at atmospheric pressure and at a cryogenic temperature of approximately -260 °F, liquid nitrogen at or below -300 °F and less than 50 psig, and stabilized condensate at ambient temperature and pressure. Cameron LNG would utilize the existing ethylene and propane storage vessels for the mixed refrigerant makeup.

The mixed refrigerant process stream would consist of methane, ethylene, propane, and nitrogen. Cryogenic temperatures as low as -260°F would occur within the mixed refrigerant process stream used to liquefy the feed gas. The temperature of NGL in the heavy hydrocarbon removal process stream would be as low as -137°F. Loss of containment of LNG, mixed refrigerant liquid (MRL), and NGL could lead to the release of both liquid and vapor into the immediate area. Exposure to either cold liquid or vapor could cause freeze burns and, depending on the length of exposure, more serious injury or death. However, spills would be contained to on-site areas and the cold state of these releases would be greatly limited due to the continuous mixing with the warmer air. The cold temperatures from the release would not present a hazard to the public, which would not have access to on-site areas.

LNG and MRL are cryogenic liquids that would quickly cool any materials contacted by the liquid on release, causing extreme thermal stress in materials not specifically designed for such conditions. These thermal stresses could subsequently subject the material to brittleness, fracture, or other loss of tensile strength. These temperatures, however, would be accounted for in the design of equipment and structural supports, and would not be substantially different from the hazards associated with the storage and transportation of liquid oxygen (-296ºF) or several other cryogenic liquids that have been routinely produced and transported in the United States.

A rapid phase transition (RPT) can occur when a cryogenic liquid is spilled onto water and changes from liquid to gas, virtually instantaneously. Unlike an explosion that releases energy and combustion products from a chemical reaction, an RPT is the result of heat transferred to the liquid inducing a change to the vapor state. RPTs have been observed during LNG test spills onto water. In some test cases, the overpressures generated were strong enough to damage test equipment in the immediate vicinity of the LNG release point. The sizes of the overpressure events have been generally small and are not expected to cause significant damage. The average overpressures recorded at the source of the RPTs during the Coyote tests have ranged from 0.2 pounds per square inch (psi) to 11 psi.[17] These events are typically limited to the area within the spill and are not expected to cause damage outside of the area engulfed by the LNG pool. However, a RPT may affect the rate of pool spreading and the rate of vaporization for a spill on water. Regardless, the proposed facilities would not be expected to produce liquid spills into the Calcasieu Ship Channel since the existing marine facilities are equipped with impoundments as required by 49 CFR 193.2173 which are drained completely to prevent water collection.

Vapor Dispersion

LNG, ethylene, propane, and NGL would vaporize during a release from storage or process equipment and piping. Depending on the size of the release, cryogenic liquids, such as LNG and MRL, as well as NGL may form a liquid pool and vaporize. Additional vaporization would result from exposure to ambient heat sources, such as water or soil. When released from a containment vessel or transfer system, LNG will generally produce 620 to 630 standard cubic feet (ft^3) of natural gas for each cubic foot of liquid. Ethylene will produce approximately 375 ft^3 of gas for each cubic foot of liquid. Propane will produce approximately 250 ft^3 of gas for each cubic foot of liquid. The composition of NGL would vary throughout the heavy hydrocarbon removal process and may produce up to 380 ft^3 of gas for each cubic foot of liquid. In the event of a loss of containment of stabilized condensate, the stabilized condensate would spill primarily as a liquid and form a pool, but would vaporize much more slowly than LNG or other refrigerants.

The resulting vapor release may form a toxic or flammable cloud depending on the material released. The dispersion of the vapor cloud will depend on the physical properties of the cloud, the ambient conditions, and the surrounding terrain and structures. Generally, a denser-than-air vapor cloud would sink to the ground due to the relative density of the vapor to the air and would travel with the prevailing wind, while a lighter-than-air vapor cloud would rise and travel with the prevailing wind. The density will depend on the material released and the temperature of the material. For example, a LNG release would initially form a denser than-air vapor cloud and transition to lighter-than-air vapor cloud as the vapor disperses downwind and mixes with the warm surrounding air. However, experimental observations and vapor dispersion modeling indicate a LNG vapor cloud would not typically be warm, or buoyant, enough to lift off from the ground before the LNG vapor cloud disperses below its lower flammable limit (LFL). An ethylene release would form a denser-than-air vapor cloud that would sink to the ground due to the cold temperature of the vapor. As the ethylene vapor cloud disperses downwind and mixes with the warm surrounding air, the ethylene vapor would become neutrally buoyant. Propane and heavier hydrocarbon releases would form a denser-than-air vapor cloud that would sink to the ground; however, both propane and heavier hydrocarbons remain denser than the surrounding air, even after warming to ambient temperatures.

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17 The Lawrence Livermore National Laboratory conducted seven tests (the Coyote series) on vapor cloud dispersion, vapor cloud ignition, and RPTs at the Naval Weapons Center in China Lake, California in 1981.

The vapor cloud would continue to be hazardous until it dispersed below toxic levels and/or flammable limits. Toxicity is primarily dependent on the concentration of the vapor cloud in the air and the exposure duration, while flammability of the vapor cloud is primarily dependent just on the concentration of the vapor when mixed with the surrounding air. In general, higher concentrations within the vapor cloud would exist near the spill, and lower concentrations would exist near the edge of the cloud as it disperses downwind.

Toxicity is defined by a number of different agencies for different purposes. Acute Exposure Guideline Levels (AEGLs) and Emergency Response Planning Guidelines (ERPGs) can be used for emergency planning, prevention, and response activities related to the accidental release of hazardous substances.[18] Other federal agencies, such as the DOE, EPA, and NOAA, use AEGLs and ERPGs as the primary measure of toxicity.[19,20,21]

There are three AEGLs and ERPGs which are distinguished by varying degrees of severity of toxic effects with AEGL-1 and ERPG-1 (level 1) being the least severe to AEGL-3 and ERPG-3 (level 3) being the most severe.

- AEGL-1 is the airborne concentration of a substance that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory- effects. However, these effects are not disabling and are transient and reversible upon cessation of the exposure.
- AEGL-2 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
- AEGL-3 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

ERPG levels have similar definitions, but are based on the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing similar effects defined in each of the AEGLs. The EPA provides ERPGs (1 hour) and AEGLs at varying exposure times (10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours) for a list of chemicals. DOT has adopted the use of the ERPG-2 level to define toxicity impacts of released materials. FERC staff uses AEGLs preferentially as they are more inclusive and provide toxicity levels at various exposure times. DOE and NOAA also use AEGLs

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18 EPA, *Dose-Response Assessment for Assessing Health Risks Associated With Exposure to Hazardous Air Pollutants*, http://www2.epa.gov/fera/dose-response-assessment-assessing-health-risks-associated-exposure-hazardous-air-pollutants, July 3, 2014.

19 DOE, *Temporary Emergency Exposure Limits for Chemicals: Methods and Practice*, DOE Handbook, DOE-HDBK-1046-2008, August 2008.

20 EPA 40 CFR 68 Final Rule: Accidental Release Prevention Requirements: Risk Management Programs Under Clean Air Act Section 112(r)(7), 61 Federal Register 31667-31732, Vol. 61, No. 120, Thursday, June 20, 1996.

21 NOAA *Public Exposure Guidelines*, http://response.restoration.noaa.gov/oil-and-chemical-spills/chemical-spills/resources/public-exposure-guidelines.html, December 3, 2013.

preferentially. The toxic properties for the various material components stored and processed on site are tabulated in table 2.7-1.

TABLE 2.7-1

Toxicity Levels of Various Material Components and Exposure Times (in ppm)a,b,

Material Components	Acute Exposure Guideline Level	10 min	30 min	60 min	4 hr	8 hr
Benzene	AEGL 1	130	73	52	18	9
	ERPG 1	-	-	50	-	-
	AEGL 2	2,000 [c]	1,100	800	400	200
	ERPG 2	-	-	150	-	-
	AEGL 3	9,700 [d]	5,600 [c]	4,000 [c]	2,000 [c]	990
	ERPG 3	-	-	1,000	-	-
Ethylbenzene	AEGL 1	33	33	33	33	33
	ERPG 1	-	-	-	-	-
	AEGL 2	2900	1600	1100	660	580
	ERPG 2	-	-	-	-	-
	AEGL 3	4700	2600	1800	1000	910
	ERPG 3	-	-	-	-	-
Hexane	AEGL 1	NR	NR	NR	NR	NR
	ERPG 1	-	-	-	-	-
	AEGL 2	4,000 [c]	2,900 [c]	2,900 [c]	2,900 [c]	2,900 [c]
	ERPG 2	-	-	-	-	-
	AEGL 3	12,000 [d]	8,600 [d]	8,600 [d]	8,600 [d]	8,600 [d]
	ERPG 3	-	-	-	-	-
Toluene	AEGL 1	200	200	200	200	200
	ERPG 1	-	-	50	-	-
	AEGL 2	3,100 [c]	1,600	1,200	790	650
	ERPG 2	-	-	300	-	-
	AEGL 3	13,000 [d]	6,100 [c]	4,500 [c]	3,000 [c]	2,500 [c]
	ERPG 3	-	-	1,000	-	-
Xylene	AEGL 1	130	130	130	130	130
	ERPG 1	-	-	-	-	-
	AEGL 2	2,500 [c]	1,300 [c]	920 [c]	500	400
	ERPG 2	-	-	-	-	-
	AEGL 3	- [d]	3,600 [c]	2,500 [c]	1,300 [c]	1,000 [c]
	ERGP 3	-	-	-	-	-

[a] U.S. Environmental Protection Agency, Acute Exposure Guideline Levels, http://www.epa.gov/oppt/aegl/pubs/chemlist.htm, December 3, 2013.
[b] American Industrial Hygiene Association, 2013 ERPG/WEEL Handbook, http://www.aiha.org/get-involved/AIHAGuidelineFoundation/EmergencyResponsePlanningGuidelines, 2013.
[c] Greater than or equal to 10 percent LFL.
[d] Greater than or equal to 50 percent LFL.

In addition, methane, heavier hydrocarbons, and nitrogen are classified as simple asphyxiates and may pose extreme health hazards, including death, if inhaled in significant quantities within a limited time. Very cold methane and heavier hydrocarbons vapors may also cause freeze burns. However, the locations of concentrations where cold temperatures and oxygen-deprivation effects could occur are greatly limited due to the continuous mixing with the warmer air surrounding the spill site. For that reason, exposure injuries from contact with releases of methane and heavier hydrocarbons normally represent negligible risks to the public.

Flammable vapors can develop when a flammable material is above its flash point and concentrations are between the LFL and the upper flammable limit (UFL). Concentrations between the LFL and UFL can be ignited, and concentrations above the UFL or below the LFL would not ignite. The flammable properties for the various material components stored and processed on site are tabulated in table 2.7-2.

TABLE 2.7-2

Flammable Properties

Material Component	Flash Point	LFL (percent volume in air)	UFL (percent volume in air)
Methane	–283°F	5.0	15.0
Ethylene	–250°F	2.7	36
Ethane	-211°F	3.0	12.5
Propane	–155°F	2.1	9.5
n-Butane	–76°F	1.8	8.5
i-Butane	–105°F	1.8	8.4
n-Pentane	–56°F	1.4	7.8
i-Pentane	–60°F	1.4	7.6
n-Hexane	–7.6°F	1.2	7.5
Benzene	11°F	1.4	7.1
Toluene	45°F	1.2	7.1
Ethylbenzene	75°F	1.0	6.7
m-Xylene	77°F	1.1	7.0
o-Xylene	75°F	1.1	6.0
p-Xylene	77°F	1.1	7.0

[a] Society of Fire Protection Engineers (SFPE), The SFPE Handbook of Fire Protection Engineering, Fourth Edition, 2008.

The extent of the affected area and the severity of the impacts on objects within a vapor cloud would primarily be dependent on the material, quantity, and duration of the initial release, the surrounding terrain, and the environmental conditions present during the dispersion of the cloud. Cameron LNG has modeled the extent of the potential vapor dispersion hazards for the project, which is discussed in section 2.7.5.3.

2.7.3 Technical Review of the Preliminary Engineering Design

Operation of the proposed facility poses a potential hazard that could affect the public safety if strict design and operational measures to control potential accidents are not applied. The primary concerns are those events that could lead to a release of hazardous fluids of sufficient magnitude to create an off-site hazard as discussed in section 2.7.2. However, it is important to recognize the stringent requirements in place for the design, construction, operation, and maintenance of the facility, as well as the extensive safety systems proposed to detect and control potential hazards.

As part of a project's preliminary safety review, Cameron LNG conducted a hazard identification (HAZID) review of the pre- FEED to identify potential risk scenarios. The proposed liquefaction trains 4 and 5 for the Expansion Project would be identical to the previously authorized liquefaction trains 1, 2 and 3 for the Liquefaction Project under docket number CP13-25-000. Therefore, Cameron LNG submitted the same HAZID report for the Liquefaction Project in addition to a new HAZID report for the new common and utilities facilities for the Expansion Project. A more detailed and thorough hazard and operability review (HAZOP) analysis would be performed by Cameron LNG during the final design phase to identify the major hazards that may be encountered during the operation of facilities. The HAZOP study would be intended to address hazards of the process, engineering and administrative controls, and would provide a qualitative evaluation of a range of possible safety, health, and environmental effects which may result from the design or operation of the facility. Recommendations to prevent or minimize these hazards would be generated from the results of the HAZOP review. These studies help establish the required safety control levels and identify whether additional process and safety instrumentation, mitigation, and/or administrative controls would be needed. Since all 5 liquefaction trains would be identical and LNG Storage Tanks 4 and 5, we believe that the same measures relating to the reliability, operability, and safety identified for liquefaction trains 1, 2, and 3 and LNG Storage Tank 4 should be applied to the proposed trains 4 and 5 and LNG Storage Tank 5. As a result, **we recommend that:**

- **<u>Prior to construction of the final design</u>, Cameron LNG should file with the Secretary, for review and written approval by the Director of the Office of Energy Projects (OEP), certification that the design for Trains 4 and 5 and Storage Tank 5 would duplicate Trains 1 through 3 and Storage Tank 4, and how the conditions from the June 19, 2014 Order (Docket No. CP13-25-000) will be incorporated in the design for Trains 4 and 5 and Storage Tank 5.**

Once the design has been subjected to a HAZOP review, the design development team tracks changes in the facility design, operations, documentation, and personnel. Cameron LNG would evaluate these changes to ensure that the safety, reliability, health, and environmental risks arising from these changes are addressed and controlled. Resolutions of the recommendations generated by the HAZOP review would be monitored by the FERC staff. We have included a recommendation that Cameron LNG should file a hazard and operability study on the completed final design.

Based on these analyses, Cameron LNG would include various layers of protection or safeguards in the facility design to reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public. These layers of protection are independent of one another so that anyone would perform its function regardless of the action or failure of any other protection layer or initiating event. These layers of protection typically include:

- a facility design that prevents hazardous events through the use of suitable materials of construction; operating and design limits for process piping, process vessels, and storage tanks; adequate design for wind, flood, seismic, and other outside hazards;
- control systems, including monitoring systems and process alarms, remotely-operated control and isolation valves, and operating procedures to ensure the facility stays within the established operating and design limits;
- safety-instrumented prevention systems, such as safety control valves and emergency shutdown systems, to prevent a release if operating and design limits are exceeded;
- physical protection systems, such as appropriate electrical area classification, proper equipment and building spacing, pressure relief valves, spill containment, and structural fire protection, to prevent escalation to a more severe event;
- site security measures for controlling access to the facility, including security inspections and patrols; response procedures to any breach of security and liaison with local law enforcement officials; and
- on-site and off-site emergency response, including hazard detection and control equipment, firewater systems, and coordination with local first responders to mitigate the consequences of a release and prevent it from escalating to an event that could impact the public.

The use of these protection layers would mitigate the potential for an initiating event to develop into an incident that could impact the safety of the off-site public. In addition, proper siting of the facility with regard to potential off-site consequences is required by DOT's regulations in 49 CFR 193, Subpart B to ensure that impacts on the public would be minimized. These siting requirements are discussed in section 2.7.4.

As part of the application, Cameron LNG provided a FEED for the Project. The FEED and specifications submitted for the proposed facilities to date are preliminary, but would serve as the basis for any detailed design to follow. We have analyzed the information filed by Cameron LNG to determine the extent that layers of protection or safeguards to enhance the safety, operability, and reliability of the facility are included in the FEED.

As a result of the technical review of the information provided by Cameron LNG in the submittal documents, we identified a number of concerns in an information data request letter issued on November 25, 2015 relating to the reliability, operability, and safety of the proposed design. Cameron LNG provided written responses to the information data request on December 16, 2015. Some of these responses indicated that Cameron LNG would correct or modify its design in order to address the identified issues. As a result, **we recommend that:**

- **<u>Prior to construction of the final design</u>, Cameron LNG should file information/revisions with the Secretary, for review and written approval by the Director of OEP, pertaining to Cameron LNG's response number 7 and 8 of its December 16, 2015 filing, which indicated features to be included or considered in the final design.**

The objectives of our FEED review focused on the engineering design and safety concepts of the various protection layers, as well as the projected operational reliability of the proposed facilities. The design would use materials of construction suited to the pressure and temperature conditions of the process design. Piping would be designed, fabricated, inspected, tested, and documented in accordance with the American Society of Mechanical Engineers (ASME) B31.3 and the NFPA's Standard 59A (NFPA 59A). Pressure vessels would be designed in accordance with ASME Section VIII and the storage tanks would be designed in accordance with American Petroleum Institute Standard 620 and American Concrete Institute 318, per 49 CFR 193 and NFPA 59A. Valves and other equipment would be designed to recommended and generally accepted good engineering practices. As proposed in the Basic Engineering Data section located in appendix C.13 of the application, Cameron LNG would design the facility to withstand a design wind velocity of a 183 mph, 3-second gust. The proposed LNG storage tank and liquefaction process area would be at minimum grade levels of 6.1 feet and 12.6 feet based on North American Vertical Datum of 1988 (NAVD88), respectively. Equipment would be installed above the 500-year storm surge elevations. We also examined the seismic and structural design of the Expansion Project facility in section 2.1.

Cameron LNG would install process control valves and instrumentation to safely operate and monitor the facility. Alarms would have visual and audible notification in the control room to warn operators that process conditions may be approaching design limits. Operators would have the capability to take action from the control room to mitigate an upset.

Cameron LNG would expand the existing facility operation procedures to include the Expansion Project after completion of the final design; this timing is fully consistent with accepted industry practice. We have made recommendations for Cameron LNG to provide more information on the operating and maintenance procedures as they are developed, including hot work procedures and permits and personnel training. In addition, we have recommended measures such as labeling of instrumentation and valves (i.e., car-seals, locks) to address human factor considerations and improve facility safety. An alarm management program following American National Standards Institute/International Society of Automation -18.2 would also be in place to ensure effectiveness of the alarms. We have also made a recommendation to ensure an alarm management program would be in place to ensure effectiveness of the alarms.

Safety valves and instrumentation would be installed to monitor, alarm, shutdown, and isolate equipment and piping during process upsets or emergency conditions. Safety instrumented systems would be defined and implemented in accordance with International Electrotechnical Commission 61508 and 61511 (ANSI-ISA-84), Application of Safety Instrumentation Systems for the Process Industry. We also made recommendations on the design, installation, and commissioning of instrumentation and emergency shutdown equipment to ensure appropriate cause and effect alarm or shutdown logic and enhanced representation of the emergency shutdown valves in the facility control system.

Safety relief valves would be installed to protect the process equipment and piping. A new low pressure flare would be installed to handle the BOG from the new LNG storage tank in the event the BOG compressors are unavailable.

In order to minimize the risk of an intentional event, Cameron LNG would provide security fencing, lighting, camera systems, and intrusion detection to deter, monitor, and detect intruders into the facility. The Cameron LNG terminal has an extensive security plan in accordance with 33 CFR 105, 49 CFR 193, and NFPA 59A. Cameron LNG must update the existing Facility Security Plan in accordance with the Coast Guard's regulations found in 33 CFR 105, Subpart D. We also made recommendations to provide security and incident reporting during operation.

In the event of a release, drainage systems from LNG storage and liquefaction process facilities would direct a spill away from equipment in order to minimize flammable vapors from dispersing to confined, occupied, or public areas and to minimize heat from impacting adjacent equipment and public areas if ignition occurs. Impoundment systems are further discussed in 2.7.5.

Cameron LNG performed a preliminary fire protection evaluation to ensure that adequate hazard detection, hazard control, and firewater coverage would be installed to detect and address any upset conditions. Structural fire protection, proposed to prevent failure of structural supports of equipment and pipe racks, would comply with NFPA 59A and other recommended and generally accepted good engineering practices. Cameron LNG would also install hazard detection systems to detect, alarm, and alert personnel in the area and control room to initiate an emergency shutdown and/or initiate appropriate procedures, and would meet NFPA 72 and other recommended and generally accepted good engineering practices. Hazard control devices would be installed to extinguish or control incipient fires and releases, and would meet NFPA 59A and NFPA 10, 11, 12, 17, and other recommended and generally accepted good engineering practices. Cameron LNG would provide automatic firewater systems and monitors for use during an emergency to cool the surface of storage vessels, piping, and equipment exposed to heat from a fire, and would meet NFPA 59A, 15, 20, 22, and 24 requirements. We have made recommendations for Cameron LNG to provide more information on the design, installation, and commissioning of hazard detection, hazard control, and firewater systems as Cameron LNG would further develop this information during the final design phase.

Cameron LNG would also update the existing emergency procedures to include the Expansion Project in accordance with 49 CFR 193 and 33 CFR 127. The emergency procedures would provide for protection of personnel and the public as well as the prevention of property damage that may occur as a result of incidents at the facility.

If authorization is granted by the Commission, the next phase of the Expansion Project would include development of the final design, including final selection of equipment manufacturers, process conditions, and resolution of some safety-related issues. To ensure the final design would be consistent with the safety and operability characteristics identified in the FEED, information regarding the development of the final design, as detailed below, would need to be filed with the Secretary for review and written approval by the Director of the OEP before equipment construction at the site would be authorized.

In addition to the final design review, we would conduct inspections during construction and would review additional materials, including quality assurance and quality control plans, nonconformance reports, and cooldown and commissioning plans. We would also conduct inspections during operation to ensure that the facility is operated and maintained in accordance with the filed design throughout the life of the facility.

To ensure that the concerns we have identified relating to the reliability, operability, and safety of the proposed design are addressed by Cameron LNG, and to ensure that the facility is subject to the Commission's construction and operational inspection program, **we recommend that the following measures should apply to the Cameron LNG Expansion Project. Information pertaining to these specific recommendations should be filed with the Secretary for review and written approval by the Director of OEP either: prior to initial site preparation; prior to construction of final design; prior to commissioning; prior to introduction of hazardous fluids; or prior to commencement of service, as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, should be submitted as critical energy infrastructure information pursuant to 18 CFR 388.112. See Critical Energy Infrastructure Information, Order No. 683, 71 Fed. Reg. 58,273 (October 3, 2006), FERC Stats. & Regs. ¶31,228 (2006). Information pertaining to items such as: offsite emergency response; procedures for public notification and evacuation; and construction and operating reporting requirements, would be subject to public disclosure. All information should be filed a minimum of 30 days before approval to proceed is requested.**

- **Prior to initial site preparation, Cameron LNG should file an overall project schedule, which includes the proposed stages of the commissioning plan.**
- **Prior to initial site preparation, Cameron LNG should provide procedures for controlling access during construction.**
- **Prior to initial site preparation, Cameron LNG should file the quality assurance and quality control procedures for construction activities.**
- **Prior to initial site preparation, Cameron LNG should file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems.**
- **The final design should include change logs that list and explain any changes made from the FEED provided in Cameron LNG's application and filings. A list of all changes with an explanation for the design alteration should be provided and all changes should be clearly indicated on all diagrams and drawings.**
- **The final design should provide up-to-date Process Flow Diagrams with heat and material balances and Piping and Instrument Diagrams (P&IDs), which include the following information:**

  a. equipment tag number, name, size, duty, capacity, and design conditions;

  b. equipment insulation type and thickness;

  c. storage tank pipe penetration size and nozzle schedule;

  d. valve high pressure side and internal and external vent locations;

e. piping with line number, piping class specification, size, and insulation type and thickness;

f. piping specification breaks and insulation limits;

g. all control and manual valves numbered;

h. relief valves with set points; and

i. drawing revision number and date.

- **The final design should provide P&IDs, specifications, and procedure that clearly show and specify the tie-in details required to safely connect the Expansion Project to the existing facility.**
- **The final design should provide an up-to-date complete equipment list, process and mechanical data sheets, and specifications.**
- **The final design should include drawings of the storage tank piping support structure and support of horizontal piping at grade including pump columns, relief valves, pipe penetrations, instrumentation, and appurtenances.**
- **The final design should include three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion.**
- **The final design should include a list of all car-sealed and locked valves consistent with the P&IDs.**
- **The final design should include an analysis of the structural integrity of the outer containment of the full containment storage tanks when exposed to a roof tank top fire or adjacent tank top fire.**
- **The final design should demonstrate that for hazardous fluids, piping and piping nipples 2 inches or less in diameter are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators.**
- **The final design should provide the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3, as required by 49 CFR 193.**
- **The final design should include a plan for clean-out, dry-out, purging, and tightness testing. This plan should address the requirements of the American Gas Association's Purging Principles and Practice required by 49 CFR 193 and should provide justification if not using an inert or non-flammable gas for cleanout, dry-out, purging, and tightness testing.**
- **The final design should include drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system meet the requirements of NFPA 59A.**
- **The final design should provide an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap should vent to a safe location and be equipped with a leak detection device that: should continuously monitor for the presence of a flammable fluid; should alarm the hazardous condition; and should shut down the appropriate systems.**
- **The final design should provide electrical area classification drawings.**

- **The <u>final design</u> should include a hazard and operability review of the completed design prior to issuing the P&IDs for construction. A copy of the review, a list of recommendations, and actions taken on the recommendations, should be filed.**
- **The <u>final design</u> should include the cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices should include alarms and shutdown functions, details of the voting and shutdown logic, and setpoints.**
- **The <u>final design</u> should include a drawing showing the location of the emergency shutdown (ESD) buttons. ESD buttons should be easily accessible, conspicuously labeled and located in an area which would be accessible during an emergency.**
- **The <u>final design</u> should specify that all ESD valves are to be equipped with open and closed position switches connected to the Distributed Control System/Safety Instrumented System.**
- **The <u>final design</u> should include the sizing basis and capacity for the final design of flare stacks as well as the pressure and vacuum relief valves for major process equipment, vessels, and storage tanks.**
- **The <u>final design</u> should include an updated fire protection evaluation of the proposed facilities carried out in accordance with the requirements of NFPA 59A 2001, chapter 9.1.2 as required by 49 CFR 193. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations should be filed.**
- **The <u>final design</u> should provide spill containment system drawings with dimensions and slopes of curbing, trenches, and impoundments.**
- **The <u>final design</u> should provide complete plan drawings and a list of the hazard detection equipment. The drawings should clearly show the location and elevation of all detection equipment. The list should include the instrument tag number, type and location, alarm locations, and shutdown functions of the proposed hazard detection equipment.**
- **The <u>final design</u> should include a list of alarm and shutdown set points for all flammable detectors that account for the calibration gas when determining the set points for flammable components such as refrigerants, natural gas liquids, and LNG.**
- **The <u>final design</u> should include a list of alarm and shutdown set points for all toxic detectors that account for the calibration gas when determining the set points for toxic components such as benzene, toluene, ethylbenze and xylenes.**
- **The <u>final design</u> should provide complete plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Drawings should clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers. The list should include the equipment tag number, type, capacity, equipment covered, and automatic and manual remote signals initiating discharge of the units.**
- **The <u>final design</u> should provide facility plans and drawings that show the location of the firewater and foam systems. Drawings should clearly show: firewater and foam piping; post indicator valves; and the location of and**

area covered by each monitor, hydrant, deluge system, foam system, water-mist system, and sprinkler. The drawings should also include piping and instrumentation diagrams of the firewater and foam system.

- **<u>Prior to commissioning</u>, Cameron LNG should provide a detailed schedule for commissioning through equipment startup. The schedule should include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids; and during commissioning and startup. Cameron LNG should file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued.**
- **<u>Prior to commissioning</u>, Cameron LNG should file plans and detailed procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service.**
- **<u>Prior to commissioning</u>, Cameron LNG should tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves.**
- **<u>Prior to commissioning</u>, Cameron LNG should provide results of the LNG storage tank hydrostatic test and foundation settlement results. At a minimum, foundation settlement results should be provided thereafter annually.**
- **<u>Prior to commissioning</u>, Cameron LNG should tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves.**
- **<u>Prior to commissioning</u>, Cameron LNG should file updates addressing the Expansion Project facilities in the operation and maintenance procedures and manuals, as well as safety procedures.**
- **<u>Prior to commissioning</u>, Cameron LNG should maintain a detailed training log to demonstrate that operating staff has completed the required training.**
- **<u>Prior to commissioning</u>, Cameron LNG should file a tabulated list and drawings of the proposed hand-held fire extinguishers. The list should include the equipment tag number, extinguishing agent type, capacity, number, and location. The drawings should show the extinguishing agent type, capacity, and tag number of all hand-held fire extinguishers.**
- **<u>Prior to introduction of hazardous fluids</u>, Cameron LNG should complete all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the Distributed Control System and the Safety Instrumented System that demonstrates full functionality and operability of the system.**
- **<u>Prior to introduction of hazardous fluids,</u> Cameron LNG should complete a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant should be shown on facility plot plan(s).**
- **<u>Prior to commencement of service</u>, Cameron LNG should develop procedures for offsite contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by Cameron LNG staff.**

- **<u>Prior to commencement of service</u>, Cameron LNG should label piping with fluid service and direction of flow in the field in addition to the pipe labeling requirements of NFPA 59A.**
- **<u>Prior to commencement of service</u>, Cameron LNG should specify an alarm management program to ensure effectiveness of process alarms.**
- **<u>Prior to commencement of service</u>, Cameron LNG should notify FERC staff of any proposed developments to the security plan of the facility.**
- **<u>Prior to commencement of service</u>, progress on the construction of the proposed systems should be reported in <u>monthly</u> reports filed with the Secretary. Details should include a summary of activities, problems encountered, contractor non-conformance/deficiency logs, remedial actions taken, and current project schedule. Problems of significant magnitude should be reported to the FERC <u>within 24 hours</u>.**

In addition, we are recommending that the following measures should apply throughout the life of the facility:

- **The facility should be subject to regular FERC staff technical reviews and site inspections on at least an <u>annual basis</u> or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Cameron LNG should respond to a specific data request, including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed P&IDs reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, should be submitted.**
- **Semi-annual operational reports should be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil-off/flash gas, etc.), plant modifications, including future plans and progress thereof. Abnormalities should include, but not be limited to: unloading/loading/shipping problems, potential hazardous conditions from off-site vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluid releases, fires involving hazardous fluids, negative pressure (vacuum) within a storage tank, and higher than predicted boil-off rates. Adverse weather conditions and the effect on the facility also should be reported. Reports should be submitted <u>within 45 days after each period ending June 30 and December 31</u>. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" also should be**

included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility.

- **In the event the temperature of any region of any secondary containment, including imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission should be notified <u>within 24 hours</u> and procedures for corrective action should be specified.**
- **Significant non-scheduled events, including safety-related incidents (e.g., hazardous fluid releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) should be reported to the FERC staff. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made <u>immediately</u>, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification should be made to the FERC staff <u>within 24 hours</u>. This notification practice should be incorporated into the LNG facility's emergency plan. Examples of reportable hazardous fluids-related incidents include:**

  a. fire;

  b. explosion;

  c. estimated property damage of $50,000 or more;

  d. death or personal injury necessitating in-patient hospitalization;

  e. release of hazardous fluids for 5 minutes or more;

  f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

  g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

  h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;

  i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;

  j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

  k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;

l. **safety-related incidents occurring at or en route to and from the LNG facility involving hazardous fluids; or**

m. **an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.**

- **In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, the FERC staff would determine the need for a separate follow-up report or follow-up in the upcoming semi-annual operational report. All company follow-up reports should include investigation results and recommendations to minimize a reoccurrence of the incident.**

In addition to the final design review, we would conduct inspections during construction and would review additional materials, including quality assurance and quality control plans, non-conformance reports, and commissioning plans, to ensure that the installed design is consistent with the safety and operability characteristics of the FEED. We would also conduct inspections during operation to ensure that the facility is operated and maintained in accordance with the filed design throughout the life of the facility. Based on our analysis and recommendations presented above, we conclude that the FEED presented by Cameron LNG would include acceptable layers of protection or safeguards which would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public.

2.7.4 LNG Facility Siting Requirements

The principal hazards associated with the substances involved in the liquefaction of LNG result from cryogenic and flashing liquid releases; flammable vapor dispersion; vapor cloud ignition; pool fires; BLEVEs, and overpressures. As discussed in section 2.7.3, our FEED review indicates that sufficient layers of protection would be incorporated into the facility design to mitigate the potential for an initiating event to develop into an incident that could impact the safety of the off-site public. Siting of the facility with regard to potential off-site consequences is required by DOT's regulations in 49 CFR 193, Subpart B to help ensure that impact to the public would be minimized. The Commission's regulations under 18 CFR 380.12(o)(14) require Cameron LNG to identify how the proposed design complies with the DOT's siting requirements. The following sections of Part 193 specifically address the siting requirements applicable to each LNG container and LNG transfer system:

- Part 193.2001, Scope of part, excludes any matter other than siting provisions pertaining to marine cargo transfer systems between the marine vessel and the last manifold or valve immediately before a storage tank;
- Part 193.2051, Scope, states that each LNG facility designed, replaced, relocated or significantly altered after March 31, 2000, must be provided with siting requirements in accordance with Subpart B and NFPA 59A (2001). In the event

of a conflict with NFPA 59A (2001), the regulatory requirements in Part 193 prevail;

- Part 193.2057, Thermal radiation protection, requires that each LNG container and LNG transfer system have thermal exclusion zones in accordance with Section 2.2.3.2 of NFPA 59A (2001); and
- Part 193.2059, Flammable vapor-gas dispersion protection, requires that each LNG container and LNG transfer system have a dispersion exclusion zone in accordance with sections 2.2.3.3 and 2.2.3.4 of NFPA 59A (2001).

For the LNG facilities proposed for the Expansion Project, these Part 193 siting requirements would be applicable to the following equipment:

- one 42,267,526 gallon (net) full containment LNG storage tank and associated piping and appurtenances - Parts 193.2057 and 2059 require the establishment of thermal and flammable vapor exclusion zones for LNG tanks. NFPA 59A (2001), section 2.2.3.2 specifies four thermal exclusion zones based on the design spill and the impounding area. NFPA 59A (2001), sections 2.2.3.3 and 2.2.3.4 specify a flammable vapor exclusion zone for the design spill which is determined with Section 2.2.3.5;
- a 30-inch-diameter LNG header used for ship loading - Parts 193.2001, 2057, and 2059 require thermal and flammable vapor exclusion zones for the marine cargo transfer system. NFPA 59A (2001) does not address LNG transfer systems;
- four 10,127-gpm in-tank pumps and associated piping and appurtenances for the proposed LNG storage tank; and two 6,058-gpm LNG product pumps (two per liquefaction train; one operating and one spare) and associated piping and appurtenances - Parts 193.2057 and 2059 require thermal and flammable vapor exclusion zones. NFPA 59A (2001) section 2.2.3.2 specifies the thermal exclusion zone and sections 2.2.3.3 and 2.2.3.4 specify the flammable vapor exclusion zone based on the design spills for containers and process areas; and
- two liquefaction heat exchangers (one per liquefaction train) and associated piping and appurtenances, including a 24-inch-diameter LNG rundown line - Parts 193.2057 and 2059 require thermal and flammable vapor exclusion zones. NFPA 59A (2001) section 2.2.3.2 specifies the thermal exclusion zone and section 2.2.3.4 specifies the flammable vapor exclusion zone based on the design spills for process areas.

Previous FERC environmental assessments/impact statements for past projects have identified inconsistencies and areas of potential conflict between the requirements in Part 193 and NFPA 59A (2001). Sections 193.2057 and 193.2059 require exclusion zones for each LNG container and LNG transfer system, and an LNG transfer system is defined in Section 193.2007 to include cargo transfer system and transfer piping (whether permanent or temporary). However, NFPA 59A (2001) requires exclusion zones only for "transfer areas," which is defined as the part of the plant where the facility introduces or removes the liquids, such as truck loading or ship-unloading areas. The NFPA 59A (2001) definition does not include permanent plant piping, such as cargo transfer lines. Section 2.2.3.1 of NFPA 59A (2001) also states that transfer areas at the water edge of marine terminals are not subject to the siting requirements in that standard.

The DOT has addressed some of these issues in a March 2010 letter of interpretation. In that letter, DOT stated that: (1) the requirements in the NFPA 59A (2001) for transfer areas for LNG apply to the marine cargo transfer system at a proposed waterfront LNG facility, except where preempted by the regulations in Part 193; (2) the regulations in Part 193 for LNG transfer systems conflict with NFPA 59A (2001) on whether an exclusion zone analysis is required for transfer piping or permanent plant piping; and (3) the regulations in Part 193 prevailed as a result of that conflict. The DOT has determined that an exclusion zone analysis of the marine cargo transfer system is required.

In the FERC environmental assessments/impact statements for past projects, we have also noted that when the DOT incorporated NFPA 59A into its regulations, it removed the regulation that required impounding systems around transfer piping. As a result of that change, it is unclear whether Part 193 or the adopted sections of NFPA 59A (2001) require impoundments for LNG transfer systems. We note that Part 193 requires exclusion zones for LNG transfer systems, and that those zones were historically calculated based on impoundment systems. We also note that the omission of containment for transfer piping is not a sound engineering practice. For these reasons, we generally recommend containment for all LNG transfer piping within a plant's property lines.

Federal regulations issued by the Occupational Safety and Health Administration (OSHA) under 29 CFR 1910.119 (Process Safety Management of Highly Hazardous Chemicals [PSM]), and the EPA under 40 CFR 68 (Chemical Accident Prevention Provisions) cover hazardous substances, such as methane, propane, and ethylene at many facilities in the U.S. However, OSHA and EPA regulations are not applicable to facilities regulated under 49 CFR 193. On October 30, 1992, shortly after the promulgation of the OSHA Process Safety Management regulations, OSHA issued a letter of interpretation that precluded the enforcement of PSM regulations over gas transmission and distribution facilities. In a subsequent letter on December 9, 1998, OSHA further clarified that this letter of interpretation applies to LNG distribution and transmission facilities.

In addition, EPA's preamble to its final rule in Federal Register, Volume 63, Number 3, 639 645, clarified that exemption from the requirements in 40 CFR 68 for regulated substances in transportation, including storage incident to transportation, is not limited to pipelines. The preamble further clarified that the transportation exemption applies to LNG facilities subject to oversight or regulation under 49 CFR 193, including facilities used to liquefy natural gas or used to transfer, store, or vaporize LNG in conjunction with pipeline transportation. Therefore, the above OSHA and EPA regulations are not applicable to facilities regulated under 49 CFR 193. As stated in Section 193.2051, LNG facilities must be provided with the siting requirements of NFPA 59A (2001 edition). The siting requirements for flammable liquids within an LNG facility are contained in NFPA 59A, Chapter 2:

- NFPA 59A, section 2.1.1 requires consideration of clearances between flammable refrigerant storage tanks, flammable liquid storage tanks, structures and plant equipment, both with respect to plant property lines and each other. This section also requires that other factors applicable to the specific site that have a bearing on the safety of plant personnel and surrounding public be considered, including an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility.

- NFPA 59A section 2.2.2.2 requires impoundments serving flammable refrigerants or flammable liquids to contain a 10-minute spill of a single accidental leakage source or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the DOT. In addition, NFPA Section 2.2.2.5 requires impoundments and drainage channels for flammable liquid containment to conform to NFPA 30, Flammable and Combustible Liquids Code.
- NFPA 59A section 2.2.3.2 requires provisions to minimize the damaging effects of fire from reaching beyond a property line, and requires provisions to prevent a radiant heat flux level of 1,600 British thermal units per square foot per hour (BTU/ft^2-hr) from reaching beyond a property line that can be built upon. The distance to this flux level is to be calculated with LNGFIRE or using models that have been validated by experimental test data appropriate for the hazard to be evaluated and that are acceptable to DOT.
- NFPA 59A section 2.2.3.4 requires provisions to minimize the possibility of any flammable mixture of vapors from a design spill from reaching a property line that can be built upon and that would result in a distinct hazard. Determination of the distance that the flammable vapors extend is to be determined with DEGADIS or alternative models that take into account physical factors influencing LNG vapor dispersion. Alternative models must have been validated by experimental test data appropriate for the hazard to be evaluated and must be acceptable to DOT. Section 2.2.3.5 requires the design spill for impounding areas serving vaporization and process areas to be based on the flow from any single accidental leakage source.

For the following liquefaction facilities that are proposed for the Expansion Project, the FERC staff identified that the refrigerant siting requirements from Part 193 and NFPA 59A would be applicable to the following refrigerant and condensate equipment:

- two liquefaction heat exchangers (one per liquefaction train) and associated piping and appurtenances;
- mixed refrigerant compressors and associated piping;
- propane compressors and associated piping; and
- one 993,600-gallon stabilized condensate product storage tanks.

2.7.5 Siting Analysis

Impoundment Sizing

Suitable sizing of impoundment systems and selection of design spills on which to base hazard analyses are critical for establishing an appropriate siting analysis. Although impoundment capacity and design spill scenarios for storage tank impoundments are well described by Part 193, a clear definition for other impoundments is not provided either directly by the regulations or by the adopted sections of NFPA 59A (2001). Under NFPA 59A (2001) section 2.2.2.2, the capacity of impounding areas for vaporization, process, or LNG transfer areas must equal the greatest volume that can be discharged from any single accidental leakage source during a 10-minute period or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the DOT.

We recommend impoundments be sized based on the greatest flow capacity from any single pipe for 10 minutes, while recognizing that different spill scenarios may be used for the single accidental leakage sources for the hazard calculations required by Part 193. A similar approach is used with impoundments for process vessels. We also recommend these impoundments be able to contain the contents of the largest process vessel served, while recognizing that smaller design spills may be appropriate for Part 193 calculations.

Part 193.2181 references NFPA 59A (2001) for siting, which specifies each impounding system serving an LNG storage tank must have a minimum volumetric liquid capacity of 110 percent of the LNG tank's maximum design liquid capacity for an impoundment serving a single tank. We also consider it prudent design practice to provide a barrier to prevent liquid from flowing to an unintended area (i.e., outside the plant property) in the event that the full containment storage tank primary and secondary containers have a common cause failure. The purpose of the barrier is to prevent liquid from flowing off the plant property, and does not define containment or an impounding area for thermal radiation or flammable vapor exclusion zone calculations or other code requirements already met by sumps and impoundments throughout the site.

Table 2.7-3 lists the spill volumes and their corresponding impoundment systems. For the Expansion Project, Cameron LNG proposes one full containment LNG storage tank where the outer tank wall would serve as the impoundment system. The proposed LNG storage tank would have a design maximum volume of 44,769,588 gallons. As shown in table 2.7-3, the outer tank would have a volumetric capacity of 52,199,423 gallons, which exceeds the 110 percent requirement by 2,952,876 gallons. The outer tank would contain 116 percent the design capacity of the inner tank, meeting the Part 193 requirements. The Cameron LNG Terminal has an existing earthen storm surge barrier around the perimeter of the facility, which also serves to limit liquid from flowing off the plant property in the case of a common cause failure of the existing full containment storage tank primary and secondary containers. Cameron LNG would extend this storm surge barrier around the proposed LNG storage tank. The existing storm surge barrier structure was constructed with a volume equivalent to one full storage tank. The new portion of the barrier surrounding the proposed LNG storage tank would increase this holding capacity and would meet our recommendation that a barrier be provided to prevent liquid from flowing off plant property.

TABLE 2.7-3 Impoundment Area Sizing			
Source	**Spill Size (gallons)**	**Impoundment System**	**Impoundment Size (gallons)**
LNG Storage Tank	44,769,588	Outer Tank Concrete Wall	52,199,423
30-inch Ship Loading Header	1,000,910	Existing LNG Impoundment Basin	781,510
LNG Rundown Line (south)	412,680	Existing LNG Impoundment Basin	781,510
LNG Rundown Line (trains 1-2)	176,200	Existing Liquefaction Train Impoundment	235,530
LNG Rundown Line (trains 3-5)	205,780	New Liquefaction Train Impoundment	206,820
24-inch MRL Process Piping	109,290	New Liquefaction Train Impoundment	206,820
Condensate Storage Tank	993,600	Condensate Containment	1,247,220
Diesel Storage Tank	54,150	Diesel Containment	62,950

One new LNG storage tank was previously authorized under docket CP13-25-000. The Expansion Project would include an additional LNG storage tank at the Cameron LNG Terminal. Cameron LNG proposes to install a new 30-inch-diameter LNG sendout header that delivers a combined flow from the two new LNG storage tanks to the existing 30-inch-diameter ship loading header. Potential spills occurring from the new 30-inch-diameter LNG sendout header would drain toward the concrete troughs and would be directed to the existing LNG Impoundment Basin. The existing LNG Impoundment Basin is 85-feet-long, 60.7-feet-wide, and 21.25-feet-deep, with a usable containment capacity (i.e. volume below the trench entrance) of 781,510 gallons. The existing LNG Impoundment Basin is within the existing storm surge barrier at the center of the Cameron LNG Terminal vaporization area, the existing LNG storage tank area, and the south jetty area. Cameron LNG determined a guillotine rupture of the new 30-inch-diameter header would result in a spill volume of 1,000,910 gallons. Each in-tank pump is rated for 10,120 gpm; however, the pump runout flow rate at the pump discharge may reach 12,384 gpm in the event of full-bore rupture due to negligible back pressure. The total spill volume of 1,000,910 gallons results from a 10-minute spill from six in-tank pumps operating in parallel at pump runout flow rate in addition to the liquid volume within over 7,000 feet of piping. The spill volume from the 30-inch-diameter header would exceed the existing LNG Impoundment Basin containment capacity by 219,400 gallons and back flow into the trench system. Staff analyzed the vapor dispersion results to determine whether the LNG backing up into the trench system would disperse to congested area and present additional risk beyond the initiating event from the 30 inch diameter header. Because the evaporation rate significantly reduces after the trench is wetted, and the liquid pool stabilizes, and the size of the vapor cloud would begin to recede approximately 13 minutes after the spill. Staff concluded that the vapor cloud from LNG backing up into the trench system would be minimal in comparison to the initial vapor dispersion and would not present additional risk that could lead to cascading events. Therefore, the existing LNG Impoundment Basin and the connecting trench system would adequately contain a spill from the 30-inchdiameter LNG sendout- header from the new LNG storage tanks.

Cameron LNG proposes to install a 24-inch-diameter LNG rundown header to deliver LNG product from liquefaction trains 4 and 5 to the LNG storage tanks. Any spills from the 24-inchdiameter LNG rundown header located south of the liquefaction area would be directed to the existing LNG Impoundment Basin. Accounting for the pump runout flow rate of 8,158 gpm- for a 10-minute duration and the liquid inventory of approximately 2 miles of piping, a total spill volume of 412,680 gallons from the 24-inch-diameter LNG rundown line would be contained in the existing LNG Impoundment Basin. Any spills from the 24-inch-diameter LNG rundown header occurring between liquefaction trains 1 and 2 would be directed to the existing Liquefaction Train Impoundment, which was previously authorized under docket number CP13-25-000. The existing Liquefaction Train Impoundment would be 32-feet-long, 32-feet-wide, and 30.75-feet-deep, with a usable volume of 235,530 gallons. The existing Liquefaction Train Impoundment would be approximately 270 feet east of liquefaction Train 2. Accounting for pump runout and piping inventory, a spill from this segment would result in a spill volume of 176,200 gallons and would be contained within the existing Liquefaction Train Impoundment.

Cameron LNG proposes to construct a new Liquefaction Train Impoundment approximately 400 feet east of liquefaction Train 3 and 800 feet north of the existing Liquefaction Train Impoundment to contain possible LNG and other hydrocarbon liquid spills from liquefaction trains 4 and 5. The Liquefaction Train Impoundment would be 32-feet-long, 32-feet-wide, and 27-feet-deep, with a usable containment capacity of 206,820 gallons. The largest spill into the new Liquefaction Train Impoundment would be from a guillotine rupture of the 24-inch-diameter LNG rundown line. With two LNG product pumps operating in parallel during liquefaction at pump runout flow rate in addition to the liquid volume within approximately 3,000 feet of piping, the total spill volume from the 24-inch-diameter LNG rundown line would be 205,780 gallons. The largest refrigerant liquid spill from the liquefaction trains would be a 10-minute spill volume of 109,290 gallons from the 24-inch-diameter Mixed Refrigerant Liquid process piping. This spill would also be contained in the proposed Liquefaction Train Impoundment.

Cameron LNG proposes to install a new 993,600-gallon stabilized condensate product storage tank adjacent to the previously authorized stabilized condensate product storage tanks. The new condensate product storage tank would be located within a 166.5-foot-long by 166.5-foot-wide by 7-foot-high concrete pad and wall. The concrete wall would have a usable volumetric capacity of 1,247,220 gallons and would hold the entire contents of the stabilized condensate product storage tank.

Cameron LNG also proposes to install a 54,150-gallon diesel storage tank that would be used for the firewater system and emergency generators. The diesel storage tank would be within a 42-foot-long by 42-foot-wide by 5-foot-high concrete pad and wall. The concrete wall would have a usable volumetric capacity of 62,950 gallons and would hold the entire contents of the diesel storage tank.

Design Spills

Design spills are used in the determination of the hazard calculations required by Part 193. Prior to the incorporation of NFPA 59A in 2000, the design spill in Part 193 assumed the full rupture of "a single transfer pipe which has the greatest overall flow capacity" for not less than 10 minutes (old Part 193.2059(d)). With the adoption of NFPA 59A, the basis for the design spill for impounding areas serving only vaporization, process, or LNG transfer areas became the flow from any single accidental leakage source. Neither Part 193 nor NFPA 59A (2001) defines "single accidental leakage source."

In a letter to the FERC staff, dated August 6, 2013, DOT requested that LNG facility applicants contact the Office of Pipeline Safety's Engineering and Research Division regarding the Part 193 siting requirements.[22] Specifically, the letter stated that DOT required a technical review of the applicant's design spill criteria for single accidental leakage sources on a case-by-case basis to determine compliance with Part 193.

In response, Cameron LNG provided DOT with its design spill criteria and identified leakage scenarios for the proposed equipment. DOT reviewed the data and methodology Cameron LNG used to determine the design spills based on the flow from various leakage sources including piping, containers, and equipment containing LNG, refrigerants, and flammable fluids. On December 24, 2015, DOT provided a letter to the FERC staff stating that DOT had no objection to Cameron LNG's methodology for determining the candidate design spills to be used in establishing the Part 193 siting requirements for the proposed LNG liquefaction facilities.[23] [24] The design spills produced by this method were identified in the documents reviewed by DOT and have been filed in the docket for this project. These are the same design spills described in the following sections.

DOT's conclusions on the candidate design spills used in the siting calculations required by Part 193 was based on preliminary design information which may be revised as the engineering design progresses. If Cameron LNG's design or operation of the proposed facility differs from the details provided in the documents on which DOT based its review, then the facility may not comply with the siting requirements of Part 193. As a result, **we recommend that:**

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22 August 6, 2013 Letter from Kenneth Lee, Director of Engineering and Research Division, Office of Pipeline Safety to Terry Turpin, LNG Engineering and Compliance Branch, Office of Energy Projects. Filed in Docket Number CP13-25 on August 13, 2013. Accession Number 20130813-4019

23 December 24, 2015 Letter "Re: Cameron LNG Expansion Project, FERC Docket CP15-560, Design Spill Determination" from Kenneth Lee to Terry L. Turpin. Filed in Docket Number CP15-560-000 on December 28, 2015. Accession Number 20151228-4001

24 The Pipeline and Hazardous Materials Safety Administration (PHMSA) based this decision on the following documents: (1) Resource Reports 1, 11, and 13, FERC Docket Accession Number 20150928-5250; (2) Supplemental Information of Cameron LNG, LLC Regarding Vapor Dispersion Analysis, FERC Docket Accession Number 20151116-5244 & 5245; (3) U.S.DOT Letter of No Objection to FERC, PHMSA Design Spill Determination, dated November 18, 2013, FERC Docket Accession Number: 20131121-4000; (4) Exclusion Zone Report, FERC Docket Accession Number 20121207-5141; (5) Exclusion Zone Analysis – Report Addendum A, FERC Docket Accession Number 20121221-5251; (6) Exclusion Zone Analysis – Report Addendum B, FERC Docket Accession Number: 20130208-5157; and (7) CFD Modeling of Updated Release Scenarios, FERC Accession Number 20140908-5022.

- **<u>Prior to the construction of the final design</u>, Cameron LNG should file with the Secretary for review and written approval by the Director of OEP, certification that the final design is consistent with the information provided to DOT as described in the design spill determination letter dated December 24, 2015 (Accession Number 20151228-4001). In the event that any modifications to the design alters the candidate design spills on which the 49 CFR 193 siting analysis was based, Cameron LNG should consult with DOT on any actions necessary to comply with Part 193.**

As design spills vary depending on the hazard (vapor dispersion, overpressure or radiant heat), the specific design spills used for the Cameron LNG siting analysis are discussed under "Vapor Dispersion Analysis" and "Thermal Radiation Analysis" in this section.

<u>Vapor Dispersion Analysis</u>

As discussed in section 2.7.2, a large quantity of LNG spilled without ignition would form a flammable vapor cloud that would travel with the prevailing wind until it either dispersed below the flammable limit or encountered an ignition source. In order to address this hazard, 49 CFR 193.2059 requires each LNG container and LNG transfer system to have a dispersion exclusion zone in accordance with sections 2.2.3.3 and 2.2.3.4 of NFPA 59A (2001). Taken together, Part 193 and NFPA 59A (2001) require that flammable vapors either from an LNG tank impoundment or a single accidental leakage source do not extend beyond a facility property line that can be built upon. This is the Part 193 standard that we used in analyzing the siting of the proposed Project.

Title 49 CFR 193.2059 requires that dispersion distances be calculated for a 2.5 percent average gas concentration (one-half the LFL of LNG vapor) under meteorological conditions which result in the longest downwind distances at least 90 percent of the time. Alternatively, maximum downwind distances may be estimated for stability Class F, a wind speed of 4.5 mph, 50 percent relative humidity, and the average regional temperature.

The regulations in Part 193 specifically approve the use of two models for performing these dispersion calculations, DEGADIS and FEM3A. The use of alternative models is also allowed, but must be specifically approved by the DOT. Although Part 193 does not require the use of a particular source term model, modeling of the spill and resulting vapor production is necessary prior to the use of vapor dispersion models.

In August 2010, the DOT issued Advisory Bulletin ADB-10-07 to provide guidance on obtaining approval of alternative vapor-gas dispersion models under Subpart B of 49 CFR 193. In October 2011, two dispersion models were approved by DOT for use in vapor dispersion exclusion zone calculations: PHAST-UDM Version 6.6 and Version 6.7 (submitted by Det Norske Veritas) and FLACS Version 9.1 Release 2 (submitted by GexCon). PHAST 6.7 and FLACS 9.1, with their built-in source term models, were used to calculate dispersion distances.

Cameron LNG reviewed multiple releases for the liquid scenarios and for the flashing and jetting scenarios. Cameron LNG used the following conditions, corresponding to 49 CFR 193.2059, for the vapor dispersion calculations: ambient temperature of 68°F, relative humidity of 50 percent, wind speed of 4.5 mph, atmospheric stability class of F and a ground surface roughness of 0.03 m. In addition, a sensitivity analysis to the wind speed and direction was provided to demonstrate the longest predicted downwind dispersion distance in accordance with the PHAST and FLACS Final Decisions.

Cameron LNG accounted for the facility geometry, including the impoundment and trench geometry details as established by available plant layout drawings. The plant geometry accounts for any on-site wind channeling that could occur. The releases were initiated after sufficient time had passed in the model simulations to allow the wind profile to stabilize from effects due to the presence of buildings and other on-site obstructions.

2.7.5.1.1 Vapor Dispersion Design Spill Analyses for LNG

As required by 49 CFR 193, design spills from containers with over the top withdrawal lines and no bottom penetrations should be the largest flow from the container (i.e., storage tank) withdrawal pumps for a 10-minute duration at full-rated capacity. With all four in-tank pumps operating at the pump runout flow rate, the maximum flow rate from the LNG storage tank withdrawal would be 49,536 gpm. However, Cameron LNG specified the design spill from the new LNG storage tank area as a guillotine rupture of the 30-inch-diameter sendout header (i.e., liquid scenario) from two LNG storage tanks, which resulted in a flow rate of 73,700 gpm from six in-tank pumps operating in parallel at pump runout flow rate. This spill volume would exceed the maximum flow rate from the new LNG storage tank withdrawal line when all 4 in-tank pumps operate at their maximum pump runout flow rate. This liquid spill would be directed into the existing LNG Impoundment Basin via the conveyance trench system. FLACS Version 9.1 was used to predict the extent of the ½-LFL vapor cloud. Cameron LNG's FLACS simulation also accounted for the vapor dispersion contributed from the liquid inventory from the piping after the 10-minute release duration.

Table 2.7-4 shows the governing LNG release scenarios from the LNG storage tank area and liquefaction area. In addition to the liquid spill scenarios at the LNG storage tank area due to guillotine ruptures of the 30-inchdiameter sendout- header (i.e., scenario 1 in Table 2.7-4), Cameron LNG also considered releases from piping connections and small holes, which resulted in mainly vapor releases and negligible liquid rainout fraction (i.e., jetting and flashing scenarios). Scenario 2 in table 2.7-4 shows a 2-inch hole release from the in-tank pump discharge header. A release from the in-tank pump discharge header may occur anywhere along the height of the LNG storage tank; however, as indicated in the April 2014 EIS for the Cameron Liquefaction Project under docket CP13-25-000, the ½-LFL vapor clouds from releases at the top and middle of the LNG storage tank would not reach the ground level. Therefore, Cameron LNG only considered a jetting and flashing release from the in-tank pump discharge header at the tank base. We agree with this assessment.

TABLE 2.7-4 LNG Design Spills					
Scenario	**Location**	**Hole Diameter (inch)**	**Pressure (psig)**	**Temperature (ºF)**	**Flow Rate (lb/hr)**
1	Tank Sendout Header (liquid scenario)	30	Ambient	-258	16.27E6
2	In-tank Pump Discharge (jetting/flashing)	2	135	-258	0.28E6
3	Tank Sendout Header (jetting/flashing)	2	109	-258	0.25E6
4	LNG Rundown (North) (liquid scenario)	24	Ambient	-258	3.60E6
5	LNG Rundown (South) (liquid scenario)	24	Ambient	-258	3.60E6
6	LNG Product Pump (jetting/flashing)	3	85	-257	0.50E6

Scenario 3 in table 2.7-4 shows the 2-inch hole release from the 30-inch-diameter sendout header. Cameron LNG proposed to install a jet-momentum barrier located 18 feet downstream of the potential release location in order to break up the momentum of the LNG jet from this release. The barrier would be attached to the pipe rack structure and would be 8.9 feet above ground level. The barrier would measure 46 feet wide and 26 feet tall. Figure 3 shows the location of the momentum barrier. In order to ensure that the jet-momentum barrier is maintained throughout the life of the facility, **we recommend that:**

- **<u>Prior to construction of the final design</u>, Cameron LNG should file with the Secretary for review and written approval by the Director of OEP the procedures to maintain and inspect the barriers provided to meet the siting provisions of 49 CFR 193.2059. This information should be filed <u>a minimum of 30 days</u> before approval to proceed is requested.**

The highest rate of LNG flow (i.e. liquid scenario) from the liquefaction area would be from a guillotine rupture of the 24-inch-diameter LNG rundown header. A spill from the LNG rundown header may occur anywhere from the liquefaction area to the LNG storage tank area. Cameron LNG selected two spill locations including a spill between trains 4 and 5 (i.e., scenario 4) and a spill adjacent to Train 1 (i.e., scenario 5). With both LNG product pumps operating at the runout flow rate, the maximum flow rate from the 24-inch-diameter header would be 16,316 gpm. FLACS was used to predict the extent of the ½-LFL vapor cloud. Cameron LNG's FLACS simulation also accounted for the vapor dispersion added from the liquid inventory from the piping after the 10-minute release duration for both scenarios. The other LNG release from the liquefaction area would be from the rupture of a 3-inch piping connection from the LNG product pump discharge header (i.e., scenario 6).

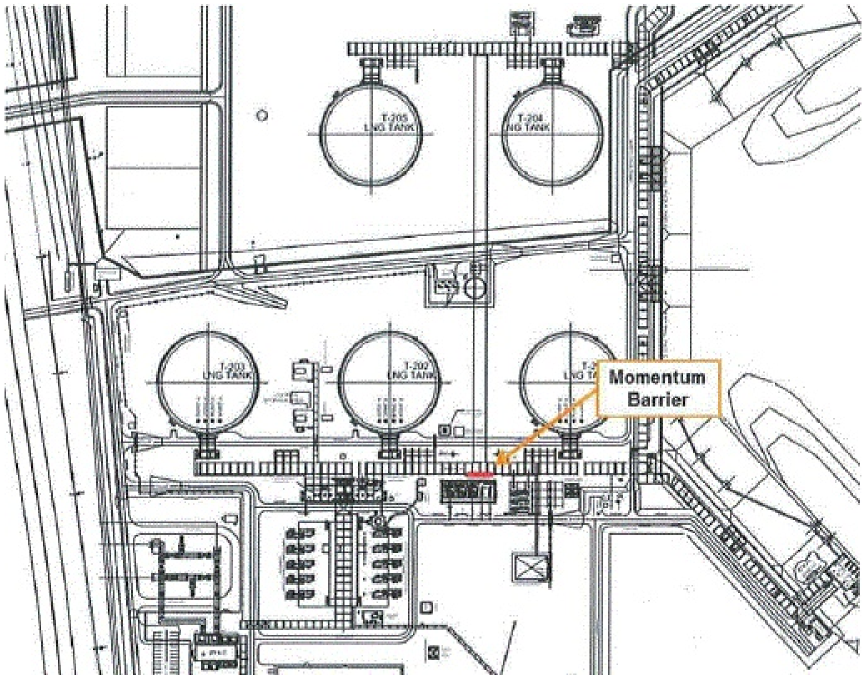

Figure 3: Location of the Momentum Barrier.

Figures 4 to 12 show the FLACS and PHAST (version 6.7) vapor dispersion results for the governing LNG release scenarios from the LNG storage tank area and liquefaction area. The red lines represent Cameron LNG's property lines.

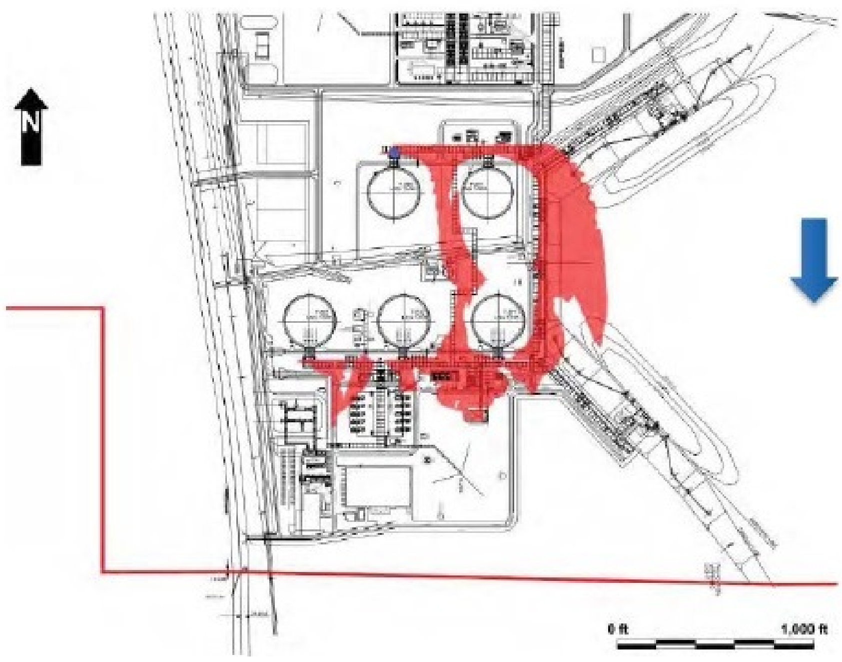

Figure 4: Time Composite Image of Vapor Dispersion for the Guillotine Release from the 30-inchdiameter Tank Sendout- Header with Wind from the North (Scenario 1).

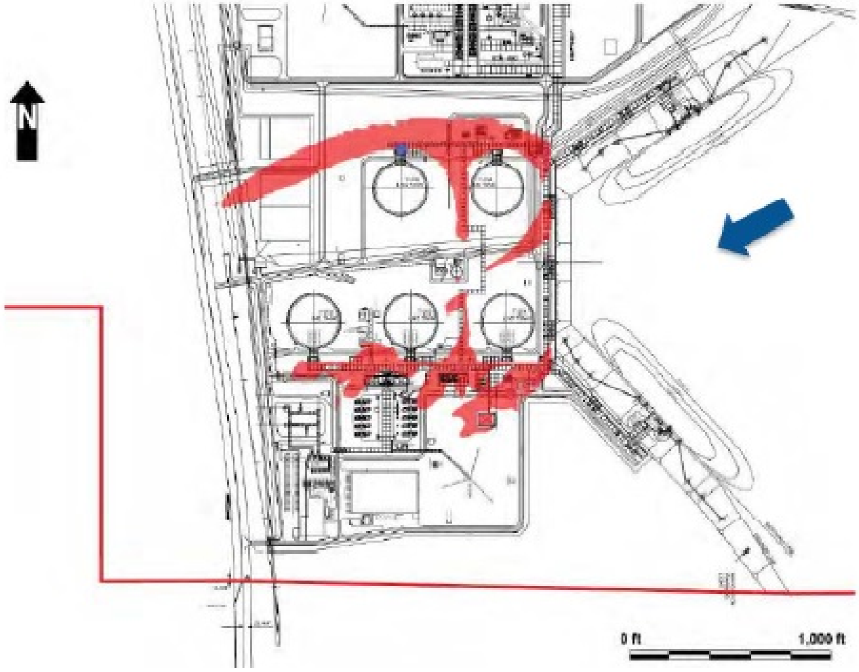

Figure 5: Time Composite Image of Vapor Dispersion for the Guillotine Release from the 30-inch-diameter Tank Sendout- Header with Wind from the Northeast (Scenario 1).

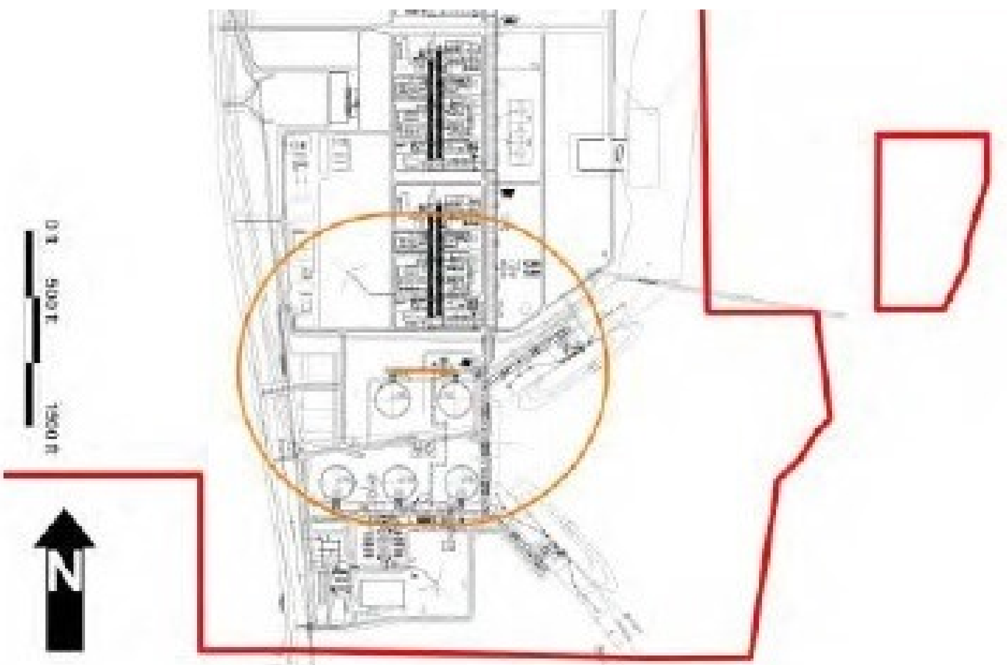

Figure 6: Flammable Vapor Exclusion for 2-inch Hole Release from the In-tank Pump Discharge Piping (Scenario 2).

Figure 7: Time Composite Image of Vapor Dispersion for the 2-inch hole Release from the Tank Sendout Header with Wind from the North (Scenario 3).

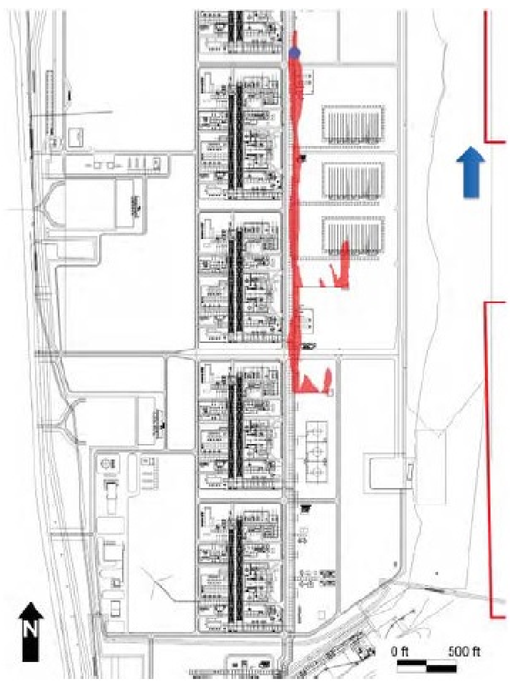

Figure 8: Time Composite Image of Vapor Dispersion for the Guillotine Release from the LNG Rundown Header at Liquefaction Trains 4 and 5 (Scenario 4) with Wind from the South.

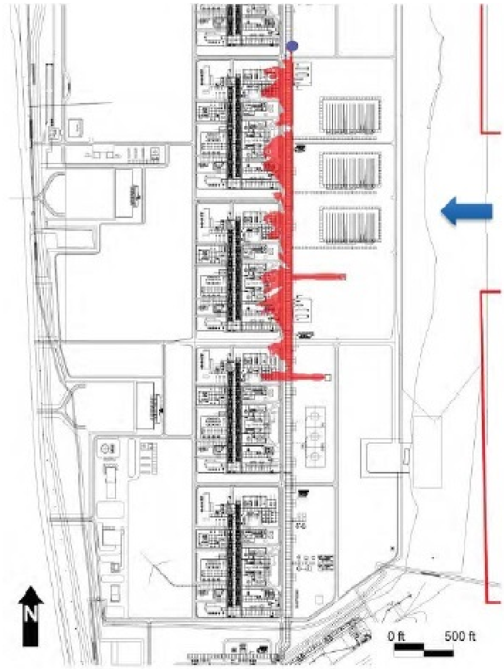

Figure 9: Time Composite Image of Vapor Dispersion for the Guillotine Release from the LNG Rundown Header at Liquefaction Trains 4 and 5 (Scenario 4) with Wind from the East.

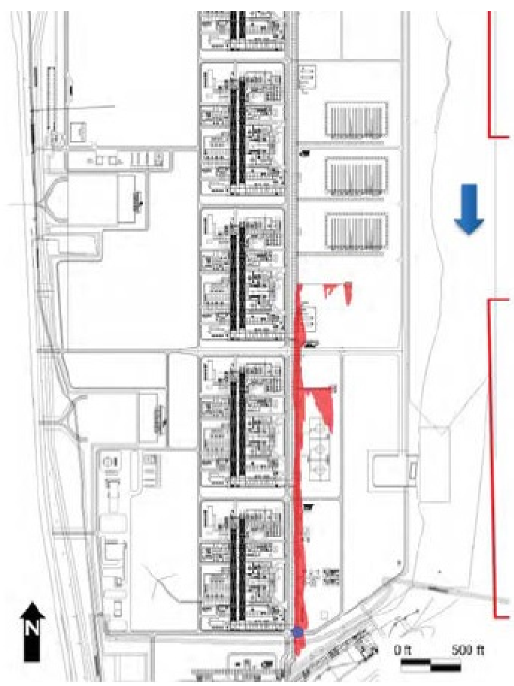

Figure 10: Time Composite Image of Vapor Dispersion for the Guillotine Release from the LNG Rundown Header at Liquefaction Train 1 (Scenario 5) with Wind from the North.

Figure 11: Time Composite Image of Vapor Dispersion for the Guillotine Release from the LNG Rundown Header at Liquefaction Train 1 (Scenario 5) with Wind from East.

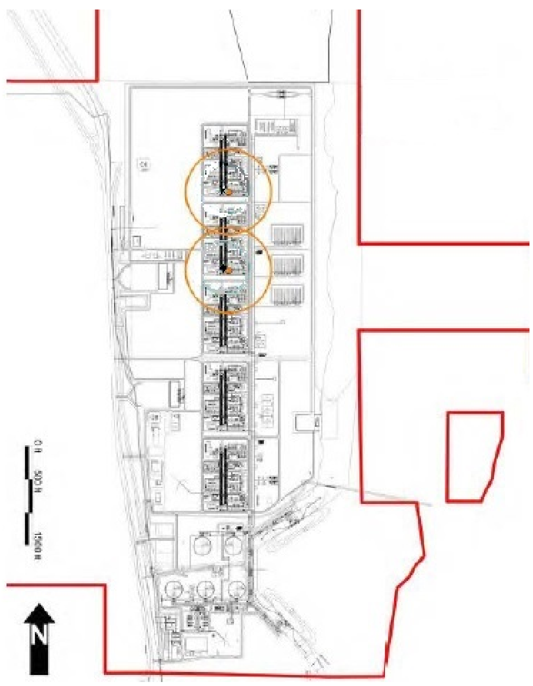

Figure 12: Flammable Vapor Exclusion Zone for a 3-inch Hole Release from the LNG Rundown Pump Discharge Header (Scenario 6).

As Cameron LNG's vapor dispersion analyses show the ½-LFL vapor cloud would stay within Cameron LNG property, we conclude that the siting of the proposed project would not have a significant impact on public safety. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of DOT's inspection and enforcement program.

2.7.5.1.2 Vapor Dispersion Analyses for Other Hazardous Fluids

In addition to the LNG releases evaluated above, Cameron LNG considered other release scenarios from the MRL process system, the propane pre-cool system, and the heavy hydrocarbon removal system at the liquefaction process area based on the design spill methodology selected by Cameron LNG and reviewed by DOT. All releases were modeled in PHAST as a horizontal release at various wind speeds and release elevations. Only the spills that produced the highest release rates and the longest ½-LFL vapor clouds are discussed in this section. Table 2.7-5 shows the release sizes that result in the highest rate of vapor flow for the refrigerant and stabilized condensate scenarios from the refrigerant storage area, liquefaction process area, and stabilized condensate storage area.

TABLE 2.7-5

Other Hazardous Fluid Design Spills

Scenario	Location	Hole Diameter (inch)	Pressure (psig)	Temperature (ºF)	Flow Rate (lb/hr)
1	MR Separator	4	778	-31	2.93E6
2	30-inch-diameter Propane	4	217	97	1.58E6
3	Heavy Liquid Removal	2	557	-84	0.74E6
4	Stabilized Condensate Storage	4	Amb	101	Instantaneous Release
5	Liquid Nitrogen Storage	3	174	-321	9.92E5

Scenario 1 represents the design spill for the rupture of a 4-inch drainage piping connection to the 24-inch-diameter Mixed Refrigerant Liquid main process piping to the Mixed Refrigerant Separator. Since liquefaction Train 5 would be closer to the north property line, Cameron LNG selected a 3-inch drainage piping in order to reduce the impact of the vapor dispersion hazard from that liquefaction train. PHAST results show a ½-LFL vapor dispersion distance of 2,650 feet from Train 4 and 1,900 feet from Train 5. The governing propane release at the liquefaction area would be from a rupture of the 4-inch drainage piping connection to the 30-inch-diameter liquid propane line that would be used to pre-cool the Mixed Refrigerant (i.e., scenario 2). PHAST result shows that the propane vapor cloud would disperse 1,890 feet from the release location. Cameron LNG also considered a design spill from the heavy removal equipment at the liquefaction area. Scenario 3 represents the release of a 2-inch hole in the heavy liquid removal stream from the Cold Recovery Exchanger to the High-High Pressure Separator. PHAST calculated a ½-LFL vapor dispersion distance of 1,870 feet.

In order to determine the longest ½-LFL vapor cloud distance for a release from the stabilized condensate storage area, Cameron LNG assumed the entire content of one stabilized condensate tank would be instantaneously spilled into the containment area. PHAST results show the ½ -LFL vapor dispersion distance of 1,300 feet.

Figures 13 to 17 provide the vapor dispersion results for the releases from mixed refrigerants, propane, heavy removal, and stabilized condensate piping and storage systems.

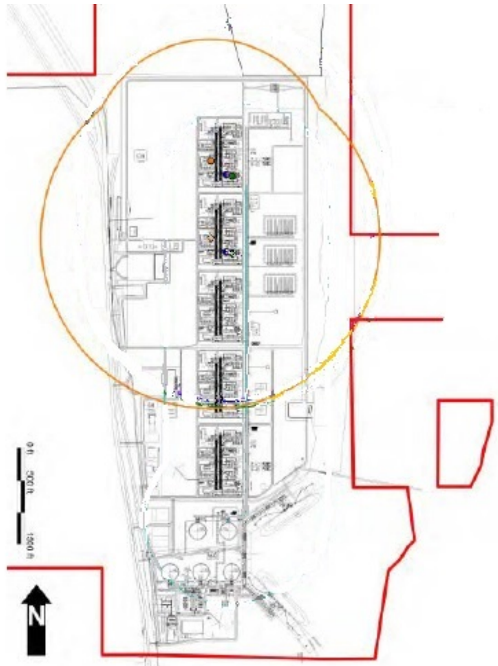

Figure 13: Flammable Vapor Exclusion Zone from for a 4-inch Mixed Refrigerant Release (Scenario 1).

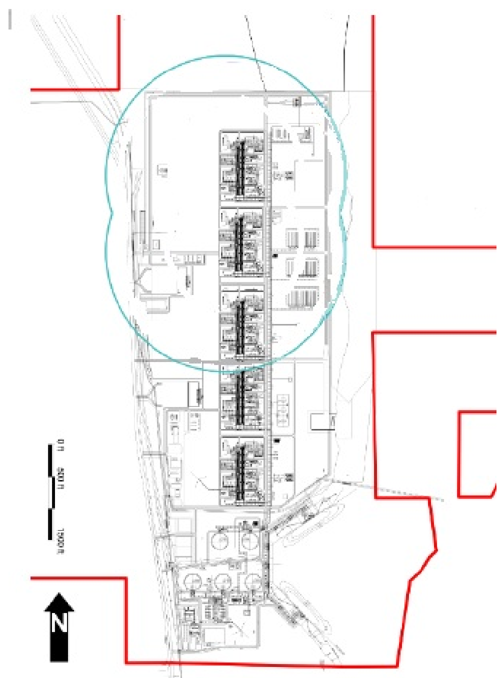

Figure 14: Flammable Vapor Exclusion Zone for a 4-inch Propane Release (Scenario 2).

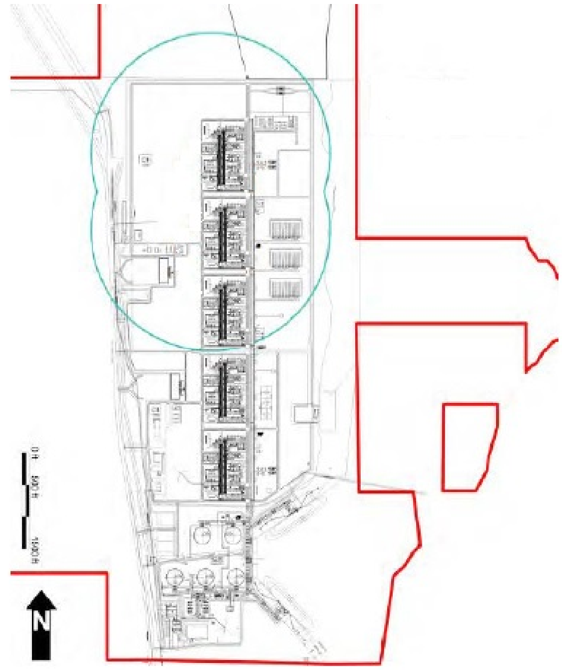

Figure 15: Flammable Vapor Exclusion Zone for a2-inch Heavy Hydrocarbon Release (Scenario 3).

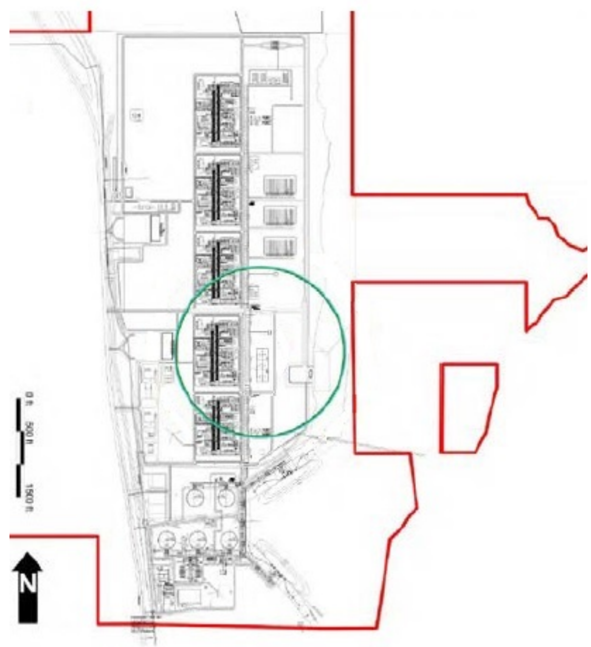

Figure 16: Flammable Vapor Exclusion Zone for Release from the Stabilized Condensate Storage Tank (Scenario 4).

Figure 13 shows the vapor dispersion from the mixed refrigerant release would extend over the Calcasieu Ship Channel. In this case, the DOT has not objected to the flammable vapor dispersion hazards extending over a navigable waterway. The distances to the ½-LFL vapor cloud for all propane and heavy hydrocarbon release scenarios would remain within the Cameron LNG property. We conclude that the siting of the proposed project would not have a significant impact on public safety. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of DOT's inspection and enforcement program.

Since the stabilized condensate would contain toxic products such as benzene, toluene, ethylbenzene, and xylenes, Cameron LNG used PHAST Version 6.7 to calculate the dispersion distances for a catastrophic failure of the proposed stabilized condensate storage tank. For the Expansion Project, Cameron LNG referred to section H2 from the DOT's LNG Plant Requirements: Frequently Asked Questions dated August 20, 2015 and modeled the vapor cloud to toxic threshold exposure limits based on the Emergency Response Planning Guidelines (ERPG) level 2. The ERPG level 2 was specified by the DOT as the preferred endpoint to calculate the dispersion of toxic substances. For ethyl benzene and xylenes which do not have an ERPG-2 value, Cameron LNG selected the Immediately Dangerous to Life or Health (IDLH) values as the toxic endpoint. Cameron LNG stated that the EPA's Risk Management Plan regulations commonly rely upon the IDLH values as the toxic endpoint for species with no ERPG-2. Table 2.7-6 shows the distances to the ERPG and IDLH values of benzene, toluene, ethyl benzene, and xylenes for a catastrophic failure scenario of the stabilized condensate storage tank.

TABLE 2.7-6

Acute Exposure Guideline Levels (in ppm) at 10 minutes From Stabilized Condensate Storage Tank using ERPG and IDLH Values

Substance	Toxic Endpoint (ppm)	ERPG-2 (feet)	IDLH (feet)
Benzene	150	1,640	-
Toluene	300	1,290	-
Ethyl Benzene	800	-	200
Xylenes	900	-	390

As stated in section 2.7.2.3, FERC staff prefers to use AEGLs because they are more inclusive and provide toxicity levels at various exposure times. Staff used PHAST to calculate the toxic vapor dispersion distances based on toxicity levels that were at ½-AEGL 1 for 1-hour exposure duration. Staff determined the design spill as a rupture of the 4-inch piping connection at the bottom of the stabilized condensate storage tank. PHAST results show that it would take approximately 12 hours to completely empty the stabilized condensate storage tank through the 4-inch hole. Table 2.7-7 shows the distances to the ½ -AEGL-1 of benzene, toluene, xylenes, and hexane for the release of stabilized condensate through the 4-inch hole at the bottom of the storage tank.

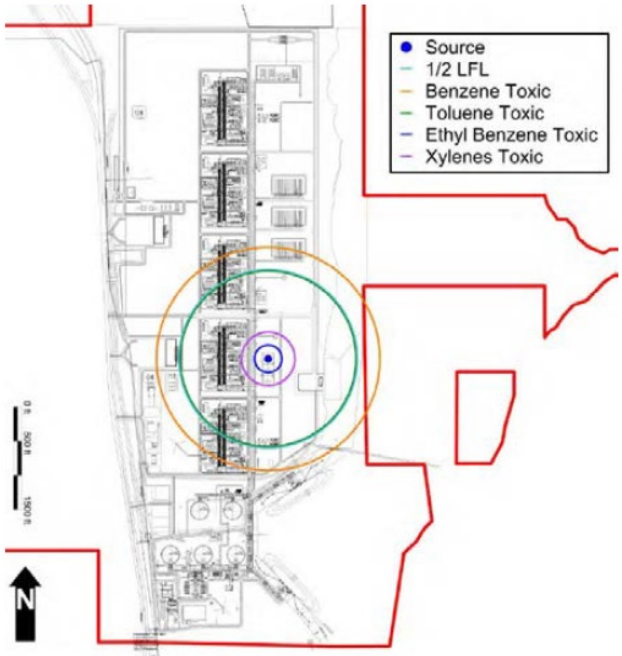

Figure 17: Toxic Vapor Dispersion for a Catastrophic Failure Scenario of the Stabilized Condensate Storage Tank.

TABLE 2.7-7

Acute Exposure Guideline Levels (in ppm) at 10 minutes Toxic Dispersion From Stabilized Condensate Storage Tank using AEGL Values

Substance	Duration (min)	½-AEGL 1 (feet)
Benzene	60	1,500
Toluene	60	1,310
Xylenes	60	1,210
Hexane	60	1,787

PHAST's results show that the distances to ERPG level 2 for benzene and ½-AEGL level for hexane would extend beyond Cameron LNG's west property line over to the water channel. There would be no residences, parks, hospitals, churches or other sensitive areas within these distances. The other toxic components due to a release from the stabilized condensate storage tank would remain within Cameron LNG's property. As a result, we conclude that the siting of the proposed project would not present a significant impact to the public with respect to the presence of the toxic components. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of DOT's inspection and enforcement program.

The Expansion Project would include an Air Separation Unit and liquid nitrogen tanks to store liquid nitrogen for use on-site. As discussed in the Vapor Dispersion section of 2.7.2, releases of nitrogen would result in asphyxiate hazards, where oxygen levels would be reduced below 19.5%. Cameron LNG selected a 3-inch piping connection from the liquid nitrogen tanks as the governing release scenario. PHAST was used to model the distance to the hazardous atmosphere. Figure 18 shows the distance to the hazardous atmosphere for a liquid nitrogen releases from the liquid nitrogen storage area.

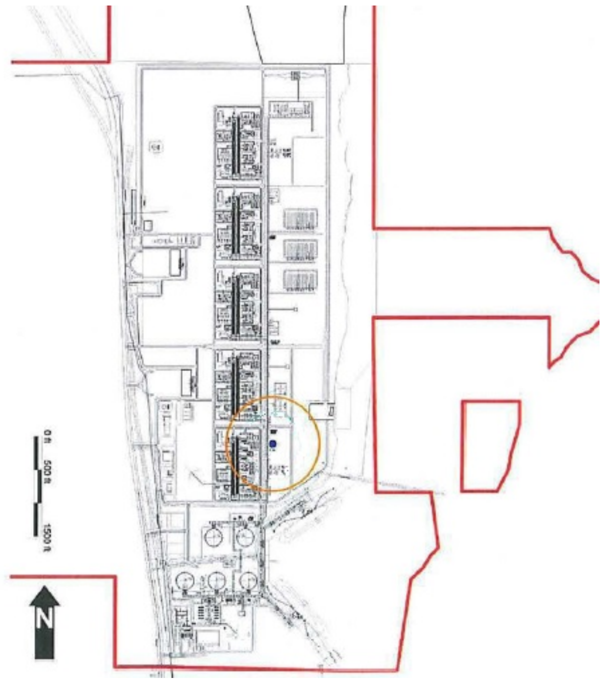

Figure 18: Distance to the Hazardous Atmosphere for a 3-inch Liquid Nitrogen Release from the Liquid Nitrogen Storage Area

The PHAST results indicate the endpoint distance of 705 feet, and Figure 18 indicate that the nitrogen vapor would remain within Cameron LNG's property. As a result, we conclude that the siting of the proposed project would not present a significant impact to the public with respect to asphyxiate hazards. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of DOT's inspection and enforcement program. Cameron LNG also proposes to consult with the nitrogen system supplier regarding safe practices and design. In order to limit the risk of asphyxiate hazards, we recommend that:

- **<u>Prior to construction of the final design,</u> Cameron LNG should file with the Secretary for review and written approval by the Director of OEP the plan and drawings to detect and notify plant personnel of asphyxiate hazards due to releases of liquid nitrogen and other hazardous fluids. This information should be filed <u>a minimum of 30 days</u> before approval to proceed is requested.**

2.7.5.1.3 Overpressure Considerations

As discussed in section 2.7.2.5, the propensity of a vapor cloud to detonate or produce damaging overpressures is influenced by the reactivity of the material, the level of confinement and congestion surrounding and within the vapor cloud, and the flame travel distance. It is possible that the prevailing wind direction may cause the vapor cloud to travel into a partially confined or congested area.

2.7.5.1.4 LNG Vapor Clouds

As adopted by Part 193, section 2.1.1 of NFPA 59A (2001) requires an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility be considered. As discussed under "Overpressures" in section 2.7.2, unconfined LNG vapor clouds would not be expected to produce damaging overpressures.

Ignition of a confined LNG vapor cloud could result in higher overpressures. In order to prevent such an occurrence, Cameron LNG would take measures to mitigate the vapor dispersion and ignition into confined areas, such as buildings. Buildings would be located away from process areas, and combustion and ventilation air intake equipment would be required to have hazard detection devices that enable isolation of the air dampers. Hazard detection with shutdown capability would also be installed at air intakes of combustion equipment whose continued operation could add to, or sustain, an emergency.

Figures 6 and 7 "Vapor Dispersion Design Spill Analyses for LNG" show the flammable vapor cloud from releases at the 30-inchdiameter sendout- header would migrate under the LNG storage tanks. On December 16, 2015, Cameron LNG stated that the LNG storage tank will be designed to withstand the effects of overpressure from ignition of the vapor cloud under the tank. If necessary, measures will be included to mitigate the effect of potential blast overpressures, including measures to prevent flammable vapors from entering the space below the tank. Therefore, **we recommend that:**

- **<u>Prior to initial site preparation</u>, Cameron LNG should file with the Secretary, for review and written approval by the Director of OEP, additional analysis that demonstrates the flammable vapor dispersion from design spills would be prevented from dispersing underneath the existing elevated LNG storage tank(s), or the LNG storage tank(s) would be able to withstand an overpressure due to ignition of the flammable vapor dispersion cloud that disperses underneath the existing elevated LNG storage tank(s).**

2.7.5.1.5 Vapor Clouds from Other Hazardous Fluids

In comparison with LNG vapor clouds, there is a higher potential for unconfined propane clouds to produce damaging overpressures, and an even high potential for unconfined ethylene vapor clouds to produce damaging overpressures. This has been shown by multiple experiments conducted by the Explosion Research Cooperative to develop predictive blast wave models for low, medium, and high reactivity fuels and varying degrees of congestion and confinement. The experiments used methane, propane, and ethylene, as the respective low, medium, and high reactivity fuels. In addition, the tests showed that if methane, propane, and ethylene is ignited within a confined space, such as in a building, they all have the potential to produce damaging overpressures. The refrigerant streams would contain all three of these components (i.e., methane, propane, and ethylene) including isopentane. Therefore, a potential exists for unconfined vapor clouds that could produce damaging overpressure in the event of a release of refrigerant.

In order to evaluate this hazard, Cameron LNG used PHAST to perform an overpressure analysis due to vapor cloud explosions for releases from mixed refrigerant, propane, and heavy removal piping and equipment. Cameron used ethylene as input into PHAST for mixed refrigerant scenarios because ethylene would be a higher reactivity fuel than other mixed refrigerant components. Figures 19 and 20 show the distances to the 1-psi overpressure for governing overpressure scenarios due to vapor cloud explosion at the proposed liquefaction areas.

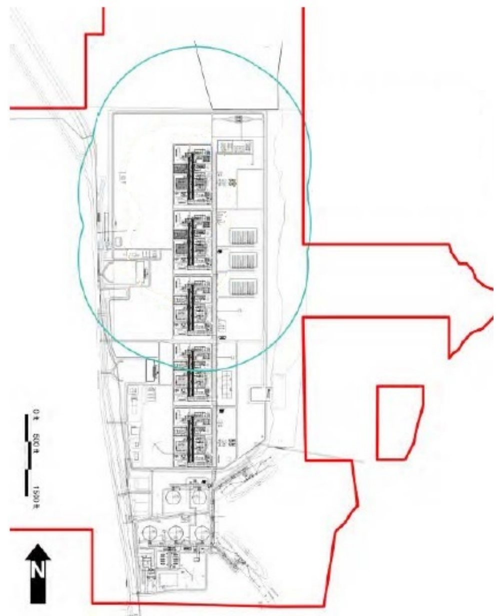

Figure 19: Vapor Cloud Explosion of Mixed Refrigerant at Liquefaction Trains

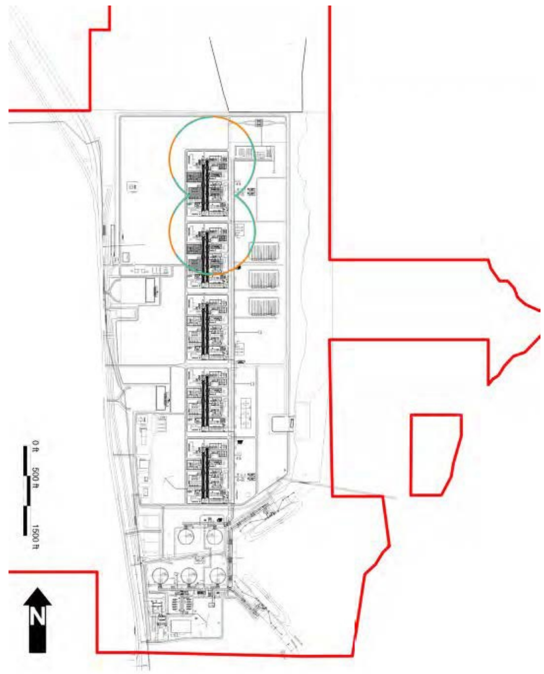

Figure 20: Vapor Cloud Explosions for Propane and Heavy Hydrocarbon Releases at Liquefaction Trains

Figure 19 shows that the overpressure from mixed refrigerant vapor cloud explosion would extend over the new firewater tank, refrigerant storage area, and trucking area. Cameron LNG also proposes evaluate the effect of vapor cloud explosions on fire protection equipment and occupied buildings during the detailed design phase. Therefore, **we recommend that:**

- **<u>Prior to initial site preparation</u>, Cameron LNG should file with the Secretary, for review and written approval by the Director of OEP, an analysis that demonstrates the fire protection system, refrigerant storage tanks, refrigerant trucks, and occupied building would be designed to withstand the overpressures due to mixed refrigerant vapor cloud explosions.**

Figure 19 also shows the 1-psi overpressure would extend over Cameron LNG's property into the water channel. In this case, the DOT has not objected to the 1-psi overpressure due to vapor cloud explosion extending over a navigable waterway. Based on Cameron LNG's overpressure analysis and our recommendations, we conclude that the siting of the proposed project would not have a significant impact on public safety due to vapor cloud explosion events. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of DOT's inspection and enforcement program.

<u>Thermal Radiation Analysis</u>

As discussed in section 2.7.2.4, if flammable vapors are ignited, the deflagration could propagate back to the spill source and result in a pool fire causing high levels of thermal radiation (i.e., heat from a fire). In order to address this, 49 CFR 193.2057 specifies hazard endpoints in terms of flux levels for spills into LNG storage tank containment and spills into impoundments for process or transfer areas. For any distance from a pool fire, a flux level, which expresses how much thermal radiation would be received at that point, can be calculated. Each LNG container and LNG transfer system is required to have a thermal exclusion zone in accordance with Section 2.2.3.2 of NFPA 59A (2001). Together, Part 193 and NFPA 59A (2001) specify different hazard endpoints for spills into LNG storage tank containment and spills into impoundments for process or transfer areas. For LNG storage tank spills, there are three radiant heat flux levels which must be considered:

- 1,600 Btu/ft^2-hr - This level can extend beyond the facility's property line that can be built upon but cannot include areas that, at the time of facility siting, are used for outdoor assembly by groups of 50 or more persons;
- 3,000 Btu/ft^2-hr - This level can extend beyond the facility's property line that can be built upon but cannot include areas that, at the time of siting, contain assembly, educational, health care, detention or residential buildings or structures; and
- 10,000 Btu/ft^2-hr - This level cannot extend beyond the facility's property line that can be built upon.

The requirements for spills from process or transfer areas are more stringent. For these impoundments, the 1,600 Btu/ft^2-hr flux level cannot extend beyond the facility's property line that can be built upon. These are the Part 193 standards that we used in analyzing the siting of the proposed Project.

Part 193 requires the use of the LNGFIRE3 computer program model developed by the Gas Research Institute to determine the extent of the thermal radiation distances. Part 193 stipulates that the wind speed, ambient temperature, and relative humidity that produce the maximum exclusion distances must be used, except for conditions that occur less than 5 percent of the time based on recorded data for the area. Cameron LNG submitted a thermal radiation analysis that showed the following ambient conditions resulted in maximum exclusion distances: wind speeds of 15 to 22 mph, ambient temperature of 32°F, and 20 percent relative humidity. We agree with Cameron LNG's selection of atmospheric conditions.

For its analysis, Cameron LNG calculated thermal radiation distances for the 1,600-, 3,000-, and 10,000-Btu/ft^2-hr incident radiant heat levels for the LNG storage tank using the outer tank's concrete wall diameter (260 feet) as the pool diameter. The flame base was set equal to the top of the concrete wall (142 feet). Target heights were set at the ground level. In addition, Cameron LNG also calculated thermal radiation distances using LNGFIRE3 for the 1,600-Btu/ft^2-hr incident radiant heat level centered on the new Liquefaction Train Impoundment.

Cameron LNG also used LNGFIRE3 to predict the thermal radiation distance at the level of 1,600-BTU/ft^2-hr for fires from the Condensate Tank Impoundment and the Diesel Storage Tank Impoundment. Although LNGFIRE3 is specifically designed to calculate thermal radiation flux levels for LNG pool fires, LNGFIRE3 could also be used to conservatively calculate the thermal radiation flux levels for flammable hydrocarbons such as ethylene, propane, NGL, and condensate. Two of the parameters used by LNGFIRE3 to calculate the thermal radiation flux is the mass burning rate of the fuel and the surface emissive power (SEP) of the flame, which is an average value of the thermal radiation flux emitted by the fire. The mass burning rate and SEP of an ethylene, propane, NGL, or condensate fire would be less than an equally sized LNG fire. Because the thermal radiation from a pool fire is dependent on the mass burning rate and SEP, the thermal radiation distances required for ethylene, propane, NGL, and condensate fires would not extend as far as the calculated exclusion zone for an LNG fire in the same sump. The resulting maximum thermal radiation distances are shown in table 2.7-8 and figure 21.

TABLE 2.7-8

Thermal Radiation Exclusion Zones for Impoundment Basins

Flux Level (Btu/ft^2-hr)	Full- Containment Tank Outer Containment (feet)[a]	New Liquefaction Train Impoundment (feet)[a]	Condensate Tank Dike (feet)[a]	Diesel Tank Dike (feet)[a]
10,000	370	130	450	160
3,000	750	170	620	210
1,600	980	195	745	245

[a] from center of impoundment

The 10,000-, 3,000-, and 1,600-Btu/ft^2-hr heat fluxes from the LNG storage tank and the 1,600-Btu/ft^2-hr heat flux from the LNG storage tank, the new Liquefaction Train Impoundment, the stabilized condensate storage tank dike, and diesel tank dike would remain within the facility property lines. Cameron LNG also evaluated jet fires from the design spills using PHAST version 6.7. The results showed that the jet fire radiant heat to 1,600 BTU/ft^2-hr for the design spills would remain within the Cameron LNG property. As Cameron LNG's calculations show the radiant heat limits for pool fire and jet fire scenarios would stay within Cameron LNG property, we conclude that the siting of the proposed project would not have a significant impact on public safety with regard to thermal radiation from fires. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of DOT's inspection and enforcement program.

Fires may also cause failures of nearby storage vessels, piping, and equipment if not properly mitigated. Cameron LNG proposed to install mitigation measures for critical equipment including passive protections such as fire proofing of structural steel columns supporting critical equipment and fire resistant critical instrument and power cabling for emergency shutdown valves, fire and gas detectors, and emergency communication systems as well as active protections such as blowdown valves, deluge system, fire monitors and hydrants, and fire safe shutdown valves. We believe these mitigation measures would prevent the likelihood of a BLEVE occurring at the liquefaction area.

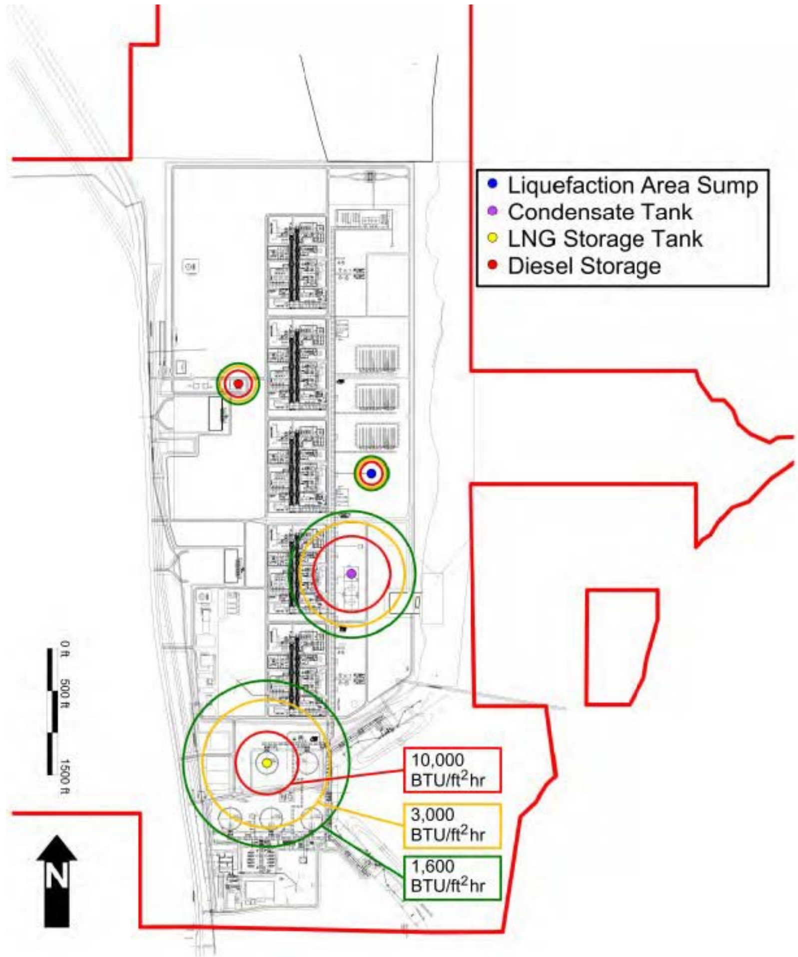

Figure 21: Thermal Radiation Exclusion Zones

As a result of Cameron LNG's proposed mitigation measures and our recommendations, we conclude that the siting of the proposed project would not have a significant impact on public safety. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of DOT's inspection and enforcement program.

2.7.6 Emergency Response

Section 3A(e) of the NGA, added by Section 311 of the EPAct, stipulated that in any order authorizing an LNG terminal, the Commission shall require the LNG terminal operator to develop an emergency response plan (ERP) in consultation with the Coast Guard and state and local agencies. The ERP has been in place since the Cameron LNG Terminal began operation in July of 2009. The existing ERP would need to be updated to include the proposed liquefaction facilities and emergencies related to refrigerant handling. Therefore, **we recommend that:**

- **<u>Prior to initial site preparation</u>, Cameron LNG should file its ERP to include the Expansion Project as well as instructions to handle on-site refrigerant and NGL-related emergencies. Cameron LNG should file the ERP with the Secretary for review and written approval by the Director of OEP.**

- **<u>Prior to initial site preparation,</u> Cameron LNG should file an ERP that includes a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on state and local agencies. In addition to the funding of direct transit-related security/emergency management costs, this comprehensive plan should include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. Cameron LNG should file the Cost-Sharing Plan for review and written approval by the Director of OEP.**

2.7.7 LNG Vessel Safety

The security requirements for the Expansion Project are governed by 49 CFR 193, Subpart J - Security. This subpart includes requirements for conducting security inspections and patrols, liaison with local law enforcement officials, design and construction of protective enclosures, lighting, monitoring, alternative power sources, and warning signs. Requirements for maintaining safety of the liquefaction facility are in the Coast Guard regulations in 33 CFR 127. Requirements for maintaining security of the terminal are in 33 CFR 105.

The Cameron LNG Terminal commenced service in July 2009 and has been receiving LNG shipments for import and re-export purposes. The existing facility has a Facility Security Plan, as required by 33 CFR 105, which has been approved by the Coast Guard. In addition, the LNG ship transits to the existing facility are performed under the "LNG Vessel Management and Emergency Plan" established by the Coast Guard for the Calcasieu Ship Channel. There are no proposed changes in the marine systems or the expected number of vessels as a result of the proposed Expansion Project.

In a letter to the Coast Guard dated January 21, 2015, Cameron LNG detailed the Expansion Project and stated it believed there would be no modification to the marine facilities and would not result in an increase in the size and/or frequency of LNG marine traffic on the Calcasieu Ship Channel. In a letter dated February 3, 2015, the Coast Guard stated that a Letter of Intent or a revision to the WSA was not required. However, the Coast Guard specified that applicable amendments to the Operations Manual, Emergency Manual, and Facility Security Plan must be made that capture changes to the operations associated with the Expansion Project. As required by 33 CFR 105 and 127, Cameron LNG would amend these documents and submit them to the Coast Guard prior to operation of the facility as an export terminal.

2.7.8 Conclusions on Facility Reliability and Safety

The principal hazards associated with the substances involved in the liquefaction, storage, and vaporization of LNG result from cryogenic and flashing liquid releases; flammable vapor dispersion; vapor cloud ignition; pool fires; overpressures, and toxicity. As part of the NEPA review, Commission staff must assess whether the proposed facilities would be able to operate safely and securely to minimize potential public safety impacts. Based on our technical review of the preliminary engineering designs, as well as our suggested mitigation measures, we conclude that sufficient layers of safeguards would be included in the facility designs to mitigate the potential for an incident that could impact the safety of the off-site public. The FEED and specifications submitted for the proposed facilities to date are preliminary, but would serve as the basis for any detailed design to follow. If authorization is granted by the Commission, the next phase of the Expansion Project would include development of the final design. We do not expect that the detailed design information to be developed would result in changes to the basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs which were presented as part of Cameron LNG's FEED. However, we are recommending that the final design be provided for further staff review to ensure it would be consistent with the safety and operability characteristics identified in the FEED. In addition, we are recommending that the facility, during construction and operation, be subject to regular FERC staff technical reviews and site inspections on at least an annual basis.

Siting of the facility with regard to potential off-site consequences from these hazards is also required by DOT's regulations in 49 CFR 193, Subpart B. As part of its application to FERC, Cameron LNG identified how its proposed design would comply with DOT's Part 193 siting requirements. We used this information to assess whether or not a facility would have a public safety impact and DOT, as a cooperating agency, assisted in this evaluation. As provided, Cameron LNG's siting analysis indicates that the siting of the proposed facility would not have a significant impact on public safety. If this facility is approved and becomes operational, the facility would also be subject to DOT's inspection program under 49 CFR 193. Final determination of whether a facility is in compliance with the requirements of Part 193 would be made by DOT staff during those inspections.

2.8 Cumulative Impacts

In accordance with NEPA and FERC policy, we considered the cumulative impacts of the Expansion Project and other projects in the general area. Cumulative impacts represent the incremental effects of the proposed action when added to other past, present, or reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a given period. The direct and indirect impacts of the Expansion Project are addressed in other sections of this EA.

This cumulative impact analysis generally follows the methodology set forth in relevant guidance (CEQ, 1997). Under these guidelines, we based our selection of other projects in the analysis by identifying commonalities of impacts. The actions considered in the cumulative analysis may vary from the Expansion Project in nature, magnitude, and duration; however, an action must meet the following three criteria to be included in the cumulative impacts analysis:

- impacts a resource potentially affected by the Expansion Project;
- causes this impact within all, or part of, the Expansion Project area; and
- causes this impact within all, or part of, the time span for the potential impact from the Expansion Project.

Project impacts would be primarily additive to the existing Cameron LNG Terminal. The Expansion Project would be within the existing Cameron LNG Terminal site, thereby minimizing additional temporary, permanent, and cumulative impacts. Potential cumulative impacts associated with current, proposed, or reasonably foreseeable future projects or activities in the region of influence (e.g., same parishes) were identified and are listed in table 2.8-1. Some of these projects do not fit all three criteria that determine the potential for cumulative impacts; however, they were large enough to mention in the analysis to ensure a more complete picture of the types of project occurring in the same region as the Expansion Project. Although we were able to find the acreage affected by the majority of the projects listed in table 2.8-1, we were unable to gather resource-specific impacts for all the projects. Where appropriate, we have included conservative assumptions regarding the scope of these projects.

2.8.1 Potential Cumulative Impacts of the Proposed Action

Potential impacts most likely to be cumulative with the Expansion Project's impacts are related to water resources, socioeconomics, visual impacts, air quality, and noise.

TABLE 2.8-1

Authorized and Planned Major Projects in the Vicinity of the Cameron LNG Expansion

Project/Location	Project Description (Distance/Direction)	Estimated Timeframe Construction to Operation
Liquefaction and LNG Export Projects at Existing LNG Terminals		
Lake Charles Liquefaction Project Industrial Canal, Calcasieu Parish	Addition of three liquefaction trains at existing terminal. (Located 6 miles north-northeast of the Expansion Project.)	2016 to 2018
Cameron Liquefaction Expansion Project Calcasieu Ship Channel, Cameron and Calcasieu Parishes	Expansion at the existing Cameron LNG Terminal to export 12 million tons of LNG per year. (Within the Expansion Terminal Project site.)	2014 to 2018
Sabine Pass Liquefaction Projects Cameron Parish	Addition of liquefaction facilities at existing terminal. (Located about 38 miles south-southwest of the Expansion Project.)	2013 to 2019
NEW LIQUEFACTION AND LNG EXPORT PROJECTS		
Magnolia LNG Project Industrial Canal, Calcasieu Parish	Construction/operation of a new LNG terminal including four liquefaction trains, two LNG storage tanks, liquefaction and refrigerant units, safety and control systems, and associated infrastructure. (Located 5.5 miles northeast of the Expansion Project.)	2016 to 2018
Live Oak LNG Project Calcasieu Ship Channel, Calcasieu Parish	Potential project that would include the construction/operation of a liquefaction and LNG export facility including eight liquefaction units capable of producing a nominal capacity of 5.2 million Mtpy of LNG, two 130,000-m3 LNG storage tanks, a marine berth and an interconnection with nearby pipeline systems. (Located about 5 miles north of the Expansion Project.)	Unknown to 2019

TABLE 2.8-1

Authorized and Planned Major Projects in the Vicinity of the Cameron LNG Expansion

Project/Location	Project Description (Distance/Direction)	Estimated Timeframe Construction to Operation
Venture Global LNG Calcasieu Pass Project Calcasieu Ship Channel, Cameron Parish	Construction/operation of a LNG export plant with the capacity to export up to 10 million Mtpy of LNG each year. (Located about 18 miles south of the Expansion Project near the Gulf of Mexico.)	2016 to 2019
Waller Point Marine LNG Terminal Calcasieu Ship Channel, Cameron Parish	Potential project that would include the use of small-scale liquefaction technology and installation of nominal 500,000 gallon per day LNG trains in phases to meet market and demands for marine LNG fuels. (Located about 18 miles south of the Expansion Project on Monkey Island.)	Unknown
NON-JURISDICTIONAL PROJECT		
Entergy's Transmission Line for the Cameron Expansion Project	Construction/operation of a 14-mile-long 230 KV electrical transmission line to provide power for the Expansion Project.	Dependent on LNG Project
PIPELINE PROJECTS		
Cameron Pipeline Expansion Project Cameron and Beauregard Parishes	Addition to existing pipeline system of 21 miles of 42-inch-diameter pipeline and 1 new compressor station for bi-directional flow capability.	2014 to 2017
Cameron Access Project Cameron, Calcasieu, and Jefferson Davis Parishes	Construction/operation of approximately 27 miles of new pipeline, 10 miles of loop pipeline, and a new compressor station. (Located about 2 miles north of the Expansion Project.)	2016 to 2017
OTHER INDUSTRIAL PROJECTS		
G2X Energy's Natural Gas to Gasoline Facility Industrial Canal, Calcasieu Parish	Construction/operation of a facility that will use natural gas to produce methanol, then convert methanol to final gasoline for 90 percent of its production. About 10 percent of the output will be liquefied petroleum gas or propane. (Located about 5 miles north-northeast of the Expansion Project.)	2015 to 2017
IFG Port Holdings/New Export Grain Terminal Project Port of Lake Charles, Calcasieu Parish	Construction/operation of a state-of-the-art export grain terminal to handle agricultural products such as Louisiana rice, wheat, corn, soybeans, and dried distillers' grain for shipment to other countries. (Located about 14 miles north-northeast of the Expansion Project.)	2014 to 2015
Juniper GTL Project Port of Lake Charles, Calcasieu Parish	Renovate a dormant steam CH_4 reformer in the Westlake area and convert it to a natural gas-to-liquids facility to produce about 1,100 barrels a day of diesels, waxes, and naphtha. (Located about 15 miles north-northeast of the Expansion Project.)	2014 to 2015

TABLE 2.8-1

Authorized and Planned Major Projects in the Vicinity of the Cameron LNG Expansion

Project/Location	Project Description (Distance/Direction)	Estimated Timeframe Construction to Operation
LA Gas Storage Expansion Project Calcasieu and Cameron Parishes	Construction/operation of one new compressor station, one new salt dome natural gas storage cavern, conversion of three existing salt dome brine storage caverns to natural gas storage caverns, 5.1-mile-long pipeline, one new meter station to interconnect with Cameron Interstate Pipeline, 4.0-mile-long brine disposal pipeline, and four salt water disposal wells. (Located about 8 miles southwest of the Expansion Project.)	2015 to 2017
Matheson Tri-Gas Sasol Supply Gas Project Calcasieu Parish	Industrial gas supply to Sasol's ethane cracker facility. Matheson Tri-Gas will supply Sasol with tonnage oxygen and nitrogen via a new Air Separation Unit, which will be part of a relocated facility set to be built on Evergreen Road. (Located about 16 miles north of the Expansion Project.)	2015 to 2016
Port of Lake Charles City Dock Project Port of Lake Charles, Calcasieu Parish	Major renovations to facilities at the City Docks off Sallier and improvements at the Bulk Terminal 1 consisting of addition of two docks that will triple vessel accommodations and improvements to the port's former administration building. (Located about 13 miles north-northeast of the Expansion Project.)	Unknown
Sasol's Ethane Cracker and Derivatives Complex Calcasieu Parish	Construction/operation of a facility to produce 1.5 million tons/year of ethylene and derivatives, which are used to make synthetic fibers, detergents, paints, and fragrances. The facility will also include six chemical manufacturing plants. (Located about 15.5 miles north of the Expansion Project.)	2014 to 2018
Sasol's Gas-to-Liquids Complex Calcasieu Parish	Construction/operation of a gas-to-liquids complex that will provide a new source of demand for the Haynesville Shale and other natural gas plants in Louisiana. The complex would produce more than 96,000 barrels of diesel fuels and chemicals per day and would also house Sasol's second linear alkyl benzene unit, which will increase the company's production of detergent alkylates. (Located about 15 miles north of the Expansion Project.)	2016 to Unknown
Westlake Chemical Corporation Calcasieu Parish	Expand its ethylene, styrene, and polyethylene capacity to increase ethane-based ethylene capacity by approximately 250 million pounds annually. (Located about 10 miles north of the Expansion Project.)	2014 to 2015/2016
UTILITY PROJECTS		

TABLE 2.8-1

Authorized and Planned Major Projects in the Vicinity of the Cameron LNG Expansion

Project/Location	Project Description (Distance/Direction)	Estimated Timeframe Construction to Operation
Calcasieu Point Development Project	Improvements in three intersection locations (Tank Farm and Big Lake Roads, Big Lake and Lincoln Roads, and Lincoln Road and Gulf Highway) to reduce impacts on local users of the roadways during construction of the G2X Energy natural gas-to-gasoline, facility, Lake Charles Liquefaction Project, and Magnolia LNG Project. (Located about 6 miles north-northeast of the Expansion Project.)	2015 to 2016
Entergy's Lake Charles Transmission Project	Construction/operation of approximately 25 miles of new transmission lines (including 500 kV and 230 kV lines), two new substations, and the expansion of one existing substation. (Located about 6 miles north-northeast of the Expansion Project.)	2016 to 2018
Entergy's Transmission Line and Substation for the Lake Charles Liquefaction Project	Construction/operation of a 19-mile-long 230 kV electric transmission line and a new substation to provide incremental power for the Lake Charles Liquefaction Project.	Dependent on LNG Project
Entergy's Transmission Line for the Cameron Liquefaction Project	Construction/operation of a 12-mile-long electrical transmission line to provide power for the Cameron LNG Liquefaction Project.	Dependent on LNG Project
RESIDENTIAL DEVELOPMENT PROJECTS		
Audubon Trace Subdivision Calcasieu Parish	Construction of a 182 single-family residential development, square footage of homes is 1600-2000 with each lot being 7,500 square feet. (Located about 20 miles north-northeast of the Expansion Project.)	2015 to Unknown
Belle Savanne Development Calcasieu Parish	Construction of a development that includes over 12 acres of commercial and 15 acres of multifamily product. Phase one included about 100 lots (238 homes total with 80 in Phase 1 – completed in April 2014). The remainder of the lots will be built out in additional phases with future plans for development over time accessing about 300 acres comprised of about 1,000 lots. (Located about 10 miles north-northwest of the Expansion Project.)	2013 to Unknown

TABLE 2.8-1 Authorized and Planned Major Projects in the Vicinity of the Cameron LNG Expansion		
Project/Location	**Project Description (Distance/Direction)**	**Estimated Timeframe Construction to Operation**
Moss Lake Worker Village Calcasieu Parish	Construction of a development that will provide housing for workers participating in several large projects in the region. About 100 acres of Southland Field Airport property will be leased. The planned community is designed to scale up and down, based on demand, and to accommodate up to 2,500 people at peak occupancy. To address traffic concerns, the transportation services incorporated into Moss Lake Village are expected to significantly reduce the number of vehicles traveling on Highway 27. (Located about 7 miles north-northwest of the Expansion Project.)	2015 to Unknown
Pelican Lodge Industrial Housing Facility Calcasieu Parish	Construction of a temporary industrial employee housing facility to be built near the Chennault International Airport on 250 acres owned by the Port of Lake Charles. It will hold up to 4,000 workers and include recreational facilities, a baseball field, basketball courts, and several different dining options. To address traffic concerns, Pelican Lodge's transportation plan will reduce impacts by offering bus service for workers to and from their work sites. (Located about 19 miles northeast of the Expansion Project.)	2014 to Unknown
Walnut Grove Development Calcasieu Parish	Development of 60 acres from the Port of Lake Charles of a mixed-use community with residential and commercial properties. (Located about 13 miles north-northeast of the Expansion Project.)	2013 to 2020
FEDERAL AND STATE PROJECTS		
U.S. Army Corps of Engineers and Lake Charles Harbor and Terminal District's Maintenance Dredging of the Calcasieu Ship Channel Cameron and Calcasieu Parishes	Maintenance dredging along the 68-mile-long Calcasieu River-Ship channel.	Ongoing

Water Resources

The Expansion Project facilities would not permanently affect any perennial, intermittent, ephemeral streams, or drainages. Temporary impacts associated with construction of the Expansion Project include runoff from construction areas that could temporarily increase turbidity and sedimentation in the adjacent Calcasieu River. Surface water discharges related to hydrostatic testing could also temporarily impact water quality. Therefore, only projects from the above table that impact the Calcasieu River within 2 miles of the Expansion Project would likely add cumulatively to water resources impacts. Therefore, the only projects that the Expansion Project would likely add sedimentation and siltation to the Expansion Project during the same timeframe would be the Liquefaction Project and the COE's maintenance dredging of the navigation channel. The Expansion Project would not directly impact any waterbodies and would comply with the FERC Procedures to minimize indirect impacts on waterbodies to the maximum extent practicable. Projects under the jurisdiction of the COE must implement their own best management practices to minimize impacts on water resources. Therefore, cumulative impacts on water resources would be minimal.

Socioeconomics

All the projects listed in table 2.8-1 have or would generate temporary construction jobs. Additionally, all of these projects are within about 40 miles, which is a reasonable distance for people to travel from residence to work. Most of these projects would overlap the Expansion Project's proposed construction timeline (June 2016- the end of 2019). While many of the construction workers may reside locally, a number of non-local construction workers with specialized training for the specific project would be needed. Non-local laborers typically reside in hotels, motels, rental units, or mobile home parks in local communities near the Expansion Project. The construction workforce for the Expansion Project would not change from construction of the Liquefaction Project. Given the number of projects in the region of influence, there are concerns over the availability to adequately house the cumulative workforce. To accommodate this concern, several work camps in the vicinity have been proposed and would likely be constructed should the need arise. These facilities would need to be permitted according to local codes.

The Expansion Project would add 90 full-time staff at the LNG Terminal, making the total LNG Terminal operations staff to 253 full-time positions. The facility would operate 24 hours/day and the 253 staff would not all work the same shift. The estimated day shift would be about 164 staff and the night shift would be about 89 staff. Additionally condensate sales would add about 8.5 trucks per day. Assuming each staff drives separate to the LNG Terminal, this would represent about 523 round trips per day on LA 27 during operation of the Expansion Project. While this could increase traffic at shift changes, the cumulative impact would be minimal.

Two positive cumulative economic benefits from the projects listed in table 2.8-1 would be local sales taxes on goods and services during construction and increased property taxes on the completed projects when operating. The projects would also add permanent jobs in facility operations to the region.

Visual Resources

The existing LNG Terminal and the Liquefaction Project are the most likely projects in the region for the Expansion Project to add to visual impacts on the surrounding area. The Expansion Project facilities would be constructed within the existing approved footprint of the LNG Terminal site, and thus add cumulatively to the visual impact of the LNG Terminal. The new LNG storage tank and the associated Expansion Project facilities would have an effect on visual resources; however, the effect would not be considered a critical impact because of the existing surrounding heavy industrial uses.

Air Quality and Noise

Construction of the Expansion Project would temporarily impact air quality due to emissions from the combustion engines used to power construction equipment and from fugitive dust resulting from equipment movement on dirt roads and earth-disturbing activities. The cumulative impact area for air quality during construction of the expanded terminal is about a one-mile radius from the Terminal. Construction of the authorized liquefaction facilities at the Cameron LNG Terminal is currently underway and would be constructed simultaneously with the Expansion Project facilities. The projects within a one-mile radius of the Terminal Expansion that would be constructed in a similar timeframe as the proposed Expansion Project are the non-jurisdictional Entergy transmission line to the Cameron LNG Terminal and maintenance dredging by the COE; the Cameron Access Project is the next nearest project that would be constructed in the same timeframe at about two miles from the Expansion Project. The construction-related impacts of the authorized facilities at the Cameron LNG Terminal and the Expansion Project would be concurrent, but these impacts would be temporary and Cameron LNG would minimize combustion emissions and fugitive dust as described in section 2.6.1.4. Because construction of the Entergy transmission line and the pipeline associated with the Cameron Access Project would be linear and move quickly, air emissions associated with these projects would be intermittent. Maintenance dredging by the COE would occur on an as needed and intermittent basis, and would be temporary. Based on the intermittent and temporary nature of construction of these projects, we believe that construction of the Terminal Expansion would not contribute to a significant cumulative impact on air quality.

The cumulative impact area for air quality during operation of the proposed Expansion Project was established based on the expanded terminal's PSD Area of Impact of 6.2 miles (10 km). This area encompasses the Lake Charles projects. The existing Golden Pass LNG Terminal, the planned Golden Pass Export Project, the Sabine Pass LNG Terminal, the Sabine Pass Liquefaction Project (currently under construction), and the planned LNG export Projects, and other projects noted in table 2.8-1 are outside of this area and are not expected to contribute to cumulative impacts on air quality in combination with the proposed Expansion Project. However, Cameron LNG conducted an ozone modeling analysis to demonstrate the Expansion Project's impacts on ozone concentrations. The ozone modeling analysis is discussed in section 2.6.1.4.

Although the region in the vicinity of the proposed Project is currently in attainment with air quality standards, increases in industrial point sources could affect local and regional air quality. Under LDEQ regulations, the expanded terminal would be considered a major emissions source and would contribute to cumulative impacts on air quality within the cumulative impact area.

The cumulative modeling analysis in section 2.6.1.4 was performed to quantitatively demonstrate that the Expansion Project operational impacts, in addition to existing major sources of air emissions in the AOI, would not have a significant impact on air quality. While the Expansion Project would contribute to a cumulative impact on air quality in the PSD area of impact, as shown in the modeling analysis, this impact would not exceed the NAAQS, which were established to protect public health (including sensitive populations) and public welfare. Projects that would potentially be constructed in the future (as shown in table 2.8-1), and are considered to be major sources of air emissions, would be required to conduct a similar PSD analysis. Should operation of a new project result in a significant impact on air quality, the LDEQ would enforce operational limitations or require emissions controls that ensure the facility's compliance with the SIP and attainment with the NAAQS. In addition, Cameron LNG would be required to comply with permit conditions during operation of the facility and incorporate the required controls to limit the emission of certain criteria pollutants, HAPs, and/or GHGs. Based on the cumulative modeling analysis and the required emission controls, we conclude that there would be no significant cumulative impact on air quality as a result of the Expansion Project.

In addition to operation of the expanded terminal and the projects listed above, air emissions from LNG marine traffic and other project-related vessels, considered mobile sources of air emissions, would occur along the entire waterway from the boundary of territorial waters to the vessel berths. Due to the transitory nature of these mobile sources and the large area covered, we believe the associated emissions would not have a significant cumulative impact on air quality along the waterway. Cameron LNG has not requested an increase in the currently authorized number of LNG carriers; therefore, operation of the carriers and any associated mobile sources would not contribute to a cumulative impact on the air quality of the area beyond that previously assessed. While there would not be an increase in the currently authorized number of LNG carriers or the previously assessed vessel emissions, we evaluated emissions for total vessel operations as part of the cumulative impact analysis for the proposed Expansion Project including the authorized Cameron LNG liquefaction facilities. Mobile source emissions were calculated for the LNG carriers while loading and while berthed at dockside without loading (a condition termed "hoteling"), for the LNG carriers while in transit, and for the tug assist vessels, both within and outside of the moored safety zone (see table 2.8-2). These mobile source emissions are not considered for permitting purposes by either EPA or LDEQ.

In order to analyze the cumulative air quality impacts associated with the Expansion Project including the existing and authorized facilities, an air quality dispersion modeling was conducted for CO, SO_2, NO_2, and stationary sources proposed for the Expansion Project, the authorized Cameron LNG liquefaction facilities, combined with mobile sources within the moored safety zone. Table 2.8-2 lists the highest levels for each pollutant per averaging period. Dispersion modeling was performed using the AERMOD version 14134. AERMAP (version 11103), the terrain preprocessor, AERMET (versions 12345 and 14134) and AERMINUTE (version 14237), the meteorological preprocessors, and AERSURFACE (version 13016), used to estimate surface characteristics required for input to AERMET, will be employed within the AERMOD system. Meteorological data from 2010 to 2014 was used as input to the models.

A screening analysis was first conducted to determine whether emissions of CO, NO_2, or SO_2 would cause any significant impact.

Maximum hourly emission rates were used for the authorized liquefaction facilities and Expansion Project for short-term averaging periods and average emission rates were used for the annual averaging period. This is the maximum permitted emissions. Therefore, the worst-case operating scenario for the authorized liquefaction facilities and Expansion Project is represented. The worst-case scenario modeled for ship activities for short-term averaging periods was the loading/hoteling operations. For the annual averaging period, an hourly emission rate was calculated based on total annual emissions inside the moored safety zone.

TABLE 2.8-2

Summary Of Existing Mobile Source Emissions From Marine Vessel Activities

Activity	Emissions (tons per year)				
	CO	SO_2	NO_x	PM	VOC
Operation While Berthing or at Berth					
Maneuvering in/out Berth	1.6	0.2	7.0	0.1	0.4
LNG Carrier Loading	40.4	5.9	148.6	2.7	3.9
LNG Carrier Hoteling	17.4	2.6	67.1	1.1	1.7
Tug Assist and Stand-by during Berthing/ Loading/Hoteling	12.0	3.1	46.3	4.5	4.3
Total	**71.4**	**11.8**	**269.0**	**8.4**	**10.3**
Outside Moored Safety Zone					
LNG Carrier Transit	42.3	3.4	165.6	2.1	14.1
Assist Tug Maneuvering/ Transit	2.2	0.7	53.9	0.9	0.8
Total	**44.5**	**4.1**	**219.5**	**3.0**	**14.9**

The years for the highest maximum concentrations predicted by the screening modeling runs for CO and SO_2 is shown in table 2.8-3. The modeling results indicate that the maximum off-site concentration of CO and SO_2 were below their respective PSD modeling significant impact levels. Therefore, refined modeling was not required.

TABLE 2.8-3

Cumulative Impacts-Expansion Project plus Mobile Emissions Screening Analysis for CO and SO2

Pollutant	Meteorological Year	Averaging Period	Modeled Concentration ($\mu g/m^3$)	Significance Impact Level ($\mu g/m^3$)
CO	2014	1-Hour	178.2	2,000
CO	2010	8-Hour	70.3	500
SO_2	2010	3-Hour	6.6	25
SO_2	2010	24-Hour	4.6	5
SO_2	2014	Annual	0.24	1

The results of the screening analysis for NO_2, as shown in table 2.8-4, indicated an exceedance of the SIL. Therefore, a refined analysis was conducted.

TABLE 2.8-4 Cumulative Impacts-Expansion Project plus Mobile Emissions Screening Analysis for NO2 Annual Standard				
Pollutant	**Meteorological Year**	**Averaging Period**	**Modeled Concentration (μg/m^3)**	**Significance Impact Level (μg/m^3)**
NO_2	2010	Annual	2.76	1
NO_2	2011	Annual	3.57	1
NO_2	2012	Annual	2.99	1
NO_2	2013	Annual	2.53	1
NO_2	2014	Annual	3.05	1

NO_2 NAAQS Comparison

Off-site sources for the refined analysis were retrieved from the LDEQ website. Sources within the AOI and out 50 kilometers from the AOI were modeled for the NO_2 annual average NAAQS run. Receptors included those locations where the SIL was exceeded in the AOI. For the NO_2 background, the Westlake monitoring station was used. An NO_2 concentration of 15 μg/m^3 was used as background for the annual average NAAQS model based on the highest annual average of the 5 years of Westlake monitoring data. As shown in table 2.8-5, the results of the annual NO_2 NAAQS analysis resulted in no exceedances of the NAAQS.

TABLE 2.8-5 Cumulative Impacts-Expansion Project plus Mobile Emissions Refined Analysis for NO2 Annual Standard			
Meteorological Year	**Averaging Period**	**Modeled Concentration Annual Average with Background (μg/m^3)**	**NAAQS Standard (μg/m^3)**
2010	Annual	36.2	100
2011	Annual	41.4	100
2012	Annual	40.1	100
2013	Annual	38.4	100
2014	Annual	38.9	100

NO_2 Increment Consumption Comparison

The NO_2 increment consumption analysis included increment consuming sources provided by the LDEQ retrieval and located within the AOI plus 50 kilometers. Current permitted sources with permitted emission rates used in the NAAQS analysis were modeled as a worst-case scenario without subtracting baseline emission rates. Table 2.8-6 shows the resulting concentration from the modeling runs compared to the Class II allowable PSD Increment Consumption Standard. The results of the increment consumption modeling showed an exceedance of the Class II levels for two of the five years. An analysis was then conducted to determine if the authorized Cameron LNG liquefaction facility and Expansion Project including mobile sources was significant at any of these exceedances (i.e., exceeding the Significant Impact Level of 1 μg/m³). Table 2.8-6 also shows Cameron LNG's contribution to the maximum concentrations. Based on this analysis, it was determined that the authorized Cameron LNG liquefaction facility and Expansion Project including mobile sources did not exceed the Significant Impact Level at any of the receptors above the increment consumption standard. As a result, the authorized Cameron LNG liquefaction facility and Expansion Project including mobile sources would not contribute significantly to consumption of the Class II increment and has demonstrated compliance with the standard.

TABLE 2.8-6

Cumulative Impacts-Expansion Project plus Mobile Emissions Refined Analysis for NO2 Annual Standard

Meteorological Year	Modeled Maxiumum Concentration ALL Sources (μg/m³)	NAAQS Standard (μg/m³)	Project Contribution to Modeled Maximum Concentration (μg/m³)	Significant Impact Analysis (μg/m³)
2010	21.2	25	N/A	1
2011	26.4	25	0.56	1
2012	25.1	25	0.69	1
2013	23.4	25	N/A	1
2014	23.9	25	N/A	1

N/A: Not applicable

Climate Change

Climate change is the change in the climate over time, whether due to natural variability or as a result of human activity, and cannot be represented by single annual events or individual anomalies. For example, a single large flood event or particularly hot summer is not an indication of climate change, while a series of floods or warm years that statistically change the average precipitation or temperature over years or decades may indicate climate change.

The Intergovernmental Panel on Climate Change (IPCC) is the leading international, multi-governmental scientific body for the assessment of climate change. The United States is a member of the IPCC and participates in the IPCC working groups to develop reports. The leading U.S. scientific body on climate change is the United States Global Change Research Program (USGCRP). Thirteen federal departments and agencies[25] participate in the USGCRP, which began as a presidential initiative in 1989 and was mandated by Congress in the Global Change Research Act of 1990.

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25 The following departments comprise the USGCRP: EPA, DOE, Department of Commerce, Department of Defense, Department of Agriculture, Department of the Interior, Department of State, DOT, Department of Health and Human Services, National Aeronautics and Space Administration, National Science Foundation, Smithsonian Institution, and Agency for International Development.

The IPCC and USGCRP have recognized that:

- globally, GHGs[26] have been accumulating in the atmosphere since the beginning of the industrial era (circa 1750);
- combustion of fossil fuels (coal, petroleum, and natural gas), combined with agriculture and clearing of forests is primarily responsible for the accumulation of GHG;
- anthropogenic GHG emissions are the primary contributing factor to climate change; and
- impacts extend beyond atmospheric climate change alone and include changes to water resources, transportation, agriculture, ecosystems, and human health.

The USGCRP issued a report, *Global Climate Change Impacts in the United States*[27] in June 2009 summarizing the impacts climate change has already had on the United States and what projected impacts climate change may have in the future. The report categorizes overall impacts by resource and impacts for various regions of the United States. Although climate change is a global concern, for this cumulative analysis, we would focus on the cumulative impacts of climate change in the Expansion Project area.

The USGCRP's report notes the following continental Southeast and Coastal regional impacts:

- average temperatures have risen about 2°F since 1970 and are projected to increase another 4.5 to 9°F during this century;
- increases in illness and death due to greater summer heat stress;
- destructive potential of Atlantic hurricanes has increased since 1970 and the intensity (with higher peak wind speeds, rainfall intensity, and storm surge height and strength) is likely to increase during this century;
- in the United States, within the past century, relative sea level changes ranged from falling several inches to rising about 2 feet and are projected to increase another 3 to 4 feet this century;
- sea level rise and human alterations have caused 1,900 square miles of coastal wetland loss in Louisiana during the past century, reducing their capacity to protect against storm surge, and projected sea level rise is anticipated to result in the loss of a large portion of the nation's remaining coastal wetlands;
- declines in dissolved oxygen in streams and lakes have caused fish kills and loss of aquatic species diversity;
- moderate to severe spring and summer drought areas have increased 12 percent to 14 percent (with frequency, duration, and intensity also projected to increase);

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26 See Section 2.6.1.2

27 U.S. Global Change Research Program. 2009. *Global Climate Change Impacts in the United States*. Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson (eds.). Cambridge University Press.

- longer periods of time between rainfall events may lead to declines in recharge of groundwater and decreased water availability;
- responses to decreased water availability, such as increased groundwater pumping, may lead to stress or depletion of aquifers and strain on surface water sources;
- increases in evaporation and plant water loss rates may alter the balance of runoff and groundwater recharge, which would likely lead to saltwater intrusion into shallow aquifers;
- coastal waters have risen about 2°F in several regions and are likely to continue to warm as much as 4 to 8°F this century; and
- coastal water warming may lead to the transport of invasive species through ballast water exchange during ship transit.

The GHG emissions associated with construction and operation of the Cameron LNG Terminal, identified in section 2.6.1.4, would not have any direct impacts on the environment in the Expansion Project area.

In its comment letter, the EPA suggested that staff review and consider the Department of Energy's National Energy Technology Laboratory's *Addendum to Environmental Review Documents Concerning Exports of Natural Gas from the United States* (DOE, 2014 a) and the May 29, 2014 report: *Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas from the United States* (DOE, 2014 b). DOE, however, acknowledges that its life cycle analysis contained in the Draft Addendum report goes beyond NEPA requirements and states that DOE cannot meaningfully analyze specific upstream impacts. Further, DOE found in the Sabine Pass Liquefaction, LLC Project (DOE/FE Order No 2961-A) that without knowing the specific location and timing for upstream production, the environmental impacts are not reasonably foreseeable within the meaning of CEQ's NEPA regulations. Upstream production is therefore outside the scope of our environmental analysis. Further, there is not a sufficient causal link between the proposed project and impacts related to the ultimate consumption of the gas. Impacts associated with the export of the commodity are appropriately under the purview of DOE. Moreover, given the global nature of the natural gas market, the Commission has no way of predicting where or how the gas exported from the project would ultimately be consumed (e.g., transportation, electric generation, heating, or feedstock for industrial processes). Section 2.6.1 considers the air emissions, including GHG emissions, attributable to the construction and operation of the project. Air emissions and the climate change impacts of such emissions from the transportation and ultimate consumption of gas exported from the Expansion Project is not part of the project before the Commission. Accordingly, staff concludes that the information provided in the DOE reports is too general to assist the Commission in its decision making process for the project.

The EPA also recommended that the EA consider the potential for increased natural gas production as a result of the expanded terminal and the potential environmental impacts associated with these potential increases. NEPA, however, requires consideration of an indirect effect if there is a "reasonably close causal relationship between the environmental effect and the alleged cause." There is not the requisite reasonably close causal relationship between the impacts of future natural gas production and the Expansion Project. Further, we note that the

Commission has no jurisdiction over the production and development of domestic natural gas. Rather, natural gas production is regulated by state and local governments. The Cameron LNG Terminal would receive natural gas through interconnections with other natural gas pipelines via the Cameron Interstate Pipeline and the Cameron Access Project Pipeline. The location and extent of potential subsequent production activity are thus unknown and are too speculative to be assumed for purposes of analyzing the impacts of such production in our environmental analysis. Accordingly, we cannot meaningfully estimate how much of the project's export volumes would come from current gas production or new production, or development or would be diverted from existing customers. Moreover, a number of factors, such as domestic natural gas prices and production costs drive new drilling. For these reasons, we conclude that analyzing the associated environmental impacts of any potential increase in natural gas production would be too speculative to assist the Commission in its decision making process for the project.

Climate change in the region would have two effects that may cause increased storm surges, increased temperatures of Gulf waters, which would increase storm intensity, and a rising sea level. In Louisiana, relative sea level changes have been estimated by the NOAA to be about 14 inches by 2050. This is greater than the global average because of regional ground subsidence. The Cameron LNG Terminal is designed for a 500-year storm surge elevation level of 12.4 feet amsl. Given that the Expansion Project's process equipment minimum elevation point of support would be 12.5 feet amsl and the LNG storage tank (T-205) would be 14.0 amsl at top of the elevated pile cap, climate change-enhanced sea level rise and subsidence are considered adequately addressed in the Expansion Project design.

Currently there is no standard methodology to determine how the Expansion Project's incremental contribution to GHGs would translate into physical effects on the global environment. However, the emissions would increase the atmospheric concentration of GHGs, in combination with past and future emissions from all other sources, and contribute incrementally to climate change that produces the impacts previously described. Because we cannot determine the Expansion Project's incremental physical impacts due to climate change on the environment, we cannot determine whether the Expansion Project would result in significant cumulative impacts related to climate change.

2.8.2 Conclusions

The most significant cumulative impacts would occur if all of these projects were constructed at the same time as the Expansion Project; however, this is not anticipated. It can be assumed that construction and operation of the projects listed in table 2-8-1 is likely to have impacts on a wide variety of environmental resources. However, construction of the Expansion Project would not cumulatively contribute to these impacts because most of the Expansion Project's impacts are minor and temporary and would be within the previously disturbed existing Cameron LNG Terminal site.

Air quality impacts could be cumulatively significant without mitigation, but each of the project proponents would be required to meet all applicable federal and state air quality standards, thereby lessening the cumulative impact.

3. ALTERNATIVES

As required by NEPA and Commission policy, we identified and evaluated alternatives to the proposed Expansion Project. These alternatives were considered to determine whether they would be reasonable and environmentally preferable to the proposed action. These alternatives include the no-action alternative, system alternatives, and alternative site configurations. The evaluation criteria for selecting potentially reasonable and environmentally preferable alternatives include the following:

- technical feasibility and practicality;
- significant environmental advantage over the Expansion Project; and
- ability to meet the Expansion Project objectives.

Our alternative assessment is based on project-specific information provided by Cameron LNG; our expertise regarding the siting, construction, and operation of LNG export facilities; and the potential effects on the environment, and takes into consideration the comments provided to the Commission about the Expansion Project.

3.1 No-Action Alternative

Under the no-action alternative Cameron LNG would not construct the Expansion Project. If the Expansion Project is not constructed, then neither the adverse nor beneficial potential impacts described in this EA would occur. Implementing the no-action alternative would not allow Cameron LNG to meet the purpose and need as described in section 1.3. Further, we have concluded that the impacts associated with the Expansion Project would not be significant. Therefore, we do not recommend the no-action alternative.

3.2 System Alternatives

System alternatives to the proposed action would use existing or other proposed natural gas export facilities, natural gas transmission facilities, or other methods of transporting natural gas to meet the purpose of the Expansion Project. Implementing a system alternative would make it unnecessary to construct all or part of the Expansion Project, although some modifications or additions to an existing transmission system or other proposed system may be necessary.

In addition to the Cameron LNG Terminal, there are currently five operating LNG import terminals in the Gulf of Mexico (Gulf LNG in Pascagoula, Mississippi; Trunkline LNG Terminal in Lake Charles, Louisiana; Freeport LNG on Quintana Island, Texas; Sabine Pass LNG in Cameron Parish, Louisiana; and Golden Pass LNG in Sabine Pass, Texas). Three liquefaction expansion projects have been approved by the Commission and are currently under construction in the Gulf area of Louisiana and Texas: Sabine Pass LNG, Freeport LNG Expansion/FLNG Liquefaction, and Corpus Christi LNG in Corpus Christi, Texas.

Several companies are seeking authorizations to construct and operate LNG liquefaction facilities and to export LNG. Each of these projects would have to add comparable facilities to liquefy similar volumes of natural gas. Given that no additional impacts on vegetation, wildlife, wetlands, or dredging would occur as a result of this project, and additional air impacts would occur regardless of which terminal these facilities were added to, it is unlikely that any of the alternatives could provide a significant environmental advantage while adding 1.96 Bcf/d of supply to their proposed facilities. Therefore, we do not recommend any system alternatives.

3.3 Alternative Configurations and Designs

Cameron LNG considered alternative configurations and designs for the Expansion Project site. However, the number of possible alternatives was limited by the siting requirements of NFPA-59A and other industry or engineering standards. Regulatory requirements stipulate that potential thermal exclusion and vapor dispersion zones remain on-site and as such dictate the locations of specific pieces of equipment for the liquefaction facilities. Likewise, thermal radiation zones associated with flares require specific distances from other pieces of equipment and property lines which require specific placement of the flare facilities. The selected location of each of the Expansion Project facility components was accomplished with these guidelines and requirements as well as minimizing the areas of land to be disturbed during the construction and operation of the Expansion Project. We have reviewed Cameron LNG's filings and believe this is a reasonable conclusion.

4. CONCLUSIONS AND RECOMMENDATIONS

We conclude that the approval of the Expansion Project would not constitute a major federal action significantly affecting the quality of the human environment. This finding is based on our environmental analysis as described above; information provided in Expansion Project application and supplemental filings; and Cameron LNG's implementation of our recommended mitigation measures. We recommend that the Commission order include the mitigation measures listed below as conditions to any Section 3 Authorization the Commission may issue.

1. Cameron LNG shall follow the construction procedures and mitigation measures described in their application and supplements, including responses to staff data requests and as identified in the EA, unless modified by the Order. Cameron LNG must:

    a. request any modification to these procedures, measures, or conditions in a filing with the Secretary;
    b. justify each modification relative to site-specific conditions;
    c. explain how that modification provides an equal or greater level of environmental protection than the original measure; and
    d. receive approval in writing from the Director of OEP before using that modification.

2. The Director of OEP has delegated authority to take all steps necessary to ensure the protection of life, health, property, and the environment during construction and operation of the Expansion Project. This authority shall include:

    a. stop-work authority and authority to cease operation; and
    b. the design and implementation of any additional measures deemed necessary to assure continued compliance with the intent of the environmental conditions of the Order.

3. **Prior to any construction,** Cameron LNG shall file an affirmative statement with the Secretary, certified by a senior company official, that all company personnel, EIs, and contractor personnel will be informed of the EI's authority and have been or will be trained on the implementation of the environmental mitigation measures appropriate to their jobs **before** becoming involved with construction and restoration activities.

4. The authorized facility locations shall be as shown in the EA, as supplemented by filed alignment sheets. **As soon as they are available, and before the start of construction,** Cameron LNG shall file with the Secretary any revised detailed survey maps/sheets at a scale not smaller than 1:6,000 with station positions for the facility authorized by the Order. All requests for modifications of environmental conditions of the Order or site-specific clearances must be written and must specify locations designated on these alignment maps/sheets.

5. Cameron LNG shall file with the Secretary detailed maps/sheets and aerial photographs at a scale not smaller than 1:6,000 identifying all facility relocations, staging areas, pipe

storage yards, new access roads, and other areas that would be used or disturbed that have not been previously identified in filings with the Secretary. Approval for use of each of these areas must be explicitly requested in writing. For each area, the request must include a description of the existing land use/cover type, documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area. All areas shall be clearly identified on the maps, or aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area**.

This requirement does not apply to route variations required herein or extra workspace allowed by FERC's Plan. Examples of alterations requiring approval include all facility location changes resulting from:

a. implementation of cultural resources mitigation measures;
b. implementation of endangered, threatened, or special concern mitigation measures;
c. recommendations by state regulatory authorities; and
d. agreements with individual landowners that affect other landowners or could affect sensitive environmental areas.

6. **Within 60 days of the acceptance of the authorization and before construction** begins, Cameron LNG shall file an Implementation Plan with the Secretary for review and written approval by the Director of OEP. Cameron LNG must file revisions to the plan as schedules change. The plan shall identify:

a. how Cameron LNG will implement the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests), identified in the EA, and required by the Order;
b. how Cameron LNG will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to onsite construction and inspection personnel;
c. the number of EIs assigned, and how the company will ensure that sufficient personnel are available to implement the environmental mitigation;
d. company personnel, including EIs and contractors, who will receive copies of the appropriate material;
e. the location and dates of the environmental compliance training and instructions Cameron LNG will give to all personnel involved with construction and restoration (initial and refresher training as the project progresses and personnel change);
f. the company personnel (if known) and specific portion of Cameron LNG's organization having responsibility for compliance;
g. the procedures (including use of contract penalties) Cameron LNG will follow if noncompliance occurs; and
h. for each discrete facility, a Gantt or PERT chart (or similar project scheduling diagram), and dates for:

(1) the completion of all required surveys and reports;
(2) the environmental compliance training of onsite personnel;
(3) the start of construction; and
(4) the start and completion of restoration.

7. Cameron LNG shall employ at least one EI during construction of the Expansion Project. The EI shall be:

a. responsible for monitoring and ensuring compliance with all mitigation measures required by the Order and other grants, permits, certificates, or other authorizing documents;
b. responsible for evaluating the construction contractor's implementation of the environmental mitigation measures required in the contract (see condition 6 above) and any other authorizing document;
c. empowered to order correction of acts that violate the environmental conditions of the Order, and any other authorizing document;
d. a full-time position, separate from all other activity inspectors;
e. responsible for documenting compliance with the environmental conditions of the Order, as well as any environmental conditions/permit requirements imposed by other federal, state, or local agencies; and
f. responsible for maintaining status reports.

8. Beginning with the filing of its Implementation Plan, Cameron LNG shall file updated status reports with the Secretary on a **monthly** basis until all construction and restoration activities are complete. On request, these status reports will also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include:

a. an update on Cameron LNG efforts to obtain the necessary federal authorizations;
b. the construction status of the project, work planned for the following reporting period, and any schedule changes for stream crossings or work in other environmentally-sensitive areas;
c. a listing of all problems encountered and each instance of noncompliance observed by the EI during the reporting period (both for the conditions imposed by the Commission and any environmental conditions/permit requirements imposed by other federal, state, or local agencies);
d. a description of the corrective actions implemented in response to all instances of noncompliance, and their cost;
e. the effectiveness of all corrective actions implemented;
f. a description of any landowner/resident complaints which may relate to compliance with the requirements of the Order, and the measures taken to satisfy their concerns; and
g. copies of any correspondence received by Cameron LNG from other federal, state, or local permitting agencies concerning instances of noncompliance, and Cameron LNG’s response.

9. **Prior to receiving written authorization from the Director of OEP to commence construction of any project facilities**, Cameron LNG shall file with the Secretary documentation that it has received all applicable authorizations required under federal law (or evidence of waiver thereof).

10. Cameron LNG must receive written authorization from the Director of OEP **before placing into service** the phases of the Expansion Project. Such authorization will only be granted following a determination that the facilities have been constructed in accordance with FERC approval and applicable standards, can be expected to operate safely as designed, and the rehabilitation and restoration of the right-of-way and other areas affected by the project are proceeding satisfactorily.

11. **Within 30 days of placing the authorized facilities in service**, Cameron LNG shall file an affirmative statement with the Secretary, certified by a senior company official:

    a. that the facilities have been installed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or
    b. identifying which of the conditions in the Order Cameron LNG has complied with or will comply with. This statement shall also identify any areas affected by the project where compliance measures were not properly implemented, if not previously identified in filed status reports, and the reason for noncompliance.

12. Cameron LNG shall file with the Secretary of the Commission (Secretary) the following information, stamped and sealed by a professional engineer-of-record licensed in Louisiana:

    a. quality control procedures that will be used for design and construction **prior to initial site preparation**.
    b. site preparation drawings and specifications **prior to construction of the final design**;
    c. LNG storage tank and foundation design drawings and calculations **prior to construction of the final design**;
    d. LNG liquefaction structures and foundation design drawings and calculations **prior to their construction of the final design**; and
    e. seismic specifications used in conjunction with the procuring equipment **prior to construction of the final design**.

    In addition, Cameron LNG shall file, in its Implementation Plan, the schedule for producing this information.

13. Cameron LNG shall file a full load noise survey with the Secretary **no later than 60 days** after placing each of the liquefaction trains (Trains 4 and 5) into service. If a full load noise survey is not possible, Cameron LNG shall provide an interim survey at the maximum possible load and provide the full load survey **within 6 months**. If the noise attributable to operation of all the equipment at the Cameron LNG Terminal, under interim or full load conditions, exceeds an L_{dn} of 55 dBA at any nearby NSA, Cameron

LNG shall file a report on the changes that are needed and shall install the additional noise controls to meet the level **within one year** of the in-service date. Cameron LNG shall confirm compliance with the above requirement by filing a second noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls.

The following measures shall apply to the Cameron LNG Expansion Project. Information pertaining to these specific conditions shall be filed with the Secretary for review and written approval by the Director of OEP either: <u>prior to initial site preparation</u>; <u>prior to construction of final design</u>; <u>prior to commissioning</u>; <u>prior to introduction of hazardous fluids</u>; or <u>prior to commencement of service</u>, as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, shall be submitted as critical energy infrastructure information pursuant to 18 CFR 388.112. See Critical Energy Infrastructure Information, Order No. 683, 71 Fed. Reg. 58,273 (October 3, 2006), FERC Stats. & Regs. ¶31,228 (2006). Information pertaining to items such as: offsite emergency response; procedures for public notification and evacuation; and construction and operating reporting requirements, would be subject to public disclosure. All information shall be filed <u>a minimum of 30 days</u> before approval to proceed is requested.

14. **Prior to initial site preparation**, Cameron LNG shall file an overall project schedule, which includes the proposed stages of the commissioning plan.

15. **Prior to initial site preparation**, Cameron LNG shall provide procedures for controlling access during construction.

16. **Prior to initial site preparation**, Cameron LNG shall file the quality assurance and quality control procedures for construction activities.

17. **Prior to initial site preparation**, Cameron LNG shall file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems.

18. **Prior to initial site preparation,** Cameron LNG shall file with the Secretary, for review and written approval by the Director of OEP, additional analysis that demonstrates the flammable vapor dispersion from design spills would be prevented from dispersing underneath the existing elevated LNG storage tank(s), or the LNG storage tank(s) would be able to withstand an overpressure due to ignition of the flammable vapor dispersion cloud that disperses underneath the existing elevated LNG storage tank(s)..

19. **Prior to initial site preparation,** Cameron LNG shall file with the Secretary, for review and written approval by the Director of OEP, an analysis that demonstrates the fire protection system, refrigerant storage tanks, refrigerant trucks, and occupied building will be designed to withstand the overpressures due to mixed refrigerant vapor cloud explosions.

20. **Prior to initial site preparation,** Cameron LNG shall file updates to the ERP to include the Expansion Project as well as instructions to handle on-site refrigerant and NGL-related emergencies.

21. **Prior to initial site preparation,** Cameron LNG shall file an ERP that includes a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that will be imposed on state and local agencies. In addition to the funding of direct transit-related security/emergency management costs, this comprehensive plan shall include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base.

22. **Prior to construction of the final design,** Cameron LNG should file with the Secretary, for review and written approval by the Director of the Office of Energy Projects (OEP), certification that the design for Trains 4 and 5 and Storage Tank 5 would duplicate Trains 1 through 3 and Storage Tank 4, and how the conditions from the June 19, 2014 Order (Docket No. CP13-25-000) will be incorporated in the design for Trains 4 and 5 and Storage Tank 5.

23. **Prior to construction of the final design,** Cameron LNG shall file information/revisions with the Secretary, for review and written approval by the Director of OEP, pertaining to Cameron LNG's response numbers 7 and 8 of its December 16, 2015 filing, which indicated features to be included or considered in the final design.

24. **Prior to the construction of the final design**, Cameron LNG shall file with the Secretary for review and written approval by the Director of OEP, certification that the final design is consistent with the information provided to DOT as described in the design spill determination letter dated December 24, 2015 (Accession Number 20151228-4001). In the event that any modifications to the design alters the candidate design spills on which the 49 CFR 193 siting analysis was based, Cameron LNG shall consult with DOT on any actions necessary to comply with Part 193.

25. **Prior to construction of the final design**, Cameron LNG shall file with the Secretary for review and written approval by the Director of OEP the procedures to maintain and inspect the barriers provided to meet the siting provisions of 49 CFR 193.2059.

26. **Prior to construction of the final design,** Cameron LNG shall file with the Secretary for review and written approval by the Director of OEP the plan and drawings to detect and notify plant personnel of asphyxiate hazards due to releases of liquid nitrogen and other hazardous fluids.

27. The **final design** shall include change logs that list and explain any changes made from the FEED provided in Cameron LNG's application and filings. A list of all changes with an explanation for the design alteration shall be provided and all changes shall be clearly indicated on all diagrams and drawings.

28. The **final design** shall provide up-to-date Process Flow Diagrams with heat and material balances and P&IDs, which include the following information:

a. equipment tag number, name, size, duty, capacity, and design conditions;
b. equipment insulation type and thickness;
c. storage tank pipe penetration size and nozzle schedule;
d. valve high pressure side and internal and external vent locations;
e. piping with line number, piping class specification, size, and insulation type and thickness;
f. piping specification breaks and insulation limits;
g. all control and manual valves numbered;
h. relief valves with set points; and
i. drawing revision number and date.

29. The **final design** shall provide P&IDs, specifications, and procedure that clearly show and specify the tie-in details required to safely connect the Expansion Project to the existing facility.

30. The **final design** shall provide an up-to-date complete equipment list, process and mechanical data sheets, and specifications.

31. The **final design** shall include three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion.

32. The **final design** shall include a list of all car-sealed and locked valves consistent with the P&IDs.

33. The **final design** shall include drawings of the storage tank piping support structure and support of horizontal piping at grade including pump columns, relief valves, pipe penetrations, instrumentation, and appurtenances.

34. The **final design** shall include an analysis of the structural integrity of the outer containment of the full containment storage tanks when exposed to a roof tank top fire or adjacent tank top fire.

35. The **final design** shall demonstrate that for hazardous fluids, piping and piping nipples 2 inches or less in diameter are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators.

36. The **final design** shall provide the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3, as required by 49 CFR 193.

37. The **final design** shall include a plan for clean-out, dry-out, purging, and tightness testing. This plan should address the requirements of the American Gas Association's Purging Principles and Practice required by 49 CFR 193 and shall provide justification if not using an inert or non-flammable gas for cleanout, dry-out, purging, and tightness testing.

38. The **final design** shall include drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system meet the requirements of NFPA 59A.

39. The **final design** shall provide an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap shall vent to a safe location and be equipped with a leak detection device that: should continuously monitor for the presence of a flammable fluid; shall alarm the hazardous condition; and should shut down the appropriate systems.

40. The **final design** shall provide electrical area classification drawings.

41. The **final design** shall include a hazard and operability review of the completed design prior to issuing the P&IDs for construction. A copy of the review, a list of recommendations, and actions taken on the recommendations, shall be filed.

42. The **final design** shall include the cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices shall include alarms and shutdown functions, details of the voting and shutdown logic, and setpoints.

43. The **final design** shall include a drawing showing the location of the ESD buttons. ESD buttons shall be easily accessible, conspicuously labeled and located in an area which would be accessible during an emergency.

44. The **final design** shall specify that all ESD valves are to be equipped with open and closed position switches connected to the Distributed Control System/Safety Instrumented System.

45. The **final design** shall include the sizing basis and capacity for the final design of flare stack as well as the pressure and vacuum relief valves for major process equipment, vessels, and storage tanks.

46. The **final design** shall include an updated fire protection evaluation of the proposed facilities carried out in accordance with the requirements of NFPA 59A 2001, chapter 9.1.2 as required by 49 CFR 193. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations shall be filed.

47. The **final design** shall provide spill containment system drawings with dimensions and slopes of curbing, trenches, and impoundments.

48. The **final design** shall provide complete plan drawings and a list of the hazard detection equipment. The drawings shall clearly show the location and elevation of all detection equipment. The list shall include the instrument tag number, type and location, alarm locations, and shutdown functions of the proposed hazard detection equipment.

49. The **final design** shall include a list of alarm and shutdown set points for all flammable detectors that account for the calibration gas when determining the set points for flammable components such as refrigerants, natural gas liquids, and LNG.

50. The **final design** shall include a list of alarm and shutdown set points for all toxic detectors that account for the calibration gas when determining the set points for toxic components such as benzene, toluene, ethylbenzene and xylenes.

51. The **final design** shall provide complete plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Drawings shall clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers. The list shall include the equipment tag number, type, capacity, equipment covered, and automatic and manual remote signals initiating discharge of the units.

52. The **final design** shall provide facility plans and drawings that show the location of the firewater and foam systems. Drawings shall clearly show: firewater and foam piping; post indicator valves; and the location of and area covered by each monitor, hydrant, deluge system, foam system, water-mist system, and sprinkler. The drawings shall also include piping and instrumentation diagrams of the firewater and foam system.

53. **Prior to commissioning**, Cameron LNG shall provide a detailed schedule for commissioning through equipment startup. The schedule shall include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids; and during commissioning and startup. Cameron LNG shall file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued.

54. **Prior to commissioning**, Cameron LNG shall file plans and detailed procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service.

55. **Prior to commissioning**, Cameron LNG shall tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves.

56. **Prior to commissioning**, Cameron LNG shall provide results of the LNG storage tank hydrostatic test and foundation settlement results. At a minimum, foundation settlement results shall be provided thereafter annually.

57. **Prior to commissioning**, Cameron LNG shall file updates addressing the Expansion Project facilities in the operation and maintenance procedures and manuals, as well as safety procedures.

58. **Prior to commissioning**, Cameron LNG shall maintain a detailed training log to demonstrate that operating staff has completed the required training.

59. **Prior to commissioning**, Cameron LNG shall file a tabulated list and drawings of the proposed hand-held fire extinguishers. The list shall include the equipment tag number, extinguishing agent type, capacity, number, and location. The drawings shall show the extinguishing agent type, capacity, and tag number of all hand-held fire extinguishers.

60. **Prior to introduction of hazardous fluids**, Cameron LNG shall complete all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the Distributed Control System and the Safety Instrumented System that demonstrates full functionality and operability of the system.

61. **Prior to introduction of hazardous fluids**, Cameron LNG shall complete a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant shall be shown on facility plot plan(s).

62. **Prior to commencement of service,** Cameron LNG shall develop procedures for offsite contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by Cameron LNG staff.

63. **Prior to commencement of service**, Cameron LNG shall label piping with fluid service and direction of flow in the field in addition to the pipe labeling requirements of NFPA 59A.

64. **Prior to commencement of service**, Cameron LNG shall specify an alarm management program to ensure effectiveness of process alarms.

65. **Prior to commencement of service**, Cameron LNG shall notify FERC staff of any proposed developments to the security plan of the facility.

66. **Prior to commencement of service**, progress on the construction of the proposed systems shall be reported in **monthly** reports filed with the Secretary. Details shall include a summary of activities, problems encountered, contractor non-conformance/deficiency logs, remedial actions taken, and current project schedule. Problems of significant magnitude shall be reported to the FERC **within 24 hours**.

In addition, the following measures shall apply throughout the life of the facility:

67. The facility shall be subject to regular FERC staff technical reviews and site inspections on at least an **annual basis** or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Cameron LNG shall respond to a specific data request, including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, shall be submitted.

68. Semi-annual operational reports shall be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil-off/flash gas, etc.), plant modifications, including future plans and progress thereof. Abnormalities shall include, but not be limited to: unloading/loading/shipping problems, potential hazardous conditions from off-site vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluid releases, fires involving hazardous fluids, negative pressure (vacuum) within a storage tank and higher than predicted boil-off rates. Adverse weather conditions and the effect on the facility also shall be reported. Reports shall be submitted **within 45 days after each period ending June 30 and December 31**. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" also shall be included in the semi-annual operational reports. Such information will provide the FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility.

69. In the event the temperature of any region of any secondary containment, including imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission shall be notified **within 24 hours** and procedures for corrective action should be specified.

70. Significant non-scheduled events, including safety-related incidents (e.g., hazardous fluid releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) shall be reported to the FERC staff. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made **immediately**, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification shall be made to the FERC staff **within 24 hours**. This notification practice shall be incorporated into the LNG facility's emergency plan. Examples of reportable hazardous fluids-related incidents include:

   a. fire;
   b. explosion;
   c. estimated property damage of $50,000 or more;
   d. death or personal injury necessitating in-patient hospitalization;
   e. release of hazardous fluids for 5 minutes or more;
   f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;

i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;

j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;

l. safety-related incidents occurring at or en route to and from the LNG facility involving hazardous fluids; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, the FERC staff will determine the need for a separate follow-up report or follow-up in the upcoming semi-annual operational report. All company follow-up reports shall include investigation results and recommendations to minimize a reoccurrence of the incident.

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