Federal Energy Regulatory Commission

Office of Energy Projects

January 2021

Port Arthur LNG Phase II, LLC and
PALNG Common Facilities Company, LLC **Docket No. CP20-55-000**

Port Arthur LNG Expansion Project

Environmental Assessment

Cooperating Agencies:
U.S. Department of Transportation
U.S Department of Energy
U.S. Coast Guard

Washington, DC 20426

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

OFFICE OF ENERGY PROJECTS

In Reply Refer To:
OEP/DG2E/Gas 1
Port Arthur LNG Phase II, LLC
PALNG Common Facilities Company, LLC
Port Arthur LNG Expansion Project
Docket No. CP20-55-000

TO THE INTERESTED PARTY:

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared an environmental assessment (EA) for the Port Arthur LNG Expansion Project, proposed by Port Arthur LNG Phase II, LLC and PALNG Common Facilities Company, LLC (collectively referred to as Applicant) in the above-referenced docket. The Applicant requests authorization to expand the previously certificated Port Arthur Liquefaction Terminal in Jefferson County, Texas by siting, constructing, and operating additional liquefied natural gas (LNG) facilities to increase the terminal's capability to liquefy natural gas for export by 13.46 million tonnes per annum (MTPA). The Port Arthur LNG Expansion Project would increase the terminal's total liquefaction capacity from 13.46 MTPA to 26.92 MTPA.

The EA assesses the potential environmental effects of the construction and operation of the Port Arthur LNG Expansion Project in accordance with the requirements of the National Environmental Policy Act (NEPA). The FERC staff concludes that approval of the proposed project, with appropriate mitigating measures, would not constitute a major federal action significantly affecting the quality of the human environment.

The U.S. Department of Energy, U.S. Department of Transportation, and U.S. Coast Guard participated as cooperating agencies in the preparation of the EA. Cooperating agencies have jurisdiction by law or special expertise with respect to resources potentially affected by the proposal and participate in the NEPA analysis.

The proposed Port Arthur LNG Expansion Project includes the following facilities:

- two liquefaction trains (Trains 3 and 4) each with a maximum LNG production capacity of 6.73 MTPA (13.46 MTPA total). Each liquefaction

train would be composed of a feed gas treatment unit consisting of a mercury removal unit; 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 a main cryogenic heat exchanger, refrigeration system, and end flash drum;

- one new low-pressure ground flare;
- new flare knockout drums;
- one new boil-off gas (BOG) compressor unit to compress BOG and deliver as fuel to gas turbine;
- two new utility and instrument air compressor packages to deliver air to two new air drier packages;
- one new 3.675 megawatt capacity diesel powered standby generator; and
- shifting location of some equipment from Base Project, including LNG storage tanks, and modifications and additions to approved 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 Commission mailed a copy of the *Notice of Availability* to federal, state, and local government representatives and agencies; elected officials; Native American tribes; potentially affected landowners and other interested individuals and groups. The EA is only available in electronic format. It may be viewed and downloaded from the FERC's website (www.ferc.gov), on the natural gas environmental documents page (https://www.ferc.gov/industries-data/natural-gas/environment/environmental-documents). In addition, the EA may be accessed by using the eLibrary link on the FERC's website. Click on the eLibrary link (https://elibrary.ferc.gov/eLibrary/search), select "General Search" and enter the docket number in the "Docket Number" field (i.e. CP20-55). Be sure you have selected an appropriate date range. For assistance, please contact FERC Online Support at FercOnlineSupport@ferc.gov or toll free at (866) 208-3676, or for TTY, contact (202) 502-8659.

The EA is not a decision document. It presents Commission staff's independent analysis of the environmental issues for the Commission to consider when addressing the merits of all issues in this proceeding. Any person wishing to comment on the EA may do so. Your comments should focus on the EA's disclosure and discussion of potential environmental effects, reasonable alternatives, and measures to avoid or lessen environmental impacts. The more specific your comments, the more useful they will be. To ensure that the Commission has the opportunity to consider your comments prior to making its decision on this project, it is important that we receive your comments in Washington, DC on or before 5:00pm Eastern Time on **February 15, 2021.**

For your convenience, there are three methods you can use to file your comments to the Commission. The Commission encourages electronic filing of comments and has staff available to assist you at (866) 208-3676 or FercOnlineSupport@ferc.gov. Please carefully follow these instructions so that your comments are properly recorded.

(1) You can file your comments electronically using the eComment feature on the Commission's website (www.ferc.gov) under the link to FERC Online. This is an easy method for submitting brief, text-only comments on a project;

(2) You can also file your comments electronically using the eFiling feature on the Commission's website (www.ferc.gov) under the link to FERC Online. With eFiling, you can provide comments in a variety of formats by attaching them as a file with your submission. New eFiling users must first create an account by clicking on "eRegister." You must select the type of filing you are making. If you are filing a comment on a particular project, please select "Comment on a Filing"; or

(3) You can file a paper copy of your comments by mailing them to the Commission. Be sure to reference the project docket number (CP20-55-000) on your letter. Submissions sent via the U.S. Postal Service must be addressed to: Kimberly D. Bose, Secretary, Federal Energy Regulatory Commission, 888 First Street NE, Room 1A, Washington, DC 20426. Submissions sent via any other carrier must be addressed to: Kimberly D. Bose, Secretary, Federal Energy Regulatory Commission, 12225 Wilkins Avenue, Rockville, Maryland 20852.

Filing environmental comments will not give you intervenor status, but you do not need intervenor status to have your comments considered. Only intervenors have the right to seek rehearing or judicial review of the Commission's decision. At this point in this proceeding, the timeframe for filing timely intervention requests has expired. Any person seeking to become a party to the proceeding must file a motion to intervene out-of-time pursuant to Rule 214(b)(3) and (d) of the Commission's Rules of Practice and Procedures (18 CFR 385.214(b)(3) and (d)) and show good cause why the time limitation should be waived. Motions to intervene are more fully described at https://www.ferc.gov/ferc-online/ferc-online/how-guides.

Additional information about the project is available from the Commission's Office of External Affairs, at **(866) 208-FERC**, or on the FERC website (www.ferc.gov) using the eLibrary link. The eLibrary link also provides access to the texts of all formal documents issued by the Commission, such as orders, notices, and rulemakings.

In addition, the Commission offers a free service called eSubscription which allows you to keep track of all formal issuances and submittals in specific dockets. This can reduce the amount of time you spend researching proceedings by automatically providing you with notification of these filings, document summaries, and direct links to the documents. Go to https://www.ferc.gov/ferc-online/overview to register for eSubscription.

TABLE OF CONTENTS

LIST OF TABLES **Page**

LIST OF FIGURES **Page**

Technical Abbreviations and Acronyms

amsl	above mean seal level
AIChE	American Institute of Chemical Engineers
AQCRs	Air Quality Control Regions
ASCE	American Society of Civil Engineers
BACT	Best Available Control Technology
Bcf/d	billion cubic feet per day
BLEVE	boiling liquid expanding vapor explosion
BOG	boil-off gas
BPA	Beaumont- Port Arthur
BPVC	Boiler and Pressure Vessel Code
CAA	Clean Air Act
CCPS	Center for Chemical Process Safety
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_{2e}	carbon dioxide equivalents
Commission or FERC	Federal Energy Regulatory Commission
COTP	Coast Guard Captain of the Port
CPT	cone penetration tests
dB	decibels
dBA	A-weighted scale decibels
DEGADIS	Dense Gas Dispersion Model
DHS	Department of Homeland Security
DOE	Department of Energy
DOT	U.S. Department of Transportation
EA	environmental assessment
EFH	Essential fish habitat
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESD	emergency shutdown
FAA	Federal Aviation Administration
FEED	front-end-engineering-design
FHWA	Federal Highway Administration
FSA	Facility Security Assessment
FSO	Facility Security Officer
FSP	Facility Security Plan
FWS	United States Fish and Wildlife Service
GHG	greenhouse gas

GIS	Geographic Information System
GMD	Geomagnetic disturbances
GWP	global warming potential
HAP	Hazardous Air Pollutant
HAZID	hazard identification
IPCC	Intergovernmental Panel on Climate Change
ISA	International Society for Automation
LNG	liquefied natural gas
L_{eq}	equivalent continuous sound level
LOD	Letter of Determination
LOI	Letter of Intent
MCR	Main Control Room
MOU	memorandum of understanding
MTPA	million tonnes per annum
MTSA	Maritime Transportation Security Act
m^3	cubic meters
NAAQS	National Ambient Air Quality Standards
NCDC	National Climatic Data Center's
NEPA	National Environmental Policy Act
NEHRP	National Earthquake Hazards Reduction Program
NESHAP	National Emission Standard for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NGA	Natural Gas Act of 1938
NGL	natural gas liquids
NHTSA	National Highway Traffic Safety Administration
NNSR	Nonattainment New Source Review
NOI	notice of intent
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxides
NSA	noise-sensitive areas
N_2O	nitrous oxide
O_3	ozone
OBE	Operating Basis Earthquake
Pb	lead
PHMSA	Pipeline and Hazardous Materials Safety Administration
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
PSD	Prevention of Significant Deterioration
RICE	reciprocating internal combustion engines
RMP	Risk Management Plan
RRC	Railroad Commission of Texas

SCPT	seismic cone penetration tests
SIP	State Implementation Plan
SIS	safety instrumented system
SO_2	sulfur dioxide
SSE	Safety Shutdown Earthquake
tpy	tons per year
TPWD	Texas Parks and Wildlife Department
TSA	Transportation Security Administration
TWIC	Transportation Worker Identification Credential
Secretary	Secretary of the Commission
USCG	U.S. Coast Guard
U.S.C.	Unites States Code
VCE	vapor cloud explosion
VOC	volatile organic compound
WMA	Wildlife Management Area
WSA	Waterway Suitability Assessment

1. PROPOSED ACTION

1.1 Introduction

On February 19, 2020, Port Arthur LNG Phase II, LLC (an affiliate of Sempra LNG Holdings, LLC) and PALNG Common Facilities Company, LLC (collectively referred to as Applicant or Port Arthur LNG) filed an application in Docket No. CP20-55-000 with the Federal Energy Regulatory Commission (Commission or FERC) pursuant to Section 3(a) of the Natural Gas Act of 1938 (NGA) and Part 157 of the Commission's regulations. The Applicant requests authorization to expand the previously certificated Port Arthur Liquefaction Terminal[1] (Base Project) in Jefferson County, Texas by siting, constructing, and operating additional liquefied natural gas (LNG) facilities within the approved Base Project property. This proposal is referred to as the Port Arthur LNG Expansion Project (Expansion Project). The Expansion Project would increase the terminals capability to liquefy natural gas for export by 13.46 million tonnes per annum (MTPA). The Expansion Project would increase the Base Project's total liquefaction capacity from 13.46 MTPA to 26.92 MTPA.

The staff of the Commission has prepared this environmental assessment (EA) to address the potential environmental impacts of the Applicant'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) Parts 1500-1508 (49 CFR 1500-1508),[2] and the Commission's regulation at 18 CFR 380. The FERC is the federal agency responsible for siting 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), U.S. Department of Transportation (DOT), and U.S. Coast Guard (Coast Guard) are cooperating agencies in the preparation of this EA. Cooperating agencies have jurisdiction by law or special expertise with

[1] The Port Arthur Liquefaction Terminal Project (Base Project), was previously evaluated and assessed by FERC in FERC Docket Nos. CP17-20-000 (Port Arthur LNG Project), CP17-21-000 (Texas Connector Project) and CP18-7-000 (Louisiana Connector Project). This authorization included marine berth loading facilities, three full containment LNG storage tanks, two systems for liquefying natural gas (Trains 1 and 2) including associated natural gas pre-treatment equipment, to produce approximately 13.5 million tonnes per year of liquefied natural gas for export, and associated operation and control facilities. The Base Project is currently under construction.

[2] On July 16, 2020, CEQ issued a final rule, Update to the Regulations Implementing the Procedural Provisions of the National Environmental Policy Act (Final Rule, 85 Fed. Reg. 43,304), which was effective as of September 14, 2020; however, the NEPA review of this project was in process at that time and was prepared pursuant to the 1978 regulations.

respect to environmental impacts involved with a proposal. The roles of the FERC, DOE, DOT, and Coast Guard in the Expansion Project review process are described in section 1.2. Our[3] EA is an integral part of the Commission's decision on whether to issue the Applicant's the authorization to construct and operate the facilities described in section 1.5 below.

1.2 Scope of this Environmental Assessment

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;
- 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.

The topics addressed in this EA include geology and soils; water resources, fisheries, and wildlife; land use, recreation, and visual resources; socioeconomics (including transportation, traffic and environmental justice); 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 to avoid or minimize impacts.

The following resources would not be affected by the Expansion Project and, therefore, are not discussed further in this EA:

- mineral resources (including oil and gas development);
- vegetation;
- wetlands;
- paleontological resources;
- agriculture; and
- residential housing and businesses.

The EA would be used by the Commission in its decision-making process to determine whether to authorize the Applicant's proposal.

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

Cooperating Agencies

U.S. Department of Energy

The DOE must meet its obligation under section 3 of the NGA to authorize the import and export of natural gas, including LNG, unless it finds that the proposed import or export would not be consistent with the public interest. On February 28, 2020, the Applicant filed an application with the DOE Office of Fossil Energy (FE) for authorization to export up to 13.5 MTPA of domestically produced LNG from its proposed Port Arthur LNG Terminal (DOE Application). The Applicant requested authorization commencing on the earlier of the date of first export or seven years from the date of issuance of the authorizations requested, for a 20-year term, or until December 31, 2050, whichever is later. The DOE Application requested authorization to export LNG from the proposed Port Arthur LNG Terminal to any country that has, or in the future develops, the capacity to import LNG, and with which the United States has, or in the future may enter into, a free trade agreement requiring national treatment for trade in natural gas (FTA), and also to any nation with which the United States does not have an FTA requiring national treatment for trade in natural gas and with which trade is not prohibited by United States law or policy (non-FTA nations). . The DOE Application was amended on March 3, 2020, to replace references to "Port Arthur LNG Holdings, LLC" with "PALNG Common Facilities Company, LLC."

Section 3(c) of the NGA, as amended by section 201 of the Energy Policy Act of 1992 (Public Law 102-486), requires that applications to DOE requesting authorization of the import or export of natural gas, including LNG, from or to a nation with which there is in effect an FTA requiring national treatment for trade in natural gas, be deemed consistent with the public interest and granted without modification or delay. On July 14, 2020 the DOE FE issued Order No. 4562 *Granting Long-term Authorization to Export Liquefied Natural Gas to Free Trade Agreement Nations*.[4]

In the case of applications to export LNG to non-FTA nations, section 3(a) of the NGA requires DOE FE to conduct a public interest review and grant the applications unless DOE FE finds that the proposed exports will not be consistent with the public interest. Additionally, NEPA requires DOE FE to consider the environmental impacts of its decisions regarding applications to export natural gas to non-FTA nations. The portion of the DOE Application relating to export of LNG to non-FTA nations is pending with the DOE FE.

[4] See https://www.energy.gov/fe/downloads/port-arthur-lng-phase-ii-llc-fe-dkt-no-20-23-lng

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.

United States Coast Guard

The Coast Guard is the principal federal agency responsible for maritime safety, security, and environmental stewardship in U.S. ports and waterways. As such, the Coast Guard is the federal agency responsible for assessing the suitability of the Project Waterways (defined as the waterways that begin at the outer boundary of the navigable waters of the U.S.) for LNG marine traffic. The Coast Guard exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173; the Magnuson Act (50 United States Code [USC] 191); the Ports and Waterways Safety Act of 1972, as amended (33 USC 1221 et seq.); and the Maritime Transportation Security Act of 2002 (MTSA) (46 USC 701). The Coast Guard is responsible for matters related to navigation safety, vessel engineering and safety standards, and all matters pertaining to the safety of facilities or equipment in or adjacent to navigable waters up to the last valve immediately before the receiving LNG tanks. As appropriate, the Coast Guard (acting under the authority in 33 USC 1221 et seq.) also would inform FERC of design- and construction-related issues identified as part of safety and security assessments. If the Project is approved, constructed, and operated, the Coast Guard would continue to exercise regulatory oversight of the safety and security of the LNG terminal facilities in compliance with 33 CFR 127.

As required by its regulations, the Coast Guard is responsible for issuing a Letter of Recommendation (LOR) as to the suitability of the waterway for LNG marine traffic following a Waterway Suitability Assessment (WSA). The process of preparing the LOR begins when an applicant submits a Letter of Intent (LOI) to the Captain of the Port (COTP). On May 17, 2019, the Applicant submitted a letter to the COTP regarding the Expansion Project to assess whether the Applicant's existing September 11, 2015 LOR and November 2017 WSA were sufficient or if an additional LOI or updated/preliminary

WSA was required. On June 13, 2019, the Coast Guard determined that the WSA was broad enough to allow for this Expansion Project, including the construction of Trains 3 and 4 and the expected outcome of LNG ship traffic. Therefore, the Coast Guard concluded that the Expansion Project did not need to update the current LOI or WSA.

1.3 Purpose and Need

The Applicant states that the purpose of the Expansion Project is to increase Port Arthur LNG Terminal's (Base Project) maximum natural gas liquefaction capabilities and to export LNG to free trade agreement and non-free trade agreement countries, consistent with DOE authorizations. The Expansion Project would increase the Base Project's LNG production capacity by 13.46 MTPA. The Applicant claims that the Expansion Project would enable it 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. 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 June 25, 2019, we granted the Applicant's request to use the pre-filing process and assigned Docket No. PF19-5-000 to the Expansion Project. The Applicant hosted, and we participated in, an open house information session for landowners, agencies, and other interested stakeholders on August 11, 2019, in Port Arthur, Texas. 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 the Applicant to stakeholders and published in local newspapers. The Applicant also established a webpage and a telephone hotline for the Expansion Project.

On October 1, 2019, we issued a *Notice of Intent to Prepare an Environmental Assessment for the Planned Port Arthur LNG Expansion Project and Request for Comments on Environmental Issues* (NOI). This NOI, which 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 comments about the Expansion Project from the Sabin Center for Climate Change Law and from the Golden Triangle Group of

the Sierra Club. Table 1.4-1 lists the concerns identified during the public comment process and identifies the applicable sections of this EA that address each issue.

TABLE 1.4-1 Issues Identified During Scoping	
Issue	**EA Section Where Addressed**
GENERAL	
Impacts related to climate change.	2.6.1; 2.8
WATER RESOURCES	
Climate impacts related to sea level rise.	2.6.1; 2.8
AIR RESOURCES	
Financial losses due to climate change.	2.6.1; 2.8
SOCIOECONOMICS	
Financial losses due to climate change.	2.6.1; 2.8
WILDLIFE AND VEGETATION	
Erosion and sedimentation on the nearby wetlands	2.2.1
Spill prevention and surface water runoff.	2.2.1
Migratory bird impacts.	2.2.3

1.5 Proposed Facilities

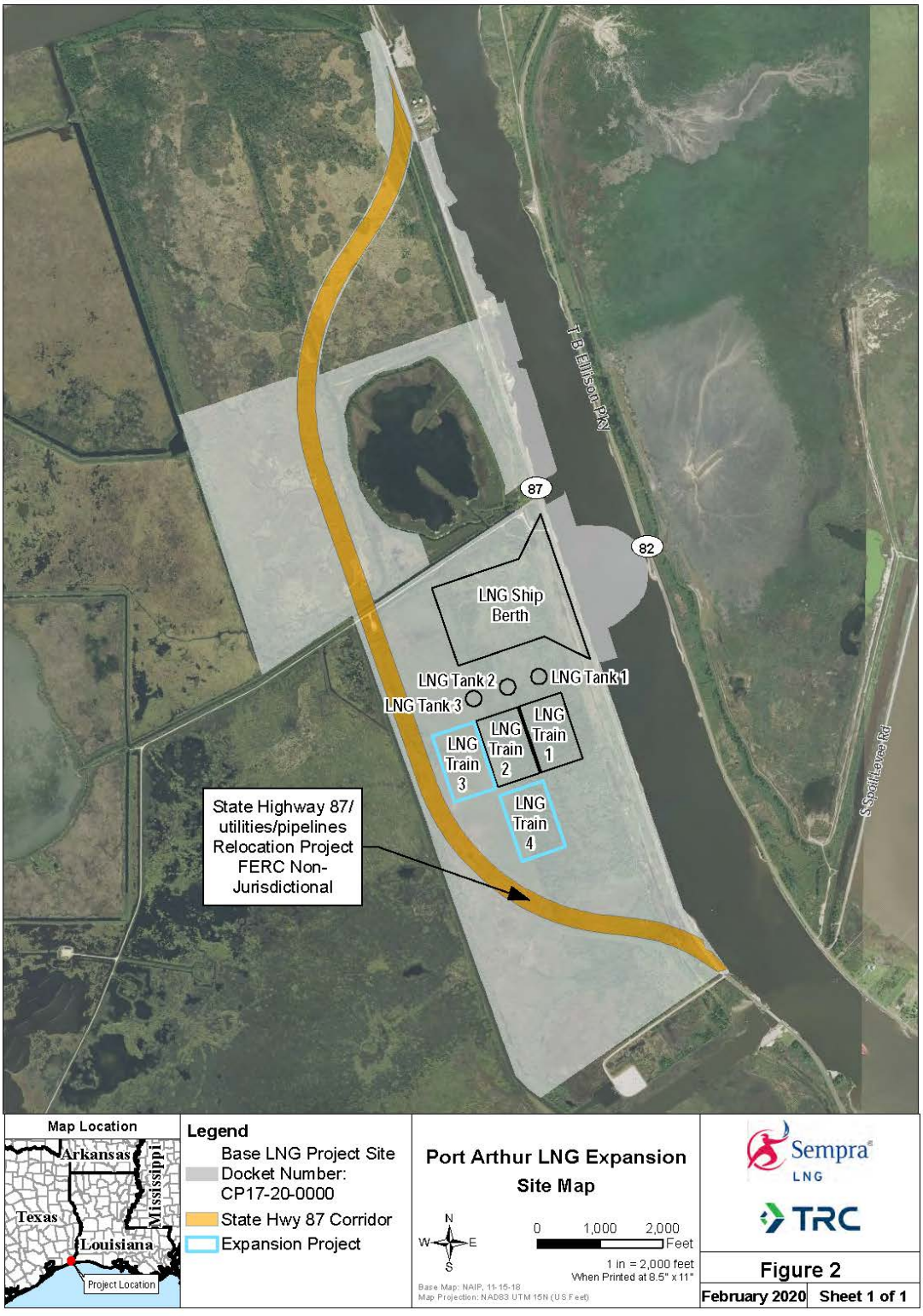
The Applicant's Expansion Project would involve the construction of two additional sets of facilities designed to liquefy LNG (LNG Trains) and support facilities at the Base Project. No new LNG storage tanks are proposed as part of the Expansion Project. The Expansion Project facilities are depicted in figures 1 and 2.

The Expansion Project facilities would receive natural gas via a natural gas pipeline approved for the Base Project. The natural gas would be pre-treated to remove contaminants (mercury, hydrogen sulfide, carbon dioxide, water) and heavy hydrocarbons then liquefied using LNG Trains. The liquefied gas would be stored as LNG in the LNG storage tanks approved for the Base Project. The LNG would be transferred from the LNG storage tanks and would be loaded onto ships berthed at the terminal's approved marine facility. The Expansion Project facilities would be constructed and operated on about 60 acres entirely within the fenced Base Project, as shown on figure 2. The Expansion Project includes the following key facilities:

- two liquefaction trains (Trains 3 and 4) each with a maximum LNG production capacity of 6.73 MTPA (13.46 MTPA total). Each liquefaction train would be composed of a feed gas treatment unit consisting of a mercury removal unit; 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 a main cryogenic heat exchanger, refrigeration system, and end flash drum;
- one new low-pressure ground flare;
- new flare knockout drums;
- one new boil-off gas (BOG) compressor unit to compress BOG and deliver as fuel to gas turbine;
- two new utility and instrument air compressor packages to deliver air to two new air drier packages;
- one new 3.675 megawatt capacity diesel powered standby generator; and
- shifting location of some equipment from Base Project, including LNG storage tanks, and modifications and additions to approved utilities, fire and gas detection systems, control system, firewater system, spill containment, tertiary berm, and infrastructure needed to accommodate the two additional liquefaction trains.

Figure 1 General Location Map of the Expansion Project

Figure 2 Aerial View of the Expansion Project Facilities



The new facilities proposed for the Expansion Project would be consistent with the Base Project facilities and would replicate the design of liquefaction Trains 1 and 2 that are currently under construction. Some of the facilities in the Base Project would be shifted, modified, or added, including LNG storage tanks approved in Base Project and approved 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 Expansion Project would not require any additional marine facilities. The Applicant 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 Base Project and the Expansion Project may not increase from the number and size of ships previously assessed by the Coast Guard WSA for the original WSA of the Import Project depending on the average capacity of LNG marine vessels utilized at the site. Additional information on the number of LNG marine vessels, WSA, and LOR, are described in the Reliability and Safety Section.

The Applicant anticipates beginning construction of the Expansion Project in March 2021, subject to receipt of the Commission's authorization and all other required permits and approvals and expects LNG Train 3 to be completed and in service in the second quarter of 2026 and Train 4 to be completed and in service in the fourth quarter of 2026.

1.6 Non-jurisdictional Facilities

Occasionally, proposed projects have associated facilities that do not come under the jurisdiction of FERC. These "non-jurisdictional" facilities may be integral to the needs of a project (e.g., a new or expanded power plant at the end of a pipeline that is not under the jurisdiction of FERC) or may be merely associated as minor, non-integral components of the jurisdictional facilities that would be constructed and operated as part of a project. There are no non-jurisdictional facilities proposed for the Expansion Project.

1.7 Construction, Operation, and Maintenance Procedures

The Applicant 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).

The Applicant has adopted, in whole without modifications, the FERC's *Upland Erosion Control, Revegetation, and Maintenance Plan* (Plan) and *Wetland and Waterbody Construction and Mitigation Procedures* (Procedures) into its Environmental Plan. We previously reviewed and approved the use of Port Arthur LNG's Environmental Plan for the Base Project, which is currently under construction. The Applicant is proposing to adopt Port Arthur LNG's Environmental Plan for the Expansion Project, and we continue to 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, the Applicant would employ at least one environmental inspector (EI). The Applicant 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 for construction workers before the start of construction and throughout the construction process, as needed. The workforce for the duration of the approximately 55-month Expansion Project construction period would average approximately 1,554 workers per month, the same number for the Base Project facilitiesconstructingproposed that was evaluated and approved. The environmental training program would include the measures outlined in the Applicant's Environmental Plan, job-specific permit conditions, company policies, and any other project requirements.

Site Preparation

The Expansion Project would involve minor modifications to the previously approved Base Project facilities. The Expansion Project construction footprint would be entirely within the Base Project site and would not require any new, or modifications of existing, construction infrastructure (i.e., roads or docks).

Site Grade and Fill

The Expansion Project process area would be adjacent to the west and to the south of the approved liquefaction Trains 1 and 2. The process area would not require additional clearing, grubbing, grading, or site preparations. 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, the Applicant would import clean structural backfill material from existing local borrow areas.

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 is expected to be produced at an onsite concrete batch plant used during the construction of the Base Project.

Materials and Equipment Delivery

Construction traffic and equipment would access the site from Texas State Highway (TX) 87 and use the same entrances already approved for the Base Project. The Applicant would also deliver materials utilizing the approved material off-loading facility constructed as part of the Base Project.

1.7.2 Operating Procedures

The Texas Connector Pipeline would deliver natural gas to the Expansion Project. The natural gas would be metered and enter the pre-treatment section of the liquefaction facilities to remove components in the natural gas stream in preparation for liquefaction. The removed components include solids, carbon dioxide (CO_2), hydrogen, sulfur, water, and mercury.

The dry gas would be fed 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 Applicant's Terminal Operations Manual would include additional operating procedures for the new liquefaction facilities. The Applicant would train the Expansion Project's additional 84 operations personnel in accordance with the DOT minimum federal safety standards specified in 49 CFR 192 and 193.

1.7.3 Maintenance Procedures

The Applicant 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 the Applicant would file amendments with the agencies prior to commissioning the Expansion Project facilities. The Applicant would train all operations and maintenance personnel to safely perform their jobs prior to commissioning the proposed facility. Applicant 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 additional land for construction or operation. The Expansion Project would temporarily affect about 60 acres within the previously authorized Base Project site during construction. A total of 60 acres would be permanently affected by the Expansion Project but is currently affected by the Base Project.

1.9 Permits, Approvals, and Regulatory Consultations

Table 1.9-1 lists the federal and state regulatory agencies that have permit or approval authority or consultation requirements and the status of that review for the Expansion Project. The Applicant 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, Approvals, and Consultations for the Expansion Project

Agency	Permit/Approval/Consultation	Actual or Anticipated Submittal	Receipt Date
FEDERAL			
Federal Energy Regulatory Commission (FERC)	Section 3 of the Natural Gas Act Certificate of Public Convenience and Necessity	February 2020	Pending
United States Coast Guard (USCG)	LOR/WSA	May 17, 2019	June 13, 2019
U.S. Department of Energy (DOE)	Authorization for Long Term, Multi-Contract Authorization to Export Liquefied Natural Gas to Free Trade Agreement Countries	February 2020	July 2020
	Authorization for Long Term, Multi-Contract Authorization to Export Liquefied Natural Gas to Non-Free Trade Agreement Countries	February 2020	Pending
U.S. Federal Aviation Administration (FAA)	Aeronautical requirements under 14 CFR 77	February 7, 2020	May 18, 2020
U.S. Fish and Wildlife Service (FWS)	Section 7 of the Endangered Species Act Consultation	January 15, 2020	Pending

TABLE 1.9-1
Permits, Approvals, and Consultations for the Expansion Project

Agency	Permit/Approval/Consultation	Actual or Anticipated Submittal	Receipt Date
National Marine Fisheries Service (NMFS)	Magnuson-Stevens Fishery Management and Conservation Act, Essential Fish Habitat (EFH) Consultation	January 15, 2020	February 7, 2020
	Section 7 of the Endangered Species Act Consultation Marine Mammal Protection Act Consultation	January 15, 2020	Pending
STATE			
Texas Parks and Wildlife Department (TPWD)	State Listed Endangered Species Consultation	Consultation for the Base Project occurred November 2016	Base Project Consultation Received November 2017. No suitable habitat present for state-listed species for the Expansion Project.
Texas Commission on Environmental Quality (TCEQ)	Prevention of Significant Deterioration (PSD) Permit New Source Review (NSR) Permit Title V Operating Permit	September 12, 2019 (Supplement February 7, 2020)	Pending
Railroad Commission of Texas (RRC)	Statement of Consistency with the Coastal Management Program	January 15, 2020	February 7, 2020
State Historic Preservation Office	State Historic Preservation Office	Under CP17-20	June 2, 2015

2. ENVIRONMENTAL ANALYSIS

In the following sections, we address the affected environment, general direct and indirect construction and operational impacts, and proposed mitigation to minimize or avoid impacts for each resource.

When considering the environmental consequences of the Expansion Project, the duration and significance of any potential impacts are described below according to the following four levels: temporary, short-term, long-term, and permanent. Temporary impacts generally occur during construction, with the resources returning to pre-construction conditions almost immediately. Short-term impacts could continue for up to three years following construction. Long-term impacts would require more than three years to recover, but eventually would recover to preconstruction conditions. Permanent impacts could occur because of activities that modify resources to the extent that they may not return to pre-construction conditions during the life of the Project, such as with the construction of an aboveground facility. An impact would be considered significant if it would result in a substantial adverse change in the physical environment.

2.1 Geology and Soils

2.1.1 Geology

The Expansion Project would be wholly within the Commission approved Base Project site which is adjacent to the Port Arthur Ship Canal. The Expansion Project is within the Coastal Prairies sub-province of the West Gulf Coastal Plain physiographic province (Hunt 1974). The underlaying strata of southeast Texas consists of geologically young sediments that were deposited in or adjacent to rivers and deltas in a coastal plain setting. These sediments extend to a depth of about 165 feet and consist of young deltaic sands, silts, and clays with imbedded organic matter (described in more detail below in Foundation Conditions).

Bedrock geologic units underlying the Expansion Project are predominantly Cenozoic sedimentary rocks, including sandstone, claystone, and tuff. The depth to bedrock ranges from 200 to several thousand feet.

The terrain of the Expansion Project site is a previously developed pad of the Base Project at an elevation of approximately 9 feet above mean sea level, surrounded by a berm of approximately 20 feet in elevation above mean sea level. The pad was constructed from local dredged soils and structural fill. If onsite material is determined to

be insufficient or unsuitable for the intended application, the Applicant would import clean structural backfill material from existing local borrow areas.

The geotechnical studies conducted to date by the Applicant, and recent work at the Base Project site indicate that there is no bedrock near the surface of the Expansion Project site that would require blasting for removal. No significant impacts to site topography would occur during construction of the Expansion Project facilities. The Applicant would construct the proposed facilities within areas that would have been previously cleared, grubbed, filled and brought to grade for the Base Project. In addition, primary surface drainage features have already been constructed for the Base 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. Based on the Expansion Project being entirely within the Base Project site and the Applicant's proposed implementation of its Environmental Plan we conclude that impacts on geologic resources would not be significant.

2.1.2 Soils

The soils that were originally close to the Sabine-Neches Waterway, prior to the development of the Base Project, consisted of dredged material from the adjacent constructed Sabine-Neches Water Way and the Intracoastal Waterway that had been periodically deposited onto the Expansion Project site. This dredged material consisted of deep clay-based hydric soil series, exhibiting low or moderate compaction potential and moderate to severe soil rutting hazard, and are typical of the extensive coastal march wetlands dominating the area. The Expansion Project site was cleared, filled, stabilized and brought to its present grade during construction of the Base Project. The current 9-foot-deep layer of fill placed during the Base Project consisted of similar hydric dredged soils and structural fill. The Expansion Project site's surface layers do not contain cover materials such as gravel. No topsoil exists or would be used as part of the Expansion Project.

The Expansion Project site shares the same soils within the Base Project that were evaluated as having no severe erosion potential resulting from construction and operation of the Expansion Project. Given the Applicant's proposed use of erosion and sedimentation control measures contained in its Plan and Procedures (within its Environmental Plan), erosion of soils from wind and construction disturbance, as well as sedimentation into surrounding wetlands, would be minimal.

The potential for disturbance of contaminated soils occupying the Expansion Project site was investigated during environmental analysis conducted for the shared Base Project site. A regulatory database search of hazardous and solid wastes within the

Base Project found no listed sites within 0.25 mile of the liquefaction facilities or the dredged material disposal areas. Site reconnaissance of the Base Project found no unusual odors, waste pits, vent pipes, ground stains, or other typical indicators of potential hazardous waste or contaminated soil, and Base Project sediment sampling conducted in several dredging and disposal areas found no indication of soil contamination areas. Thus, it is not likely that contaminated sediments or soils are present within the Expansion Project.

In the event contaminated soils are discovered during construction, the Applicant would employ notification, analytical and mitigation measures contained in its Unanticipated Hazardous Waste Discovery Plan (within its Environmental Plan) to avoid or minimize contaminated soil impacts.

We have determined that the pre-existing soil conditions and the Applicant's implementation of soil disturbance mitigation measures contained within its Environmental Plan would adequately minimize soil impacts during construction and restoration. Therefore, we conclude that impacts would not be significant.

2.2 Water Resources, Fisheries, and Wildlife

2.2.1 Water Resources

Groundwater and Hydrostatic Testing

The coastal lowlands aquifer system within the State of Texas is also called the Gulf Coast aquifer. The Gulf Coast aquifer consists of three individual aquifers named the Chicot, Evangeline, and Jasper aquifers, from shallowest to deepest. A fourth, deeper aquifer, named the Catahoula aquifer, is also sometimes recognized; however, the Catahoula aquifer is more often identified as a confining layer (Texas Water Development Board [TWDB], 2011). The Chicot aquifer underlies the Base Project with the base of the aquifer at a depth of about 800 to 1,200 feet. The lower portion of the Chicot aquifer (700-foot sand) is the primary water source for the Project area. The Chicot aquifers consists of interbedded clays, silts, sands, and gravels. Over much of the Expansion Project, the first usable sand layer within the Chicot aquifer is overlain by a 50- to 100-foot-thick clay confining layer. Recharge to the Chicot aquifer occurs mainly in sandy outcrops northwest of the Expansion Project area.

The Chicot aquifer in Texas does not have sole source status according to the EPA, while in nearby southwest Louisiana the Chicot aquifer does have sole-source status. Thus, no sole-source aquifers would be impacted by the Expansion Project. There are no water supply wells or springs within 150 feet of the Expansion Project site (TWDB 2019).

Local surficial groundwater sources consist of discontinuous beds of sand near the surface, which provide small quantities of groundwater for domestic use. The Applicant measured the depth to groundwater at the terminal site as part of geotechnical surveys in 2019. Groundwater was measured at 0 to 3.5 feet below ground surface. Surficial aquifers in the vicinity of the Expansion Project are brackish or saline and are unsuitable for domestic use.

During construction and operation of the Expansion Project, the City of Port Arthur would supply water through an existing 16-inch-diameter water main line. The City of Port Arthur obtains its water from surface water sources in the region. The Applicant would use about 16 million gallons of water over a construction period of approximately 18 months from the City of Port Arthur, including:

- 5 million gallons for hydrostatic testing of the piping;
- 10 million gallons for dust control; and
- 1 million gallons for the concrete batch plant operations.

No chemicals would be added to the hydrostatic test water before or after testing. The Applicant would sample, test and discharge all hydrostatic test water in accordance with the Railroad Commission of Texas's (RRC) Hydrostatic Test Discharge Permit guidelines and the Applicant's Environmental Plan. The Applicant would comply with any local regulatory requirements for the use of this water. The RRC and the Environmental Protection Agency (EPA) regulate the discharge of hydrostatic test water through their surface waste management manual. The Applicant would obtain all necessary permits required to discharge hydrostatic test waters. Water used for hydrotesting would be filtered and discharged in accordance with applicable state and federal permits. As allowed by permit, discharges would be either through internal or external outfalls at the specific discharge locations approved for the Base Project. All water testing would be conducted in accordance with ASME standards. Impacts associated with the discharge of hydrostatic test water are expected to be temporary and negligible. We conclude that the impacts of hydrostatic testing at the Expansion Project site are expected to be temporary and negligible.

Some groundwater withdrawals (such as for dewatering for foundation construction) would be required, but these withdrawals would only potentially affect the surficial aquifer. The water pumped for construction dewatering would be brackish or saline. This water would be discharged in well vegetated upland areas using energy dissipation devices in accordance with the Applicant's Environmental Plan. No significant withdrawals from the surficial aquifer would be required for 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 Trains 3 and 4. The outer piles would be driven to a depth of approximately 110 feet and the inner piles to a depth of 95 feet. As discussed, the lower portion of the Chicot aquifer (700-foot sand) is the primary water source for the Project area and would not be directly impacted by construction of the planned piles.

Contaminated water is not likely to be present within the Expansion Project. No potentially contaminated waterbodies are located within the Expansion Project area. According to the Texas Commission on Environmental Quality (TCEQ), there are no critical groundwater problems resulting from contamination of groundwater supplies in the vicinity of the Expansion Project site, (TCEQ 2018).

If contaminated groundwater is encountered, the Applicant would immediately discontinue any activities that may be using such water and any activities which could potentially be causing contamination. The Applicant 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.

The Applicant has committed to employing a spill handling plan to avoid or mitigate contamination of spill impacts to groundwater quality during construction of the Project. The Base Project included a Spill Prevention, Containment, and Countermeasure Plan (SPCC Plan) which included measures to avoid spills, reduce response time, and ensure adequate clean-up of inadvertent spills during construction. However, the Applicant has not developed a SPCC Plan for the Expansion Project or clarified it would adopt the Base Project SPCC Plan for the Expansion Project. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Port Arthur LNG should file with the Secretary of the Commission (Secretary), for review and written approval by the Director of the Office of Energy Projects (OEP), or the Director's designee, a project-specific Spill Prevention, Control, and Countermeasures Plan developed in accordance with federal and state spill regulations and addressing contingency planning, spill response procedures, training, reporting, agency communications, and best management practices to prevent and control the discharge of pollutants from spill events as a result of construction activities.**

Based on the above analysis and compliance with our recommendation, we conclude that impacts on groundwater resources would be temporary and there would be no significant impacts on groundwater resources from construction or operation of the Expansion Project.

Surface Water

The Expansion Project facilities would be constructed completely within the Base Project site but away from the perimeter edges. Therefore, construction activities associated with the Expansion Project would not directly affect the Sabine Neches Waterway (SNWW) or the Port Arthur Canal. Land disturbing activities required for the construction of the Expansion Project would be confined to the approved graded portions of the Base Project site with no grubbing or clearing and minimal grading and soil disturbance to raise the surface elevations under some proposed aboveground structures. The Applicant would implement its Environmental Plan to minimize the impacts of erosion and sedimentation install erosion and sedimentation control structures as needed.

The Sierra Club (Sierra Club) commented questioning what measures would be taken to avoid spills or releases of hazardous materials from entering waterways and bayous. The Applicant would implement its SPCC Plan during construction to prevent spills, leaks, or other releases of hazardous materials from adversely impacting surface waters, which includes mitigations measures, such as not refueling within 100 feet of wetlands or waterbodies. The Sierra Club also commented about the locations of drainage outfalls to carry surface runoff and capture features developed for pollutants, sediments, and hazardous materials before entering outside waterbodies. Stormwater and other discharges from operation of the Expansion Project would be addressed in a modification of the Base Project's National Pollutant Discharge Elimination System (NPDES) permit for stormwater and industrial wastewater. However, no additional stormwater accumulation or stormwater outfalls are proposed.

Barge traffic would be consistent with the level of construction traffic to and from the approved material offloading facility dock for the transportation of construction equipment and supplies. Barge traffic would occur primarily during the construction period, resulting in temporary impacts on surface waters, including the suspension of sediment from tug propeller wash or wave action in the Port Arthur Canal. As part of the Base Project, erosion control measures, including riprap and other prevention measures, are installed along the entire length of the Base Project shoreline to minimize erosion.

The number and size of LNG ships calling on the Base Project and the Expansion Project would total 360 vessels per year, whereas the EIS for the Base Project accounted for the environmental impact of 180 vessels per year. Although the Base Project did not analyze the potential environmental impacts of the total 360 vessels per year, it did identify that the LNG facilities would be capable of loading 360 LNG ships per year. Additionally, the Coast Guard WSA for the Base Project approved (both in size and number) of vessels (up to 360). Thus, the additional 180 LNG ships associated with the operation of the Expansion Project falls within the scope of the original WSA in Docket CP05-83-000. Approximately 180 additional LNG ships per year would result from operation of the Expansion Project. The LNG ships are required to maintain and

implement its Shipboard Oil Pollution Emergency Plan to implement in the case of a potential oil spill or spill of hazardous materials, in accordance with the International Maritime Organization, as required under Regulation 37 of Annex I of the International Convention for Prevention of Pollutions from Ships, as modified by Protocol of 1978. The additional 180 LNG ships per year during operations may impact water quality in the existing Port Arthur Canal, which may include resuspension of sediments by propeller wash or wave action or may alter water quality due to ballast water discharges. During operation, LNG ships and barges require water for cooling of the main engine/condenser, diesel generators diesel generators, and equipment associated with fire and hotel services (Hunt, 2003). This could result in an increase in water temperature near the LNG ship. Due to the limited temperature increase, and relatively small volume of discharge compared to the total water within the Port Arthur Canal, we anticipate that the increased water temperature levels would diminish shortly after discharge, and therefore, would have temporary and minor impacts on water quality (FERC 2019). Further, the anticipated 180 LNG ships would represent less than a one percent increase in the total number of annual vessels in the project area and would not represent a significant change to ongoing activities in the Port Arthur Canal. In addition, all LNG ships would be required to discharge ballast water in accordance with federal regulations 33 CFR 151.151 and 46 CFR 162.060. Therefore, we conclude there would be no significant impacts on surface waters due to temporary barge traffic, the permanent additional LNG ships 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, the Applicant would use and maintain appropriate erosion and sedimentation measures contained in its Environmental Plan to prevent the movement of disturbed materials off the construction site. 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 Expansion Project area, although the Base Project is adjacent to the Port Arthur Canal, Round Lake, and Round Lake Canal. These three waterbodies are classified as warm water marine or estuarine waterbodies. While the Expansion Project construction would not directly impact waterbodies, a temporary increase in barge traffic to and from the construction dock (consistent with the barge traffic associated with the Base Project, i.e. 7 LNG ships per week or approximately 360 vessels per year) would be associated with the transportation of construction equipment and supplies. The proposed Project would extend the construction of the Base Project by approximately 18 months.

The Expansion Project is expected to double the number of vessels calling on the Base Project during operation, from 180 LNG ships per year up to 360 ships per year. The additional 180 LNG ships expected during operation of the Expansion Project would constitute less a one-percent increase in vessel traffic and could contribute to the background turbidity of the Port Arthur Canal and the SNWW. The wave action from LNG ship wakes could cause erosion of the Port Arthur Canal shoreline, increasing turbidity. As part of the Base Project, erosion control measures, including riprap and other prevention measures, are installed along the entire length of the Base Project shoreline. Therefore, we conclude any impacts on water quality within the Port Arthur Canal or SNWW from sediment resuspension would be localized, consistent with the current vessel traffic, and not significant.

Ballast Water

The release of ballast water into the Port Arthur Canal has the potential to impact fisheries by changing the temperature, salinity, pH, and dissolved oxygen concentrations in the water. However, the EIS for the Base Project concluded that the volume of water discharged into the Port Arthur Canal during each vessel would represent 0.03 percent of the water within a 500-meter stretch of the Port Arthur Canal, which would represent a minor influence on the overall system (FERC 2019). The effects of ballast water discharge associated with the Expansion Project would be similar to that of the Base Project. Additionally, federal oversight and regulations are in place to regulate ballast water discharge into U.S. waters, and all LNG ships would be required to adhere to the federal regulations (33 CFR 151.151 and 46 CFR 162.060). Therefore, we conclude that the effects of ballast water discharge on surface water temperature, salinity, pH, and dissolved oxygen in the Port Arthur Canal would be localized and minor.

Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act was established to promote the protection of Essential Fish Habitat (EFH) in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. Federal agencies that authorize, fund, or undertake activities that may affect EFH must consult with NMFS. EFH is defined as the waters and substrate necessary for the spawning, feeding, or growth to maturity of managed fish species. Managed species include marine, estuarine, and anadromous finfish; mollusks; and crustaceans.

The Expansion Project area contains EFH for six species: red drum, gray snapper, lane snapper, brown shrimp, white shrimp, and bull shark. The Expansion Project would affect EFH in the SNWW and Port Arthur Canal due to increased ballast water discharges, construction vessel traffic, and LNG ship traffic. However, as discussed

above, these impacts would be highly localized and minor. The NMFS stated in email correspondence dated February 7, 2020 that the Expansion Project would not adversely impact EFH and no further consultation is required.

Based on the characteristics of the identified fisheries and implementation of impact minimization methods, we have determined that constructing and operating the Expansion Project would not significantly affect fisheries, including EFH.

2.2.3 Wildlife

The Expansion Project would be constructed within the cleared and graded Base Project site that is devoid of vegetation and, therefore, would provide unsuitable habitat for most wildlife. Mobile wildlife species could be temporarily displaced from the construction workspace to surrounding habitats nearby. Further, there is an abundance of suitable habitat for wildlife species adjacent to the construction and operational areas. The Expansion Project would result in minor additional light and noise to the Base Project. We conclude that impacts on wildlife from construction and operation of the Expansion Project, while permanent, would not be significant.

Migratory Birds

Migratory birds are protected under the Migratory Bird Treaty Act of 1918 (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.

We received comments from the Sierra Club stating that the Project would impact migratory bird species including federally listed bird species. The Sierra Club also commented regarding impacts on migratory bird habitat and asserting that compensatory mitigation should be used to offset those impacts. Federally listed species are discussed in section B.1.1.4 below. As the Expansion Project site has been previously cleared and graded during the ongoing construction of the Base Project, there is minimal migratory bird habitat at the site due to the lack of vegetation, wetlands, or other suitable foraging and nesting features. Further, the Applicant received concurrence from the FWS-Texas Coastal Ecological Services Field Office that construction and operation of the Base Project would not have significant impacts on migratory birds. The Applicant would incorporate the voluntary avoidance and mitigation measures to protect migratory birds recommended by the FWS for the Base Project, such as, but not limited to:

- facility lighting would be designed to minimize the quantity of lights required to that needed to safely operate the facility;
- lighting would be installed with downward oriented shrouds, unless safety concerns warrant otherwise;
- The Applicant would attempt to avoid construction during the primary migratory bird nesting season, March through August (in accordance with FWS recommendations for the Base Project). If, however, this is not possible, prior to construction, the Applicant would coordinate with the FWS to identify specific MBTA species of concern and potential avoidance, surveys, or other measures to protect these migratory birds;
- The Applicant understands Entergy would install "avian friendly" power poles that eliminates avian fatalities due to electrical contact at the structure; and
- The Applicant would immediately notify the FWS if a large number of bird strikes occur within the vicinity of the project site (such as powerline strikes) in order to develop additional avoidance and/or diversion measures necessary to prevent future impacts on migratory birds.

As habitat for migratory birds has already been removed and with implementation of the Applicant's proposed mitigation measures, we conclude impacts on migratory birds, while permanent, would not be significant.

Special Status Species

Federal agencies are required by Section 7 of the Endangered Species Act (ESA) to consult with the FWS and the 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, species proposed for listing, or their critical habitat. As the lead federal agency, the FERC is responsible for Section 7 consultation with the FWS and NMFS. The Applicant, acting as FERC's non-federal representative, conducted informal consultations with the FWS and NMFS about species under their jurisdictions that could be affected by the Expansion Project. In addition, The Applicant also consulted with the Texas Parks and Wildlife Department (TPWD).

Through consultation with the FWS, Texas Coastal Ecological Services Field Office and the TPWD, 19 federally listed species were identified as potentially occurring in the Expansion Project area. These species include 11 federally listed endangered species (least tern, smalltooth sawfish, west Indian manatee, Atlantic hawksbill sea turtle, Kemp's Ridley sea turtle, Sei whale, fin whale, sperm whale, north Atlantic right whale, blue whale, and Bryde's whale), 8 federally listed threatened species (black rail, piping plover, red knot, wood stork, giant manta ray, green sea turtle, leatherback sea turtle, and

loggerhead sea turtle). Table 2.2-1 lists the special status species that may occur in the Expansion Project area and the potential effects the Expansion Project poses to each species.

The TPWD previously determined that potential impacts on state-listed and rare species associated with the Base Project could be avoided if all workers were educated on all sensitive habitats and wildlife species. The Applicant would educate all workers on sensitive habitats and wildlife species prior to allowing them access to the site during the environmental training. We have determined that the Expansion Project area would not provide any suitable habitat for any state-listed species other than marine mammals and sea turtles, which are discussed further below.

Federally Listed Species

The Expansion Project would be constructed entirely within the Base Project site. Based on the proposed location of the Expansion Project activities (cleared and graded area), there is no suitable habitat for any of the identified species at the LNG facility site. However, the Expansion Project would increase construction vessel traffic and LNG ship traffic in the SNWW and the Port Arthur Canal, and may affect federally listed aquatic species in the SNWW and the Port Arthur Canal. We are requesting that the FWS and NMFS consider this EA as our Biological Assessment and request concurrence with our determinations of effect for federally listed species, discussed further below.

TABLE 2.2-1
Federal and State-Listed Species Potentially Occurring in the Expansion Project Area

Species	Federal Status	State Status	Suitable Habitat	Determination of Effect
Birds				
American peregrine falcon (*Falco peregrinus anatum*) Arctic peregrine falcon (*Falco peregrinus tundrius*)	Not Listed	Threatened	No Suitable Habitat	*No impact*
Black rail (*Laterallus jamaicensis*)	Threatened	Rare	No Suitable Habitat	*No effect*
Henslow's sparrow (*Ammodramus henslowii*)	Not Listed	Rare	No Suitable Habitat	*No impact*
Least tern (*Sternula antillarum*)	Endangered	Endangered	No Suitable Habitat	*No effect*
Piping plover (*Charadrius melodus*)	Threatened	Threatened	No Suitable Habitat	*No effect*

TABLE 2.2-1
Federal and State-Listed Species Potentially Occurring in the Expansion Project Area

Species	Federal Status	State Status	Suitable Habitat	Determination of Effect
Red knot (*Calidris canutus*)	Threatened	Rare	No Suitable Habitat	*No effect*
Swallow-tailed kite (*Elanoides forficatus*)	Not Listed	Threatened	No Suitable Habitat	*No impact*
White-faced Ibis (*Plegadis chihi*)	Not Listed	Threatened	No Suitable Habitat	*No iimpact*
Wood stork (*Fusconaia askewi*)	Threatened	Threatened	No Suitable Habitat	*No effect*
Snowy plover (*Charadrinus alexandrius)*	Not Listed	Rare	No Suitable Habitat	*No impact*
Fish				
American eel (*Anguilla rostrate*)	Not Listed	Rare	No Suitable Habitat	*No impact*
Giant manta ray (*Manta birostris*)	Threatened	Not Listed	Offshore areas along LNG ship transit routes used for migration and feeding	*May affect, not likely to adversely affect*
Smalltooth sawfish (*Pristis pectinata*)	Endangered	Endangered	No Suitable Habitat	*No effect*
Amphibians				
Southern crawfish frog (*Lithobates areolatus areolatus*)	Not Listed	Rare	No Suitable Habitat	*No impact*
Reptiles				
Alligator snapping turtle (*Macrochelys temminckii*)	Not Listed [1]	Threatened	No Suitable Habitat	*No impact*
Northern scarlet snake (*Cemophora coccineacopei copei*)	Not Listed	Threatened	No Suitable Habitat	*No impact*
Texas horned lizard (*Phrynosoma cornutum*)	Not Listed	Threatened	No Suitable Habitat	*No impact*
Timber/canebrake rattlesnake (*Crotalus horridus*)	Not Listed	Threatened	No Suitable Habitat	*No impact*
Texas diamondback terrapin (*Malaclemys terrapin littoralis*)	Not Listed	Rare	No Suitable Habitat	*No impact*
Marine Reptiles				

TABLE 2.2-1
Federal and State-Listed Species Potentially Occurring in the Expansion Project Area

Species	Federal Status	State Status	Suitable Habitat	Determination of Effect
Green sea turtle (*Chelonia mydas*)	Threatened	Threatened	Foraging and transit habitat in the SNWW and Gulf of Mexico LNG transit routes	*May affect, not likely to adversely affect*
Atlantic hawksbill sea turtle (*Eretmochelys imbricate*)	Endangered	Endangered	Foraging and transit habitat in the SNWW and Gulf of Mexico LNG transit routes	*May affect, not likely to adversely affect*
Kemp's Ridley sea turtle (*Lepidochelys kempii*)	Endangered	Endangered	Foraging and transit habitat in the SNWW and Gulf of Mexico LNG transit routes	*May affect, not likely to adversely affect*
Leatherback sea turtle (*Dermochelys coriacea*)	Threatened	Endangered	Foraging and transit habitat in the SNWW and Gulf of Mexico LNG transit routes	*May affect, not likely to adversely affect*
Loggerhead sea turtle (*Caretta caretta*)	Threatened	Threatened	Foraging and transit habitat in the SNWW and Gulf of Mexico LNG transit routes	*May affect, not likely to adversely affect*
Mammals				
Plains spotted skunk (*Spilogale putorius interrupta*)	Not Listed	Rare	No Suitable Habitat	*No impact*
Rafinesque's big-eared bat (*Corynorhinus rafinesquii*)	Not Listed	Threatened	No Suitable Habitat	*No impact*
Southeastern myotis bat (*Myotis austroriparius*)	Not Listed	Rare	No Suitable Habitat	*No impact*
Marine/Aquatic Mammals				
West Indian manatee (*Trichechus manatus*)	Endangered	Endangered	Foraging and transit habitat present in the SNWW	*May affect, not likely to adversely affect*
Sei whale (*Balaenoptera borealis*)	Endangered	Not Listed	LNG transit routes in the Gulf of Mexico used for migration and feeding	*May affect, not likely to adversely affect*

TABLE 2.2-1
Federal and State-Listed Species Potentially Occurring in the Expansion Project Area

Species	Federal Status	State Status	Suitable Habitat	Determination of Effect
Fin whale (*Balaenoptera physalus*)	Endangered	Not Listed	LNG transit routes in the Gulf of Mexico used for migration and feeding	*May affect, not likely to adversely affect*
Sperm whale (*Physeter microcephalus*)	Endangered	Not Listed	LNG transit routes in the Gulf of Mexico used for migration and feeding	*May affect, not likely to adversely affect*
North Atlantic right whale (*Eubalaena glacialis*)	Endangered	Not Listed	LNG transit routes in the Gulf of Mexico used for migration and feeding	*May affect, not likely to adversely affect*
Blue whale (*Baleanoptera musculus*)	Endangered	Not Listed	LNG transit routes in the Gulf of Mexico used for migration and feeding	*May affect, not likely to adversely affect*
Bryde's whale (*Baleanoptera edeni*)	Endangered	Not Listed	LNG transit routes in the Gulf of Mexico used for migration and feeding	*May affect, not likely to adversely affect*
Insects				
Bay skipper (Euphyes bayensis)	Not Listed	Rare	No Suitable Habitat	*No impact*
Mussels				
Louisiana pigtoe (*Pleurobema riddellii*)	Not Listed[1]	Threatened	No Suitable Habitat	*No impact*
Sandbank pocketbook (*Lampsilis satura*)	Not Listed	Threatened	No Suitable Habitat	*No impact*
Southern hickorynut (*Obovaria jacksoniana*)	Not Listed	Threatened	No Suitable Habitat	*No impact*
Texas heelsplitter (*Potamilus amphichaenus*)	Not Listed	Threatened	No Suitable Habitat	*No impact*
Texas pigtoe (*Fusconaia askewi*)	Not Listed	Threatened	No Suitable Habitat	*No impact*
Triangle pigtoe (*Fusconaia lananensis*)	Not Listed	Threatened	No Suitable Habitat	*No impact*
Plants				
Chapman's orchid (*Platanthera chapmanii*)	Not Listed	Rare	No Suitable Habitat	*No impact*

TABLE 2.2-1
Federal and State-Listed Species Potentially Occurring in the Expansion Project Area

Species	Federal Status	State Status	Suitable Habitat	Determination of Effect
Awnless bluestem (*Bothriochloa exaristata*)	Not Listed	Rare	No Suitable Habitat	*No impact*
Large beakrush (*Rhynchospora macra*)	Not Listed	Rare	No Suitable Habitat	*No impact*

[1] Currently under review for potential FWS federal listing.

West Indian Manatee

The West Indian manatee is unable to tolerate temperatures below 68 °F for extended periods of time, which keeps its population concentrated in Florida during the winter months. During the summer, manatees expand their range and can be found throughout the Gulf of Mexico and along the Atlantic coast as far north as Rhode Island. Although the presence of manatees is rare, increased marine traffic poses a risk to manatees from vessel strikes, which is the primary threat to this species. The Applicant would provide LNG ship captains with the NMFS's *Vessel Strike Avoidance Measures and Reporting for Mariners* (NMFS, 2008) guidance, which includes collision avoidance measures. In addition, the Applicant adopted several recommendations from the FWS for the Base Project that would further reduce the potential for impacts on manatees, such as but not limited to:

- during in-water work in areas that potentially support manatees, all personnel associated with the project should be instructed about the potential presence of manatees, manatee speed zones, and the need to avoid collisions with and injury to manatees. All personnel should be advised that there are civil and criminal penalties for harming, harassing, or killing manatees, which are protected under the MMPA of 1972 and the ESA. Additionally, personnel should be instructed not to attempt to feed or otherwise interact with the animal, although passively taking pictures or video would be acceptable;
- all on-site personnel would be responsible for observing water-related activities for the presence of manatees. The following measures are recommended to minimize potential impacts to manatees in areas of their potential presence:
- All work, equipment, and vessel operation should cease if a manatee is spotted within a 50-foot radius (buffer zone) of the active work area. Once the manatee has left the buffer zone on its own accord (manatees must not be herded or harassed into leaving), or after 30 minutes have passed

without additional sightings of manatees in the buffer zone, in-water work can resume under careful observation for manatees;

- if a manatee is sighted in or near the project area, all vessels associated with the project should operate at "no wake/idle" speeds within the construction area and at all times while in waters where the draft of the vessel provides less than a fourfoot clearance from the bottom. Vessels should follow routes of deep water whenever possible;
- if used, siltation or turbidity barriers should be properly secured, made of material in which manatees cannot become entangled, and be monitored to avoid manatee entrapment or impeding their movement;
- temporary signs concerning manatees should be posted prior to and during all in-water project activities and removed upon completion. Each vessel involved in construction activities should display at the vessel control station or in a prominent location, visible to all employees operating the vessel, a temporary sign (at least 8.5 by 11 inches) reading language similar to the following: "CAUTION BOATERS: MANATEE AREA/IDLE SPEED IS REQUIRED IN CONSTRUCTION AREA AND WHERE THERE IS LESS THAN FOUR FOOT BOTTOM CLEARANCE WHEN MANATEE IS PRESENT." A second temporary sign measuring 8.5 by 11 inches should be posted at a location prominently visible to all personnel engaged in water-related activities and should read language similar to the following: "CAUTION: MANATEE AREA/EQUIPMENT MUST BE SHUTDOWN IMMEDIATELY IF A MANATEE COMES WITHIN 50 FEET OF OPERATION."; and
- collisions with, injury to, or sightings of manatees should be reported immediately to the Louisiana FWS ([337] 291-3100), the LDWF, Natural Heritage Program ([225] 765-2821), and the Texas Coastal Ecological Service (Donna Anderson [281] 212-1505). Provide the nature of the call (report of an incident, manatee sighting, etc.); time of the incident/sighting; and the approximate location, including the latitude and longitude coordinates, if possible.

It is possible for manatees to be struck by construction or LNG ships, but the Applicant would implement their proposed mitigation measures to avoid/minimize these interactions, we conclude that the Project *may affect, but is not likely to adversely affect* the West Indian manatee.

Whales and Sea Turtles

Six whales (sei, fin, sperm, North Atlantic right, blue, and Bryde's), five sea turtles (green, Atlantic hawksbill, Kemp's Ridley, leatherback, and loggerhead) and one fish (giant manta ray) may occur along shipping routes and could potentially be impacted by collisions with LNG ships or barges that are transiting to and from the LNG terminal.

LNG ships and barges would use well-traveled shipping lanes. The final EIS for the Base Project estimated that the LNG ships traveling to the terminal would represent approximately 0.038 percent of the overall shipping transits throughout the Gulf of Mexico. Therefore, with the Expansion Project, we estimate that LNG ships traveling to the Applicant's terminal would represent 0.076 percent of the total shipping transits in the Gulf of Mexico (0.038 for each the Base Project and Expansion Project). To reduce the risk associated with vessel strikes or disturbance of protected whales and sea turtles, the Applicant would provide LNG ship captains with the NMFS's *Vessel Strike Avoidance Measures and Reporting for Mariners* guidance, which includes collision avoidance measures such as maintaining a distance of 100 yards or greater between the whale and the vessel when whales are sighted and attempting to maintain a distance of 50 yards or greater between the animal and the vessel whenever possible when sea turtles are sighted.

Given the minor increase in the ship traffic that would result from the Expansion Project relative to the existing traffic and the avoidance measures that would be implemented, we conclude that the proposal *may affect, but is not likely to adversely affect* federally listed whales, sea turtles, and fish.

Clearance letters from the FWS (dated June 2018 and December 2018) and NMFS (dated August 2018) were received for the Port Arthur LNG facilities (FERC 2019). However, these clearance letters do not include the proposed impacts and the proposed project facilities expansion thus additional consultation with FWS and NMFS is still necessary. Therefore, **we recommend that**:

- **Port Arthur LNG should not begin construction of the Expansion Project until:**
  a. **FERC staff receives comments from the FWS/NMFS regarding the proposed action;**
  b. **FERC staff completes formal consultation with the FWS/NMFS, if required; and**
  c. **Port Arthur LNG receives written notification from the Director of OEP, or the Director's designee, that construction or use of mitigation may begin.**

2.3 Land Use, Recreation, and Visual Resources

2.3.1 Land Use

No previously undisturbed land would be required for the Expansion Project. The Applicant would construct its Expansion Project on 60 acres of land within the previously approved Base Project site. The Expansion Project site is already cleared and graded; therefore, no other land use impacts would occur due to construction.

Wetlands

The Expansion Project would be constructed within the boundaries of the previously approved Base Project site. The Base Project site, which currently consists of wetlands, would be filled and converted to industrial uplands. Therefore, there are no wetlands within or within 50 feet of the Expansion Project area. The Sierra Club submitted comments concerning the effects of erosion and sedimentation on the nearby wetlands caused by ground disturbance during construction of the Expansion Project, specifically the JD Murphree Wildlife Management Area wetlands and the Big Bayou Management Area. Further, the Sierra Club requests that permanent impacts on wetlands should be addressed. While the Expansion Project does not involve impacts on wetlands, compensatory mitigation for the permanent impacts on wetlands associated with the Base Project would be addressed as part of the section 404 permit process with the U.S. Army Corps of Engineers. The Applicant would construct the proposed facilities in accordance with its Environmental Plan which would prevent offsite movement of sediments from impacting wetlands in the surrounding areas.

Coastal Zone Management

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 RRC administers Texas's Coastal Zone Management Programs for oil & gas development projects and is the lead agency that performs federal consistency reviews. The Expansion Project is within the coastal zone boundary, which is locally defined as the area south of the Interstate 10 (I-10).. On February 7, 2020, the RRC confirmed that the Expansion Project would be covered under the Consistency Determination previously issued for the Base Project.

2.3.2 Recreation and Public Interest Areas

The Expansion Project would be within the footprint of the Base Project site and would not cross public or conservation lands. Texas State Highway 87 (SH 87) would be the primary road access for workers and material transport, and construction activities may delay or temporary effect vehicular traffic during peak hours. The Applicant would utilize the Traffic Management Plan developed and implemented for the Base Project to alleviate congestion on SH 87. Mitigations in the plan include developing a Park & Ride system from surrounding areas, using multiple designated access points to the site, implementing off-peak hours material deliveries, implementing uniformed traffic control as needed to ensure safe traffic flow patterns, and utilizing marine delivery of material where applicable.

Designated natural and recreational areas in the vicinity of the Expansion Project include: J.D. Murphree Wildlife Management Area (WMA) (about 0.25 mile west of the

Expansion Project); McFaddin National Wildlife Refuge (NWR) (about 5 miles southwest of the Expansion Project); Texas Point NWR (about 5 miles southeast of the Expansion Project); Sea Rim State Park (about 6 miles southwest of the Expansion Project); Sabine Pass Battleground State Historical Park (about 6 miles southeast of the Expansion Project); Walter Umphrey State Park (about 3 miles southeast of the Expansion Project); SNWW (adjacent to the Expansion Project); and Sabine Lake (about 5 miles southeast of the Expansion Project).

The start of the Expansion Project construction activities would occur concurrently with the ongoing activities for the Base Project and the work would be completed by the same workers. There would be no increase in the size of the workforce, but the construction schedule would be extended by approximately 18 months. Public access to recreational resources in the vicinity of the Expansion Project would not be restricted and vehicle traffic would not be rerouted during construction. Because the size of the workforce would not increase above the Base Project's, the Applicant would implement its Traffic Management Plan to minimize impacts on traffic, and public access would not be restricted, we conclude that construction of the Expansion Project would have a temporary and not significant impact on recreational resources.

During operation of the Expansion Project, the additional LNG ships would increase the likelihood of boaters encountering LNG ships within the Port Arthur Canal. However, the Port Arthur Canal is heavily used by large commercial vessel traffic and the additional LNG ships would represent an insignificant increase in the yearly traffic within the canal (less than one percent). Additionally, recreational boating activities are concentrated in the areas within the J.D. Murphree WMA and Sabine Lake. Therefore, we conclude that construction and operation of the Expansion Project would not significantly affect 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 Base Project. Construction of all facilities associated with the Expansion Project would result in temporary visual impacts on the immediate area consistent with that of the Base Project. Therefore, the level of temporary visual impacts on the immediate area would remain essentially unchanged, but the duration of those visual impacts would be lengthened by approximately 18 months.

The construction of liquefaction Trains 3 and 4, and associated facilities would be within the Base Project site and installed adjacent to liquefaction Trains 1 and 2, which are under construction at the Base Project site. The Expansion Project trains would be constructed and illuminated in the same manner as Trains 1 and 2. Intermittent views of the facility would be available to boaters in the Port Arthur Canal and motorists using SH 87. The visual impact of the construction and operation of the Expansion Project would

be relatively minor because it would be within an approved, similar industrial facility and construction of liquefaction Trains 3 and 4 would be consistent with the existing viewshed. Therefore, we conclude that while the visual impact of the Expansion Project would be permanent, it would not have a significant impact on visual resources.

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. Economic activity generally encompasses regional employment, personal income, and revenues and expenditures. Impacts on these fundamental socioeconomic components can influence other issues such as regional housing availability and provision of community services.

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.

For the purpose of this analysis we include all geographic areas within reasonable commuting distance for local hires (40 mile radius from the Expansion Project). This area includes portions of Orange and Jefferson Counties where much of the construction labor force would come from.

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

City/County/State	Population	Population Density (per square mile)
	2018 (est.) (a)	2018 (a) (b)
Texas	28,701,845	109.9
Jefferson County	255,001	291.1
Orange County	83,572	250.2
City of Beaumont	118,428	1,430.3
City of Port Arthur	55,018	715.4

TABLE 2.4-1
Existing Population and Demographics

City/County/State	Population	Population Density (per square mile)
	2018 (est.) (a)	2018 (a) (b)

(a) U.S. Census Bureau, State and County Quick Facts
(b) Persons per square mile, based on population and area size: Texas (261,231 sq. mi.), Jefferson County (876 sq. mi.), Orange County (334 sq. mi); Beaumont City (82.8 sq. mi), and Port Arthur (76.9 sq. mi.)

2.4.2 Housing

With an increase in non-local workers during both construction and operation, housing within the Jefferson and Orange Counties 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. The workforce for the duration of the approximately 55-month Expansion Project construction period would average approximately 1,554 workers per month.

The Expansion Project would utilize the construction workforce hired for the ongoing Base Project. The Applicant anticipates adding approximately 84 additional permanent staff positions to operate the Expansion Project facilities.

Due to the adequate availability of housing for the Base Project and the fact that construction at the site would not be increased from what is required for the ongoing Base Project, we conclude that no significant impacts on housing resources would occur during the construction and operation of the Expansion Project.

2.4.3 Public Services

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

Education and School System

There are 100 public schools in the region with a population greater than 58,363 students. Jefferson County has 74 public schools with a 2018-2019 enrollment of 42,728 students and Orange County has 26 public schools with a 2018-2019 enrollment of 15,635 students (Texas Education Agency 2019). The closest schools to the Expansion Project site include Abraham Lincoln Middle School and the Port Arthur Alternative Center, both are approximately 6 miles away to the north, and Sabine Pass School, approximately 7 miles to the south.

It is anticipated that some temporary employees would move their families into the area during the construction of the Expansion Project and that these families would have children that may be attending area schools, most likely in Jefferson County and more specifically in the City of Port Arthur. Using the average of 1,554 construction personnel per month (55 months of construction) and that 310 (or 20 percent) of the workers are local, then 80 percent (1,243) would be non-local and 60 percent of the non-local workforce (745) would temporarily relocate to within the project area. Based on trends identified by regional experts in business development in the Port Arthur area, it is assumed that the vast majority of workers would not relocate with their families for the duration of the temporary construction period; however, some executive and management personnel who would be in the area for the majority of the construction phase may bring their families (Southeast Texas Economic Development Foundation 2015; Port Arthur Economic Development Council 2015). Of those workers who would relocate to the area, it is assumed that 10 percent (74 construction workers) would bring their families. Using the 2017 American Community Survey data for Jefferson County, which indicates that a typical household consists of 2.54 people and 74 construction workers would bring their families, a maximum of 188 additional children may attend local schools during construction, if all household non-workers were children, which is highly unlikely.

The student teacher ratio in the Beaumont Independent School District is 16:1, 11:1 in the Sabine Pass Independent School District, and 14:1 in The Port Neches-Groves Independent School District. The ratio in the Nederland Independent School District is 15:1 and 16:1 at the Bob Hope School in Port Arthur. Using the 16:1 ratio as a worst case scenario for the analysis, if all 188 students were added to an independent school district with this ratio, the addition of these students would increase the ratio to 16.05:1 from 16:1. We conclude this increase would be temporary and short-term, lasting only the duration of construction and would not be significant.

The addition of 84 full-time workers could add up to 129 students during operation of the Expansion Project (assuming 2.54 persons per household and all non-workers were students). Even though this impact would be permanent, as demonstrated above for construction worker students, this would not meaningfully increase the student to teacher ratio. Therefore, we conclude that impacts from operations staff on the local school system would be negligible.

Health Care

Beaumont has two major hospitals, Baptist Hospital with 396 beds and Christus St. Elizabeth Hospital with 431 acute care beds and a trauma center. Christus Southeast Texas Saint Mary in Port Arthur has 240 beds. The nearest hospital is the Medical Center of Southeast Texas with 216 beds and is approximately 10 miles north of the Expansion Project site.

Health care demands during construction are expected to include emergency medical services to treat injuries resulting from construction accidents. Medical facilities within the nearby counties 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 negligible. The addition of about 84 full-time permanent workers from the Expansion Project would have a negligible effect on hospitals.

Police and Fire Services

Jefferson County has one sheriff's office, five police departments, one university police department, one school district police department, and 10 fire stations (five paid and five volunteer stations) (Jefferson County, 2019). Orange County has one sheriff's office, seven police departments, and seven volunteer and paid fire departments, some of which have multiple stations within their respective service areas (SETRPC, 2019).

The nearest fire station is the Port Arthur Fire Station located at 1201 Grannis Avenue in Port Arthur which is approximately 6 miles from the Expansion Project site. The nearest police station is the Port Arthur Police Department located at 645 4th Street in Port Arthur which is approximately 7.5 miles from the Expansion Project site.

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 counties can absorb any increase in demand by the temporary construction workforce with minimal cost to the local governments. 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 84 full-time permanent workers for the Expansion Project would have a negligible effect on police and fire services.

2.4.4 Transportation

Access for transporting equipment, materials, and personnel to the Expansion Project site would be provided by existing roads and by barge. Access to the Expansion Project would be provided by SH 87; site traffic would pass through Premcor Refinery, also through the intersection with SH 82. State Highway 82 intersects with SH 73, which can be taken in the direction of the town of Winnie where it interconnects with Interstate 10. Toward the City of Groves to the east, SH73 intersects with US 96/US 69/US 287 to the City of Beaumont and Interstate 10.

Construction and operations employee parking and equipment storage would be provided within the Base Project site and at offsite parking lots. Material deliveries by truck to the site would occur throughout the 55-month construction phase, peaking in month 20 at 617 deliveries. On average, 225 material deliveries by truck per month would be anticipated through the balance of the construction period. Whenever possible, the Applicant would schedule the arrival of deliveries to occur in non-peak traffic periods. Traffic for the Expansion Project would be consistent with the traffic for the Base Project, essentially extending impacts by the Base Project construction by 18 months. Therefore, the Applicant would use the Traffic Management Plan for the Base Project that addresses the key intersections and access routes to the site for the construction traffic (workers and deliveries) for the construction of the Expansion Project. The barge deliveries scheduled per month during construction are provided in Figure 5.2-5. This number is consistent with the equipment deliveries by barge for the Base Project and would not have an adverse effect on the traffic in the SNWW.

During the peak of construction there would be a total of approximately 3,500 construction workers commuting to the site on a daily basis. The site has 500 parking spaces. Thus, with a vehicle occupancy rate of 1.3 workers per car, approximately 650 workers would be coming directly to the site. The other 2,850 workers would be coming to an offsite parking lot in town (location yet to be determined) and then take a shuttle bus to the project site. Assuming the occupancy rate for buses is 50, a total of 57 busses would be transporting workers to and from the site during morning and afternoon peak hours. The traffic anticipated from the Expansion Project construction would be an extension of the traffic for the Base Project, and with the implementation of the Traffic Management Plan, would ensure that critical intersections and roadways would continue to operate at acceptable levels of service and would not be significant.

Because the Expansion Project would only add 84 permanent employees, we conclude no significant delays would occur from the operation of the Expansion Project.

2.4.5 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 Base Project site and not near any low-income or minority population areas. Therefore, we conclude that 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 county 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 population living in the county. The minor impacts that would occur would be temporary or would be similar to 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 impacts are anticipated 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. CP17-20-000. On June 2, 2015, the Texas SHPO concurred that no historic properties would be affected by the Liquefaction Project within the 2,900-acre property. Cultural resources/Section 106 review and tribal consultation completed under that docket concluded that no historic properties would be affected. The Applicant would implement the Unanticipated Discoveries Plan provided under Docket No. CP17-20-000. We find the plan acceptable.

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 3 and 4 and associated facilities proposed by the Applicant.

Existing Environment

The climate in the Expansion Project vicinity is subtropical humid, characterized by warm summers, mild winters, and the predominance of an on-shore flow of tropical marine air from the Gulf of Mexico. The climate is periodically influenced by continental air masses during the winter months; however, severe temperatures are uncommon because of the low latitude and coastal location. The mild climate is reflected

in the 30-year normal climate data (1981 to 2010) recorded by the National Centers for Environmental Information[5] [formerly National Climatic Data Center (NCDC)].

Normal annual precipitation for Port Arthur is 60.5 inches. Rainfall occurs throughout the year and is greatest in June (7.09 inches) and least in April (3.21 inches). Measurable precipitation (0.01 inches or greater) has occurred on average (over a 71-year period of record) on 106 days per year. Days with measurable precipitation are relatively evenly distributed throughout the year and exhibit a subtle maximum of 11 days per month each for July and August. Frozen precipitation is a rarity in the area, infrequently occurring in only trace amounts.

Severe weather events documented for the region include thunderstorms, tornados, hail, drought, flooding, tropical storms, and hurricanes. According to the NCDC's Storm Events Database, approximately 101 tornados were recorded in Jefferson County between 1955 and 2014. Hurricanes and tropical storms are less frequent, affecting the area on average approximately once every 4.5 years since 1879.

As recorded nearby in Beaumont, Texas during the 1988-1992 period[6], the dominant wind directions vary seasonally in the vicinity of the Expansion Project. The dominant wind flow is from the north and north-northeast in January and from the east-southeast and south from February through May. Summertime wind flow is predominantly from the south. From September through December, the wind directions are mixed but generally are from the eastern quadrants (north, northeast, east, southeast, and south). Winds from the western quadrants (as monthly averages) are small both in magnitude and frequency during these months. Annually, the dominant wind direction is from the south and south-southeast. The strongest monthly-average wind speeds occur during the spring (March and April), and the lowest monthly-average wind speeds occur in the summer. The average annual wind speed over the 59-year period of record is approximately 9.6 miles per hour.

Ambient Air Quality

The Clean Air Act (CAA) designates criteria pollutants for which standards are promulgated to protect public health and welfare. They include nitrogen dioxide (NO_2), carbon monoxide (CO), respirable particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}), fine particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$), sulfur dioxide (SO_2), ozone (O_3), and lead (Pb).

[5] *Comparative Climatic Data for the United States Through 2018* National Centers for Environmental Information, https://www.ncdc.noaa.gov/sites/default/files/attachments/CCD-2018.pdf.

[6] Provided by TCEQ at: http://www.tceq.state.tx.us/airquality/monops/windroses.html.

The National Ambient Air Quality Standards (NAAQS) and the attainment status relative to the NAAQS establish the framework for the application of permitting regulations. The EPA established primary standards to protect public health; these are based on observable human health studies and are intended to be protective of sensitive segments of the population. In addition, secondary standards have been established to protect public welfare interests such as structures, vegetation, and livestock. Projects must comply with both the primary and secondary NAAQS.

The NAAQS are codified in 40 CFR 50 and are summarized in table 2.6-1. The TCEQ has adopted the EPA's promulgated ambient air quality standards (at Title 30, Subchapter 101A, Section 21 of the Texas Administrative Code, which is part of the EPA-approved State Implementation Plan [SIP] for Texas). Areas of the country where the ambient air quality occasionally exceeds the NAAQS are designated as nonattainment areas, and new sources within or near these areas may be subject to more stringent air permitting requirements. The Expansion Project would be in Jefferson County, Texas, which is part of the Beaumont-Port Arthur (BPA) area. The BPA area is currently designated as "unclassifiable" (considered "attainment") or attainment for all criteria pollutants, i.e., O_3, PM_{10}, $PM_{2.5}$, SO_2, CO, NO_2, and Pb.

In September 2016, Texas recommended that Jefferson County be designated as attainment with regards to the 2015 O_3 standard. In November 2017 the EPA designated Jefferson County as Attainment/Unclassifiable (82 Fed Reg 54276, November 16, 2017).

The current NAAQS for these criteria pollutants are summarized in table 2.6-1.

TABLE 2.6-1
National Ambient Air Quality Standards

Air Contaminant	NAAQS		Averaging Time
	Primary	Secondary	
CO	35 ppm	NA	1-hour
	9 ppm	NA	8-hour
Pb	0.15 µg/m^3	0.15 µg/m^3	Rolling 3-month Average
NO_2	100 ppb	NA	1-hour
	53 ppb	53 ppb	Annual
O_3	0.070 ppm	0.070 ppm	8-hour
$PM_{2.5}$	35 µg/m^3	35 µg/m^3	24-hour
	12 µg/m^3	15 µg/m^3	Annual

TABLE 2.6-1
National Ambient Air Quality Standards

Air Contaminant	NAAQS		Averaging Time
	Primary	Secondary	
PM_{10}	150 µg/m^3	150 µg/m^3	24-hour
SO_2	75 ppb	NA	1-hour
	NA	0.5 ppm	3-hour
	NA	NA	24-hour[1]
	NA	NA	Annual[1]

Source: EPA 2014

Abbreviations:
mg = milligram(s)
µg = microgram(s)
m^3 = cubic meter(s)
ppm = part(s) per million
ppb = part(s) per billion
NA = not applicable

On December 7, 2009, the EPA defined air pollution to include six greenhouse gases (GHG), CO_2, CH_4, nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, finding that the presence of these GHGs in 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. Emissions of GHGs are typically quantified and regulated in units of carbon dioxide equivalents (CO_2e).

The CO_2e takes into account the global warming potential (GWP) of each GHG. 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.[7] 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.

Air Quality Control Regions (AQCRs) 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. Jefferson, Orange, and Hardin Counties, which are potentially affected by emissions from the Expansion Project, are classified as attainment or unclassified for all six of the NAAQS criteria pollutants.

Regulatory Requirements

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

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

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

Prevention of Significant Deterioration/Nonattainment New Source Review

Separate procedures have been established under the NSR program for preconstruction review of certain large projects ("major" projects) in attainment areas versus nonattainment areas. Note that "major" has different meanings under different air quality programs, and its use herein is relative to the NSR program.

Preconstruction review of major sources or projects in nonattainment areas is referred to as NNSR. As noted above, the BPA area is attainment for all criteria pollutants; therefore, NNSR is not applicable to the Expansion Project. Preconstruction review of major sources or projects in attainment areas is referred to as PSD review (or PSD permitting). The 1977 CAA Amendments established the PSD permitting program to limit the degradation of air quality in attainment areas. It is a federally-mandated program that applies only to projects deemed "major" for PSD purposes. PSD review is pollutant specific; for a new source it applies only to those pollutants for which a project is considered major by comparison to major source thresholds, including significant emission rates.

Federal PSD regulations (40 CFR 52.21) address construction in air quality attainment areas and define a major source as any source with a potential to emit (PTE) PSD-regulated pollutants in amounts equal to or greater than 250 tons per year (tpy) for all source types (as a facility-wide total) or 100 tpy for 28 named source categories. In Texas, PSD regulations are part of the EPA-approved SIP and are codified in Subchapter 116B, New Source Review Permits, of Title 30 of the Texas Administrative Code (TAC) (specifically, 30 TAC 116.160). The Applicant's proposed simple-cycle combustion turbines would not produce steam; therefore, the power block would not be a steam electric plant and would not be one of the 28 named source categories.

In 2010 the EPA promulgated the "Tailoring Rule" which established PSD and Title V permit applicability thresholds based on GHG emissions, including three GHGs that are associated with combustion. These GHGs include CO_2, CH_4, and N_2O. CH_4 is also the primary constituent of natural gas and LNG. Collectively, emissions of these GHGs are regulated as CO_2e, which includes emissions of each GHG weighted by the GWP of each compound. However, on June 23, 2014, the U.S. Supreme Court issued a

decision that GHG emissions could not be a basis for PSD or Title V applicability, and this decision was followed by a July 24, 2014, memorandum from the EPA that stated that the EPA would comply with the Court's decision and would not apply or enforce regulations that would require a PSD permit where PSD would be applicable solely because of the Tailoring Rule. Therefore, CO_2e emissions are no longer considered for PSD or Title V permit applicability.

Although GHG emissions can no longer be a PSD applicability trigger, the U.S. Supreme Court decision retained a component of the Tailoring Rule regarding the application of Best Available Control Technology (BACT) to GHG emissions, and the July 24, 2014, EPA memorandum indicated that BACT should continue to be evaluated for major sources of GHG emissions that are required to obtain a PSD permit for reasons other than GHG emissions (referred to as "anyway sources"). The BACT threshold for GHG emissions is 75,000 tpy CO_2e.

The TCEQ issued the air quality permits, including PSD approval, for the Base Project on February 17, 2016[8]. A permit supplement has been submitted for the combined Base and Expansion Projects.

The combined Base and Expansion Projects is not one of the 28 named PSD source categories; therefore, the PSD major source threshold is a facility-wide PTE of 250 tpy of a PSD-regulated air pollutant. Table 2.6-2 shows the Major Stationary Source/Major Modification Emission Thresholds and table 2.6-3 shows the combined Potential-to-Emit of the Base Project and the Expansion Project. Based on the proposed emissions, the combined Base and Expansion Projects would exceed the 250 ton threshold for oxides of nitrogen (NO_X), CO, particulate matter (PM), PM_{10}, and $PM_{2.5}$. Therefore, the combined Base and Expansion Project was subject to PSD review. Potential GHG emissions would exceed the 75,000-tpy CO_2e threshold and were therefore subject to BACT review (Project is an "anyway source"). As a major project for PSD purposes, potential emissions of other PSD regulated air pollutants were compared to the following PSD significant emission rates to determine the applicability of PSD review to each pollutant:

- 40 tpy SO2;
- 40 tpy volatile organic compounds (VOC);
- 0.6 tpy Pb; and
- 7 tpy sulfuric acid mist.

[8] TCEQ Permits 131769, PSDTX1456, and GHGPSDTX134

Because the Base and the Expansion Projects are considered major for PSD, emissions of all other federally regulated NSR pollutants are compared to the PSD Significant Emission Rate (SER). PSD review is required for each regulated pollutant that exceeds its Significant Emission Rate. The proposed emissions increases of SO_2, H_2SO_4, and VOC exceed their respective Significant Emission Rates and are also subject to PSD review.

In addition to the BACT analysis, PSD regulations require analyses of the following:

- existing air quality in the Project area;
- air quality impacts;
- PSD increment consumption;
- visibility impacts;
- Expansion Project impacts on air quality related values at nearby Class I areas;
- effects of emitted pollutants on soils and vegetation;
- indirect economic growth impacts; and
- environmental justice.

PSD increments establish maximum allowable increases of certain PSD-regulated air pollutants above baseline ambient concentrations.

The PSD program provides special protections for "Class I" areas, which include national parks, wilderness areas, and other areas determined to warrant special protection of air quality related values. The closest Class I area to the Expansion Project is the Breton Wilderness Area in Louisiana. It is approximately 300 miles east of the Expansion Project site; therefore, an analysis of Class I area impacts is not warranted.

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)
O_3 (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
H_2SO_4	250	7
Pb	250	0.6
GHG	100,000 tons/yr of CO_2e and 250 tons/yr of GHGs[(a)]	75,000 tons/yr of CO_2e and >0 tons/yr 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).

TABLE 2.6-3
Potential to Emit Summary
(Base Project Plus Expansion Project)

Emission Unit	Pollutant Emissions												
	Nitrogen Oxides (NO_x)		CO		SO_2		PM_{10}		VOC		HAPs*	CO_2e	
	tpy	MSS* tpy	tpy	MSS tpy	tpy	MSS tpy	tpy	MSS tpy	tpy	MSS tpy	tpy	tpy	MSS tpy
Refrigeration Compressor Turbines (8)	1,110.56	6.16	1,877.76	29.92	20.80	-	337.20	-	85.84	2.16	35.41	4,036,136	-
Generator Combustion Turbine (9)	252.54	1.35	276.75	0.72	16.92	-	79.56	-	35.10	0.27	6.19	1,412,208	-
Gas Turbine Preheater (2)	1.64	-	2.74	-	0.04	-	0.24	-	0.18	-	<.0.01	3,902	-
Diesel Fire Water Pump (2)	0.34	-	0.2	-	<0.02	-	0.02	-	0.02	-	<0.01	40	-
Diesel Standby Generator (4)	2.28	-	1.32	-	<0.04	-	0.08	-	0.16	-	<0.01	264	-
Thermal Oxidizer (4)	82.00	-	112.56	-	22.92	-	10.20	-	7.44	-	0.01	1,891,744	-
Marine Flare	26.11	-	52.13	-	0.14	-	0.01	-	0.69	-	-	26,024	-
Ground Flare	52.94	368.66	105.69	735.97	0.33	1.87	0.55	-	5.32	-	-	45,923	321,676
Equipment Leak Fugitives	-	-	-	-	-	-	-	-	43.29	-	-	2,226	-
Ammonia Piping Fugitives	-	-	-	-	-	-	-	-	-	-	-	-	-
Condensate Truck Loading Fugitives	-	-	-	-	-	-	-	-	0.73	-	-	-	-
Process Wastewater Truck Fugitives	-	-	-	-	-	-	-	-	<0.01	-	-	-	-
Diesel Storage Tank for FWP (2)	-	-	-	-	-	-	-	-	<0.02	-	-	-	-

TABLE 2.6-3
Potential to Emit Summary
(Base Project Plus Expansion Project)

Emission Unit	Pollutant Emissions												
	Nitrogen Oxides (NO_x)		CO		SO_2		PM_{10}		VOC		HAPs*	CO_2e	
	tpy	MSS* tpy	tpy	MSS tpy	tpy	MSS tpy	tpy	MSS tpy	tpy	MSS tpy	tpy	tpy	MSS tpy
Diesel Storage Tank for Standby Generator (4)	-	-	-	-	-	-	-	-	<0.04	-	-	-	-
Diesel Storage Tank	-	-	-	-	-	-	-	-	<0.01	-	-	-	-
Lean Amine Storage Tank	-	-	-	-	-	-	-	-	<0.01	-	-	-	-
Fresh Amine Storage Tank	-	-	-	-	-	-	-	-	<0.01	-	-	-	-
Slop Oil Storage Tank	-	-	-	-	-	-	-	-	<0.01	-	-	-	-
Hot Oil Storage Tank	-	-	-	-	-	-	-	-	<0.01	-	-	-	-
Process Wastewater Storage Tank	-	-	-	-	-	-	-	-	<0.01	-	-	-	-
Total Facility	**1,528.41**	**376.17**	**2,429.15**	**766.70**	**61.21**	**1.87**	**427.86**	**-**	**178.77**	**27.16**	**41.61**	**7,418,467**	**321,673**

* HAPs: Hazardous Air Pollutants
** MSS = maintenance, startup, and shutdown

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 supplement is still under TCEQ's review. The Applicant would be subject to the emissions limitations, monitoring requirements, and other permit conditions.

Title V Operating Permit

A Title V major source, as defined in 40 CFR 70.2 and 30 TAC 122.10, is any source or group of stationary sources (all new and existing sources included) that: (1) are within a contiguous or adjacent property, (2) are under common control, (3) belong to the same major (two-digit) Standard Industrial Classification, and (4) collectively have a PTE that exceeds one or more Title V applicability thresholds (100 tpy for each criteria pollutant or a major quantity of hazardous air pollutants [HAPs]). The Project PTE exceeds Title V applicability thresholds for multiple regulated pollutants. Pursuant to 30 TAC 122.130(b)(1), a Title V operating permit application must be submitted prior to operating new sources that are subject to Title V. The Applicant filed for a Title V permit on September 12, 2019 with a supplemental filing on February 7, 2020.

National Emission Standards for Hazardous Air Pollutants

NESHAPs in 40 CFR Parts 61 and 63 regulate the emission of HAPs from existing and new sources. The Expansion Project would not include any processes that are regulated by Part 61. Part 63 establishes standards for source categories that are primarily for major sources of HAPs but also includes standards for certain minor (or "area") sources of HAPs. Part 63 standards are also referred to as Maximum Achievable Control Technology (MACT) standards. Sources are major for HAPs if the facility-wide PTE of an individual HAP equals or exceeds 10 tpy or if the PTE of the aggregate of HAPs equals or exceeds 25 tpy. Formaldehyde is the primary HAP associated with combustion turbines, and the facility-wide PTE is greater than 10 tpy. Therefore, the Expansion Project would be major for HAPs. The Expansion Project would be subject to NESHAPs under the following subparts:

- Subpart A, General Provisions;
- Subpart EEEE, Organic Liquid Distribution (Non-Gasoline);
- Subpart YYYY, Stationary Combustion Turbines; and
- Subpart ZZZZ, Stationary Reciprocating Internal Combustion Engine (RICE).

Texas has been delegated by the EPA authority to issue permits to sources subject to these subparts for standards. In addition, in 30 TAC 113.100 the TCEQ has incorporated Subpart A requirements by reference (with limited exceptions for which the

TCEQ has adopted alternative provisions). The individual Subparts are incorporated by reference as noted below.

Subpart A specifies the general provisions such as notification, recordkeeping, testing, and reporting requirements. The Applicant would comply with the applicable Subpart A requirements.

Subpart EEEE applies to organic liquid distribution operations at a major source of HAPs; it specifies requirements related to the liquid condensate tanks and condensate truck loading. The condensate storage tanks are subject to the emission limits in Item 5 of Table 2 to Subpart EEEE for storage tanks at a new affected source with a capacity equal to or greater than 50,000 gallons. Total organic HAP emissions must be reduced by at least 95 weight-percent. The tanks would be vented to a closed vent system to capture working and breathing losses. The closed vent system is routed to thermal oxidizers for minimizing VOC emissions to the atmosphere.

The condensate loading rack is subject to the emission limits in Item 10 of Table 2. For all loading arms at the rack, emissions of total organic HAPs from the loading of organic liquids must be reduced, achieving at least 98 weight-percent reduction. Emissions from truck loading would be captured and routed to a ground flare. This subpart is incorporated by reference at 30 TAC 113.880 for requirements as amended through December 22, 2008.

Subpart YYYY specifies requirements for stationary combustion turbines at major sources of HAPs; however, per 40 CFR 63.6095(d), there is a stay of the standards for gas-fired combustion turbines until EPA takes final action to require compliance with this subpart. The only requirement for the new turbines is to comply with the initial notification requirements in 40 CFR 63.6145, which must include the information in 40 CFR 63.9(b)(2)(i) through (v). The preconstruction application satisfied the initial notification requirement. The Applicant would comply with applicable requirements. This subpart is incorporated by reference at 30 TAC 113.1080 for requirements as amended through April 20, 2006.

On March 9, 2020, the EPA published a final rule amending Subpart YYYY. The amendment requires new or reconstructed lean premix gas-fired stationary combustion turbines to meet a formaldehyde limit of 91 parts per billion by volume, dry basis at 15 percent oxygen. Compliance would be demonstrated through the Applicant's initial and annual performance testing and continuous monitoring of operating parameters. Refrigeration Compressor Turbines 5, 6, 7, and 8 would comply with the emission limitations, testing, and monitoring requirements.

Subpart ZZZZ specifies requirements for stationary RICE. The diesel-fired Standby Generator engine would be a new emergency stationary RICE with a rated

capacity that is greater than 500 brake horsepower. Pursuant to 40 CFR 63.6590(b)(1)(i), emergency engines with a site rating of more than 500 brake horsepower and located at a major source of HAPs emissions are not subject to the requirements of Subpart ZZZZ except for the initial notification requirements of 40 CFR 63.6645(f). The diesel-fired Standby Generator engine would not be required to be available for more than 15 hours per calendar year for emergency demand response programs and voltage deviations. The preconstruction application satisfied the initial notification requirement for each engine. This subpart is incorporated by reference at 30 TAC 113.1090 for requirements as amended through January 30, 2013.

General Conformity

In addition to other regulatory requirements, projects that are undertaken in areas designated as nonattainment or maintenance for certain criteria air pollutants, and that require federal agency approvals or authorization, must provide certification that the project emissions would comply with General Conformity requirements. A General Conformity determination is required if a project's annual emissions are determined to be above a specified de minimis annual emission threshold quantity. Because FERC must approve the construction and operation of the Expansion Project, a General Conformity determination is required in accordance with 40 CFR 93.

As of April 6, 2015, the BPA area is no longer subject to General Conformity requirements as no criteria air pollutants are designated as nonattainment or maintenance. However, some construction-related emissions would occur in the Houston-Galveston-Brazoria, Texas, 8-hour O_3 nonattainment area, which has the following General Conformity applicability thresholds:

- 100 tpy NOx; and
- 100 tpy VOC.

The General Conformity analysis and estimated construction emissions and non-process emissions for the Project determined that the Expansion Project construction emissions would be below the General Conformity thresholds for NO_x and VOC and therefore the Project is not subject to General Conformity.

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 rule does not apply to construction emissions.

The new LNG facilities associated with the Expansion Project would be subject to the GHG Mandatory Reporting Rule as it would emit greater than 25,000 tpy of CO_2e. The rule establishes reporting requirements based on actual emissions; however, it does not require emission controls. The Applicant would monitor emissions in accordance with the reporting rule.

Applicable State Air Quality Requirements

The following Texas Air Pollution Control regulations were evaluated for their applicability.

Compliance with General Air Quality Rules – The Expansion Project would be operated in accordance with the applicable General Air Quality Rules (30 TAC 101) relating to circumvention, nuisance, traffic hazard, notification requirements for emissions events, notification requirements for maintenance, sampling, sampling ports, sampling procedures, emissions inventory requirements, compliance with EPA standards, inspection fees, emissions fees, emissions events, maintenance, startup and shutdown activities, excessive emissions, and other applicable General Air Quality Rules.

Control of Air Pollution from Visible Emissions and Particulate Matter – The Expansion Project would be subject to 30 TAC 111, which controls air pollution from visible emissions and particulate matter. The Expansion Project would comply with the specified emission limits.

Division 4 of Subchapter A requires the use of water or suitable oil or chemicals to control dust from demolition and construction activities at sites greater than one acre in size. The Applicant would use the Fugitive Dust Control Plan previously approved for the Base Project to ensure compliance with these regulations. We find this plan acceptable.

Subchapter B of Chapter 111 controls outdoor burning. The Expansion Project would comply with the applicable requirements. The Applicant would not conduct open burning unless approved by the TCEQ pursuant to Chapter 111, including the provisions applicable to coastal areas, including Jefferson County.

Control of Air Pollution from Sulfur Compounds – The Expansion Project would operate in accordance with 30 TAC 112, which regulates air pollution from sulfur compounds. Emissions of sulfur compounds (primarily SO_2) would be negligible from combustion of both natural gas and ultra-low sulfur diesel. Ground-level concentrations of SO_2 would not exceed the specified concentration for Jefferson County in 30 TAC

112.3(c), and ground-level concentrations of hydrogen sulfide and H_2SO_4 would not exceed the concentration specified in 30 TAC 112.31 and 112.41, respectively.

Standards of Performance for Hazardous Air Pollutants – The Expansion Project would comply with NESHAPs as described in Section 9.1.3.4. The NESHAPs are incorporated by reference in 30 TAC 113C.

Control of Air Pollution from Motor Vehicles and Nonroad Engines – 30 TAC 114 addresses inspection requirements and maintenance and operation of air pollution control systems/devices for motor vehicles owned and/or operated at the Expansion Project facilities. It applies to the use of vehicles during construction and operation. Chapter 114 includes emissions requirements that are applicable to spark-ignition engines rated at 25 horsepower or greater and requires that the emissions of these engines meet the exhaust emissions standards specified in Title 13, California Code of Regulations, Chapter 9, 2433(b).

The Texas Low Emissions Diesel Program requires the use of clean diesel fuel in 110 eastern Texas counties, including the BPA area. The fuel for both on-road and off-road use must have a cetane number of 48 or greater and must have an aromatic hydrocarbon content that is less than 10 percent by volume. These rules took effect in October 2005 and were revised in August 2012; the EPA has approved the revisions as part of the Texas SIP.

Chapter 114 includes a prohibition of motor vehicle idling for more than five consecutive minutes when a motor vehicle is not in motion. There are exemptions based on gross vehicle weight, traffic conditions, clean engine certification, and usage.

The Expansion Project would comply with the applicable requirements of Chapter 114 and the Texas Low Emissions Diesel Program.

Control of Air Pollution from Volatile Organic Compounds – The Expansion Project would be subject to certain applicable requirements specified in 30 TAC 115, which regulates air pollution from VOCs. The Expansion Project would be in Jefferson County and would include storage vessels, loading operations, and process vents operated in compliance with the applicable standards, recordkeeping, and reporting requirements specified for sources in the BPA area.

Permits for New Construction or Modification – The Expansion Project is subject to air permitting provisions of 30 TAC 116, including PSD requirements (preconstruction approval) specified in Division 6 of this Chapter. The TCEQ issued the air quality permits, including PSD approval, for the Base Project on February 17, 2016. The air quality permits and permit application provide details of source emissions and regulatory requirements. A modeling protocol was submitted to TCEQ. Submittal of the

modeling report is pending. The AERMOD model would be used for the determination of ambient impacts. In addition to PSD modeling requirements, TCEQ-required analyses would be performed. These include a State Property Line Analysis for SO_2, a State Health Effects Analysis, and an assessment of impacts on O_3. The Applicant would comply with the applicable requirements of Chapter 116.

Control of Air Pollution Episodes – The Expansion Project would operate in compliance with the rules established for generalized and localized air pollution episodes that are specified in 30 TAC 118. An emissions reduction plan would be developed pursuant to 30 TAC 118.5 within six months after the facility commences operation.

Federal Operating Permits Program – The Expansion Project is subject to the permit requirements of 30 TAC 122, Federal Operating Permits Program, and would comply with applicable requirements. The Expansion Project has potential emissions that exceed the Title V operating permit major source thresholds and would be a major source as defined in 30 TAC 122.10(14)(C). In accordance with 30 TAC 122.130(b)(1), the Applicant would not operate the new emission units before an abbreviated Federal Operating Permit application is submitted to the TCEQ.

Impacts and Mitigation

The Expansion Project would produce air pollutant emissions during construction and operation. Although many construction activities would be considered temporary, construction at the Expansion Project would occur over a 55 month period in one location. Construction of the Expansion Project facilities would extend the temporary construction period at the Base Project for an additional 18 months. In addition, following construction, air quality near the Expansion Project would not revert to previous conditions but would transition to operational-phase emissions after commissioning and initial startup of liquefaction Trains 3 and 4.

Construction Emissions

Air quality impacts associated with construction activities generally can be classified as:

- impacts associated with fugitive dust generation; and
- impacts associated with the operation of equipment during construction activities that may result in a minor, temporary increase in emissions.

Fugitive dust generation may result from construction activities such as grading, excavation, and concrete work, along with vehicular traffic on paved and unpaved roads. The magnitude of fugitive dust generation would be primarily a function of the area of construction, silt and moisture contents of the soil, wind speed, frequency of precipitation, amount of vehicle traffic, vehicle types, and paved roadway characteristics. Fugitive dust may be produced during construction. Emissions would be greater during the drier months (February through April) and in areas of fine-textured soils. During these periods and as needed throughout the duration of construction, dust suppression techniques, such as watering, would be used to minimize the generation of fugitive dust emissions and impacts on sensitive areas. The Applicant would use a Fugitive Dust Control Plan previously developed for the Base Project for the Expansion Project. Fugitive PM emissions are typically addressed through state or local nuisance regulations. However, fugitive emissions during the construction activities alone would not require a permit.

Air quality impacts are also associated with the operation of gasoline or diesel fueled engines in grading equipment, cranes, bulldozers, and various types of trucks and cars. The "tailpipe" emissions from these engines would be relatively small. Other sources of construction-related emissions include compactors, pavers, welding, brazing, soldering, solvent cleaning, grinding, cutting, etc.

Emissions of NO_X, CO, $PM_{10}/PM_{2.5}$, SO_2, VOCs, and GHGs from nonroad 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 nonroad 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*.

Barges and vehicles transporting construction materials, equipment, and workers would travel through the Houston-Galveston-Brazoria ("HGB") area, which is classified as moderate nonattainment for the 2015 O_3 standard and attainment/unclassified for all other current NAAQS. The HGB area is also considered a maintenance area under the revoked 1997 O_3 standard. In the HGB area the General Conformity *de minimis* thresholds are 100 tpy for NO_x and VOC.

Estimated construction emissions are summarized in Table 2.6-4.

TABLE 2.6-4
Expansion Project Construction Emissions

Construction Activity	Emissions (tons)						
	NO_x	CO	SO_2	PM_{10}	$PM_{2.5}$	VOC	GHG
Construction Emissions by Construction Year							
Construction Year 1	4.18	4.08	3.66E-2	18.6	2.24	3.39E-1	2,131
Construction Year 2	21.2	35.4	9.43E-2	37.0	5.2	2.49	10,232
Construction Year 3	27.3	101	1.55E-1	85.5	11.7	3.20	17,421
Construction Year 4	17.6	74.1	1.19E-1	48.5	6.91	2.45	14,169
Construction Year 5	5.26	27.2	5.39E-2	17.6	2.49	9.33E-1	6,448
Maximum Year Emissions	27.3	101	1.55E-1	85.5	11.7	3.20	17,421
Maximum Year	3	3	3	3	3	3	3
Maximum Year Construction Emission by Source Category							
Nonroad Equipment	21.8	13.9	7.07E-2	1.22	1.22	2.52	6,256
Onroad Vehicles	5.53	86.9	8.19E-2	1.68E-1	1.49E-1	6.71E-1	12,573
Construction Fugitive Dust	--	--	--	28.1	2.81	--	--
Roadway Fugitive Dust	--	--	--	56.0	7.47	--	--
Tug Boats	1.53	3.55E-1	2.02E-2	4.43E-2	4.30E-2	4.20E-2	108

Notes:
GHG are quantified as carbon dioxide equivalents (CO_2e).

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 equipped with typical emission control equipment. Once construction activities are completed, fugitive dust and construction equipment emissions would subside. Conditions after construction would transition to operational-phase emissions after commissioning and initial startup of liquefaction Trains 3 and 4.

The BPA area is not subject to General Conformity. Nevertheless, air emissions from barges, trucks, and passenger vehicles would occur as they transport construction materials and workers though the HGB area to the Expansion Project site. The General Conformity de minimis threshold is 100 tpy of NO_x or VOC. As is shown in Table 2.6-5, total barge and on road vehicle NO_x and VOC emissions (including both attainment and nonattainment areas) are well below the de minimis threshold in all years. Therefore, construction emissions in the HGB area are not subject to General Conformity.

Operational Emissions

The Expansion Project includes the following stationary point sources of air pollutants for liquefaction Trains 3 and 4:

- four refrigeration turbines;
- two thermal oxidizers;
- one diesel standby generator;
- one diesel storage tank for standby generator;
- process wastewater storage tank; and
- fugitive emission sources (valves, flanges, connectors, and pump seals).

Each liquefaction train would receive feed gas (i.e., natural gas) via pipeline, and inlet gas conditioning would remove mercury and acid gases and recover condensable liquids prior to liquefaction. A thermal oxidizer would control acid gas and VOC emissions.

Potential emissions for the Base plus the Expansion Project are contained in table 2.6-3. The emission data are based on the Application for State and Prevention of Significant Deterioration Air Quality Permits submitted by The WCM Group (representing the Applicant) to the TCEQ in September 2019 and amended in a supplemental filing to the TCEQ in February 2020.

The Applicant would mitigate air quality impacts through the following aspects of the Expansion Project:

- complying with the air permit;
- equipment complying with applicable New Source Performance Standards and NESHAP requirements;
- incorporating BACT emissions controls per PSD requirements;
- using thermal oxidizers to control acid gas emissions and VOC emissions;
- venting VOC emissions from the condensate storage and truck loading activities to the ground flare through a closed system;
- controlling emissions (through flares) from the inlet gas conditioning and liquefaction operations (Ground Flare);
- using natural gas and ULSD (low sulfur contents and therefore low emissions of SO2 and PM, PM10, and PM2.5);
- using natural gas for Refrigeration Compressor Turbines 5, 6, 7, and 8 (low GHG emissions relative to other fossil fuels); and
- only operating the diesel-fired Standby Generator and Fire Water Pump engines up to 100 hours per year each for maintenance and testing purposes.

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 TCEQ, the Applicant would reduce emissions of NO_X for the turbines by using dry-low NO_X combustion. The Applicant would maintain CO and VOC emission rates by using good combustion practices. Further, the Applicant is proposing a $PM_{10}/PM_{2.5}$ BACT emission limitation of 7.6×10^{-3} lbs/million British terminal units based on manufacturer provided data for each proposed gas driven refrigeration compressor.

Air Modeling

A thorough examination of the potential impacts on air quality is necessary to evaluate the Expansion Project. An air quality modeling analyses that quantifies the impacts of the Expansion Project is required as part of the air quality permit application process. 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 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 exceeds the applicable SIL, a full impact analysis, including the Expansion Project and 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 2.6-5 and show that predicted impacts of NO_2 (both 1-hour and annual), CO (1-hour), PM_{10} (24-hour), $PM_{2.5}$ (both 24-hour and annual), and SO_2 (1-hour, 3-hour, and 24-hour) exceeded their respective SILs. However, none of the predicted impacts exceed their associated monitoring *de minimis* levels. Therefore, a

cumulative impacts analysis was required for NO_2 (both 1-hour and annual), CO (1-hour), PM_{10} (24-hour), $PM_{2.5}$ (both 24-hour and annual), and SO_2 (1-hour, 3-hour, and 24-hour), and preconstruction monitoring of the ambient air quality was not required.

TABLE 2.6-5
Port Arthur LNG Terminal Significant Impact Analysis Summary*

Pollutant	Averaging Period	Predicted Impact (µg/m³)	SIL (µg/m³)	Monitoring *De Minimis* Level (µg/m³)
CO	1-hour	2,456	2,000	NA
CO	8-hour	70	500	575
NO_2	1-hour	68.7	7.5	NA
NO_2	Annual	0.65	1	14
PM_{10}	24-hour	8.13	5	10
$PM_{2.5}$	24-hour	7.05**	1.2	NA
$PM_{2.5}$	Annual	0.43	0.3	NA
SO_2	1-hour	12.4	7.8	NA
SO_2	3-hour	55.1	25	NA
SO_2	24-hour	9.69	5	13
SO_2	Annual	0.8	1	NA

*Includes base project and expansion project
** Includes primary and secondary $PM_{2.5}$

Cumulative Impact Analysis

Table 2.6-6 below shows the cumulative impact analysis for the Port Arthur LNG Terminal, including the Base and Expansion Projects. Because the maximum cumulative impacts for 1-hour NO_2 and 24-hour $PM_{2.5}$ exceed their respective NAAQS, dispersion modeling was used to determine the contribution of the facility sources (including the associated marine vessel emissions) to any potential 1-hour NO_2 or 24- hour $PM_{2.5}$ NAAQS exceedances. The maximum contribution to any potential 1-hour NO_2 NAAQS exceedance determined to be 2.42 micrograms per cubic meter (µg/m³) which is below the SIL for 1-hour NO_2 (7.5 µg/m³). The maximum contribution to any potential 24-hour $PM_{2.5}$ NAAQS exceedance was 0.528 µg/m³ (with secondary $PM_{2.5}$ formation added) which is below the SIL for 24-hour $PM_{2.5}$ (1.2 µg/m³). Predicted impacts below the SIL are not considered by the EPA to have an adverse effect on ambient air quality. These results indicate that the Expansion Project would not contribute to any NAAQS violation and therefore would not result in any significant air quality impacts.

TABLE 2.6-6 Port Arthur LNG Terminal Cumulative Analysis Summary					
Pollutant	**Averaging Period**	**Maximum Predicted Impact**	**Background Concentration**	**Maximum Cumulative Impact**	**NAAQS**
		(µg/m3)	**(µg/m3)**	**(µg/m3)**	**(µg/m3)**
NO_2	1-Hour	526	54.9	581	188
	Annual	4.9	24	29	100
CO	1-Hour	2,457	801.5	3,259	40,000
PM_{10}	24-Hour	16.4	88	104	150
$PM_{2.5}$	24-Hour	27.6	21.0	48.6	35
	Annual	0.80	9.4	10.2	12
SO_2	1-Hour	12.4	107.2	120	196
	3-Hour	55.1	66.3	121	1,300
	24-Hour	18.9	15.1	34	365

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, week, and seasons, in part due to animal behavior, 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 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 for a perceivable change in loudness 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.

Because neither the State of Texas nor Jefferson County has noise regulations that would limit noise from the Expansion Project, the FERC criteria and the noise limits prescribed by the City of Port Arthur form the basis for determining the acceptability of expected Expansion Project related noise levels. The FERC criteria limits the sound level contribution from operation of major new above-ground facilities at any pre-existing NSA to 55 dBA (L_{dn}). Construction noise is exempted from the Port Arthur noise regulations provided the construction is restricted to daylight hours.

Existing Noise Conditions

The Expansion Project would be wholly within the Base Project site area which is in an area along the western bank of the Port Arthur Ship Canal, approximately 5 miles south of Port Arthur. With the exception of an elevated, elongated dredge material containment dike on the site, the topography surrounding the site is predominantly flat, consisting mainly of open marsh, water bodies, and grassy fields. Stands of tall marsh grasses and short trees tend to be present around the periphery of the waterbodies.

The primary sources of manmade noise in the surrounding area include vehicle traffic on the local roads and boat traffic in the channel to the east of the site. Natural sounds include birds, frogs, and insects. The nearest residence, at 3564 Martin Luther King (SH 82), is the first row of residences lining the narrow strip of land between the shipping channel and Sabine Lake. This cluster of homes is identified as NSA 1. The more distant residence on the west side of the shipping channel on SH 87 is identified as NSA 2. Due to field access issues, the residence at 4175 Backridge Road was used to represent the ambient noise level in NSA 2. Distances from the NSAs to the proposed site are given in Table 2.6-7. Existing ambient noise levels in the vicinity of NSA 1 and NSA 2 were based on the previous noise survey conducted by the Applicant for the

previously authorized Base Project (FERC Docket CP17-20-000). 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

Noise would be very sporadic during most of the construction period as the types of equipment in use at a construction site change with the construction phase and the type of activities and construction noise would occasionally exceed levels that currently characterize the area; however, due to the temporary nature of construction noise, no long-term effects are anticipated.

Noise levels from facility construction were evaluated using a screening-level analysis approach. The calculation methodology requires the input of the number and type of construction equipment by phase as well as a typical noise source levels associated with that equipment to determine the composite sound levels for a standard distance of 50 feet.

Construction activities at the Expansion Project site would generate increases in sound levels over an approximate four to five-year period. Only standard construction equipment would be used, and most construction would take place during normal working hours of 7:00 a.m. until 7:00 p.m. However, emergencies or other unusual circumstances may necessitate nighttime work.

The first phase of the Expansion Project construction (consisting of minor grading) would involve using heavy earth-moving equipment, pile driving, and concrete pouring for foundations and would generate the highest sound levels. The next phase would consist of erection of buildings, structures, and the installation of mechanical and electrical equipment.

Pile driving noise levels would range from a maximum of approximately 55 to 60 dBA at the NSA. Pile driving activities typically would occur during daylight hours and would be intermittent. The noise levels associated with the pile driving would not likely have an adverse effect during the day but, under certain atmospheric conditions, may result in increased noise impacts at night if pile driving activities occur during that time period.

The construction equipment utilized would differ during each phase of construction, but in general, heavy equipment (bulldozers, loaders, dump trucks) would be used during the minor grading and pile driving phase of the Expansion Project construction. Constant noise is generated during construction primarily due to diesel engines that power the equipment. Exhaust noise is usually the predominant source of diesel engine noise.

A worst-case construction scenario would include simultaneous activates at both the Base and Expansion Projects with a 24-hour daily schedule. The scenario evaluated includes final equipment installation in Train 2, heavy equipment installation and erection in Train 4. Table 2.6-6 shows the expected noise level impact at the NSA locations during this construction activity. Noise levels from construction would remain below 55 dBA at all NSAs. Therefore, there would not be any significant noise impacts from construction activities.

TABLE 2.6-6
Noise Impact Due to Construction

NSA Location	Distance (miles)/Direction	Construction L_{dn}, dBA
NSA 1	.95 / E	54.8
NSA 2	1.4 / SE	48.4

Should construction activities be necessary during nighttime hours (including pile driving), the Applicant would seek necessary approvals and limit these activities to any conditions imposed by the City of Port Arthur and/or FERC.

Operation Noise Impacts and Mitigation

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 2.6-7.

The noise analysis for the proposed Expansion Project incorporated specific noise mitigation measures to reduce potential impacts. The Applicant incorporated these measures into their analysis to achieve the levels presented. These mitigation measures include the following:

- gas turbine enclosure - maximum of 82 dBA at 1 meter;
- gas turbine air intake ducting - average sound pressure level of 88 dBA at 1 meter;
- compressors and other gas turbine equipment - average of 85 dBA or less at 1 meter;
- gas turbine exhaust muffler sound power level of the exhaust exit to 109 dBA or less; and
- refrigerant piping with Class D insulation.

TABLE 2.6-7 Project Noise Quality Analysis							
NSA	Direction & Distance	Ambient	Base Project Only	Expansion Project Only	Total Facility	Total Facility plus Ambient	Increase Above Ambient
		Ldn	Ldn	Ldn	Ldn	Ldn	Ldn
1	E @ 0.95 mi	64.0	54.0	46.4	54.7	64.5	0.5
2	SE @ 1.4 mi	56.0	46.0	40.9	47.2	56.5	0.5

The results of the acoustical analysis for the Base Project plus Expansion Project are shown to be below our 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 below the threshold of a perceptible change. Therefore, we conclude that while noise impacts from operation of the Base Project plus the Expansion Project would be permanent, these impacts would not be significant. However, to ensure that the Applicant meets our noise criterion, **we recommend that:**

- **Port Arthur LNG should file with the Secretary a full load noise survey of the LNG terminal no later than 60 days after placing each liquefaction train in service. If a full load condition noise survey is not possible, Port Arthur LNG should file an interim survey at the maximum possible load within 60 days of placing each liquefaction train in service and file the full load operational survey within 6 months. If the noise attributable to operation of all the equipment at the terminal, under interim or full load conditions, exceeds an Ldn of 55 dBA at any nearby NSA, Port Arthur LNG should file a report on the changes that are needed and should install the additional noise controls to meet the level within one year of the in-service date. Port Arthur LNG should confirm compliance with the above requirement by filing a second noise survey with the Secretary no later than 60 days after it installs additional noise controls.**

2.7 Reliability and Safety

2.7.1 LNG Facility Reliability Oversight

LNG facilities handle flammable and sometimes toxic materials that can pose a risk to the public if not properly managed. These risks are managed by the companies owning the facilities, through selecting the site location and plant layout as well as through suitable design, engineering, construction, and operation of the LNG facilities. Multiple federal agencies share regulatory authority over the LNG facilities and the operator's approach to risk management. The safety, security, and reliability of the proposed Port Arthur's Trains 3 and 4 Expansion Project (Expansion Project) would be regulated by the USDOT PHMSA, Coast Guard, and FERC.

In February 2004, the USDOT PHMSA, Coast Guard, and FERC entered into an Interagency Agreement to ensure greater coordination among these three agencies in addressing the full range of safety and security issues at LNG terminals, including terminal facilities and LNG ship operations, and maximizing the exchange of information related to the safety and security aspects of LNG facilities and related marine operations. Under the Interagency Agreement, FERC is the lead federal agency responsible for the preparation of the analysis required under NEPA for impacts associated with terminal construction and operation. The USDOT PHMSA and Coast Guard participate as cooperating agencies but remain responsible for enforcing their regulations covering LNG facility siting, design, construction, operation, maintenance, and security. All three agencies have some oversight and responsibility for the inspection and compliance during the LNG facility's operation.

The USDOT PHMSA establishes and has the authority to enforce the federal safety standards for the location, design, installation, construction, inspection, testing, operation, and maintenance of onshore LNG facilities under the Federal Pipeline Safety Laws (49 USC 60101, et, seq.). USDOT PHMSA's LNG safety regulations are codified in 49 CFR 193, which prescribes safety standards for LNG facilities used in the transportation of gas by pipeline that are subject to federal pipeline safety laws (49 USC 60101 *et seq.*), and 49 CFR 192. On August 31, 2018, USDOT PHMSA and FERC signed a Memorandum of Understanding (MOU) regarding methods to improve coordination throughout the LNG permit application process for FERC jurisdictional LNG facilities. In the MOU, USDOT PHMSA agreed to issue a Letter of Determination (LOD) stating whether the LNG facilities would be capable of complying with location criteria and design standards contained in Subpart B of Part 193. The Commission committed to rely upon the LOD in conducting its review of whether the facilities would be consisted with the public interest. The issuance of the LOD does not abrogate USDOT PHMSA's continuing authority and responsibility over a proposed project's compliance with Part 193 during facility construction and future operation. USDOT PHMSA's

conclusion on the siting and hazard analysis required by Part 193 is based on preliminary design information which may be revised as the engineering design progresses to final design. USDOT PHMSA regulations also contain requirements for the design, construction, equipment, testing, operation, maintenance, qualifications and training of personal, fire protection, and security for LNG facilities as defined in 49 CFR 193, which would be completed during later stages of the Expansion Project. If the Expansion Project is authorized, constructed and operated, the LNG facilities, as defined in 49 CFR 193, would be subject to USDOT PHMSA's inspection and enforcement programs to ensure compliance with the requirements of 49 CFR 193.

The Coast Guard has authority over the safety of an LNG terminal's marine transfer area and LNG marine vessel traffic, as well as over security plans for the waterfront facilities handling LNG terminal and LNG marine vessel traffic. The Coast Guard regulations for waterfront facilities handling LNG are codified in 33 CFR 105 and 33 CFR 127. As a cooperating agency, the Coast Guard assists FERC staff in evaluating whether an Applicant's proposed waterway would be suitable for LNG marine traffic and whether the waterfront facilities handling LNG would be operated in accordance with 33 CFR 105 and 33 CFR 127. If the facilities are constructed and become operational, the facilities would be subject to the Coast Guard inspection program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

FERC authorizes the siting and construction of LNG terminals under the NGA and delegated authority from the DOE. FERC requires standard information to be submitted to perform safety and reliability engineering reviews. FERC's filing regulations are codified in 18 CFR 380.12 (m) and (o), and requires each Applicant to identify how its proposed design would comply with the USDOT PHMSA's siting requirements of 49 CFR 193, Subpart B. The level of detail necessary for this submittal requires Port Arthur LNG to perform substantial front-end engineering of the complete project. The design information is required to be site-specific and developed to the extent that further detailed design would not result in significant changes to the siting considerations, basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs. As part of the review required for a FERC order, we use this information from Port Arthur LNG to assess whether the proposed facilities would have a public safety impact and to recommend mitigation measures for the Commission to incorporate as conditions in the order. If the facilities are approved, FERC staff would review material filed to satisfy the conditions of the order and conduct periodic inspections throughout construction and operation.

In addition, the Energy Policy Act of 2005 requires FERC to coordinate and consult with the DoD on the siting, construction, expansion, and operation of LNG terminals that would affect the military. On November 21, 2007, FERC and the DoD (https://www.ferc.gov/sites/default/files/2020-04/mou-dod_2.pdf) entered into a MOU formalizing this process. In accordance with the MOU, FERC sent a letter to the DoD on

August 31, 2020, requesting their comments on whether the planned Expansion Project could potentially have an impact on the test, training, or operational activities of any active military installation[9]. On October 14, 2020, FERC received a response letter from the DoD Siting Clearinghouse stating that the Expansion Project would have a minimal impact on military training and operations conducted in the area.[10]

2.7.2 USDOT PHMSA Siting Requirements and Part 193 Subpart B Determination

The siting of LNG facilities, as defined in 49 CFR 193, with regard to ensuring that the proposed site selection and location would not pose an unacceptable level or risk to public safety is required by USDOT PHMSA's regulations in 49 CFR 193, Subpart B. The Commission's regulations under 18 CFR 380.12 (o) (14) require Port Arthur LNG to identify how the proposed design complies with the siting requirements of 49 CFR 193, Subpart B. The scope of USDOT PHMSA's siting authority under 49 CFR 193 applies to LNG facilities used in the transportation of gas by pipeline subject to the federal pipeline safety laws and 49 CFR 192.[11]

The requirements in 49 CFR 193, Subpart B, require the establishment of an exclusive zone surrounding an LNG facility in which an operator or government agency must exercise legal control over the activities where specified levels of thermal radiation and flammable vapors may occur in the event of a release for as long as the facility is in operation. Approved mathematical models must be used to calculate the dimensions of these exclusion zones. Title 49 CFR 193, Subpart B incorporates by reference, with regulatory preemption in the event of conflict, NFPA 59A (2001), an industry consensus standard for LNG facilities. The siting requirements of 49 CFR 193, Subpart B are described below.

Section 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.

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[9] August 31, 2020 "Letter requesting Department of Defense Siting Clearinghouse to provide comments within 30 days on the Port Arthur LNG Expansion Project under CP20-55". Accession Number 20200831-3022.

[10] October 19, 2020 FERC Memo/Internal Transmittal Memo "Memo dated 10/19/2020 forwarding Department of Defense's response letter for the Port Arthur LNG Expansion Project under CP20-55". Accession Number 20201019-3039.

[11] 49 CFR 193.2001(b)(3), Scope of part, excludes any matter other than siting provisions pertaining to marine cargo transfer systems between the LNG ship and the last manifold (or in the absence of a manifold, the last valve) located immediately before a storage tank.

- Section 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).
- Section 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).
- Section 193.2067, Wind forces, requires that shop fabricated containers of LNG or other hazardous fluid containers less than 70,000 gallons must be designed to withstand wind forces based on the applicable wind load data in American Society of Civil Engineers (ASCE) 7 (2005). All other LNG facilities must be designed for a sustained wind velocity of not less than 150 miles per hour (mph) unless the USDOT PHMSA Administrator finds a lower wind speed is justified or the most critical combination of wind velocity and duration for a 10,000-year mean return interval.

As stated in section 193.2051, LNG facilities must meet the siting requirements of NFPA 59A (2001), Chapter 2, and include but may not be limited to:

NFPA 59A (2001) section 2.1.1(c) requires consideration of protection against forces of nature.

NFPA 59A (2001) section 2.1.1(d) 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 facility design or operation.

NFPA 59A (2001) 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 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 LNGFIRE3 or with models that have been validated by experimental test data appropriate for the hazard to be evaluated and that have been approved by USDOT PHMSA.

NFPA 59A (2001) 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 (Dense Gas Dispersion

Model) or approved alternative models that take into account physical factors influencing LNG vapor dispersion. [12]

Taken together, 49 CFR 193, Subpart B, and NFPA 59A (2001) require that flammable LNG vapors from design spills do not extend beyond areas in which the operator or a government agency legally controls all activities. Furthermore, consideration of other hazards which may affect the public or plant personnel must be evaluated as prescribed in NFPA 59A (2001) section 2.1.1(d).

Title 49 CFR 193, Subpart B, and NFPA 59A (2001) also specify three radiant heat flux levels which must be considered for LNG storage tank spills for as long as the facility is in operation:

- 1,600 Btu/ft2-hr - this level can extend beyond the plant property line that can be built upon but cannot include areas that are used for outdoor assembly by groups of 50 or more persons; [13]
- 3,000 Btu/ft2-hr - this level can extend beyond the plant property line that can be built upon but cannot include areas that contain assembly, educational, health care, detention or residential buildings or structures; [14] and10,000 Btu/ft2-hr - this level cannot extend beyond the plant property line that can be built upon. [15]

[12] The USDOT PHMSA has approved two additional models for the determination of vapor dispersion exclusion zones in accordance with 49 CFR 193.2059: FLACS 9.1 Release 2 (Oct. 7, 2011) and PHAST-UDM Version 6.6 and 6. 7 (Oct. 7, 2011).

[13] The 1,600 Btu/ft2-hr flux level is associated with producing pain in less than 15 seconds, first degree burns in 20 seconds, second degree burns in approximately 30-40 seconds, 1% mortality in approximately 120 seconds, and 100% mortality in approximately 400 seconds, assuming no shielding from the heat, and is typically the maximum allowable intensity for emergency operations with appropriate clothing based on average 10 minute exposure.

[14] The 3,000 Btu/ft2-hr flux level is associated with producing pain in less than 5 seconds, first degree burns in 5 seconds, second degree burns in approximately 10-15 seconds, 1% mortality in approximately 50 seconds, and 100% mortality in approximately 180 seconds, assuming no shielding from the heat, and is typically the critical heat flux for piloted ignition of common building materials (e.g., wood, PVC, fiberglass, etc.) with prolonged exposures.

[15] The 10,000 Btu/ft2-hr flux level is associated with producing pain in less than 1 seconds, first degree burns in 1 seconds, second degree burns in approximately 3 seconds, 1% mortality in approximately 10 seconds, and 100% mortality in approximately 35 seconds, assuming no shielding from the heat, and is typically the critical heat flux for unpiloted ignition of common building materials (e.g., wood, PVC, fiberglass) and degradation of unprotected process equipment after approximate 10 minute exposure and to reinforced concrete after prolonged exposure.

The requirements for design spills from process or transfer areas are more stringent. For LNG spills, the 1,600 Btu/ft^2-hr flux level cannot extend beyond the plant property line onto a property that can be built upon.

In addition, section 2.1.1 of NFPA 59A (2001) requires that factors applicable to the specific site with a bearing on the safety of plant personnel and the surrounding public must be considered, including an evaluation of potential incidents and safety measures incorporated into the design or operation of the facility. The USDOT PHMSA has indicated that potential incidents, such as vapor cloud explosions and toxic releases should be considered to comply with Part 193 Subpart B.[16]

In accordance with the August 31, 2018 MOU, USDOT PHMSA issued an LOD to the Commission on December 7, 2020, regarding the Expansion Project's compliance with the 49 CFR 193 Subpart B siting requirements.[17] The LOD provides the USDOT PHMSA's analysis and conclusions regarding 49 CFR 193 Subpart B regulatory requirements for the Commission to consider in its decision to authorize, with or without modification or conditions, or deny an application. Based on the review, the USDOT PHMSA determined that the Expansion Project complies with the Federal Pipeline Safety Standards set forth in Part 193, Subpart B. Also, it states that, if the proposed Expansion Project is subsequently modified so that it differs from the details provided in the documentation submitted to FERC and USDOT PHMSA, further review will be conducted by USDOT PHMSA.

2.7.3 Coast Guard Safety Regulatory Requirements and Letter of Recommendation

The Coast Guard is the principal federal agency responsible for the safety of an LNG terminal's marine transfer area and LNG carrier traffic, as well as over security plans for the waterfront facilities handling LNG and LNG carrier traffic in U.S. ports and waterways. In addition, the Coast Guard also has authority for LNG facility security plan review, approval, and compliance verification as provided in 33 CFR 105. If the Expansion Project is approved, constructed, and operated, the Coast Guard would

[16] The USDOT PHMSA's "LNG Plant Requirements: Frequently Asked Questions" item H1, https://www.phmsa.dot.gov/pipeline/liquified-natural-gas/lng-plant-requirements-frequently-asked-questions, accessed October 2020.

[17] December 7, 2020 letter "Re: Port Arthur LNG Expansion Project, Docket No. CP20-55-000, 49 CFR Part 193, Subpart B, Siting – Letter of Determination" from Massoud Tahamtani to Andrew Kohout. Filed in Docket Number CP20-55-000 on December 8, 2020. FERC eLibrary accession number 20201208-3005.

continue to exercise regulatory oversight of the safety and security of the Expansion Project facilities in compliance with 33 CFR 127.

The Coast Guard is also responsible for issuing a Letter of Recommendation (LOR) as to the suitability of the waterway for LNG marine traffic. On May 17, 2019, Port Arthur LNG submitted a letter to the Coast Guard Captain of the Port (COTP) regarding the Expansion Project to assess whether Port Arthur LNG's existing September 11, 2015 LOR and November 2017 Waterway Suitability Assessment (WSA) were sufficient or if an additional Letter of Intent (LOI) or updated/preliminary WSA was required. On June 13, 2019, after reviewing the WSA that was completed in November 2017 for the Base Project, the Coast Guard determined that, for the Port Arthur Expansion Project in Docket No. CP20-55-000, the original WSA was broad enough to allow for the construction of Trains 3 and 4 and the expected outcome of LNG ship traffic, based on construction planned as of the date of the letter, fell within the scope of the original WSA. Therefore, the Coast Guard concluded that the Expansion Project did not need to update the current LOI or WSA.

The approved Base Project analyzed 180 LNG carriers from the operation of Trains 1 and 2. Operations of the proposed Trains 3 and 4 could increase the number of LNG carriers by an additional 180, or a total number of 360 LNG carriers. FERC staff reviewed Applicant's filings and determined that increasing the number of LNG carriers to 360 is within the previously approved level of 360 that was analyzed by FERC and Coast Guard for the import terminal, in Docket No. CP05-83-000. Any increase in LNG carrier traffic or change in LNG carrier sizes would be subject to Coast Guard review and inspection process, which is responsible for the safety and security of the Port and waterway.

The LNG carriers would utilize the same waterway transit route used by the approved Base Project and is described in the previously issued EIS located in Docket No. CP17-20-000. In addition, as also discussed in the Base Project's EIS, Navigation and Vessel Inspection Circular – *Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic* (NVIC 01-11), published by the Coast Guard, directs the use of the three concentric Zones of Concern to assess the maritime safety and security risks of LNG marine traffic. The areas impacted by the three different hazards zones would not change from the approved Base Project. Although Port Arthur LNG has suggested mitigation measures for responsibly managing the maritime safety and security risks associated with LNG ship marine traffic, the necessary vessel traffic and/or facility control measures may change depending on changes in conditions along the waterway. The Coast Guard regulations in 33 CFR 127 require that applicants annually review WSAs until a facility begins operation. The annual review and report to the Coast Guard would identify any changes in conditions, such as changes to the port environment, the liquefaction facility, or the LNG ship route, that would affect the suitability of the waterway.

The Coast Guard's LOR is a recommendation regarding the current status of the waterway to FERC, the lead agency responsible for siting the on-shore LNG facilities. Neither the Coast Guard nor FERC has authority to require waterway resources of anyone other than Port Arthur LNG under any statutory authority or under the ERP or Cost Sharing Plan. As stated in the LOR, the Coast Guard would assess each vessel transit on a case by case basis to identify safety and security measures that may be necessary to safeguard the public health and welfare, critical infrastructure, key resources, the marine environment, and vessels.

Under the Ports and Waterways Safety Act, the Magnuson Act, the Maritime Transportation Security Act (MTSA), and the Security and Accountability For Every Port Act, the COTP has the authority to prohibit LNG transfer or LNG marine vessel movements within his or her area of responsibility if he or she determines that such action is necessary to protect the waterway, port, or marine environment. If this Expansion Project is approved and appropriate resources are not in place prior to LNG marine vessel movement along the waterway, then the COTP would consider at that time what, if any, vessel traffic and/or facility control measures would be appropriate to adequately address navigational safety and maritime security considerations.

2.7.4 LNG Facility Security Regulatory Requirements

The security requirements for the proposed Expansion Project are governed by 33 CFR 105, 33 CFR 127, and 49 CFR 193, Subpart J - Security. Title 33 CFR 105, as authorized by the MTSA, requires all terminal owners and operators to submit a Facility Security Assessment (FSA) and a Facility Security Plan (FSP) to the Coast Guard for review and approval before commencement of operations of the proposed project facilities. Port Arthur LNG would also be required to control and restrict access, patrol and monitor the plant, detect unauthorized access, and respond to security threats or breaches under 33 CFR 105. Some of the responsibilities of Port Arthur LNG include, but are not limited to:

- designating a Facility Security Officer (FSO) with a general knowledge of current security threats and patterns, security assessment methodology, LNG marine vessel and facility operations, conditions, security measures, emergency preparedness, response, and contingency plans, who would be responsible for implementing the FSA and FSP and performing an annual audit for the life of the Project;
- conducting a FSA to identify site vulnerabilities, possible security threats and consequences of an attack, and facility protective measures; developing a FSP based on the FSA, with procedures for: responding to transportation security incidents; notification and coordination with federal, state, and local authorities; prevention of unauthorized access; measures to prevent or

deter entrance with dangerous substances or devices; training; and evacuation;

- defining the security organizational structure with facility personnel with knowledge or training in current security threats and patterns; recognition and detection of dangerous substances and devices, recognition of characteristics and behavioral patterns of persons who are likely to threaten security; techniques to circumvent security measures; emergency procedures and contingency plans; operation, testing, calibration, and maintenance of security equipment; and inspection, control, monitoring, and screening techniques;
- implementing scalable security measures to provide increasing levels of security at increasing maritime security levels for facility access control, restricted areas, cargo handling, LNG ship stores and bunkers, and monitoring; ensuring that the Transportation Worker Identification Credential (TWIC) program is properly implemented;
- ensuring coordination of shore leave for LNG marine vessel personnel or crew change out as well as access through the facility for visitors to the LNG ship; conducting drills and exercises to test the proficiency of security and facility personnel on a quarterly and annual basis; and
- reporting all breaches of security and transportation security incidents to the National Response Center.

Title 33 CFR 127 has requirements for access controls, lighting, security systems, security personnel, protective enclosures, communications, and emergency power. In addition, an LNG facility regulated under 33 CFR 105 and 33 CFR 127 would be subject to the TWIC Reader Requirements Rule issued by the Coast Guard on August 23, 2016. This rule requires owners and operators of certain vessels and facilities regulated by the US Coast Guard to conduct electronic inspections of TWICs (e.g., readers with biometric fingerprint authentication) as an access control measure. The final rule would also include recordkeeping requirements and security plan amendments that would incorporate these TWIC requirements. The implementation of the rule was first proposed to be in effect by August 23, 2018. In a subsequent notice issued on June 22, 2018, Coast Guard indicated delaying the effective date for certain facilities by 3 years, until August 23, 2021. On August 2, 2018, the President of the United States signed into law the TWIC Accountability Act of 2018 (H.R. 5729). This law prohibits the Coast Guard from implementing the rule requiring electronic inspections of TWICs until after the Department of Homeland Security (DHS) has submitted a report to Congress. On March 9, 2020, the Coast Guard issued a final rule delaying the implementation of the TWIC Reader Requirement Rule for certain affected owners and operators of vessels and facilities by 3 years effective on May 8, 2020. Although the implementation of this rule has been postponed for certain facilities, the company may need to consider the rule when developing access control and security plan provisions for the facility.

Port Arthur LNG indicated that TWIC is required by the MTSA for workers who need access to secure areas of the nation's maritime facilities and vessels. Transportation Security Administration (TSA) conducts a security threat assessment (background check) to determine a person's eligibility and issues the credential. The FSO shall ensure implementation of access security measures and enforce TWIC regulations.

Title 49 CFR 193, Subpart J also specifies security requirements for the onshore components of LNG facilities, as defined in 49 CFR 193, including requirements for conducting security inspections and patrols, including a liaison with local law enforcement officials, design and construction of protective enclosures, lighting, monitoring, alternative power sources, and warning signs.

If the Expansion Project is authorized, constructed and operated, compliance with the security requirements of 33 CFR 105, 33 CFR 127, and 49 CFR 193, Subpart J would be subject to the respective Coast Guard and USDOT PHMSA inspection and enforcement programs for the Expansion Facilities.

Since the Expansion Project would be located within the approved Base Project footprint, Port Arthur LNG indicated there would be no changes to the preliminary security design plans that were approved as part of the Base Project. The Expansion Project would be provided with the same security design features as the Base Project which would include: physical security plans, facility lighting, physical barriers (e.g., fences, vehicle barriers, etc.), site and onsite access controls, intrusion monitoring and detection, and site security communication personnel plans. Port Arthur LNG indicated that additional details would be completed in the final design. Therefore, we recommend in section 2.7.9 that Port Arthur LNG provide final design details on the security features, for review and approval, including lighting coverage drawings, camera coverage drawings, security specifications, and implementation techniques as well as any other security design features that would apply to the Expansion Project.

Furthermore, in accordance with the February 2004 Interagency Agreement among FERC, USDOT PHMSA, and the Coast Guard, FERC staff would collaborate with the Coast Guard and USDOT PHMSA on the Expansion Project's security features.

2.7.5 FERC Engineering and Technical Review of the Preliminary Engineering Designs

2.7.5.1 LNG Facility Historical Record

The operating history of the U.S. LNG industry has been free of safety-related incidents resulting in adverse effects on the public or the environment with the exception of the October 20, 1944, failure at an LNG plant in Cleveland, Ohio. The 1944 incident

in Cleveland led to a fire that killed 128 people and injured 200 to 400 more people.[18] The failure of the LNG storage tank was due to the use of materials not suited for cryogenic temperatures. LNG migrated through streets and into underground sewers due to inadequate spill impoundments at the site. Current regulatory requirements ensure that proper materials suited for cryogenic temperatures are used in the design and that spill impoundments are designed and constructed properly to contain a spill at the site. To ensure that this potential hazard would be addressed for proposed LNG facilities, we evaluate the preliminary and final specifications for suitable materials of construction and for the design of spill containment systems that would properly contain a spill at the site.

Another operational accident occurred in 1979 at the Cove Point LNG plant in Lusby, Maryland. A pump electrical seal located on a submerged electrical motor LNG pump leaked causing flammable gas vapors to enter an electrical conduit and settle in a confined space. When a worker switched off a circuit breaker, the flammable gas ignited, causing severe damage to the building and a worker fatality. With the participation of the FERC, lessons learned from the 1979 Cove Point accident led to changes in the national fire codes to better ensure that the situation would not occur again. To ensure that this potential hazard would be addressed for proposed facilities that have electrical seal interfaces, we evaluated the preliminary designs and recommend in section 2.7.9 that Port Arthur LNG provide, for review and approval, the final design details of the electrical seal design at the interface between flammable fluids and the electrical conduit or wiring system, details of the electrical seal leak detection system, and the details of a downstream physical break (i.e., air gap) in the electrical conduit to prevent the migration of flammable vapors.

On January 19, 2004, a blast occurred at Sonatrach's Skikda, Algeria, LNG liquefaction plant that killed 27 and injured 56 workers. No members of the public were injured. The investigation suggested that a cold hydrocarbon leak occurred at Liquefaction Train 40 and was introduced into a high-pressure steam boiler by the combustion air fan. An explosion developed inside the boiler firebox, which subsequently triggered a larger explosion of the hydrocarbon vapors in the immediate vicinity. The resulting fire damaged the adjacent liquefaction process and liquid petroleum gas separation equipment of Train 40 and spread to Trains 20 and 30. Although Trains 10, 20, and 30 had been modernized in 1998 and 1999, Train 40 had been operating with its original equipment since start-up in 1981. To ensure that this potential hazard would be addressed for proposed facilities, we evaluate the preliminary design for mitigation of flammable vapor dispersion and ignition in buildings and combustion equipment to ensure they are adequately covered by hazard detection equipment that could isolate and deactivate any combustion equipment whose continued operation could add to or sustain

[18] For a description of the incident and the findings of the investigation, see "U.S. Bureau of Mines, Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944," dated February 1946.

an emergency. We also recommend in section 2.7.9 that Port Arthur LNG provide, for review and approval, the final design drawings of hazard detection equipment, including the location and elevation of all detection equipment, instrument tag numbers, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment.

On March 31, 2014, a detonation occurred within a gas heater at Northwest Pipeline Corporation's LNG peak-shaving plant in Plymouth, Washington.[19] This internal detonation subsequently caused the failure of pressurized equipment, resulting in high velocity projectiles. The plant was immediately shut down, and emergency procedures were activated, which included notifying local authorities and evacuating all plant personnel. No members of the public were injured, but one worker was sent to the hospital for injuries. As a result of the incident, the liquefaction trains and a compressor station located onsite were rendered inoperable. Projectiles from the incident also damaged the control building that was located near the pre-treatment facilities and penetrated the outer shell of one of the single containment LNG storage tanks. All damaged facilities were ultimately taken out of service for repair. The accident investigation showed that an inadequate purge after maintenance activities resulted in a fuel-air mixture remaining in the system. The fuel-air mixture auto-ignited during startup after it passed through the gas heater at full operating pressure and temperature. To ensure that this potential hazard would be addressed for proposed facilities, FERC staff recommends in section 2.7.9 that Port Arthur LNG provide a plan for purging, for review and approval, which addresses the requirements of the American Gas Association *Purging Principles and Practice* and to provide justification if not using an inert or non-flammable gas for purging. In evaluating such plans, we would assess whether the purging could be done safely based on review of other plans and lessons learned from this and other past incidents. If a plan proposes the use of flammable mediums for cleaning, dry-out or other activities, we would evaluate the plans against other recommended and generally accepted good engineering practices, such as NFPA 56, *Standard for Fire and Explosion Prevention during Cleaning and Purging of Flammable Gas Piping Systems*.

We also recommend in section 2.7.9 that Port Arthur LNG provide, for review and approval, operating and maintenance plans, including safety procedures, prior to commissioning. In evaluating such plans, we would assess whether the plans cover all standard operations, including purging activities associated with startup and shutdown. Also, in order to prevent other sources of projectiles from affecting occupied buildings and storage tanks, we recommend in section 2.7.9 that Port Arthur LNG incorporate mitigation measures into their final design with supportive information, for review and

[19] For a description of the incident and the findings of the investigation, see Root Cause Failure Analysis, Plymouth LNG Plant Incident Investigation under CP14-515.

approval, that demonstrates it would mitigate the risk of a pressure vessel burst or boiling liquid expanding vapor explosion (BLEVE) from occurring.

2.7.5.2 FERC Preliminary Engineering Review

The FERC requires an applicant to provide safety, reliability, and engineering design information as part of its application, including hazard identification studies and front-end-engineering-design (FEED) information for a proposed project. FERC staff evaluates this information with a focus on potential hazards from within and nearby the site, including external events, which may have the potential to cause damage or failure to the Expansion Project facilities, and the engineering design and safety and reliability concepts of the various protection layers to mitigate the risks of potential hazards.

The primary concerns are those events that could lead to a hazardous release of sufficient magnitude to create an offsite hazard or interruption of service. Further, the potential hazards are dictated by the site location and the engineering details. In general, FERC staff considers an acceptable design to include various layers of protection or safeguards to reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public. These layers of protection are generally independent of one another so that any one layer would perform its function regardless of the initiating event or failure of any other protection layer. Such design features and safeguards typically include:

- a facility design that prevents hazardous events, including the use of inherently safer designs; suitable materials of construction; adequate design margins from operating 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 that the facility stays within the established operating and design limits;
- safety instrumented prevention systems, such as safety control valves and ESD 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 cryogenic, overpressure, and fire structural protection, to prevent escalation to a more severe event;
- site security measures for controlling access to the plant, including security inspections and patrols, response procedures to any breach of security, and liaison with local law enforcement officials; and

- onsite and offsite emergency response, including hazard detection, hazard 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.

We believe the inclusion of such protection systems or safeguards in a plant design can minimize the potential for an initiating event to develop into an incident that could impact the safety of the offsite public. The review of the engineering design for these layers of protection is initiated in the application process and carried through to the next phase of the Project in final design if authorization is granted by the Commission.

The reliability of these layers of protection is informed by occurrence and likelihood of root causes and the potential severity of consequences based on past incidents and validated hazard modeling. As a result of the continuing engineering review, we recommend mitigation measures and continuous oversight to the Commission for consideration to include as conditions in the Order. If the proposed facility is authorized and recommendations are adopted as conditions to the Order, FERC staff would continue its engineering review through final design, construction, commissioning, and operation.

2.7.5.3 Process Design Review

The Port Arthur Expansion Project facilities would be located wholly within property previously authorized for the Base Project under FERC Docket No. CP17-20-000. Therefore, no additional land would need to be required. The Expansion Project would add two liquefaction trains and would be located adjacent to Trains 1 and 2 of the Base Project. LNG produced from Trains 3 and 4 would be stored and exported using the LNG storage tanks and marine facilities approved as part of the Base Project. The natural gas delivered to the Expansion Project via the Port Arthur Texas Connector Pipeline, also authorized under FERC Docket No. CP17-21-000, would be cooled into a liquid form by the liquefaction trains. The Expansion Project would increase LNG production capacity from 13.5 MTPA in aggregate from Trains 1 and 2 to approximately 27.0 MTPA in aggregate from Trains 1 through 4. The Expansion Project would not require a change in the size or quantity of LNG ships previously evaluated by the U.S. Coast Guard in the LOR.

In order to liquefy natural gas, most liquefaction technologies require that the feed gas stream be pre-treated. After pressure regulation, the feed gas would be treated to remove components that could freeze out and clog the liquefaction equipment or would otherwise be incompatible with the liquefaction process or equipment, including mercury, acid gas (consisting of H_2S and CO_2), water, and heavy hydrocarbons. For example, mercury is typically limited to concentrations less than 0.01 microgram per normal cubic meter because it can cause embrittlement and corrosion resulting in a catastrophic failure

of aluminum, which is commonly used in heat exchangers for the liquefaction of natural gas.

Inlet feed gas from the pipeline would be conditioned to remove solids and water droplets before it is routed to the mercury adsorber vessels to reduce the mercury concentration in the feed gas. The mercury adsorber vessels would be equipped with mercury adsorbent media that would consist of either alumina-based pre-sulfide, non-regenerable catalyst/adsorbent or activated carbon. After mercury removal, the feed gas would contact an amine-based solvent solution in an absorber column to remove acid gas. Once the acid gas components accumulate in the amine solution, the amine solution is routed to an amine regenerator column that utilizes a reboiler to create hot amine vapor. Contact with the hot amine vapor would release the acid gas from the amine solution. The regenerated amine solution would be recycled back to the absorber column and the removed acid gas would be sent through the H_2S scavenger drums to remove hydrogen sulfide. The acid gas stream is then routed to a thermal oxidizer, where CO_2, trace amounts of H_2S not removed in the H_2S scavenger drums, and trace amounts of hydrocarbons would be incinerated. The treated feed gas exiting the absorber column then enters the dehydration unit where a dryer inlet separator would recover bulk water. The bulk water would be routed to a recovered water tank that would supply make-up water to the absorber column. After the dryer inlet separator, any remaining water in the feed gas would be removed in regenerative molecular sieve beds. During the molecular sieve bed regeneration process, heated regeneration gas would release water from the molecular sieve beds. Water would then be separated from the regeneration gas and would be routed to the recovered water tank. The treated dry gas would then be sent to a natural gas liquids (NGL) extraction unit to extract heavy hydrocarbons. The resulting heavy hydrocarbon stream would be stabilized and sent to the relocated and resized condensate storage tanks for removal and transport by truck to outside facility. Ethane and propane would also be extracted as part of the NGL extraction process and would be sent to storage for use as make-up refrigerant in the liquefaction process. The treated lean gas that exits the NGL extraction unit would be routed through a booster compressor prior to entering the liquefaction process.

The Expansion Project would utilize the same liquefaction process that is authorized for the Base Project which would be designed and optimized by Air Products and Chemicals Inc. In order to achieve the cryogenic temperatures needed to liquefy the treated lean gas stream, the gas would be pre-cooled by a thermal exchange process with propane and further cooled using a mixed refrigerant stream to condense the natural gas into a liquid at approximately -260°F. The mixed refrigerant process stream would be comprised of a mixture of nitrogen, methane, ethane, and propane designed to achieve the liquefaction temperature. The ethane and propane refrigerants required for the liquefaction process would be supplied from the NGL extraction unit discussed above. As authorized in the Base Project, additional supplies of ethane and propane would also be supplied by trucks and would be stored in onsite storage tanks. The truck

loading/unloading facility would serve to unload make-up refrigerants brought to the site and a separate truck loading area would also load condensate product stored onsite.

After cooling the natural gas into its liquid form, the LNG would be routed to the end gas flash knock-out drum and pumped to the three full-containment LNG storage tanks which were authorized as part of the Base Project. During ship loading operations, LNG stored within the LNG storage tanks would be sent out through the previously authorized in-tank pumps, marine transfer line, and marine transfer arms connected to an LNG marine vessel. The Base Project also includes a LNG recirculation line to keep the marine transfer line cold between LNG export cargoes and avoid cool down prior to every LNG marine vessel loading operation. Displaced LNG marine vessel vapors during ship loading operations would be sent back through the vapor marine transfer arm, vapor return line, and back to LNG storage tanks. Once loaded, the LNG ship would be disconnected and leave for export.

The Expansion Project included utilities and associated auxiliary equipment. The main utilities required for operation of the Expansion Project facility include boil-off gas (BOG), fuel gas, hot oil, flares, instrument and utility air supply, water supply, demineralized water, nitrogen, and backup power. Boil-off gas generated from the Expansion Project facilities due to heat transfer into the system components; LNG run down to LNG storage tanks; and from vapor return associated with ship loading would be routed to one new BOG compressor which would compress the BOG for delivery into the fuel gas system. The fuel gas system for the liquefaction trains would be primarily flash gas from the liquefaction process augmented with boil-off gas and feed gas from the pipeline(s). Furthermore, hot oil would be used to provide the heat demand to the plant users, molecular sieve regeneration, amine regeneration, and deethanizer and debutanizer reboilers. In addition, Port Arthur LNG proposed the facility would have a total of 4x33% with 1x33% proposed multi-point configuration ground flare system to ensure the plant would not have to completely shut down due to outage of one of the flare systems. Diesel would be stored in dedicated tanks for their respective equipment, which includes essential firewater pumps and three diesel generators. Electric power would be generated on-site but would be located outside the storm levee and would require using eight of nine gas turbine driven generators. Liquid nitrogen vaporizers would be used to supply gaseous nitrogen for various uses in the plant including pre-commissioning and start-up. In addition, aqueous ammonia would be used in the selective catalytic removal process to reduce the NO_x emissions from the self-generation power turbines proposed as part of the Expansion Project.

The failure of process equipment could pose potential harm if not properly safeguarded through the use of appropriate engineering controls and operation. Port Arthur LNG would install process control valves and instrumentation to safely operate and monitor the Expansion Project facilities. Alarms would have visual and audible notification in the new control room to warn operators that process conditions may be

approaching design limits. The Main Control Room (MCR), approved as part of the Base Project, would not accommodate new consoles for the Expansion Project. In the application, Port Arthur LNG proposed a new larger MCR which would be located on the southeast corner of the main administration building. The MCR would house all the BPCS/SIS control console for both Base Project and Expansion Project facilities. Port Arthur LNG would design control systems and human machine interfaces to meet the International Society for Automation (ISA) Standards 5.3, 5.5, 60.1, 60.3, 60.4, and 60.6, and other standards and recommended practices. We recommend in section 2.7.9 that Port Arthur LNG provide final specifications for these systems. In addition, we recommend in section 2.7.9 that Port Arthur LNG develop and implement an alarm management program, for review and approval, to ensure the effectiveness of the alarms. FERC staff would evaluate the alarm management program against recommended and generally accepted good engineering practices, such as ISA Standard 18.2.

Operators would have the capability to take action from the control room to mitigate an upset. Port Arthur LNG would develop facility operation procedures after completion of the Expansion Project final design; this timing is fully consistent with accepted industry practice. We also recommend in section 2.7.9, for the Expansion Project, Port Arthur LNG should provide updated information on the operating and maintenance procedures, including, but not limited to, safety procedures, hot work procedures and permits, abnormal operating conditions procedures, and personnel training prior to commissioning. We would evaluate these procedures to ensure that an operator can operate and maintain all systems safely, based on benchmarking against other operating and maintenance plans and comparing against recommended and generally accepted good engineering practices, such as American Institute of Chemical Engineers (AIChE) Center for Chemical Process Safety (CCPS) *Guidelines for Writing Effective Operating and Maintenance Procedures*, AIChE CCPS *Guidelines for Management of Change for Process Safety*, AIChE CCPS *Guidelines for Effective Pre-Startup Safety Reviews*, American Gas Association *Purging Principles and Practices*, and NFPA 51B *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*. In addition, we recommend in section 2.7.9 that Port Arthur LNG tag and label instrumentation and valves, piping, and equipment and provide car-seals/locks to address human factor considerations and improve facility safety and prevent incidents.

In the event of a process deviation, ESD valves and instrumentation would be installed to monitor, alarm, shutdown, and isolate equipment and piping during process upsets or emergency conditions. The Expansion Project would have an ESD system to initiate closure of valves and shutdown of the process during emergency situations. Safety-instrumented systems would comply with ISA Standard 84.00.01 and other recommended and generally accepted good engineering practices. There would be an overall plant ESD and area ESDs to shutdown designated areas in the event of an emergency. However, logic behind hazard detection triggered ESDs has not yet been finalized. Additionally, the final locations of field mounted ESD hand switches were not

finalized and Applicant stated it would be determined during detailed design. Therefore, FERC staff recommends in section 2.7.9 that Port Arthur LNG provide details of the ESD system, for review and approval, including shutdown logic for each ESD and final locations. We also recommend in section 2.7.9 that Port Arthur LNG file information, for review and approval, on the final design, installation, and commissioning of instrumentation and ESD equipment to ensure appropriate cause-and-effect alarm or shutdown logic and enhanced representation of the ESD system in the plant control room and throughout the plant.

In developing the FEED, Port Arthur LNG conducted a hazard identification (HAZID) review to identify potential hazards (both safety and environmental) associated with the proposed facility location, site layout, process design, marine operations, simultaneous operations, and construction. This review generated a number of recommendations which Port Arthur LNG indicated would be tracked for closure and any changes would be captured as part of the detailed design as required. In addition, a more detailed hazard and operability review (HAZOP) analysis would be performed by Port Arthur LNG during the final design to identify the major process hazards that may occur during the operation of the 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 consequences that may result from the process hazard, and identify whether there are adequate safeguards (e.g., engineering and administrative controls) to prevent or mitigate the risk from such events. Where insufficient engineering or administrative controls were identified, recommendations to prevent or minimize these hazards would be generated from the results of the HAZOP review. We recommend in section 2.7.9 that Port Arthur LNG file the HAZOP study on the completed final design for review and approval. We would evaluate the HAZOP to ensure all systems and process deviations are addressed appropriately based on likelihood, severity and risk values with commensurate layers of protection in accordance with recommended and generally accepted good engineering practices, such as American Institute of Chemical Engineers, *Guidelines for Hazard Evaluation Procedures*. We also recommend in section 2.7.9 that Port Arthur LNG file the resolutions of the recommendations generated by the HAZID and HAZOP review for evaluation and approval by FERC staff. Once the design has been subjected to a HAZOP review, the design development team would track, manage, and keep records of changes in the facility design, construction, operations, documentation, and personnel Port Arthur LNG would evaluate these changes to ensure that the safety, health, and environmental risks arising from these changes are addressed and controlled based on its management of change procedures. If FERC staff's recommendations are adopted into the Commission Order, resolutions of the recommendations generated by the HAZID and HAZOP review would be monitored by FERC staff. We also recommend in section 2.7.9 that Port Arthur LNG file all changes to their FEED for review and approval by FERC staff. However, major modifications could require an amendment or new proceeding.

If the Expansion Project is authorized, constructed, and operated, Port Arthur LNG would install equipment in accordance with its design. We recommend in section 2.7.9 that the Expansion Project facilities be subject to construction inspections and that Port Arthur LNG provide, for review and approval, commissioning plans, procedures and commissioning demonstration tests that would verify the performance of equipment. In addition, we recommend in section 2.7.9 that Port Arthur LNG provide semi-annual reports that include abnormal operating conditions and facility modifications. Furthermore, we recommend in section 2.7.9 that the Expansion Project facilities be subject to regular inspections throughout the life of the facilities to verify that equipment is being properly maintained and that basis of design conditions, such as feed gas and stored LNG conditions, do not exceed the original basis of design.

2.7.5.4 Mechanical Design

Port Arthur LNG provided codes and standards for the design, fabrication, construction and installation of piping and equipment and specifications for the Expansion Project facilities. These were evaluated against recommended and generally accepted good engineering practices.

The design specifies materials of construction and ratings suitable for the pressure and temperature conditions of the process design. Piping would be designed, fabricated, assembled, erected, inspected, examined, and tested in accordance with the ASME Standards B31.1, B31.3, B31.5, and B31.8. Valves and fittings would be designed to standards and recommended practices such as API Standards 594, 598, 600, 602, 607, and 609; ASME Standards B16.5, B16.9, B16.10, B16.11, B16.20, B16.21, B16.25, B16.34, and B16.47, B16.48; and ISA Standard 75.08.01 and 75.08.05.

Pressure vessels must be designed, fabricated, inspected, examined, and tested in accordance with ASME Boiler and Pressure Vessel Code (BPVC) Section VIII and must be code-stamped per NFPA 59A (2001 edition), as incorporated by 49 CFR 193 Subparts C, D, and E. Low-pressure storage tanks such as the amine, and condensate storage tanks, would be designed, inspected, and maintained in accordance with the API Standards 620, 650 and 653. Heat exchangers would be designed to ASME BPVC section VIII standards; API Standards 660, 661; and the Tubular Exchanger Manufacturers Association standards. Fired heaters would be specified and designed to standards and recommended practices, such as API Standards 535, 556 and 560. Rotating equipment would be designed to standards and recommended practices, such as API Standards 610, 611, 613, 614, 616, 617, 670, 671, 672, 675, 676, and 682; and ASME Standards B73.1 and B73.2.

Pressure and vacuum safety relief valves and flares would be installed to protect the storage containers, pressure vessels, process equipment, and piping in the event of an unexpected vapor release or uncontrolled pressure excursion. The safety relief valves

would be designed to handle process upsets and thermal expansion, per NFPA 59A (2001), ASME Standard B31.3, and ASME BPVC section VIII; and would be designed in accordance with API Standards 520, 521, 526, 527, and 2000; and other recommended and generally accepted good engineering practices. Therefore, we recommend in section 2.7.9 that, prior to construction of final design, Port Arthur LNG to provide final design information on pressure and vacuum relief devices and flares and/or vent stacks to ensure that the final capacity sizing, design, and installation of these components are adequate and in accordance with the standards reference and other recommended and generally accepted good engineering practices. We also recommend in section 2.7.9 that Port Arthur LNG install thermal relief valves in certain piping segments that can be isolated by valves.

FERC staff reviewed codes and standards, design specifications and pressure and vacuum safety relief valves and flare for the proposed Expansion Project. The codes and standards were described or listed as ones the project would meet, Port Arthur LNG did not make reference to all codes and standards (e.g., ASME B36.10/19, API 530, 594, 598, etc.), that are recommended and generally accepted good engineering practices and there were inconsistencies among the codes and standards provided in the list, specifications, basis of design and criteria, and data sheets. In addition, the list included codes and standards that did not seem applicable to the Expansion Project, (e.g., ASME B31.4). Therefore, we recommend in section 2.7.9, prior to construction of final design, that Port Arthur LNG provide the final specifications for all equipment and a cross-referenced list of all applicable codes and standards required by regulations or that are recommended and generally accepted good engineering practices for review and approval.

Vent and relief flows from PALNG's facility would be handled by a Ground Flare System and a separate Marine Flare System. The Marine Flare would be provided for collecting and processing the relief streams from the LNG Storage and Loading ship. The sizing basis for the Marine Flare would be to handle the capacity of one BOG Compressor. This would be for an emergency condition where all four LNG trains would be offline, and the BOG flow could not be returned to the trains. The Ground Flare System would be provided for collecting and processing vents and reliefs form all four liquefaction trains. The Ground Flare System would be consisting of a total of four independent flare systems. For the Expansion Project, Port Arthur LNG proposed one additional 1x33% Ground Flare system that would be identical in size and capacity to the three ground flare systems previously approved for the Base Project. The added ground flare would be consists of a Wet Flare, Dry Flare, Low-Pressure Wet Flare, and Low-Pressure Dry Flare in order to handle potential simultaneous flaring due to addition of Trains 3 and 4. PALNG indicated that the ground flare systems would be configured as 4x33% with 1x33% new flare proposed as a spare. The spare ground flare would be used when performing maintenance. For the Base Project, the ground flare system was designed 3x50% with 1x50% as spare. However, due to an increase in the number of

trains in the Expansion Project over the Base Project, considerations were given to the simultaneous relief from other trains in the flaring load estimate and one ground flare system was added. In addition, Port Arthur LNG, in its preliminary Flaring Load and Venting Capacities and Sizing calculation, used many flaring, de-pressuring and venting cases to size the ground flare capacity case load. However, it was unclear which case was considered for the final flare load capacity. Therefore, we recommend in section 2.7.9, prior to construction of final design, that Port Arthur LNG to file detailed final design and flaring load and venting capacities and a completed sizing study, for FERC staff review and approval.

If the Expansion Project is authorized, constructed, and operated, Port Arthur LNG would install equipment in accordance with its specifications and design, and FERC staff would verify equipment nameplates to ensure equipment is being installed based on the approved design. FERC staff would conduct construction inspections, including reviewing quality assurance and quality control plans, to ensure construction work is being performed according to proposed Project specifications, procedures, codes, and standards. We also recommend in section 2.7.9 that Port Arthur LNG provide semi-annual reports that include equipment malfunctions and abnormal maintenance activities. In addition, we recommend in section 2.7.9 that the Project facilities be subject to inspections throughout the life of the facility to verify that the plant equipment is being properly maintained.

2.7.5.5 Hazard Mitigation Design

If operational control of the facilities were lost and operational controls and ESD systems failed to maintain the Expansion Project within the design limits of the piping, containers, and safety relief valves, a release could potentially occur. FERC regulations under 18 CFR 380.12 (o) (1) through (4) require Applicants to provide information on spill containment, spacing and plant layout, hazard detection, hazard control, and firewater systems. In addition, 18 CFR 380.12 (o) (7) require Applicants to provide engineering studies on the design approach and 18 CFR 380.12 (o) (14) requires Applicants to demonstrate how they comply with 49 CFR 193 and NFPA 59A. As required by 49 CFR 193 Subpart I and by incorporation section 9.1.2 of NFPA 59A (2001), fire protection must be provided for all USDOT PHMSA regulated LNG plant facilities based on an evaluation of sound fire protection engineering principles, analysis of local conditions, hazards within the facility, and exposure to or from other property. NFPA 59A (2001) also requires the evaluation on the type, quantity, and location of hazard detection and hazard control, passive fire protection, ESD and depressurizing systems, and emergency response equipment, training, and qualifications. If authorized, constructed, and operated, LNG facilities, as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 Subpart I and would be subject to USDOT PHMSA's inspection and enforcement programs. However, NFPA 59A (2001) also indicates the wide range in size, design, and location of LNG facilities precludes the inclusion of

detailed fire protection provisions that apply to all facilities comprehensively and includes subjective performance-based language on where ESD systems and hazard control are required. However, it does not provide any additional guidance on placement or selection of hazard detection equipment and provides minimal requirements on firewater. Therefore, FERC staff evaluated the proposed spill containment and spacing, hazard detection, ESD and depressurization systems, hazard control, firewater coverage, structural protection, and onsite and offsite emergency response to ensure they would provide adequate protection of the Expansion Project as described below.

Port Arthur LNG provided a preliminary fire protection evaluation to ensure that adequate mitigation would be in place, including spill containment and equipment spacing, hazard detection, ESD and depressurization systems, hazard control, firewater coverage, structural protection, and onsite and offsite emergency response. However, the preliminary fire protection evaluation provided was a high-level summary of the hazardous materials present, potential release scenarios, general hazard mitigation and layers of protection that would be in place. The evaluation did not appear to incorporate the latest plot plan which includes all Expansion Project facilities and also the relocation of the Base Project's facilities. In addition, although the evaluation identified various fire scenarios, there were no details on the hazard mitigation that would be provided to respond to each scenario. Consequently, the evaluation did not contain enough details to substantially evaluate or inform the adequacy of the hazard mitigation design in accordance with RAGAGEPs, such as NFPA 10, API 2218, or other sound fire protection engineering practices. Therefore, we reviewed the hazard mitigation design as described in each subsection below. We also recommend in section 2.7.9 that Port Arthur LNG provide a final fire protection evaluation for review and approval prior to the construction of the final design and to provide more information on the final design, installation, and commissioning of spill containment, hazard detection, hazard control, firewater systems, structural low temperature, and fire protection, as well as to provide finalized onsite and offsite emergency response procedures for review and approval prior to the introduction of hazardous fluids.

2.7.5.5.1 Spill Containment

In the event of a hazardous fluid release, sloped areas at the base of storage and process facilities would direct a spill away from equipment and into the impoundment system. This arrangement would minimize the dispersion of flammable vapors into confined, occupied, public areas, or into areas where uncontrolled ignition sources may be present, and would minimize the potential for heat from a fire to impact adjacent equipment, occupied buildings, or public areas if ignition were to occur.

No LNG storage tanks are proposed to be added or modified by the Expansion Project, although the LNG storage tanks are proposed to be relocated within previously approved tertiary berms, and other new or re-sized facilities are proposed. Under NFPA

59A (2001) section 2.2.2.2, for all of the USDOT PHMSA regulated facilities under 49 CFR 193 Subpart C, 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 a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the USDOT PHMSA. However, neither 49 CFR 193 nor NFPA 59A define what constitutes a single accidental leakage source and whether it is the same for design spills and impoundment sizing. If authorized, constructed, and operated, the Expansion Project facilities, as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193, Subpart C and would be subject to the USDOT PHMSA's inspection and enforcement programs. The impoundment system design for the marine facilities would be subject to the Coast Guard's 33 CFR 127, which does not specify a spill or duration for impoundment sizing. We evaluated whether all hazardous liquids would be provided with spill containment based on the largest flow capacity from a single pipe for 10 minutes, accounting for de-inventory, or the liquid capacity of the largest vessel served (or total of vessel capacities where multiple hazardous liquid vessels would share a common impoundment and would not be mitigated from cascading failure), whichever is greater. This approach is consistent with NFPA 59A (2019 edition).

Port Arthur LNG would install concrete curbing, paving, and trenches to direct hazardous liquid spills from process and transfer areas to concrete impoundments. Port Arthur LNG proposes to enlarge LNG Spill Impoundment 1, which had been authorized for the Base Project, and relocate it north of LNG Storage Tank 3 to collect a spill from the LNG ship loading lines, condensate truck loading lines, the main pipe rack, or the process areas of Liquefaction Trains 1, 2, and 3, which contain LNG, refrigerants, natural gas liquids, and hot oil. Because this impoundment would handle LNG spills from all of the marine area LNG piping, Port Arthur LNG proposes to eliminate the North Jetty LNG impoundment that had been located in the marine area of the Base Project. Port Arthur LNG also proposes to install LNG Spill Impoundment 2, located east of Train 4, to collect a potential spill of LNG, refrigerants, natural gas liquids, or hot oil from process areas in Train 4. A spill of hot oil in the southern utility areas of all LNG trains would be directed to a proposed Hot Oil Spill Impoundment located just south of LNG Spill Impoundment 2. However, the hot oil supply piping in those utility areas is indicated to cross over top of the local containment for the expansion drum, which would possibly allow hot oil, spilled above its flashpoint, to collect in that local containment as well. In addition, a potential spill of hot oil occurring in the area near the hot oil heater would appear to be outside of the collection areas for any of the LNG and Hot Oil Spill Impoundments, and Port Arthur LNG has not defined a containment or collection system in that area. Because this hot oil would be handled at significant flow rates, well above its flashpoint, we recommend in section 2.7.9 that, for review and approval, prior to construction of the final design, Port Arthur LNG provide spill containment for an impoundment sizing spill of hot oil in the area of the hot oil heater, unless it can be demonstrated that providing containment would not be needed to prevent flammable

vapors or radiant heat of 1,600 BTU/ft^2-hr reaching offsite or onto occupied buildings or result in cascading damage that could cause impacts to extend offsite . Port Arthur LNG also proposes a minor relocation of the Refrigerant Storage Impoundment, which was included in the Base Project to contain a spill from the refrigerant storage tanks in an adjacent location. This relocation would increase the distance between the remote impoundment and the refrigerant tanks, and this impoundment would also collect any spills occurring in the refrigerant truck transfer area.

The Base Project also included local impoundments for two amine storage tanks, a hot oil storage tank, and a diesel storage tank. Previously, these tanks were all planned to be located in adjacent impoundments in the utility area. The amine and hot oil would be stored below their flashpoints, and Port Arthur LNG now proposes to relocate the diesel storage tank and its impoundment from the utility area to west of LNG Storage Tank 3.

In addition, Port Arthur LNG proposes to increase the size of the two condensate storage tanks and their impoundments, which were included in the Base Project, and relocate them from the far north end of the site to just west of the refrigerant storage area. The nearby condensate truck loading station is proposed to be located within its own spill impoundment, and troughs and curbed areas would be provided in between the condensate storage and truck loading impoundment. As noted above, in order to review full design details of spill collection for the plant, including to verify continuous spill collection for the condensate truck loading piping, we recommend in section 2.7.9 that Port Arthur LNG provide final design details of the overall spill containment system, for review and approval prior to construction of the final design. In addition, the condensate truck loading impoundment would appear to be proposed with pipe sleeves running underneath the truck station road area, potentially for the purpose of joining the impoundment capacity on either side of the truck station. Therefore, we recommend in section 2.7.9 that, for review and approval, prior to construction of the final design, Port Arthur LNG provide details on the condensate truck loading impoundment design, including any potential for grated end covers for the pipe sleeves and addressing deflagration venting considerations, to demonstrate that overpressures that could cause cascading damage or significant safety hazards would not occur. New flare knockout drums are proposed to be located adjacent to knockout drums for the Base Project, which are pressure vessels that can contain a significant amount of hazardous liquid. Spill containment in this area has not yet been addressed. Therefore, we recommend in section 2.7.9 that, for review and approval, prior to construction of the final design, Port Arthur LNG provide details of a containment system for hazardous liquid knockout vessels, or demonstrate that providing this containment would not significantly reduce the potential vapor dispersion or radiant heat consequences of a spill. No aqueous ammonia equipment or facilities are proposed, in addition to those included in the Base Project, and the impoundment system details for the storage, piping, and truck transfer in the aqueous ammonia area would be addressed during final design of the Base Project.

As discussed above, we evaluated whether the proposed impoundments would contain either the largest flow capacity from a single pipe for 10 minutes, accounting for de-inventory, or the maximum liquid capacity of the largest vessel served (or total for vessels within a common impoundment), whichever is greater. The largest flow rate that could be contained by LNG Spill Impoundment 1 would come from the LNG ship loading line. The LNG ship loading pumps are proposed to be provided with an interlock to prevent the activation of additional installed pumps that would have the potential to increase the total flowrate from a failure of the ship loading line. To provide reliability for this measure, we recommend in section 2.7.9 that, for review and approval, prior to construction of the final design, these interlocks be demonstrated to meet safety integrity level (SIL) 2 or higher reliability design and maintenance requirements in accordance with the International Society of Automation (ISA) 84 standards. In addition, all pump driven scenarios were considered at 140-percent pump run out flowrates, except the LNG loading pump scenario for which the pump curve was provided, indicating 150-percent pump run out flowrates. In certain areas, Port Arthur LNG indicates that firewater coverages during an impoundment fire event would be directed to the local impoundment in addition to the spill, and Port Arthur LNG provided firewater volumes that were considered in the capacity calculations for those impoundments. However, the exact capacity of the condensate truck station impoundment was not yet provided, and firewater that may be needed to protect the condensate truck from a fire over a loading line spill in the condensate truck station impoundment could have potential to cause impoundment capacity to be exceeded. Therefore, we recommend in section 2.7.9 that, for review and approval, prior to construction of the final design, Port Arthur LNG evaluate the sizing of this impoundment basin to contain the sizing spill in addition to firewater overages or demonstrate that additional impoundment capacity would not significantly reduce the potential vapor dispersion or radiant heat consequences of a spill. In addition, FERC staff determined that the capacity of the Hot Oil Spill Impoundment would not be consistent with our impoundment sizing criteria. Port Arthur LNG considered a release from a 2-inch diameter hole for sizing this impoundment, rather than the greatest flow from a line. Therefore, we recommend in section 2.7.9 that, for review and approval, prior to construction of the final design, Port Arthur LNG provide details of a spill containment system that can contain the full hot oil sizing spill from the southern utility area of each liquefaction train, unless it can be demonstrated that providing this containment would not significantly reduce the potential vapor dispersion or radiant heat consequences of a spill. We also evaluated the size of spill conveyance troughs based on the sizing spill flow rates. However, details of all troughs were not available, and we recommend in section 2.7.9 that, for review and approval, prior to construction of the final design, Port Arthur LNG provide the final dimensions and slopes of all hazardous liquid spill troughs, sized to convey the sizing spill flow rate.

FERC staff also generally evaluate the means to remove water and snow from impounding areas to ensure impoundment volumes would not be reduced through accumulations of rainwater or snow. In addition, FERC staff generally evaluate whether

there are provisions to ensure that hazardous fluids are not accidentally discharged through the systems intended to remove rainwater or snow. Snow would not be expected to accumulate in the impoundment system for Port Arthur LNG's terminal, due to its location near the Gulf of Mexico. To address stormwater in LNG impoundments, Port Arthur LNG provided design documents indicating that the LNG impoundment stormwater pumps would be automatically operated by level control and interlocked using low temperature detectors to prevent pumps from operating if LNG is present and that smaller sump pumps would be used to routinely discharge small amounts of rainwater that collects in the sump. Subsequently, Port Arthur LNG stated that an LNG impoundment basin pump would be started manually only after confirmation that no contaminants are present in the basin and that any hot oil or condensate present in the basin would be removed by vacuum truck. However, the design documents currently indicate automatic on and off levels for both the smaller and larger sump pumps in the LNG impoundments. Therefore, we recommend in section 2.7.9 that, for review and approval, prior to construction of the final design, Port Arthur LNG provide revised design documents indicating that automatic discharge of hazardous liquids from an impoundment would be prevented. The sump pumps for the relocated and resized Condensate Tank Impoundments would be manually started, when needed to drain the basin, and stopped automatically on low level, while the sump pumps for the relocated refrigerant storage impoundment basin sump pumps would be automatically started and stopped on level control, interlocked with the low temperature detectors to prevent operation upon detection of a refrigerant spill. Water removal for the hot oil impoundments has not yet been provided, but stormwater would be removed from the relocated Diesel Tank Impoundment by gravity drainage if no contaminants are observed. Port Arthur LNG would also need to verify that the applicable sump pumps for USDOT PHMSA regulated impoundments meet the automatic shutdown controls and water removal requirements specified in 49 CFR 193 Subpart C. We recommend that Port Arthur LNG consult with USDOT PHMSA on compliance with 49 CFR 193 for the water removal design using drains. If the facilities are approved, constructed, and operated, final compliance with the requirements of 49 CFR 193 Subpart C would be subject to the USDOT PHMSA inspection and enforcement programs.

If the Expansion Project is authorized and the above recommendations are resolved, Port Arthur LNG would install hazardous fluid spill impoundments in accordance with its final design, and FERC staff would verify during construction inspections that the spill containment system – including dimensions, slopes of curbing and trenches, and volumetric capacity – matches final design information. In addition, we recommend in section 2.7.9 that project facilities be subject to regular inspections throughout the life of the facility to verify that impoundments are being properly maintained.

2.7.5.5.2 Spacing and Plant Layout

The spacing of vessels and equipment play an important role in the safety of a facility. The spacing and plant layout typically would separate facilities handling hazardous fluids from facilities handling non-hazardous fluids, and then further group equipment together into smaller discrete curbed areas to minimize the spread of a release and minimize subsequent hazards in one area affecting other areas. The spacing between these discrete areas would typically be designed to minimize the risk of cascading damage and the risk of ignition. Further, they would be spaced away from the property line to minimize the risk of any offsite impacts. In addition, facilities handling fluids with other unique process conditions (e.g. temperature and pressures) or hazardous properties (e.g., combustible, flammable, toxic, and corrosive) may be segregated from each other to separate and better manage the unique hazards of those facilities.

For all of USDOT PHMSA regulated facilities under 49 CFR 193, the spacing of vessels and equipment between each other, from ignition sources, and to the property line must meet the requirements of 49 CFR 193 Subparts C, D, and E, which incorporate NFPA 59A (2001). NFPA 59A (2001) further references NFPA 30, NFPA 58, and NFPA 59 for additional spacing and plant layout requirements. If the facilities are authorized, constructed, and operated, Port Arthur LNG must comply with the requirements of 49 CFR 193 and would be subject to USDOT PHMSA's inspection and enforcement programs.

In addition, FERC staff evaluated the spacing to determine if there could be cascading damage and to inform what fire protection measures may be necessary to reduce the risk of cascading damage. If it was not practical for spacing to mitigate the potential for cascading damage, FERC staff evaluated whether other mitigation measures were in place and evaluated those systems in further detail as discussed in subsequent sections. We evaluated the spacing of buildings in line with AIChE CCPS, *Guidelines for Evaluating Process Plant Buildings for External Explosions and Fires*, API 752 and API 753, which provide guidance on identifying and evaluating explosion and fire impacts to buildings and occupants resulting from events external to the buildings. In addition, FERC staff evaluated other hazards associated with releases and whether any damage would likely occur at buildings or would result in cascading damage.

The project would primarily handle materials with cryogenic, flammable, combustible, toxic, and asphyxiation properties. The plot plan for the Expansion Project indicates that a majority of equipment locations have been changed from that previously approved for the Base Project, including the LNG storage tanks, marine flare, Trains 1 and 2, the condensate storage tanks, diesel storage tank, firewater tank and pumps, chemical storage buildings, pipe racks, and other facilities.

To minimize the risk of cryogenic spills causing structural supports and equipment from cooling below their minimum design metal temperature, Port Arthur LNG would generally locate cryogenic equipment away from noncryogenic process areas and would

direct cryogenic releases to remote impoundment basins. In addition, for areas of the Expansion Project that would have cryogenic equipment and could be exposed to cryogenic temperatures, we included a recommendation under Passive Cryogenic and Fire Protection, below, for Port Arthur LNG to insulate structural steel and pipe racks or use materials of construction suitable for cryogenic temperatures.

To minimize risk for flammable or toxic vapor ingress into buildings, the occupied buildings authorized for the Base Project would generally be located away from process areas. Port Arthur LNG provided hazard analyses using software modeling that shows flammable and toxic vapor dispersion could reach most facilities and buildings onsite. A condition in the Base Project authorization order required Port Arthur LNG to conduct a technical review of the facility identifying all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release, and verify that these areas would be adequately covered by hazard detection devices that would isolate or shut down any combustion or heating ventilation and air conditioning (HVAC) equipment whose continued operation could add to or sustain an emergency. Due to the facility additions and re-locations associated with the Expansion Project, we recommend in section 2.7.9 that, for review and approval, prior to construction of the final design, this technical review of combustion/ventilation air intakes be conducted using an up-to-date plot plan that includes both the Base and Expansion Project facilities. We also recommend in section 2.7.9 that project facilities be subject to periodic inspections during construction to verify flammable/toxic gas detection equipment is installed in HVAC intakes of buildings at appropriate locations. In addition, we recommend in section 2.7.9 that project facilities be subject to regular inspections throughout the life of the facilities to continue to verify that flammable/toxic gas detection equipment installed in building air intakes function as designed and are being maintained and calibrated.

To minimize overpressures generated from ignition of flammable vapors Port Arthur LNG proposed a design of the process facilities that minimizes confinement and congestion. However, the LNG storage tanks authorized under the Base Project would be elevated on piles, creating a semi-confined space that may have potential to produce overpressures if flammable vapors accumulating in that space would be ignited. Flammable vapors from design spills evaluated by the USDOT PHMSA for siting of the Expansion Project could reach the LNG storage tanks. To address this, Port Arthur LNG had indicated in the Base Project application that provisions would be made to either eliminate vapor build-up beneath the tanks, or the tank would be designed for the potential explosion overpressure arising from an ignited vapor build-up. Certain plant buildings would be elevated, which may include the chemical storage buildings that are proposed to be located near the firewater storage tank. The potential for overpressures to develop underneath these buildings due to an ignited flammable vapor cloud has not yet been addressed. Therefore, we recommend in section 2.7.9 that, for review and approval, prior to construction of the final design, Port Arthur LNG provide the detailed design of the measures to prevent flammable vapors from accumulating underneath LNG storage

tanks or buildings or provide a demonstration that ignition of any flammable vapors reaching underneath an LNG storage tank or building from a design spill would not cause cascading damage or significant safety hazards. Pipe sleeves within the condensate truck impoundment, which may create smaller semi-confined areas, were addressed in the Spill Containment section above. In addition, flammable vapors of propane and other hydrocarbons from the design spills evaluated by the USDOT PHMSA for siting of the Expansion Project could reach the marine area, including over a dock and berthed LNG ship. Port Arthur LNG does not indicate the extent of potential overpressures from an ignited design spill release of flammable vapors in this area. Based on preliminary staff analysis, damaging overpressures would likely not impact the public. In order to confirm this, we recommend in section 2.7.9 that, for review and approval, prior to construction of the final design, Port Arthur LNG file an analysis demonstrating that a berthed LNG ship would be able to withstand overpressures and projectiles from vapor cloud explosions from ignition of flammable vapors generated from a design spill release.

In addition, Port Arthur LNG indicates that overpressures above 1 psi due to a vapor cloud explosion (VCE) of heavy hydrocarbon vapor from design spills could reach beyond most facilities in and around the process areas. Therefore, we recommend in section 2.7.9 that, for review and approval, prior to construction of the final design, Port Arthur LNG file an analysis that demonstrates safety-related equipment (e.g., firewater pumps and tank and other emergency equipment) as well as the LNG storage tanks and refrigerant storage tanks would be able to withstand overpressures and projectiles from vapor cloud explosions from ignition of flammable vapors generated from a design spill release in the plant. A storm surge dike around the process areas may mitigate potential overpressure events from Train 3 to the adjacent State Highway 87, but this has not been demonstrated. Therefore, we recommend in section 2.7.9 that, for review and approval, prior to construction of the final design, Port Arthur LNG file calculations demonstrating that the storm surge barrier or other mitigation would prevent adverse impacts due to a potential VCE event within the plant from reaching the highway users.

Most flammable and combustible fluid containing piping and equipment for the Expansion Project would be located away from buildings and process areas that do not handle flammable and combustible materials. To address impacts to buildings that would be occupied or critical to the safety of the plant from fires or explosions, a condition in the Base Project authorization order required that a building siting assessment be conducted to evaluate the external fire and explosion risks for these buildings. The *Guidelines for Evaluating Process Plant Buildings for External Explosions and Fires* (Center for Chemical Process Safety of the American Institute of Chemical Engineers, 1996) and API 752 provide guidance on identifying and evaluating explosion and fire impacts to plant buildings and occupants resulting from events external to the buildings. Port Arthur LNG indicates that a building siting assessment based on API 752 would be conducted during the final design phase. However, API 752 does not define the release scenarios to be modeled, and FERC staff experience has shown that this is one of the

most critical parameters in the building siting analysis and greatly impacts the risk. We note that Port Arthur LNG provided software modeling results indicating that jet fires from design spill releases from the LNG ship loading line, which was authorized for the Base Project, could impact buildings that would serve the Expansion Project, such as the Control Building, the Emergency Response Equipment building, and the Maintenance Shop & Warehouse Building. Potentially heat from a jet fire from the new marine flare piping may reach the Control Building as well. Port Arthur LNG provided computer modeling results demonstrating that overpressures from vapor cloud explosions of design spills in process or transfer areas, as well as heat from spill impoundment fires, would not appear to impact occupied buildings. The 1,600 Btu/ft^2-hr heat flux level from a tank top fire would extend over portions of buildings that may have potential to be occupied. Therefore, we recommend in section 2.7.9 that, for review and approval, prior to construction of the final design, Port Arthur LNG file a building siting assessment demonstrating that occupied buildings and buildings critical to the safety of the plant would be able to withstand radiant heats from pool fires, as well as jet fires and overpressures and projectiles from vapor cloud explosions from ignition of flammable vapors generated from a design spill release (e.g., 2-inch to 4-inch diameter), considering an up-to-date plot plan that includes both the Base and Expansion Project facilities. Alternatively, Port Arthur LNG should file an analysis demonstrating the occupied buildings and buildings critical to the safety of the LNG plant have been relocated or provided with passive and active measures that would prevent impacts.

To minimize the risk of pool fires from causing cascading damage that could exacerbate the initial hazard, Port Arthur LNG would generally locate spill impoundments such that the radiant heats would have a minimal impact on most areas of the plant. However, fires in certain impoundments would have potential to impact nearby facilities. Due to the relatively close spacing of the proposed LNG Spill Impoundment 1 to LNG Storage Tank 3, an LNG fire in that impoundment would result in high radiant heat levels onto the concrete outer wall of LNG tank, in excess of the design specification for that wall. In order to achieve a protection system for this scenario that would have a reliability equivalent to a SIL 3 system, Port Arthur LNG intends to install a high-expansion foam system with a reliability equivalent to SIL 2 plus a firewater coverage system with a reliability equivalent to SIL 1. The application states that the high expansion foam is conservatively expected to reduce the radiant heat distances by 50 percent. Port Arthur LNG also indicates that research from Texas A&M, including the 2008 paper "The Application of Expansion Foam on Liquefied Natural Gas (LNG) to Suppress LNG Vapor and LNG Pool Fire Thermal Radiation" by Jaffee Suardin, estimates foam application could reduce LNG pool fire thermal radiation levels by up to 90 percent. The report continues that this radiant heat reduction leads to the reduction of the distance to 5kW/m2 by 56% forming the basis for an estimated 50 percent reduction in thermal exclusion zones. However, this is based on specific tests of different sizes and high expansion foam application rates for specified durations and Port Arthur LNG did not provide this literature for review, and the detailed design of the high expansion foam

system has not yet been provided. The estimated 50 percent reduction would indicate that the heat flux could be reduced to levels below the concrete outer wall specification. Port Arthur LNG also indicated that, based on its calculations, adequate firewater capacity would be available to absorb the radiant heat onto the LNG tank without having the water evaporate off before reaching the tank bottom, but the calculations were not provided for verification. In addition, calculations to determine the firewater densities needed to absorb the high radiant heat levels on the nearest points of the LNG tank do not appear to have been conducted yet. Port Arthur LNG also indicates that the type of firewater coverage facilities that would provide this protection for LNG Storage Tank 3 would be confirmed during the final design phase. Therefore, we recommend in section 2.7.9 that, for review and approval, prior to construction of the final design, Port Arthur LNG file details to demonstrate that LNG storage tanks would be protected from radiant heat levels above the design specification from a spill impoundment fire, by a system or multiple systems with a reliability equivalent to a SIL 3 system.

While no additional LNG storage tanks are proposed to be added by the Expansion Project, the layout of the LNG storage tanks has been reconfigured for the Expansion Project, which shows reduced spacing between those tanks. Therefore, we further recommend in section 2.7.9 that, prior to construction of the final design, Port Arthur LNG file an analysis of the structural integrity of the outer containment of the full containment LNG storage tanks, demonstrating it can to withstand the heat flux from an adjacent tank top fire for 2 hours, considering representative target elevations in the radiant heat modeling.

We also assessed the potential for cascading damage or significant safety hazards to other facilities due to heat from impoundment fires. Heat flux levels over 4,000 Btu/ft^2-hr, depending on duration, and if not mitigated, can cause pressure vessels to experience boiling liquid expanding vapor explosions (BLEVEs) or pressure vessel bursts (PVBs), and heat flux levels over 4,900 Btu/ft^2-hr can cause loss of strength in structural steel.

Documentation provided in the application shows that a fire in the Condensate Tank Impoundments would produce higher heat flux levels onto refrigerant storage tanks. Port Arthur LNG indicated that low expansion foam system would completely extinguish the condensate impoundment fire, with an equivalent SIL 2 reliability, plus firewater systems to cool refrigerant storage tanks, with an equivalent SIL 1 reliability. Other potential mitigation measures, such as fire walls or fire jacketing for those vessels, would be available as well. In addition, FERC staff understands that the model Port Arthur LNG used to model the radiant heat, LNGFIREIII, may significantly overestimate the radiant heat of a condensate fire. However, the adequacy of the proposed mitigations should be demonstrated. Therefore, we recommend in section 2.7.9 that Port Arthur LNG provide a more accurate assessment that demonstrates radiant heat from a condensate storage impoundment fire would prevent a BLEVE of refrigerant storage tanks or provide

sufficient passive and/or active mitigation measures with a reliability equivalent to a SIL 3 system. Separately, the Letter of Determination (LOD) provided on December 7, 2020 by USDOT PHMSA indicates that, at least 60 days prior to installation of the refrigerant storage tanks, Port Arthur LNG must demonstrate to the USDOT PHMSA the capabilities of the water spray system to reduce the risk of BLEVEs of the refrigerant storage tanks.

In addition, as discussed in the previous section, hot oil spills near the hot oil heater would not appear to have a defined containment and could have potential to result in a large fire if not directed to an impoundment. Also, it appears that a hot oil spill above its flashpoint could collect near the hot oil expansion drum and potentially cause impacts to this pressure vessel. LNG Spill Impoundment 2 would be spaced farther from vessels and equipment, but the higher heat levels from a fire in this impoundment would appear to reach some of these facilities. In addition, Port Arthur LNG indicates that radiant heat levels greater than 4,000 Btu/ft^2-hr from a fire over an LNG storage tank top could impact surrounding plant facilities, including those in the northern portions of liquefaction trains and some refrigerant storage tanks. The risk of an LNG tank top fire would be expected to be much lower than a spill impoundment fire, and Port Arthur LNG plans to protect any pressure vessels and critical emergency equipment inside the 4,000 Btu/ft^2-hr zone from an LNG tank top fire by applying firewater as a cooling system. Details to demonstrate the effectiveness of this protection measure have not yet been provided. Therefore, to address the above scenarios, we included recommendations in section 2.7.9, for review and approval, prior to construction of the final design, for Port Arthur LNG to demonstrate that measures would be in place to prevent potential cascading damage or significant safety hazards for radiant heat from pool fires.

To minimize the risk of jet fires from causing cascading damage that could exacerbate the initial hazard, Port Arthur LNG would generally locate flammable and combustible fluid containing piping and equipment away from buildings and process areas that do not handle flammable and combustible materials. However, as discussed above, jet fires may result in greater than 1,600 Btu/ft^2-hr at the Control Building, the Emergency Response Equipment building, and the Maintenance Shop & Warehouse Building. Also, in areas that handle flammable and combustible fluids, jet fire distances to 4,000 Btu/ft^2-hr and 4,900 Btu/ft^2-hr levels from piping and equipment could impact other components handling or supporting hazardous fluids and could also impact utilities and emergency equipment, including the firewater tank and pumps. To mitigate jet fires within the plant, Port Arthur LNG indicates that measures would be in place to prevent cascading events, including ESD systems with fire resistant valves and associated instrument and power cabling to isolate inventory and limit jet fire duration, depressurization blowdown systems to decrease pressure and reduce jet fire severity and potential risk of pressure vessel bursts (PVBs) and boiling liquid expanding vapor explosions (BLEVEs); firewater systems to cool equipment and structures and reduce potential risk of structural failures, PVBs, and BLEVEs; and passive fire protection to

reduce potential risk of structural failures, PVBs, and BLEVEs, as described in subsequent sections. However, details of these systems would be developed in the final design. We recommend in section 2.7.9 that Port Arthur LNG provide the final design of these thermal mitigat0ion measures, for review and approval, to demonstrate cascading events would be mitigated.

If the project is authorized and the above recommendations are resolved, Port Arthur LNG would finalize the plot plan, and we recommend in section 2.7.9 that Port Arthur LNG provide any changes for review and approval to ensure capacities and setbacks are maintained. If the facilities are constructed, Port Arthur LNG would install equipment in accordance with the spacing indicated on the final plot plans, after review and approval. In addition, we recommend in section 2.7.9 that Expansion Project facilities be subject to periodic inspections during construction to verify equipment is installed in appropriate locations and the spacing is met in the field. We also recommend in section 2.7.9 that project facilities be subject to regular inspections throughout the life of the facilities to verify that equipment setbacks from other equipment and ignition sources are being maintained during operation.

2.7.5.5.3 Ignition Controls

Port Arthur LNG's overall plant areas for the Expansion Project would be designated with an appropriate hazardous electrical classification and process seals commensurate with the risk of the hazardous fluids being handled in accordance with NFPA 59A (2001), 70, 496, 497, and API Recommended Practice (RP) 500. If authorized, constructed, and operated, the Expansion Project facilities, as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to the USDOT PHMSA's inspection and enforcement programs, which require compliance, by incorporation by reference, with NFPA 59A (2001). NFPA 59A (2001) subsequently references NFPA 70 (1999) for installation of electrical equipment wiring. Depending on the risk level, these areas would either be classified as non-classified, Class 1 Division 1, or Class 1 Division 2. Electrical equipment located in these areas would be designed such that in the event a flammable vapor is present, the equipment would have a minimal risk of igniting the vapor. FERC staff evaluated the electrical area classification drawings for the Expansion Project to determine whether Port Arthur LNG would meet the electrical area classification requirements and good engineering practices in NFPA 59A, 70, 497, and API RP 500, as applicable. However, many of the codes and standards applicable to the electrical classification area requirements were only listed in the master project codes and standards list rather than the specific basis of design documents and specifications. Therefore, we recommend in section 2.7.9 that Port Arthur LNG file a list of all codes and standards and the final specification document number and basis of design where they are referenced.

Port Arthur LNG provided preliminary electrical area classification detail drawings that indicate the electrical classification for dikes and spill containment systems would be consistent with the requirements in NFPA 59A, NFPA 497 and API 500. However, in the application and responses to FERC staff information requests, Port Arthur LNG selected electrical area classification designations from NFPA 497 and API typically used for drilling rigs and production facilities, which depending on the application, may not be appropriate for liquid products such as LNG. Therefore, we recommend in section 2.7.9 that Port Arthur LNG justify the electrical area classification designations by performing hazard modeling using the release rates specified in NFPA 497 or modify the API RP 500 electrical area classification designations to be consistent with operations. In addition, the area classification key plan drawings provided did not show below-grade sumps and trenches as being designated as Class 1 Division 1 as required by NFPA 59A, NFPA 497, and API 500. FERC staff requested both spill containment system electrical classification drawings and updated area classification key plan drawings showing that spill containment systems would be consistent with the electrical area classification detail drawings. Port Arthur LNG provided updated drawings, however, although the updated area drawings had notes that were consistent with the electrical area classification details, the below-grade trenches themselves were not marked as Class 1 Division 1. Additionally, Port Arthur LNG indicated that the electrical area classification drawings for the spill containment system, including trenches and impoundments would be completed in detailed design. In addition, Port Arthur LNG provided general cross-sectional details that show the electrical classification for major equipment reliefs, valves, operational bleeds, vents, or drains, etc. FERC staff verified that the cross-sectional areas for this equipment would be designed in accordance with NFPA 59A, NFPA 497, and API 500. Other details of the electrical classification area design, including the final location of air intakes for thermal oxidizers were not provided, however, Port Arthur LNG stated the air intakes would be located outside of Class 1 Division 2 areas. FERC staff also identified several locations where internal plant roadways would be located within Class 1 Division 2 designated areas. Port Arthur LNG indicated in a response that operational controls would be implemented to prevent personnel, equipment, and vehicles from entering Class 1 Division 2 areas during hazardous situations through the use of strobes, sirens, alarms, public address, and general alarm sirens, etc. FERC staff also noted that the electrical and instrumentation buildings within the liquefaction trains would be located in electrically classified areas. Port Arthur LNG provided revised drawings and stated that the electrical and instrumentation buildings would either be relocated outside of electrically classified areas or would be elevated such that they would not be located within electrically classified areas. We recommend in section 2.7.9 that Port Arthur LNG file final electrical area classification drawings, including cross-sectional drawings and electrical and instrumentation building location details, for review and approval, for all areas of the Expansion Project that demonstrates the designs meets applicable codes and standards such as NFPA 59A, 70, 497, and API 500. In addition, we recommend that Port Arthur LNG file a technical review using an up-to-date plot plan that includes both the Base

Project and Expansion Project that identifies all combustion/ventilation air intake equipment, including the final location of the thermal oxidizer air intakes, and the distances to any possible flammable gas or toxic release and demonstrate these areas are covered by adequate hazard mitigation. We also recommend in section 2.7.9 that Port Arthur LNG provide more information on the operating and maintenance procedures, including, but not limited to, safety procedures and abnormal operating conditions procedures that incorporates operational controls in electrically classified areas during hazardous situations.

In addition, the Expansion Project would have submerged pumps and instrumentation that must be equipped with electrical process seals and instrumentation in accordance with NFPA 59A (2001) and NFPA 70 at each interface between a flammable fluid system and an electrical conduit or wiring system. Port Arthur LNG provided preliminary drawings that show the pump electrical process seals would include a primary seal, a gap that would be continuously purged with nitrogen and vented to a safe location, and a secondary seal. The drawings indicate that the primary and secondary seal would be monitored by the nitrogen purge system installed between the primary and secondary seal through a pressure and/or temperature transmitter including alarms. We recommend in section 2.7.9 that Port Arthur LNG provide, prior to construction of final design, for review and approval, final design drawings showing process seals installed at the interface between a flammable fluid system and an electrical conduit or wiring system that meet the requirements of NFPA 59A (2001) and NFPA 70. In addition, we recommend in section 2.7.9 that Port Arthur LNG file, for review and approval, details of an air gap or vent equipped with a leak detection device that should continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems. In addition, we recommend in section 2.7.9 that Expansion Project facilities be subject to regular inspections throughout the life of the facility to ensure electrical process seals for submerged electrical motor pumps continue to conform to NFPA 59A and NFPA 70 and that air gaps are being properly maintained.

If the Expansion Project is authorized, Port Arthur LNG would finalize the electrical area classification drawings and would describes changes made from the FEED design. We recommend in section 2.7.9 that Port Arthur LNG file the final design of the electrical area classification drawings for review and approval. If facilities are constructed, Port Arthur LNG would install appropriately classed electrical equipment, and we recommend in section 2.7.9 that the Expansion Project facilities be subject to periodic inspections during construction for FERC staff to spot check electrical equipment and verify that equipment is installed per classification and are properly bonded or grounded in accordance with NFPA 70. We also recommend in section 2.7.9 that Expansion Project facilities be subject to regular inspections throughout the life of the facility to ensure electrical equipment is maintained (e.g., bolts on explosion proof equipment properly installed and maintained, panels provided with purge), and electrical

equipment are appropriately de-energized and locked out and tagged out when being serviced.

2.7.5.5.4 Hazard Detection, Emergency Shutdown, and Depressurization Systems

Port Arthur LNG would also install hazard detection systems to detect cryogenic spills, flammable and toxic vapors, and fires throughout the Expansion Project facilities. The hazard detection systems would alarm and notify personnel in the area and control room to initiate an ESD, depressurization, or initiate appropriate procedures, and would meet NFPA Standard 72, ISA Standard 12.13 and other recommended and generally accepted good engineering practices. However, Port Arthur LNG did not provide specifications for security and fire safety in the application. In response to a FERC staff data request, Port Arthur LNG filed specifications for flammable gas, flame, smoke and heat detectors and CCTV, however, there were no specifications provided that contained details on toxic gas detectors. Therefore, we recommend in section 2.7.9 that Port Arthur LNG provide specifications and vendor datasheets, for review and approval, of the final design of fire safety specifications, including all hazard detection.

FERC staff also evaluated the adequacy of the hazard detection equipment type, location, and layout to ensure adequate coverage to detect cryogenic spills, flammable and toxic vapors, and fires near potential release sources (i.e., pumps, compressors, sumps, trenches, flanges, and instrument and valve connections). Port Arthur LNG did not provide hazard detection layout drawings for certain areas such as the power generation, refrigerant storage, and LNG transfer piping areas. FERC staff requested this information in a data request and Port Arthur LNG's response stated that hazard detection layout drawings for these areas would be prepared as part of the final detailed design. Port Arthur LNG also did not provide drawings that showed where toxic gas detection would be located. Port Arthur LNG stated, in a supplemental response, that the final locations would be determined during detailed design and that toxic gas detection would be located near potential acid gas sources where modeling indicates exceedance of the permissible limits. Port Arthur LNG indicated that low temperature detection would be provided within spill containment areas and would alarm to the central control room in the event of a spill of LNG or refrigerant. Preliminary information for the voting logic, set points, and some locations of low temperature detection were provided, and Port Arthur LNG stated that these details would be finalized during detailed design. However, based on the preliminary information provided, there appears to be an overall lack of low temperature detectors in the LNG and hydrocarbon spill trenches. FERC staff verified that flammable gas detectors would be provided at air intakes of equipment (i.e., gas turbines) and HVAC air intakes of buildings. Port Arthur LNG noted that flammable gas detection would be installed on the air intakes of various equipment such as the air compressors, gas turbines, and occupied building HVAC inlets. However, Port Arthur LNG indicated that drawings that show the locations of flammable gas detectors in combustion/ventilation air intake equipment/buildings and the distances from possible

hydrocarbon releases would be completed in detailed design. Therefore, it is unclear whether there would be sufficient coverage on all combustion and ventilation air intakes such as the thermal oxidizer air intakes, non-occupied buildings HVAC air intakes, etc. to prevent an unwanted migration of flammable vapors. Port Arthur LNG noted in the cause and effect matrices that the flammable gas detectors would pre-alarm at 20-percent LFL, and that 40-percent LFL would activate the air intake system to automatically shut. However, the building fire protection specifications indicate the alarm set points for flammable gas detection would be a warning at 15-percent LFL and critical at 25-percent LFL. Therefore, the alarm set points for the flammable gas detectors located at air intakes is unclear, however, would not be higher than typical setpoints of 20- to 25-percent LFL for first alarm setpoint and 40- to 50-percent LFL for second alarm set point. Port Arthur LNG also indicated that toxic gas detectors would be provided at building HVAC air intakes in the vicinity of potential toxic gas releases and where plant personnel may be present. The toxic gas detectors located at building HVAC air intakes would include alarm set points and voting logic that, if triggered, would shut the building HVAC unit. Based on this review, we recommend in section 2.7.9 that Port Arthur LNG provide additional information, for review and approval, on the final design of all hazard detection layout drawings. We also recommend in section 4.18.9 that AGDC provide hazard detection study to evaluate the effectiveness of the flammable and gas detection system in accordance with ISA 84.00.07 or equivalent methodologies in having two or more detectors that would detect 90 percent or more of releases (unignited and ignited) that could result in an off-site impact—or a cascading impact that could extend off site—resulting in isolation and de-inventory within 10 minutes. The analysis should also take into account the set points, voting logic, and different wind speeds and directions. Furthermore, we recommend in section 2.7.9 that Port Arthur LNG provide additional information, for review and approval, on the final design of all hazard detection systems (e.g., manufacturer, model, and elevations) and hazard detection layout drawings.

FERC staff also identified a lack of oxygen detector coverage in the liquid nitrogen storage and vaporization areas to alert plant personnel of potential asphyxiation hazards. In response to a FERC staff data request, Port Arthur LNG indicated that three low oxygen detectors would be added near the nitrogen storage and vaporization areas, however, drawings showing the location of these detectors and details such as alarm setpoints and orientation would be determined during detailed design. Therefore, we recommend in section 2.7.9 that Port Arthur LNG provide low oxygen detectors to notify operators of a potential liquid nitrogen release. Port Arthur LNG FERC staff reviewed the preliminary fire and gas system cause and effect matrices which typically indicates how each hazard detector would initiate an alarm, shutdown, depressurization, or conduct other action. However, the fire and gas system cause and effect matrices provided did not include all hazard detection devices (i.e., fixed temperature heat detectors) and did not specify all hazard detection device tag numbers, voting logic, and set points that would initiate any type of action. Additionally, fire and gas detection actions that would trigger a safety instrumented system (SIS) interlock have not been finalized, therefore, FERC

staff was unable to determine whether the proposed hazard detection design would result in detection and shutdown within adequate time of a potential release. In addition, Port Arthur LNG provided the ESD and Depressurization Philosophy, however, the document was not updated for the Expansion Project and preliminary drawings that show ESD pushbutton locations were not included. In response to a FERC staff information request, Port Arthur LNG provided an updated ESD and Depressurization Philosophy and indicated that all emergency depressuring buttons would generally be located in the central control room and there would be not be field mounted ESD pushbuttons. However, in a follow-up information request, FERC staff noted that NFPA 59A (2001) section 9.2.5 specifies that manual ESD actuators be: located in an area accessible in an emergency, at least 50 feet from the equipment they serve, and conspicuously marked and with their designated function. Port Arthur LNG responded that the Expansion Project would comply with NFPA 59A by providing ESD hand switches in the central control room as well as in strategic and safe locations. The ESD hand switches would also be marked distinctly and include a tag name, function description for plant personnel. Port Arthur LNG also provided a preliminary drawing that included the locations of the ESD hand switches for the liquefaction trains 3 and 4 with a note that final locations and quantities to be determined during detailed design. The preliminary drawing did not indicate whether ESD pushbuttons would be provided in other areas of the facility. We recommend in section 2.7.9 that Port Arthur LNG file, for review and approval, the final design of the ESD system that includes a drawing of all ESD pushbutton locations as well as other final design details associated with the ESD valves such as open and closed position switches are connected to the DCS/SIS and adequate ESD valve closure times in the event of a process upset or hazardous condition and to ensure plant personnel are promptly alerted.

If the Expansion Project is authorized, constructed, and operated, Port Arthur LNG would install hazard detectors according to its specifications, and we recommend in section 2.7.9 that the Expansion Project facilities be subject to periodic inspections during construction to verify hazard detectors and ESD pushbuttons are appropriately installed per approved design and functional based on cause and effect matrices prior to introduction of hazardous fluids. In addition, we recommend in section 2.7.9 that the Expansion Project facilities be subject to regular inspections throughout the life of the facility to verify hazard detector coverage and functionality are being maintained and are not being bypassed without appropriate precautions.

2.7.5.5.5 Hazard Control

If ignition of flammable vapors occurred, hazard control devices would be installed to extinguish or control incipient fires and releases. Port Arthur LNG indicates the hazard control layout and design would meet NFPA 59A (2001); NFPA 10, 12, 15, 17, and 2001; API 2510A; as well as other recommended and generally accepted good engineering practices. We evaluated the adequacy of the number and availability of

handheld, wheeled, and fixed fire extinguishing devices throughout the site based on the FEED. We also evaluated whether the spacing of the fire extinguishers would meet NFPA 10. FERC staff noted that general fire extinguisher coverage distances did not appear to be consistent with the minimum travel distances specified in NFPA 10 nor did the use of a 15-lb. CO_2 extinguisher with the minimum extinguisher rating also specified in NFPA 10. Port Arthur LNG indicated relocation or additional extinguishers would be required and extinguisher capacity ratings would be revised to ensure sufficient coverage and compliance with NFPA 10 requirements. Therefore, we recommend in section 2.7.9 that Port Arthur LNG file comprehensive documentation that demonstrates travel distances are along normal paths of access and egress and in compliance with NFPA 10. In addition, we also recommend in section 2.7.9 that Port Arthur LNG file additional information on the final design of hazard control systems, for review and approval, where details are yet to be determined (e.g., type, elevations, flowrate, capacities, etc.) and where the final design could change as a result of these details or other changes in the final design of the Expansion Project.

We also evaluated whether clean agent systems would be installed in all electrical switchgear and instrumentation buildings systems in accordance with NFPA 2001, and CO_2 or water mist system in gas turbine enclosures in accordance with NFPA 12 or NFPA 750. While Port Arthur LNG indicated clean agent would be utilized, it was unclear the scope of its application. In addition, while Port Arthur LNG indicated that the Base Project would utilize CO_2 systems in turbine enclosures as consistent with NFPA 12, the Expansion Project omitted discussion of hazard control for turbines in its application. Therefore, we recommend in section 2.7.9 that Port Arthur LNG file additional information on the final design of these systems, for review and approval, where details are yet to be determined and where the final design could change as a result of these details or other changes in the final design of the Expansion Project.

If authorized, constructed, and operated, Port Arthur LNG would install hazard control equipment, and we recommend in section 2.7.9 that project facilities be subject to periodic inspections during construction to verify hazard control equipment is installed in the field and functional prior to introduction of hazardous fluids. In addition, we recommend in section 2.7.9 that project facilities be subject to regular inspections throughout the life of the facility to verify in the field that hazard control coverage and functionality is being properly maintained and inspected.

2.7.5.5.6 Passive Cryogenic Temperature and Fire Protection

If low temperature releases and fires could not be mitigated from affecting facility components to insignificant levels, passive protection (e.g., fireproofing structural steel and low temperature protection) should be provided to prevent failure of structural supports of equipment and pipe racks. USDOT PHMSA incorporates NFPA 59A (2001) by reference in 49 CFR 193.2101, under Subpart C for design, 49 CFR 193.2301, under

Subpart D for construction, 49 CFR 193.2401, under Subpart E for equipment, 49 CFR 193.2521, under Subpart F for operational records, and 49 CFR 193.2693, under Subpart G for maintenance records. NFPA 59A (2001), section 6.4.1, requires pipe supports including any insulation systems used to support pipe whose stability is essential to plant safety, to be resistant to or protected against fire exposure, escaping cold liquid, or both, if they are subject to such exposure. We also note that 49 CFR 193.2801, under Subpart I for fire protection only incorporates sections 9.1 through 9.7 and 9.9 of NFPA 59A (2001), which requires an evaluation of methods necessary for protection of equipment and structures from effects of fire exposure but does not reference requirements for passive cryogenic protection. In addition, NFPA 59A (2001) does not address passive cryogenic equipment or structures other than pipe supports. Moreover, NFPA 59A (2001) does not provide the criteria anywhere for determining if pipe supports, equipment, or structures are subject to cold liquid or fire exposures or the level of protection needed to protect the pipe supports, equipment, or structures against such exposures. Therefore, FERC staff evaluated whether passive cryogenic and fire protection would be applied to pressure vessels and structural supports to facilities that could be exposed to low temperature liquids (i.e., below the MDMT) or to radiant heats of 4,000 Btu/ft^2-hr or greater from fires with durations that could result in failures[20] and that they are specified in accordance with recommended and generally accepted good engineering practices, such as International Organization for Standards (ISO) 20088, API 2001, API 2510A, API 2218, ASCE/Society of Fire Protection Engineers (SFPE) 29, American Society for Testing and Materials (ASTM) E84, ASTM E2226, Institute of Electrical and Electronics Engineers (IEEE) 1202, ISO 22899, National Association of Corrosion Engineers (NACE) 0198, NFPA 58, NFPA 290, OTI 95 634, Underwriters Laboratories (UL) 723, UL 1709, and/or UL 2080, with a cryogenic temperature and duration and fire protection rating commensurate to the exposure.

In its application, Port Arthur LNG stated it would provide fireproofing for cryogenic structural protection. The specific locations where the cryogenic structural protection would be applied have not yet been provided and the materials and thicknesses that would provide this protection have not yet been specified. Therefore, we recommend in section 2.7.9 that Port Arthur LNG provide additional information, including drawings and specifications, for these passive cryogenic protection systems for equipment and supports, for review and approval, prior to construction of the final design.

In addition, documents provided in the application did not appear to provide adequate coverage of passive protection systems based on radiant heat zones cast by pool fires. In response to data requests, Port Arthur LNG relocated an assortment of

[20] Pool fires from impoundments are generally mitigated through use of ESDs, depressurization systems, structural fire protection, and firewater; jet fires are primarily mitigated through the use of ESDs, depressurization systems, and firewater with or without structural fire protection.

impoundments, storage vessels, buildings, and equipment would be relocated outside of high radiant heat areas in lieu of the installation of passive protection equipment and structures. The relocated equipment includes the refrigerant storage impoundment, the firewater storage tank, and the Hazardous Chemical Storage Building. However, powerhouses and structures are exposed to radiant heat zones in excess of 4,000 Btu/ft^2-hr from impoundment fires and are not provided with passive protection. Therefore, FERC staff recommend in section 2.7.9 that Port Arthur LNG provide thermal mitigation on all systems that could be exposed radiant heats of 4,000 Btu/ft^2-hr or greater from fires with durations that could result in failures, for review and approval. In addition, Port Arthur LNG committed to providing final design information on these analyses. Therefore, we recommend in section 2.7.9 that Port Arthur LNG provide these details that are yet to be determined (e.g., calculation of structural fire protection materials, thicknesses, etc.) and where the final design could change as a result of these details or other changes in the final design of the Expansion Project.

FERC staff also evaluated whether Port Arthur LNG would include blast or fire walls inside buildings/modules, and whether Port Arthur LNG would include blast or fire walls between transformers per NFPA 850 to prevent cascading damage among transformers. Within its application Port Arthur LNG did not demonstrate that sufficient spacing, fire-rated barriers, and/or active systems would to prevent cascading damage to transformers. Therefore, we recommend in section 2.7.9 that Port Arthur LNG provide specifications, drawings, and other related documentation which demonstrate transformers at the proposed project are sufficiently protected from cascading damage in accordance with NFPA 850 as well as provide a building siting assessment to ensure plant buildings that are occupied or critical to the safety of the LNG plant are adequately protected from potential hazards involving fires and vapor cloud explosions.

If the project is authorized and constructed, Port Arthur LNG would install structural cryogenic and fire protection according to its design, and FERC staff recommends in section 2.7.9 that Expansion Project facilities be subject to periodic inspections during construction to verify structural cryogenic and fire protection is properly installed in the field as designed prior to introduction of hazardous fluids. In addition, FERC staff recommends in section 2.7.9 that Expansion Project facilities be subject to regular inspections throughout the life of the facility to continue to verify that passive protection is being properly maintained.

2.7.5.5.7 Firewater Systems

Firewater systems may be used to extinguish or mitigate impacts from fires by cooling surfaces exposed to the heat from a fire to prevent failure of structural supports of equipment and pipe racks. However, for LNG and other flammable liquids stored at low temperatures, firewater can cause the fire to grow larger due to the relatively warm water

causing more of the flammable liquid to vaporize. Therefore, much of the firewater at a LNG terminal is used for exposure cooling purposes.

FERC regulations under 18 CFR §380.12(o)(2) require applicants to provide information on fire protection systems. In addition, 18 CFR §380.12(o)(7) requires applicants to provide engineering studies on the design approach and 18 CFR §380.12(o)(12) requires applicants to identify all codes and standards under which the plant would be designed. FERC regulations under 18 CFR §380.12(o)(13) and (14) also require an applicant to provide a list of all permits or approvals from local state, federal, or Native American agencies and to demonstrate how they comply with the requirements in 49 CFR 193, NFPA 59A, and 33 CFR 127, if applicable.

USDOT PHMSA regulations in 49 CFR §193.2801, under Subpart I, requires an operator provide and maintain fire protection at LNG plants according to sections 9.1 through 9.7 and section 9.9 in NFPA 59A (2001). As aforementioned, NFPA 59A (2001) section 9.1.2 requires a fire protection evaluation to be undertaken using sound fire protection engineering principles, analysis of local conditions, hazards within the facility, and exposure to or from other property to be considered in the evaluation in the determination of fire protection equipment, including fire protection water systems. However, NFPA 59A (2001) does not define any additional criteria and states that the wide range in size, design, and location of LNG facilities precludes the inclusion of detailed fire protection provisions that apply to all facilities comprehensively. Coast Guard regulations under 33 CFR §127.601 and 33 CFR §127.607 provides requirements for firewater systems in marine transfer areas, which are not proposed to be added or significantly modified as part of the Expansion Project.

FERC staff evaluated the adequacy of the general firewater system coverage to assess the appropriateness of the associated firewater demands of those systems for worst-case fire scenarios to size the firewater pumps as well as onsite firewater storage. While, Port Arthur LNG would provide firewater systems, including remotely operated firewater monitors, sprinkler systems, fixed water spray systems as well as firewater hydrants and hoses for use during an emergency to cool the surface of storage vessels, piping, and equipment exposed to heat from a fire, based on our review, we noted various potential deficiencies.

Reviews identified that the hydrants and monitors used for coverage would, in cases, be near the hazard and Port Arthur LNG has not demonstrated that the manual monitors and hydrants, including necessary extents of hoses, could be accessed in an emergency to provide the required coverage. This review may identify locations where the monitors should be automatically oscillating or remotely-controlled. Port Arthur LNG committed to providing final design information on these analyses. Therefore, we recommend in section 2.7.9 that Port Arthur LNG provide these details that are yet to be determined (e.g., monitor coverage distances, access during fire events, etc.) and where

the final design could change as a result of these details or other changes in the final design of the Expansion Project.

FERC staff also recommends in section 2.7.9 that Port Arthur LNG provide firewater coverage by two or more hydrants or monitors (or deluge systems) based on radiant heat exposure and corresponding design densities and areas to be cooled by firewater for all areas that contain flammable or combustible fluids. In addition, we recommend in section 2.7.9 that where coverage circles intersect pipe racks, large vessels or process equipment, the firewater coverage could be blocked, and the coverage circles should be modified to account for obstructions during the final design.

While the above portion of this section speaks towards general firewater coverage, the effectiveness of the proposed mitigation from pool fires emanating from LNG Impoundment 1 also need further support. Port Arthur LNG filed information speaking to how the proposed project would mitigate the radiant heat hazards associated with impoundment fires. In reference to the pool fire emanating from LNG Impoundment 1, Port Arthur LNG did not identify which firewater equipment would be providing coverage to the LNG Storage Tank T0-2003 in the event of a pool fire from LNG Impoundment 1 and did not demonstrate that the firewater equipment at the site was suited to provide the required firewater rates to mitigate the radiant heat hazard. Therefore, we recommend in section 2.7.9 that Port Arthur LNG indicate which firewater equipment would be providing the required firewater rates to the affected areas of LNG Storage Tank T0-2003 and demonstrate that firewater equipment which would be utilized to protect the affected areas of LNG Storage Tank T0-2003 could effectively be activated during an LNG Impoundment 1 fire (i.e., if radiant heat would allow manual operation of hydrants and monitors). In addition to firewater coverage, Port Arthur LNG's proposed plan to mitigate the radiant heat hazard onto LNG Storage Tank T0-2003 also utilizes a high expansion foam system. FERC staff recommends that the fire protection systems proposed to mitigate high radiant heat pool fires have an effective reliability rating equivalent to a SIL 3 or higher. Port Arthur LNG asserts that its fixed high expansion foam system and fire water application would provide an overall equivalent SIL 3 level reliability for LNG impoundment fire impacting LNG Storage Tank T0-2003 and that the reliability of each system would be confirmed during detailed design. We recommend in section 2.7.9 that Port Arthur LNG demonstrate the effectiveness and reliability of its proposed thermal mitigation systems for pool and jet fires, which would include the firewater application and foam system.

In addition, while Port Arthur LNG did provide a preliminary firewater demand case to determine the maximum anticipated firewater demands of the facility during a fire event, the demand case did not include detailed quantitative justification and the associated fire scenarios detailed qualitative descriptions of the firewater scenarios in which the demand case was based. As such, Port Arthur LNG did not clearly demonstrate how the demand case accounts for impounded pool fires, LNG tank top fires, and jet

fires. In response to these reviews Port Arthur LNG committed to providing additional information on these analyses in final design. Therefore, FERC staff recommend in section 2.7.9 that Port Arthur LNG provide a detailed quantitative analysis to demonstrate that adequate mitigation would be provided for each significant component within the 4,000 Btu/ft^2-hr zone from pool or jet fires that could cause failure of components within that radiant heat zone. In addition, we recommend in section 2.7.9 that Port Arthur LNG provide these details that are yet to be determined (e.g., defined fire cases, quantitatively supported demand case, etc.) and where the final design could change as a result of these details or other changes in the final design of the Expansion Project.

FERC staff also assessed whether the reliability of the firewater pumps and firewater source or onsite storage volume are appropriate. The facility proposes to supply firewater from the municipal system into the previously approved, but relocated and resized, firewater tank. The firewater tank is in accordance with NFPA 22 with exception of refilling requirements. However, the supply provided by the proposed tank would exceed the 2-hour onsite supply requirements in NFPA 59A and the design would allow for river water to be used as back up, if a fire would persist longer than 2 hours. The firewater supply would feed previously approved diesel and electric pumps which are proposed to act as the main firewater pumps and a previously approved third diesel pump that is proposed to be provided as a spare pump. The collective main and backup pumps would be in accordance with NFPA 20 redundancy requirements. New firewater piping would be added to supply the monitors and hydrants and other firewater users associated with the Expansion Project and would be isolatable by post-indicator valves to ensure that any one section of the fire main can be taken out of service without affecting the supply of firewater to the rest of the network. However, given the number of firewater hydrants and monitors on a given section is unknown at this time because firewater piping drawings have not been finalized. Therefore, FERC staff recommends in section 2.7.9 that Port Arthur LNG file information on the final design of these systems, for review and approval, where details are yet to be determined (e.g., manufacturer and model, nozzle types, etc.), including that the drawings should demonstrate that each process area, fire zone, or other sections of piping with several users can be isolated with post indicator valves.

If the project is authorized and constructed, Port Arthur LNG would finalize the firewater and foam system designs, which we recommend in section 2.7.9 that the final design be filed for FERC staff review and approval. If the design is approved, Port Arthur LNG would install the firewater and foam systems as designed in accordance with their quality assurance and quality control procedures, which we recommend in section 2.7.9 be filed for FERC staff review and approval. We also recommend in section 2.7.9 that the facilities be subject to periodic inspections during construction by FERC staff, which would allow FERC staff to independently verify installation and construction of the firewater and foam systems. We also recommend in section 2.7.9 that companies provide results of commissioning tests to verify the firewater and foam systems are

installed and functional as designed prior to introduction of hazardous fluids, including that Port Arthur LNG complete and document the firewater pump tests and firewater monitor and hydrant coverage tests to verify that actual coverage area from each monitor and hydrant matches the design coverage shown on facility plot plan(s). In addition, FERC staff recommends in section 2.7.9 that the Expansion facilities be subject to regular inspections throughout the life of the facility to ensure firewater and foam systems are being properly maintained and tested.

2.7.6 Geotechnical and Structural Design

Port Arthur LNG provided geotechnical and structural design information for its Expansion Project facilities to demonstrate the site preparation and foundation designs would be appropriate for the underlying soil characteristics and to ensure the structural design of the Expansion Project facilities would be in accordance with federal regulations, standards, and recommended and generally accepted good engineering practices. The application focuses on the resilience of the Expansion Project facilities against natural hazards, including extreme geological, meteorological, and hydrological events, such as earthquakes, tsunamis, seiches, hurricanes, tornadoes, floods, rain, ice, snow, regional subsidence, sea level rise, landslides, wildfires, volcanic activity, and geomagnetism.

2.7.6.1 Geotechnical Evaluation

FERC regulations under 18 CFR 380.12 (h) (3) require geotechnical investigations to be provided. In addition, FERC regulations under 18 CFR 380.12 (o) (14) require an Applicant to demonstrate compliance with regulations under 49 CFR 193 and NFPA 59A (2001). All facilities, once constructed, must comply with the requirements of 49 CFR 193 and would be subject to USDOT PHMSA's inspection and enforcement programs. USDOT PHMSA regulations incorporated by reference NFPA 59A (2001). NFPA 59A (2001) section 2.1.4 requires soil and general investigations of the site to determine the design basis for the facility. However, no additional requirements are set forth in 49 CFR 193 or NFPA 59A on minimum requirements for evaluating existing soil site conditions or evaluating the adequacy of the foundations, therefore, FERC staff evaluated the existing site conditions, geotechnical report, and proposed foundations to ensure they are adequate for the Expansion Project facilities as described below.

Port Arthur LNG contracted Fugro to conduct geotechnical investigations to evaluate the existing soil site conditions and proposed foundation design for the Expansion Project. The existing site elevation ranges from +1 feet to +8 feet NAVD88. The site would be cleared, grubbed, and prepared using standard earthmoving and compaction equipment. Site preparation would result in a final grade elevation being raised from +1 to +8 feet to +5.5 to +10 feet NAVD88 with between 2 feet and 7 feet of fill added across the site, depending on the location. On the canal side, the berm crest

elevation would be a post-settlement height of +20.5 feet NAVD88, and on all land sides, the floodwall crest elevation would be a post-settlement height of +17.0 feet NAVD88 to protect the facilities from storm surge as discussed in more detail later in this section. The fill material would consist of various layers, including two different layers of fill placed in lifts specified in the Geotechnical Engineering Report and would be compacted to 90 to 98 percent of maximum dry density for standard proctor tests in accordance with ASTM D698 depending on location. Alternatively, cement stabilization is provided as an alternative to one of the layers of fill for improving the soil conditions and bearing capacity.

Fugro conducted 5 soil borings to a depth of 200 feet below existing grade, 6 cone penetration tests (CPT) to a depth 170 feet (or to refusal) below existing grade, and 1 seismic cone penetration tests (SCPT) to a depth of 170 feet below existing grade. Additionally, three (3) previous geotechnical investigations completed between 2004 and 2015 consisted of a total of 82 soil borings and 31 CPTs. Over 14 different tests were conducted on 185 recovered soil samples, including classification tests (water content, Atterberg liquid and plastic limits, sieve tests), compression tests, consolidation tests, shear tests, organic content tests, corrosion potential tests (pH, sulfate, chloride, electrical resistivity) in general accordance with pertinent ASTM standards. FERC staff evaluated the geotechnical investigation to ensure the adequacy in the number, coverage, and types of the geotechnical borings, CPTs, SCPTs, and other tests, and found them to adequately cover all major facilities, including the Expansion Facilities. FERC staff evaluated the geotechnical investigation to ensure the adequacy in the number, coverage, and types of the geotechnical borings, CPTs, SCPTs, and other tests, and found them to more than adequately cover all Expansion Project facilities that would require deep foundations. FERC staff concluded that an adequate number of test borings were performed and soil samples were collected for the Expansion Project, and would continue our review of the results of the geotechnical investigation to ensure foundation designs are appropriate prior to construction of final design and throughout the life of the facilities.

Based on the test borings conducted, the site is composed of approximately 0 to 15 feet of fill material consisting of very soft to stiff sandy organic clay, underlain by natural soft to stiff clays from 15 to 90 feet below ground surface with interbedded lenses of sandy clays and sandy silts; firm to very stiff natural sandy clays from 90 to 140 feet below ground surface; stiff to very stiff sandy clay with organic material from 140 to165 feet below ground surface; medium to dense silty and clayey sands from 165 to 185 feet below ground surface; and stiff to very stiff clays and sandy clays from depths of 185 feet to 200 feet below ground surface. Laboratory tests indicate there is a very high potential for corrosion of steel based on laboratory test results (chloride ion concentration generally indicated high and pH generally indicated mild corrosion potential), and a mild to several deterioration of concrete based on sulfate ion concentrations depending on location within the site. Based on these results, the Expansion Project has considered potential for corrosion and concrete degradation in the design.

Based on the subsurface conditions, shallow foundations would be suitable for some lightly loaded structures; however, for heavier structures in areas with these types of soil conditions, liquefaction blocks, and many associated structures would require deep foundations. Therefore, Port Arthur LNG is proposing to use driven precast square concrete piles or driven steel pipe piles for facilities including, but not limited to: liquefaction equipment, compressors, and blowers. Piles are proposed to be embedded between 80 and 160 feet below grade, depending on the equipment being supported, pile spacing, pile type, and pile diameter. Grade-supported slabs would only be used for light structures insensitive to total and/or differential vertical movements.

Subsidence is the sudden sinking or gradual downward settling of land with little or no horizontal motion, caused by movements on surface faults or by subsurface mining or pumping of oil, natural gas, or ground water. The results of Port Arthur LNG's geotechnical investigation at the Expansion Project site indicate that subsurface conditions are generally suitable for the proposed facilities, if adequate site preparation, foundation design, and construction methods are implemented. Because subsidence is a recognized concern in the area of the Expansion Project, Port Arthur LNG proposes to install the relocated LNG storage tanks and liquefaction facilities on piles. Port Arthur LNG would monitor foundations and other critical facilities to ensure they are maintained within acceptable limits. Site preparation activities would be monitored to ensure adherence to the geotechnical design. Surface subsidence would be controlled by potential use of lime stabilization of the fill materials during placement and compaction with monitoring settlement and systematic reworking, as needed. Foundations would be constructed with pile supports to protect equipment and interconnecting piping from differential movement. Earthen containment embankments would be earth-supported and constricted with wide bases (using 2 horizontal to 1 vertical or 3 horizontal to 1 vertical slopes, depending on height) to ensure stability. Earth-supported elements, such as the storm surge barrier and plant roads, would require periodic maintenance to mitigate the long-term effects of settlements and differential movements. Because site-specific geotechnical mitigation has been incorporated into the Expansion Project (e.g., pile-supported foundations) in accordance with NFPA 59A (2001) and where applicable, NFPA 59A (2006), subsidence would not be a significant hazard to the proposed facilities.

The results of Port Arthur LNG's geotechnical investigation at the project site indicate that subsurface conditions are generally suitable for the proposed facilities, if proposed site preparation, foundation design, and construction methods are implemented appropriately.

2.7.6.2 Structural and Natural Hazard Evaluation

FERC regulations under 18 CFR 380.12(m) requires Applicants to address the potential hazard to the public from failure of facility components resulting from accidents or natural catastrophes, evaluate how these events would affect reliability, and describe what design features and procedures it would use to reduce potential hazards. In addition, 18 CFR 380.12(o)(14) requires an Applicant to demonstrate how it would comply with 49 CFR 193 and NFPA 59A. USDOT PHMSA regulations under 49 CFR 193 have some specific requirements on designs to withstand certain loads from natural hazards and also incorporates by reference NFPA 59A (2001 and 2006) and ASCE/SEI 7-05 and ASCE 7-93 via NFPA 59A (2001). If the proposed project is authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to USDOT PHMSA's inspection and enforcement programs.

Port Arthur LNG states that the Expansion Project facilities would be constructed to the requirements in the 2009 International Building Code (IBC), ASCE/SEI 705, and ASCE/SEI 7-10. The standards require various structural loads to be applied to the design of the facilities, including live (i.e., dynamic) loads, dead (i.e., static) loads, and environmental loads. FERC staff also evaluated whether the engineering design would withstand impacts from natural hazards, such as earthquakes, tsunamis, seiches, hurricanes, tornadoes, floods, rain, ice, snow, regional subsidence, sea level rise, landslides, wildfires, volcanic activity, and geomagnetism. We recommend in section 2.7.9 that prior to construction of final design, Port Arthur LNG should file with the Secretary the final design package (e.g., structures and foundations drawings, design specifications, and calculations, etc.) and associated quality assurance and control procedures with the documents reviewed, approved, and stamped and sealed by the professional engineer of record in the State of Texas. If the Expansion Project is authorized and constructed, the company would install equipment in accordance with its final design.

2.7.6.2.1 Earthquakes, Tsunamis, and Seiches

FERC regulations under 18 CFR 380.12(h)(5) requires evaluation of earthquake hazards based on whether there is potential seismicity, surface faulting, or liquefaction. Earthquakes and tsunamis have the potential to cause damage from shaking ground motion and fault ruptures. Earthquakes and tsunamis often result from sudden slips along fractures in the earth's crust (i.e., faults) and the resultant ground motions caused by those movements but can also be a result of volcanic activity or other causes of vibration in the earth's crust. The damage that could occur as a result of ground motions is affected by the type/direction and severity of the fault activity and the distance and type of soils the seismic waves must travel from the hypocenter (or point below the epicenter where seismic activity occurs). To assess the potential impact from earthquakes and

tsunamis, Port Arthur LNG evaluated historic earthquakes along fault locations and their resultant ground motions.

The United States Geological Survey (USGS) maintains a database containing information on surface and subsurface faults and folds in the United States that are believed to be sources of earthquakes of greater than 6.0 magnitude occurring during the past 1.6 million years (Quaternary Period).[21] The location of the Expansion Project is within the Gulf Coast Basin geologic tectonic province. The Gulf Coast Basin is characterized as having thick sedimentary rocks above basement rock structures. The province's sedimentary strata thickness toward the south, with salt domes and relatively shallow listric growth faults that run parallel to the Gulf of Mexico Coastline and extend outside of Texas. Movement within the fault system has been classified as a general creep as opposed to the breaking of rocks, which is often associated with earthquake events (Stevenson and McCulloh, 2001). Salt domes are prevalent throughout the Gulf Coast Basin and are characterized by having a system of faults arranged in a circular pattern around them (Gagliano, 1999).

These growth fault systems have previously been assessed by the USGS as not being capable of generating significant earthquakes, and these faults have not previously been considered as seismogenic sources. While growth faults are not a source of seismic hazard for the Expansion Project site, there may be a potential source of surface deformation. Fugro was contracted to perform site specific geotechnical investigations. Based on 3 surface expressions observed in the geotechnical investigation, Fugro recommended that a second detailed investigation be performed, as the surface deformations could potentially indicate the presence of faults or other geological hazards. While the presence of faults can require special consideration, the presence or lack of faults identified near the site does not define whether earthquake ground motions can impact the site because ground motions can be felt large distances away from an earthquake hypocenter depending on number of factors.

Fugro performed a second study that consisted of 21 supplemental borings with stratigraphic markers to assess the potential risk for surface faulting. Fugro's boring logs and stratigraphic markers indicate very minor deviations in the subsurface profile. Therefore, Fugro concluded that there is an absence of fault related geotechnical concerns within the project area. FERC staff agrees with Fugro's conclusion, but also acknowledges that settlement and surface deformation is still a potential hazard that would require further consideration during detailed design.

[21] USGS. Earthquake Hazards Program. Quaternary Fault and Fold Database of the United States. Available at: https://www.usgs.gov/natural-hazards/earthquake-hazards/faults Accessed December 2020

Port Arthur LNG indicates that the Expansion Project facilities would be located wholly within property previously authorized by the Commission in the April 18, 2019 Order. Port Arthur LNG contracted Fugro to perform a seismic hazard study for the Expansion Project, involving field investigations and subsequent data evaluation. Fugro's *Seismic Hazard Assessment* report includes the development of design ground motions and assessment of liquefaction and tsunami hazard for the proposed Project.

FERC staff recognize the current FERC regulations under Title 18 CFR 380.12 (h) (5) continues to incorporate NBSIR 84-2833. NBSIR 84-2833 provides guidance on classifying stationary storage containers and related safety equipment as Category I and classifying the remainder of the LNG project structures, systems, and components as either Category II or Category III, but does not provide specific guidance for the seismic design requirements for them. Absent any other regulatory requirements, this guidance recommends that other LNG project structures classified as Seismic Category II or Category III be seismically designed to satisfy the Design Earthquake and seismic requirements of the ASCE/SEI 7-05 in order to demonstrate there is not a significant impact on the safety of the public. ASCE/SEI 7-05 is recommended as it is a complete American National Standards Institute (ANSI) consensus design standard, its seismic requirements are based directly on the National Earthquake Hazards Reduction Program (NEHRP) Recommended Provisions, and it is referenced directly by the IBC. Having a link directly to the IBC and ASCE 7 is important to accommodate seals by the engineer of record because the IBC is directly linked to state professional licensing laws while the NEHRP Recommended Provisions are not.

The Fugro geotechnical investigations of the existing site report indicates the site is classified as Site Class E[22] in accordance with ASCE/SEI 7-05 and in accordance with IBC 2009 based on a site average shear wave velocity that ranged between approximately 362 and 693 feet per second (Fugro, 2017a) in the upper 100 feet (i.e., V_{s30}) of strata. Sites with soil conditions of this type could experience significant amplifications of surface earthquake ground motions. However, due to the absence of a major fault in proximity to the site and lower ground motions, the seismic risk to the site is considered low.

Fugro performed a site-specific seismic hazard study for the site. The study concluded that the site would have an Operating Basis Earthquake (OBE) Peak Ground Acceleration (PGA) of 0.042 g, a Safety Shutdown Earthquake (SSE) PGA of 0.116 g, a design spectral response acceleration parameter at short periods value of S_{DS} = 0.164 g, a

[22] There are six different site classes in ASCE/SEI 7-05, A through F, that are representative of different soil conditions that impact the ground motions and potential hazard ranging from Hard Rock (Site Class A), Rock (Site Class B), Very dense soil and soft rock (Site Class C), Stiff Soil (Site Class D), Soft Clay Soil (Site Class E), to soils vulnerable to potential failure or collapse, such as liquefiable soils, quick and highly sensitive clays, and collapsible weakly cemented soils (Site Class F).

design spectral response acceleration at a period of 1.0-second at the site of S_{D1} = 0.118 g, a spectral response acceleration parameter at short periods adjusted for site class effects S_{MS} = 0.247 g, and a spectral response acceleration parameter at the period of 1.0-second adjusted for site class effects S_{M1} = 0.177 g (Fugro, 2017a). FERC staff independently evaluated the OBE PGA, SSE PGA, short periods design spectral response acceleration, and 1.0-second design spectral response accelerations for the site using the USGS Earthquake Hazards Program Seismic Design Maps[23] and Unified Hazard[24] tools for all occupancy categories (I through IV). FERC believes the SSE PGA, OBE PGA, and 5 percent-damped design spectral response accelerations used by Port Arthur LNG are acceptable. These ground motions are relatively low compared to other locations in the United States. Based on the design ground motions for the site and the importance of the facilities, the facility seismic design is assigned Seismic Category I for (1) LNG storage containers and their impounding systems; (2) system components required for isolation of LNG containers and maintain it in a safe shutdown condition; and structures and systems including fire protection systems, the failure of which would affect the integrity of (1) or (2) above. Seismic Category 2 as all structures, components, and systems other than those in Category I, which are required to maintain safe plant operation. Seismic Category 3 includes all other facilities that are not included in Categories 1 and 2.

ASCE/SEI 7-05 also requires determination of the Seismic Design Category based on the Occupancy Category (or Risk Category in ASCE/SEI 7-10 and 7-16) and severity of the earthquake design motion. The Occupancy Category (or Risk Category) is based on the importance of the facility and the risk it poses to the public.[25] FERC staff has identified the Expansion Project as a Seismic Design Category B based on the ground motions for the site and an Occupancy Category (or Risk Category) of III, this seismic

[23] https://earthquake.usgs.gov/designmaps/us/application.php

[24] https://earthquake.usgs.gov/hazards/interactive/

[25] ASCE/SEI 7-05 defines Occupancy Categories I, II, III, and IV. Occupancy Category I represents facilities with a low hazard to human life in even of failure, such as agricultural facilities; Occupancy Category III represents facilities with a substantial hazard to human life in the event of failure or with a substantial economic impact or disruption of day to day civilian life in the event of failure, such as buildings where more than 300 people aggregate, daycare facilities with facilities greater than 150, schools with capacities greater than 250 for elementary and secondary and greater than 500 for colleges, health care facilities with 50 or more patients, jails and detention facilities, power generating stations, water treatment facilities, telecommunication centers, hazardous facilities that could impact public; Occupancy Category IV represents essential facilities, such as hospitals, fire, rescue, and police stations, emergency shelters, power generating stations and utilities needed in an emergency, aviation control towers, water storage and pump structures for fire suppression, national defense facilities, and hazardous facilities that could substantially impact public; and Occupancy Category II represents all other facilities. ASCE/SEI 7-10 changed the term to Risk Categories I, II, III, and IV with some modification.

design categorization would appear to be consistent with the 2009 IBC and ASCE/SEI 7-05 (and ASCE/SEI 7-10).

Seismic events can also result in soil liquefaction in which saturated, non-cohesive soils temporarily lose their strength/cohesion and liquefy (i.e., behave like viscous liquid) as a result of increased pore pressure and reduced effective stress when subjected to dynamic forces such as intense and prolonged ground shaking. Areas susceptible to liquefaction may include saturated soils that are generally sandy or silty. Typically, these soils are located along rivers, streams, lakes, and shorelines or in areas with shallow groundwater. The site-specific geotechnical investigations indicate the presence of layers of silty sands and sandy silts that are dense to very dense. These sand layers could be liquefiable under sufficiently strong ground motions. However, due to the low seismicity of the region, the potential for soil liquefaction to occur is low. In addition, Port Arthur LNG would address possible issues relating to the potential for soil liquefaction and loss of soil strength by using piles in the foundation design. Should soil improvement be required to counteract soil liquefaction, Port Arthur LNG would utilize in-situ ground improvement techniques (e.g., soil mixing) and indicated that detailed performance specifications would be developed for the selected ground improvement technique during final design.

Seismic events in waterbodies can also cause tsunamis or seiches by sudden displacement of the sea floors in the ocean or standing water. Tsunamis and seiches may also be generated from volcanic eruptions or landslides. Tsunami wave action can cause extensive damage to coastal regions and facilities. The Terminal site's low-lying position would make it potentially vulnerable were a tsunami to occur. There is little evidence that the northern Gulf of Mexico is prone to tsunami events, but the occurrence of a tsunami is possible. Two did occur in the Gulf of Mexico in the early 20th century and had wave heights of 3 feet or less (USGS, 2009), which is not significantly higher than the average breaking wave height of 1.5 feet (Owen, 2008). Hydrodynamic modeling conducted off the coast of south Texas in 2004 indicated that the maximum tsunami run-up could be as high as 12 feet above mean sea level. No earthquake generating faults have been identified that are likely to produce tsunamis, despite recorded seismic activity in the area.

The potential for tsunamis associated with submarine landslides is more likely a source in the Gulf of Mexico and remains a focus of government research (USGS, 2009). Fugro's *Seismic Hazard Assessment* report included a Tsunami Hazard Assessment for the Project area. There are four main submarine landslide hazard zones in the Gulf of Mexico including the Northwest Gulf of Mexico, Mississippi Canyon and Fan, the Florida Escarpment, and the Campeche Escarpment (USGS, 2009). Based on modeling and limited historical data, it is estimated that tsunamis generated wave heights from landslides associated with 100-year and 500-year return periods may be somewhat larger than 2 feet and less than 13 feet, respectively. These tsunami run-up elevations are

significantly less than the hurricane design storm surge elevations discussed below, so any tsunami hazard has been considered in design.

2.7.6.2.2 Hurricanes, Tornadoes, and other Meteorological Events

Hurricanes, tornadoes, and other meteorological events have the potential to cause damage or failure of facilities due to high winds and floods, including failures from flying or floating debris. The severity of these events are often determined on their probability of occurrence, and are sometimes referred to as the average number years that the event is expected to re-occur, or in terms of its mean return/recurrence interval.

The Project must meet 49 CFR 193.2067, under Subpart B for wind load requirements for LNG facilities. FERC regulations for 18 CFR 380.12(o)(14) requires Applicants to demonstrate how they comply with 49 CFR 193 and NFPA 59A. There are several corresponding authorities on this topic. Applicants are required to address hazards to the public from natural catastrophes and disclose how design features reduce these potential hazards by 18 CFR 380.12(m), as incorporated into Resource Report 11. Also, in accordance with the MOU, USDOT PHMSA evaluated in its LOD whether an Applicant's proposed Project meets USDOT PHMSA's siting requirements of 49 CFR 193 Subpart B.

Port Arthur LNG states that the Expansion Project would be designed to comply with ASCE/SEI 7-05 and 7-10 and IBC 2009 to meet requirements in 49 CFR 193 under Subpart B for wind load requirements.

To assess the potential impact from hurricanes, tornadoes, and other meteorological events, Port Arthur LNG evaluated such events historically. The severity of these events is often determined on the probability that they occur and are sometimes referred to as the average number years that the event is expected to re-occur, or in terms of its mean return/recurrence interval. Port Arthur LNG indicates that the Expansion Project facilities would be located wholly within property previously authorized by the Commission in the April 18, 2019 Order. Because of its location, the Expansion Project site would likely be subject to hurricane force winds during the life of the project. Port Arthur LNG states that all Expansion Project facilities would be designed to withstand a 183-mph 3-second gust wind speed at 33 feet above the ground in exposure Category C. A 183 mph 3-second gust wind speed at 33 feet (10 m) above the ground would convert to a sustained wind speed of 150 mph, using the Durst Curve in ASCE/SEI 7-05 or using a 1.23 gust factor recommended for offshore winds at a coast line in World Meteorological Organization, *Guidelines for Converting between Various Wind Averaging Periods in Tropical Cyclone Conditions*. These wind speeds are equivalent to approximately 16,000-year mean return interval or 0.31 percent probability of exceedance in a 50-year period for the site, based on whether ASCE 7-05 wind speed return period conversions. The 183 mph 3-second gust equates to a strong Category 4

Hurricane using the Saffir-Simpson scale (130-156 mph sustained winds, 166-195 mph 3-second gusts). In accordance with the MOU, USDOT PHMSA evaluated in its LOD whether the Expansion Project meets USDOT PHMSA's siting requirements under Subpart B. If the project is constructed and becomes operational, the Expansion Project facilities would be subject to USDOT PHMSA's inspection and enforcement programs. The Letter of Determination (LOD) provided on December 7, 2020 by USDOT PHMSA indicates that, within 30 days of submitting its construction notification to PHMSA, Port Arthur LNG must provide to the USDOT PHMSA calculations demonstrating that the LNG facilities are designed to the wind force requirements in 49 CFR 193.2067(a). Final determination of whether the facilities are in compliance with the requirements of 49 CFR 193 would be made by USDOT PHMSA staff.

However, as noted in the limitation of ASCE/SEI 7-05, tornadoes were not considered in developing basic wind speed distributions. This leaves a potential gap in potential impacts from tornadoes. Therefore, FERC staff evaluated the potential for tornadoes. Appendix C of ASCE/SEI 7-05 makes reference to American Nuclear Society 2.3 (1983 edition), *Standard for Estimating Tornado and Extreme Wind Characteristics at Nuclear Power Sites*. This document has since been revised in 2011 and reaffirmed in 2016 and is consistent with NUREG/CR-4461, Tornado Climatology of the Contiguous U.S. Rev. 2 (NUREG2007). These documents provide maps of a 100,000-mean-year return period for tornadoes using 2° latitude and longitude boxes in the region to estimate a tornado striking within 4,000-ft of an area. Figures 5-8 and 8-1 from NUREG/CR-4461 indicate a 100,000-year-maximum tornado wind speeds would be approximately 140 mph 3-second gusts for the project site location. Later editions of ASCE 7 (ASCE/SEI 7-10 and ASCE/SEI 7-16) make reference to International Code Council 500, Standard for Design and Construction of Storm Shelters, for 10,000-year tornadoes. However, the International Code Council 500 maps were conservatively developed based on tornadoes striking regions and indicate a 200 mph 3-second gust for a 10,000-year event, which is higher than the 140 mph 3-second gust in American Nuclear Society 2.3 and NUREG/CR-4461. As a result, FERC staff believes the use of a 183 mph 3-second gust wind speed at 33 ft (10m) above the ground is adequate for the proposed expansion project facilities and conservative from a risk standpoint for the LNG facilities.

In addition, FERC staff evaluated historical tropical storm, hurricane, and tornado tracks in the vicinity of the project facilities using data from the DHS Homeland Infrastructure Foundation Level Data and National Oceanic and Atmospheric

Administration (NOAA) Historical Hurricane Tracker.[26,27] Between 1865 and 2020, 49 hurricanes and tropical storms made landfall within 60 miles of the Expansion Project site (NOAA, including Unnamed Hurricane (Category 1) in 1886, Hurricane Audrey (Category 3) in 1957, Hurricane Rita (Category 5) in 2005, and Hurricane Harvey (Category 4) in 2017 which all made landfall within 30 miles of Port Arthur, Texas and produced significant storm surges, with maximum heights greater than 12 feet AMSL (Needham and Keim, 2012).[28] In addition, in 2008, Hurricane Ike (Category 4) made landfall east of Houston, Texas and continued northwest toward Port Arthur, resulting in water height of 14.5 feet (NOAA, 2009; LSU, 2013). The Port Arthur area received 26 inches of rain in 24 hours, with a storm total of over 47 inches, resulting in widespread flooding, and is being considered a 500-year or 1,000-year storm event. NOAA reported that the maximum storm surge near Port Arthur was between 3 and 5 feet (NOAA, 2017b). Port Arthur LNG would be designed to withstand a 183 mph 3-second gusts wind sped at 33 ft (10m) above the ground and flood elevations of historical events.

Potential flood levels may also be informed from the FEMA Flood Insurance Rate Maps, which identifies Special Flood Hazard Areas (base flood) that have a 1 percent probability of exceedance in 1 year to flood (or a 100 year mean return interval) and moderate flood hazard areas that have a 0.2 percent probability of exceedance in 1 year to flood (or a 500 year mean return interval). According to the FEMA National Flood Insurance Rate Maps (FEMA, 2013) for Jefferson County, Texas, the 100-year Base Flood Elevation for the Expansion Project site is 12 feet in reference to the National Geodetic Vertical Datum of 1929 and 12.04 feet in reference to the NAVD88. We also recognize that a 500-year flood event has been recommended as the basis of design for critical infrastructure in publications, including ASCE 24, *Flood Resistant Design and Construction*. Therefore, we believe it is good practice to design critical energy infrastructure to withstand 500-year event from a safety and reliability standpoint for both SWEL and wave crests. Port Arthur LNG has proposed to design the Expansion Project to withstand a 500-year flood event. Furthermore, we believe the use of intermediate values from NOAA for sea level rise and subsidence is more appropriate for design and

[26] DHS. Homeland Infrastructure Foundation Level Data. Available at: https://hifld-geoplatform.opendata.arcgis.com/. Accessed December 2020.

[27] NOAA. Historical Hurricane Tracker. Available at: https://coast.noaa.gov/hurricanes/. Accessed December 2020.

[28] Global and Regional Sea Level Rise Scenarios for the United States. U.S. Department of Commerce. National Ocean and Atmospheric Administration. National Ocean Service Center for Operational Oceanographic Products and Services. October2020.

higher projections are more appropriate for planning in accordance with NOAA 2017,[29] which recommends defining a central estimate or mid-range scenario as baseline for shorter-term planning, such as setting initial adaptation plans for the next two decades and defining upper bound scenarios as a guide for long-term adaptation strategies and a general planning envelope.

The entire Expansion Project site would be enclosed for flood protection by construction of earthen levees on the channel and land sides. The channel-side earthen levee height is designed to a 500-year SWEL of 14.0 feet NAVD88, a 500-year wave of 5.9 feet (rounded to 6.0 feet for the purposes of levee sizing), 0.6 feet of sea level rise and subsidence, and 1.6 feet of expected settlement, yielding an initial crest height of 22.2 feet with a final post-settlement height not lower than 20.6 feet. The land-side earthen levee height is designed to a combined 100-year SWEL, 100-year wave, and sea level rise height of 17.0 feet, and 2.0 feet of expected settlement, yielding an initial crest height of 19.0 feet with a final post-settlement crest height not lower than 17.0 feet. In addition, given the uncertainty in levee settlement, Port Arthur LNG would periodically monitor and maintain the crest elevation of the levee to be no less than 20.5 feet NAVD88 on the channel side and no less than 17.0 feet NAVD88 on the land side.

We generally evaluate the design against a 500-year SWEL with a 500-year wave crest and sea level rise and subsidence. Using maximum envelope of water (MEOW) storm surge inundation maps generated from the Sea, Lake, and Overland Surge from Hurricanes model developed by NOAA National Hurricane Center, a 500-year event would equate to a Category 2 Hurricane and approximately 3-9 feet MEOW.[30] This is lower than indicated in the 500-year FEMA maps. In addition, while NOAA seems to provide higher resolution of topographic features, it limits its SLOSH maps to storm surge levels at high tide above 9 feet. As a result, FERC staff evaluated the storm surge against other sources using SLOSH maps that indicate a similar upper range of 8-10 feet MEOW for Category 2 Hurricanes, and also indicated 13-16 feet MEOW for Category 3 Hurricanes, 16-20 feet MEOW for Category 4 Hurricanes, and 20-25 feet MEOW for Category 5 Hurricanes.[31] This data suggests that Port Arthur LNG design may withstand Category 3 or 4 Hurricane storm surge SWEL equivalent to 1,000 to 10,000 year mean

[29] Global and Regional Sea Level Rise Scenarios for the United States. U.S. Department of Commerce. National Ocean and Atmospheric Administration. National Ocean Service Center for Operational Oceanographic Products and Services. October 2020.

[30] U.S. Department of Commerce. NOAA. National Hurricane Center. National Storm Surge Hazard Maps. Available at: https://www.nhc.noaa.gov/nationalsurge/#pop. Accessed October 2020.

[31] Masters. J. Weather Underground. Storm Surge Inundation Maps for the U.S. Coast. Available at:https://www.wunderground.com/hurricane/surge_images.asp. Accessed October 2020.

return intervals. In addition, wave heights would likely impact the channel side, but would not reach the landward side. We also would expect the sea level rise to be approximately closer to the 1.21 feet intermediate projection for the project life till 2050 provided by NOAA. As a result of the SLOSH data and NOAA sea level rise projections, we would expect the berm to be at least 19.7 feet on the channel side and 14.2 feet on the landward side post settlement. However, given the uncertainty in the 500-year SWEL data, 500-year wave data, SLOSH maps, sea level rise and subsidence projections, and settlement projections and uncertainties, we agree that the 20.6 feet NAVD88 on the channel side and 17.0 feet NAVD88 on the land side post settlement levee would provide adequate protection of the Expansion Project site and should be periodically monitored and maintained to assure the crest elevation would not be lower than 20.6 feet NAVD88 on the channel side and 17.0 feet NAVD88 on the land side. We also recommend in section 2.7.9 that Port Arthur LNG provide the monitoring and maintenance plan that has been reviewed, approved, stamped and sealed by a professional engineer of record registered in the State of Texas.

The Texas and Louisiana Gulf Coast area is experiencing the highest rates of coastal erosion and wetland loss in the United States (Ruple, 1993). The average coastal erosion rate is -1.2 meters per year between 2000 and 2012 along the Texas coastal shoreline, with the area between Sabine Pass and Rollover Pass experiencing a shoreline loss rate of -4.7 meters per year between 2000 and 2012 (McKenna, 2014). Shoreline erosion could occur at the Expansion Project site and along the opposite shoreline as a result of waves, currents, and vessel wakes. To prevent erosion, new revetment in the form of sheet piling and rip rap would be installed on the water side of the storm protection berm. Even though shoreline erosion is a concern at the site, the proposed mitigation measures would minimize erosion and scour impacts. In addition, Port Arthur LNG indicates that the Expansion Project facilities would be located wholly within property previously authorized by the Commission in the April 18, 2019 Order. Therefore, we conclude that the proposed Expansion Project would not be affected by the coastal erosion and wetland.

2.7.6.2.3 Landslides and other Natural Hazards

Landslides involve the downslope movement of earth materials under force of gravity due to natural or human causes. Landslides in the United States occur in all 50 states. However, the proposed Expansion Project area has low relief which reduces the likelihood of landslides. In addition, the proposed Expansion Project facilities would be located wholly within property previously authorized by the Commission in the April 18, 2019 Order. Therefore, we conclude the landslide would not be a significant risk for the proposed Expansion Project area.

Wildfires are prevalent in the Pacific Northwest, especially in West Coast, Alaska and Hawaii. The proposed Expansion Project site is surrounded by the Sabine Pass

Channel on the North/East and Keith Lake on the South/East and there is not enough vegetation or trees around the West side of the project site to trigger wildfires. Therefore, we conclude that the risk of wildfires at the proposed Expansion Project site would be very low.

Volcanic activity is primarily a concern along plate boundaries on the West Coast and Alaska and also Hawaii. Based on FERC staff review of maps from USGS[32] and DHS[33] of the nearly 1,500 volcanoes with eruptions since the Holocene period (in the past 10,000 years) there are no known active or historic volcanic activity within approximately 700 miles away across the Gulf of Mexico in Los Atlixcos, Mexico.

Geomagnetic disturbances (GMD) may occur due to solar flares or other natural events with varying frequencies that can cause geomagnetically induced currents, which can potentially disrupt the operation of transformers and other electrical equipment. USGS provides a map of GMD intensities with an estimated 100 year mean return interval.[34] The map indicates the Expansion Project site could experience GMD intensities of 70-100 nano-Tesla with a 100 year mean return interval. However, the Expansion Project facilities would be designed such that if a loss of power were to occur the valves would move into a fail-safe position. In addition, the Expansion Project is an export facility that does not serve any U.S. customers.

2.7.7 External Impacts

To assess the potential impact from external events, FERC staff conducted a series of reviews to evaluate transportation routes, land use, and activities within and surrounding the proposed Project site, and the safeguards in place to mitigate the risk from events, where warranted. FERC staff coordinated the results of the reviews with other federal agencies to assess potential impacts from vehicles and rail; aircraft impacts to and from nearby airports and heliports; pipeline impacts from nearby pipelines; impacts to and from adjacent facilities that handle hazardous materials under the Environmental Protection Agency's (EPA) Risk Management Plan (RMP) regulations; and power plants, including nuclear facilities under the Nuclear Regulatory Commission regulations. Specific mitigation of impacts from use of external roadways, rail, helipads, airstrips, or pipelines are also considered as part of the engineering review done in conjunction with the NEPA review.

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[32] United States Geological Survey. U.S. Volcanoes and Current Activity Alerts. Available at: https://volcanoes.usgs.gov/index.html. Accessed August 2018.

[33] Department of Homeland Security. Homeland Infrastructure. Foundation-Level data (HIFLD). Natural Hazards. hifld-geoplatform.opendata.arcgis.com. accessed Aug 2018

[34] United States Geological Survey. Magnetic Anomaly Maps and Data for North America. Available at: https://mrdata.usgs.gov/magnetic/map-us.html#home. Accessed August 2018.

FERC staff uses a risk-based approach to assess the potential impact of the external events and the adequacy of the mitigation measures. The risk-based approach uses data based on the frequency of events that could lead to an impact and the potential severity of consequences posed to the Expansion Project site and the resulting consequences to the public beyond the initiating events. The frequency data is based on past incidents and the consequences are based on past incidents and/or hazard modeling of potential failures.

2.7.7.1 Road

FERC staff reviewed whether any truck operations would be associated with the Expansion Project and whether any existing roads would be located near the site. FERC staff uses this information to evaluate whether the Expansion Project and any associated truck operations could increase the risk along the roadways and subsequently to the public and whether any pre-existing unassociated vehicular traffic could adversely increase the risk to the Expansion Project site and subsequently increase the risk to the public. In addition, if authorized, constructed, and operated, the Expansion Project facilities, as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to USDOT PHMSA's inspection and enforcement programs. USDOT PHMSA regulations under 49 CFR 193.2155(a)(5)(ii) under Subpart C require that structural members of an impoundment system must be designed and constructed to prevent impairment of the system's performance reliability and structural integrity as a result of a collision by or explosion of a tank truck that could reasonably be expected to cause the most severe loading if the Expansion Project facility adjoins the right-of-way of any highway. Similarly, NFPA 59A (2001), section 8.5.4, requires transfer piping, pumps, and compressors to be located or protected by barriers so that they are safe from damage by rail or vehicle movements. However, USDOT PHMSA regulations and NFPA 59A (2001) requirements do not indicate what collision(s) or explosion(s) could reasonably be expected to cause the most severe loading. FERC staff evaluated consequence and frequency data from these events to evaluate these potential impacts.

FERC staff evaluated the risk of the truck operations based on the consequences from a release, incident data from the DOT Federal Highway Administration (FHWA),[35] the DOT National Highway Traffic Safety Administration (NHTSA),[36] EPA, NOAA,[37]

[30] FHWA, Office of Highway Policy Information, Highway Statistics 2016, https://www.fhwa.dot.gov/policyinformation/statistics/2016.

[36] NHTSA, Traffic Safety Facts Annual Report Tables, https://cdan.nhtsa.gov/tsftables/tsfar.html.

[37] EPA, NOAA, ALOHA®, User's Manual, The CAMEO® Software System, February 2007.

and other reports,[38,39,40] and frequency of trucks and proposed mitigation to prevent or reduce the impacts of a vehicular incident.

Incident data from the FHWA, NHTSA, and USDOT PHMSA indicates hazardous material incidents are very infrequent (4e-3 incidents per lane mile per year), and that nearly 75 to 80 percent of hazardous material vehicular incidents occur during unloading and loading operations, while the other 20 to 25 percent occur while in transit or in transit storage. In addition, approximately 99 percent of releases are 1,000 gallons or less, and catastrophic events that would spill 10,000 gallons or more make up less than 0.1 percent of releases. In addition, less than 1 percent of all reportable hazardous material incidents with spillage result in injuries and less than 0.1 percent of all reportable hazardous material incidents with spillage resulting in fatalities.

The EPA and NOAA report that 80 percent of fires that lead to container ruptures results in projectiles and that 80 percent of projectiles from liquefied petroleum gas (LPG) incidents, which constitute the largest product involved in boiling liquid expanding vapor explosions (BLEVEs), travel less than 660 feet. The EPA also reports that on average container ruptures would result in less than four projectiles for cylindrical containers and 8.3 for spherical vessels. FERC staff evaluated other reports that affirmed the EPA estimates based on data for approximately 150 experimental and accidental pressure vessel bursts and BLEVEs with approximately 683 total projectiles (4.6 average fragments per incident) that showed approximately 80 percent of fragments traveled 490 to 820 feet and within 6.25 times the estimated or observed fireball radius. The data also showed projectiles have traveled up to 3,900 feet for large LPG vessels and 1,200 feet for LPG rail cars. In all the documented cases, the projectiles traveled less than 15 times the fireball diameter, but one of the reports indicated up to 30 times the fireball radius is possible, albeit very rare.

Unmitigated consequences under average ambient conditions from releases of 1,000 gallons through a 1-inch hole would result in distances ranging from 25 to 200 feet for flammable vapor dispersion, and 75 to 175 feet for jet fires. Unmitigated consequences under worst case weather conditions from catastrophic failures of trucks proposed at sites generally can range from 200 to 2,000 feet for flammable vapor dispersion, 275 to 350 feet for radiant heat of 5 kW/m^2 from jet fires, 800 to 1,050 feet to a 1 psi overpressure from a BLEVE, 850 to 1,500 feet for a heat dose equivalent to a

[38] Birk, A.M., BLEVE Response and Prevention Technical Documentation, 1995.

[39] AiChE CCPS, Guidelines for Vapor Cloud Explosion, Pressure Vessel Burst, BLEVE, and Flash Fire Hazards, Second Edition, 2010.

[40] Lees, F.P, Lees Loss Prevention in the Process Industries, Hazard Identification, Assessment, and Control, Volume 2, Second Edition, 1996.

radiant heat of 5 kW/m2 over 40 seconds from 250 to 325 radii fireballs burning for 5 to 15 seconds from a BLEVE, and projectiles from BLEVEs possibly extending farther. Based on distribution function of the projectile distances, FERC staff estimate approximately 90 percent of all projectiles for a 10,000-gallon tanker truck would be within 0.5 mile, and that there is about a 1-percent probability they would extend beyond 1 mile and less than 0.1 percent probability they would extend 30 times the fireball radius. These values are also close to the distances provided by the FHWA for designating hazardous material trucking routes (0.5 mile for flammable gases for potential impact distance) and USDOT PHMSA for emergency response (0.5 to 1 mile for initial evacuation and 1 mile for potential BLEVEs for flammable gases).

During operation of the Base Project, Port Arthur LNG estimated 30 trucks or tanker trucks would transport commodities (e.g., condensate product, etc.) to or from the facility each week. Diesel trucks would come to and from the facility on a bi-weekly basis. This would result in approximately 1,586 trucks or tanker trucks that would transport hazardous fluids to or from the site each year. Nitrogen needed during the liquefaction process for the Expansion Project would be supplied to the facility via a pipeline. As stated in the Base Project EIS, Port Arthur LNG would relocate the existing SH 87 to the western side of the proposed site. SH 87 would remain a two-lane highway with a speed limit of 65 miles per hour. Port Arthur LNG also proposes to install a 17 feet high storm levee that would separate SH 87 from the process equipment and piping within the liquefaction facility. Distances from external roads to the berm is approximately 400 feet with another approximate 100 feet to equipment. FERC staff did not identify any other major highways or roads within close proximity to piping or equipment containing hazardous materials at the site that would not be protected by the berm to raise concerns of direct impacts from a vehicle impacting the site. The berm and separation distances would also provide some protection from flammable vapor dispersion and radiant heats. While we believe the berm would provide adequate protection from most potential accidental and intentional vehicle impacts, FERC staff recommended in section 4.12.6 of the Base Project EIS that Port Arthur LNG file specifications and drawings of vehicle barriers at the access points, for review and approval, to further mitigate accidental and intentional vehicle impacts. In addition, FERC staff recommended in section 4.12.6 of the Base Project EIS that Port Arthur LNG file an evaluation, for review and approval, on the need to install turning lanes to minimize the risk of incidents from hazardous material truck and other vehicle incidents entering and exiting the facility from SH 87. In addition, while FERC staff could find information on the protection of fire hydrants, FERC staff could not locate information in the application indicating that Port Arthur LNG would install guard rails, bollards, stop signs, speed limits, etc. that would be located internal to the liquefaction facility to protect equipment containing hazardous fluids and safety related equipment. Therefore, FERC staff recommends in section 2.7.9 that Port Arthur LNG provide final design information, for review and approval, on internal road and vehicle protections, (e.g., guard rails, barriers, and bollards) to protect transfer piping, pumps, and compressors, etc.

and to ensure that they are located away from roadway or protected from damage by vehicle movements.

With the implementation of our recommendations in the Base and Expansion Projects, we conclude the proposed Expansion Project would not pose a significant risk or significant increase in risk to the public due to vehicle impacts as a result of the potential consequences, incident data, and frequency of trucks.

2.7.7.2 Rail

FERC staff reviewed whether any rail operations would be associated with the project and whether any existing rail lines would be located near the facility. FERC staff uses this information to evaluate whether the project and any associated rail operations could increase the risk along the rail line and subsequently to the public and whether any pre-existing unassociated rail operations could adversely increase the risk to Port Arthur LNG site and subsequently increase the risk to the public. In addition, all facilities, once constructed, must comply with the requirements of 49 CFR 193 and would be subject to USDOT PHMSA's inspection and enforcement programs. USDOT PHMSA regulations under 49 CFR 193.2155 (a) (5) (ii) under Subpart C states if the LNG facility adjoins the right-of-way of any railroad, the structural members of an impoundment system must be designed and constructed to prevent impairment of the system's performance reliability and structural integrity as a result of a collision by or explosion of a train or tank car that could reasonably be expected to cause the most severe loading. Section 8.5.4 of NFPA 59A (2001), incorporated by reference in 49 CFR 193, requires transfer piping, pumps, and compressors to be located or protected by barriers so that they are safe from damage by rail or vehicle movements. However, USDOT PHMSA regulations and NFPA 59A (2001) requirements do not indicate what collision(s) or explosion(s) could reasonably be expected to cause the most severe loading. Therefore, FERC staff evaluated consequence and frequency data from these events to evaluate these potential impacts. There would be no rail transportation associated with the Expansion Project.

In the Base Project, FERC staff evaluated the risk of the rail operations based on the consequences from a release, incident data from USDOT PHMSA Federal Rail Administration and USDOT PHMSA, and frequency of rail operations nearby the proposed Expansion Project site.

Since the approval of the Base Project with the Commission's Order on April 18, 2019, there have been no new rail lines constructed near the approved facility. The closest rail line is still located adjacent to SH 87 near the West Port Arthur Bridge approximately 3 miles away that services the adjacent chemical facilities (KMTEX, etc.). This would be farther than consequence distances from vapor dispersion or fires and farther than more than 99.9% of the potential projectile distances under worst case weather conditions and events. In addition, the position of the rail operations would be to

the north of the Expansion Project and in closer proximity and higher risk to populated areas than any potential failures from rail incidents causing cascading effects to the Expansion Project facilities.

Therefore, we conclude the proposed project would not pose a significant risk or significant increase in risk to the public due to nearby rail as a result of the potential consequences, incident data, and distance and position of the closest rail lines serving other industrial facilities relative to the populated areas to the north of the liquefaction facilities and industrial facilities.

2.7.7.3 Air

FERC staff generally reviews whether any aircraft operations would be associated with the project and whether any existing aircraft operations would be located near the site. FERC staff uses this information to evaluate whether the project and any associated aircraft operations could increase the risk to the public and whether any pre-existing unassociated aircraft operations could adversely increase the risk to the project site and subsequently increase the risk to the public. In addition, all facilities, once constructed, must comply with the requirements of 49 CFR 193 and would be subject to USDOT PHMSA's inspection and enforcement programs. USDOT PHMSA's regulations under 49 CFR 193.2155 (b) under Subpart C require an LNG storage tank must not be located within a horizontal distance of one mile from the ends, or 1/4 mile from the nearest point of a runway, whichever is longer and that the height of LNG structures in the vicinity of an airport must comply with DOT Federal Aviation Administration (FAA) requirements. In addition, FERC staff evaluated the risk of an aircraft impact from nearby airports. There would be no aircraft associated with the Expansion Project (e.g., helipads) that would warrant a review that would increase the risk to the public from aircraft operations.

Since the approval of the Base Project with the Commission's Order on April 18, 2019, there have been no new airports constructed near the approved facility. The closest airport to the Expansion Project site is still the Vaughn Farm Airport located approximately 6.1 miles away. FERC staff also identified 4 other airports within a 20-mile radius from the proposed site: Jack Brooks Regional Airport located 11.4 miles away, Kelley Crop Service Airport located 17.1 miles away, Wilber Farms Airport located 18.0 miles away, and Chesson Airport located 19.3 miles away. These are all farther than the 0.25-mile distance referenced in USDOT PHMSA regulations, 49 CFR 193.2155(b).

The DOT FAA regulations in 14 CFR 77 require Port Arthur LNG to provide a notice to the FAA of its proposed construction. This notification should identify all equipment that are more than 200 feet above ground level or lesser heights if the facilities are within 20,000 feet of an airport (at 100:1 ratio or 50:1 ratio depending on length of runway) or within 5,000 feet of a helipad (at 100:1 ratio). In addition, mobile objects,

including the LNG ship that would be above the height of the highest mobile object that would normally traverse it would require notification to DOT FAA. The FAA aeronautical study would identify which structures and mobile objects exceed obstruction standards and would indicate if the identified structures would be a hazard to air navigation. Based on this study, the FAA would issue a determination for each structure and mobile object that exceeds the obstruction standards.

On December 17, 2018 Port Arthur LNG filed to FERC the letter of determination of aeronautical study from the FAA for the Base Project. The aeronautical study revealed that the permanent and temporary structures (LNG Storage Tanks, Temporary Cranes and LNG ship) do not exceed obstruction standards and would not be a hazard to air navigation provided they are marked/lighted in accordance with FAA Advisory circular 70/7460-1 L Change 2, Obstruction Marking and Lighting. Also, the aeronautical study confirmed that the temporary structure would have no effect on any existing or proposed arrival, departure or en-route instrument/visual flight rules (IFR/VFR) operations or procedures. Additionally, the aeronautical study confirmed that the temporary structure would have no physical or electromagnetic effect on the operation of air navigation and communications facilities and would not impact any airspace and routes used by the military. Based on this aeronautical study, the FAA finds the temporary structures would have no adverse effect on air navigation and would not impact any aeronautical operations or procedures. Based upon the results of the FAA's review, we conclude that the Expansion Project would not pose a hazard to air navigation provided they are marked/lighted in accordance with FAA guidance. The aeronautical studies would expire in November 2021 for the LNG storage tanks, LNG ship(s), and the temporary construction cranes. Therefore, Port Arthur LNG would need to apply for an extension to these aeronautical studies with the FAA before they expire.

In addition, FERC staff analyzed existing aircraft operation frequency data based on the airports identified above and their proximity to the LNG storage tanks and process areas, the type and frequency of aircraft operations, take-off and landing directions, and the non-airport flight paths using the DOE Standard, DOE-STD-3014-2006, *Accident Analysis for Aircraft Crash into Hazardous Facilities*. Based upon that review, FERC staff does not believe the proposed Expansion Project would pose a significant risk as a result of the proximity of the Expansion Project to the airports.

Therefore, we conclude the proposed project would not pose a significant risk or significant increase in risk to the public due to nearby aircraft operations as a result of the potential consequences, incident data, and distance and position of the closest aircraft operations relative to the populated areas north of the LNG terminal.

2.7.7.4 Pipelines

FERC staff generally reviews whether any pipeline operations would be associated with the project and whether any existing pipelines would be located near the site. FERC staff uses this information to evaluate whether the project and any associated pipeline operations could increase the risk to the pipeline facilities and subsequently to the public and whether any pre-existing unassociated pipeline operations could adversely increase the risk to the project site and subsequently increase the risk to the public. In addition, pipelines associated with this project must meet USDOT PHMSA regulations under 49 CFR 192 and are discussed in section 4.2 above. All facilities, once constructed, must comply with the requirements of 49 CFR 192 and 49 CFR 193 and would be subject to USDOT PHMSA's inspection and enforcement programs. FERC staff evaluated the risk of a pipeline incident impacting the Expansion Project and the potential of cascading damage increasing the risk to the public based on the consequences from a release, incident data from the DOT, and proposed mitigation to prevent or reduce the impacts of a pipeline incident from the Expansion Project facilities.

For the Base Project, Port Arthur LNG identified five pipelines located adjacent to SH 87. The pipelines would either be relocated or abandoned in connection with the development of the Base and Expansion Projects and adequately marked during construction of both projects. FERC staff evaluated the potential risk from an incident from the pipelines and their potential impacts. Based on the proposed re-route, marking, and damage prevention measures and based on an evaluation of the potential likelihood of pipeline incidents and potential consequences from a pipeline incident, FERC staff does not believe the proposed Expansion Project would significantly increase the risk to the public beyond existing risk levels that are present from the pipelines.

Therefore, we conclude the proposed Expansion Project would not pose a significant increase in risk to the public as a result of the potential consequences from the pipelines in the vicinity of the Expansion Project, the frequency of pipeline incidents, and the proposed mitigation to prevent and reduce the impacts of a pipeline incident from the Expansion Project facilities.

2.7.7.5 Hazardous Material Facilities and Power Plants

FERC staff reviewed whether any EPA RMP regulated facilities handling hazardous materials and power plants were located near the site to evaluate whether the facilities could adversely increase the risk to the project site and whether the project site could increase the risk to the EPA RMP facilities and power plants and subsequently increase the risk to the public.

Since the approval of the Base Project with the Commission's Order on April 18, 2019, there have been no new hazardous material facilities and power plants constructed

near the approved facility. There were no adjacent facilities handling hazardous materials or power plants identified adjacent to the site. FERC staff also evaluated whether any EPA RMP regulated facilities would be located near the proposed site and if these facilities could adversely increase the risk to Port Arthur LNG's site and whether the Liquefaction Project could increase the risk to the EPA RMP facilities and power plants and subsequently increase the risk to the public. The closest facility handling hazardous materials would be the KMCO Port Arthur facility located approximately 2.8 miles north of the LNG storage tanks. In addition, the Golden Pass LNG terminal would be located approximately 2.8 miles southeast of the LNG storage tanks. The closest power plant identified was a gas power plant at a refinery approximately 4 miles north of the facility and the closest nuclear power plant is over 100 miles away.

Given the distances and locations of the facilities relative to the populated areas of the Port Arthur and Sabine Pass communities, we conclude the proposed project would not pose a significant increase in risk to the public or that the hazardous material facilities and power plants would pose a significant risk to the project and subsequently to the public.

2.7.8 Onsite and Offsite Emergency Response Plans

As part of its application, Port Arthur LNG indicated that the Project would develop a comprehensive ERP with local, state, and federal agencies and emergency response officials to discuss the Project. Port Arthur LNG would continue these collaborative efforts during the development, design, and construction of the Project. The emergency procedures would provide for the protection of personnel and the public as well as the prevention of property damage that may occur as a result of incidents at the project facilities. The facility would also provide appropriate personnel protective equipment to enable operations personnel and first responder access to the area.

As required by 49 CFR 193.2509 under Subpart F, Port Arthur LNG would need to prepare emergency procedures manuals that provide for: a) responding to controllable emergencies and recognizing an uncontrollable emergency; b) taking action to minimize harm to the public including the possible need to evacuate the public; and c) coordination and cooperation with appropriate local officials. Specifically, 49 CFR 193.2509(b)(3) requires "Coordinating with appropriate local officials in preparation of an emergency evacuation plan…," which sets forth the steps required to protect the public in the event of an emergency, including catastrophic failure of an LNG storage tank. USDOT PHMSA regulations under 49 CFR 193.2905 under Subpart J also require at least two access points in each protective enclosure to be located to minimize the escape distance in the event of emergency. FERC staff also verified road widths were at least 20 feet wide to accommodate emergency apparatus. In addition, the Letter of Determination (LOD) provided on December 7, 2020 by USDOT PHMSA indicated that, at least 60 days prior to placing Port Arthur LNG's Terminal into service, Port Arthur LNG must prepare and provide an emergency response procedure to USDOT PHMSA. The procedure must provide a process for Port Arthur LNG to coordinate with Texas Parks and Wildlife Department to warn and evacuate any visitors who are with the exclusion zone within the J.D. Murphree Wildlife Management Area (WMA) in the event of flammable vapor releases from Port Arthur LNG's Terminal. The emergency response procedure must clearly define the type of emergency event. In addition, the USDOT PHMSA LOD indicates that, at least 60 days prior to placing Port Arthur LNG's Terminal into service, Port Arthur LNG must provide a final operating procedure to PHMSA specifying routine inspections of signs along the perimeter of the exclusion zone within the WMA at least once a month. Following a prescribed marsh burn or a natural disaster, Port Arthur LNG must inspect the signs within 24 hours once TPWD has advised the exclusion area is safe for reentry. Deteriorated or illegible signs must be replaced within 3 days of being identified.

In accordance with the EPAct 2005, FERC must also approve an ERP covering the terminal and ship transit prior to construction. Section 3A(e) of the NGA, added by section 311 of the EPAct 2005, stipulates that in any order authorizing an LNG terminal, the Commission must require the LNG terminal operator to develop an ERP in consultation with the Coast Guard and state and local agencies. The final ERP would need to be evaluated by appropriate ERPs and officials. Section 3A (e) of the NGA (as amended by EPAct 2005) specifies that the ERP must include a Cost-Sharing Plan that contains a description of any direct cost reimbursements Port Arthur LNG agrees to provide to any state and local agencies with responsibility for security and safety at the LNG terminal and in proximity to LNG marine carriers that serve the facility. The Cost-Sharing Plan must specify what the LNG terminal operator would provide to cover the cost of the state and local resources required to manage the security of the LNG terminal and LNG marine carrier, and the state and local resources required for safety and emergency management, including:

- direct reimbursement for any per-transit security and/or emergency management costs (for example, overtime for police or fire department personnel);
- capital costs associated with security/emergency management equipment and personnel base (for example, patrol boats, firefighting equipment); and
- annual costs for providing specialized training for local fire departments, mutual aid departments, and emergency response personnel; and for conducting exercises.

The cost-sharing plan must include the LNG terminal operator's letter of commitment with agency acknowledgement for each state and local agency designated to receive resources.

As stated above, Port Arthur LNG would develop an ERP that would include both the Base Project and Expansion Project. This ERP would meet regulatory requirements and would address site-specific hazards and scenarios associated with the Projects. The ERP would include public notification, protection, and evacuation. We recommend in section 2.7.9 that Port Arthur LNG provide additional information, for review and approval, on development of the ERP prior to initial site preparation. We also recommend in section 2.7.9 that Port Arthur LNG file three-dimensional drawings, for review and approval, that demonstrate there is a sufficient number of access and egress locations. If this Project is authorized, constructed, and operated, Port Arthur LNG would coordinate with local, state, and federal agencies on the development of an ERP and cost sharing plan. We recommend in section 2.7.9 that Port Arthur LNG provide periodic updates on the development of these plans, for review and approval, and ensure they are in place prior to introduction of hazardous fluids. In addition, we recommend in section 2.7.9 that the Project facilities be subject to regular inspections throughout the life of the facility and would continue to require companies to file updates to the ERP.

2.7.9 Recommendations from FERC Preliminary Engineering and Technical Review

Based on FERC staff's preliminary engineering and technical review of the reliability and safety of the Expansion Project, we recommend the following mitigation measures to the Commission for consideration to incorporate as conditions to an order. These recommendations would be implemented prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout the life of the Expansion Project facilities to enhance the reliability and safety of the facilities and to mitigate the risk of impact on the public.

- **Prior to construction of final design, Port Arthur LNG should file with the Secretary the following information, stamped and sealed by the professional engineer-of-record, registered in Texas:**

    a. **site preparation drawings and specifications;**
    b. **a list of the foundation systems to be used for each structure;**
    c. **LNG terminal structures and foundation design drawings as well as associated calculations, including prefabricated and field constructed structures;**
    d. **seismic specifications for procured equipment; and**
    e. **quality control procedures to be used for civil/structural design and construction.**

- **Prior to construction of final design, Port Arthur LNG should provide concurrence from the USDOT PHMSA for the stormwater removal design for any hazardous liquid impoundments that would use a drainage system, rather than stormwater pumps, including for any local curbing used as an impounding area.**

Information pertaining to the following specific recommendations should be filed with the Secretary for review and written approval by the Director of OEP, or the Director's designee, within the timeframe indicated by each recommendation. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 833 (Docket No. RM16-15-000), including security information, should be submitted as critical energy infrastructure information pursuant to 18 CFR 388.113. See Critical Electric Infrastructure Security and Amending Critical Energy Infrastructure Information, Order No. 833, 81 Fed. Reg. 93,732 (December 21, 2016), FERC Stats. & Regs. 31,389 (2016). 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, Port Arthur LNG should file an overall project schedule, which includes the proposed stages of the commissioning plan.**

- **Prior to initial site preparation, Port Arthur LNG should file procedures for controlling access during construction.**

- **Prior to initial site preparation, Port Arthur LNG should file quality assurance and quality control procedures for construction activities.**

- **Prior to initial site preparation, Port Arthur LNG should develop or update the ERP (including evacuation) to include Expansion Project facilities and coordinate procedures, as applicable, with the Coast Guard; state, county, and local emergency planning groups; fire departments; state and local law enforcement; and appropriate federal agencies. This plan should include for the Expansion facilities at a minimum any changes or updates for:**

    a. **designated contacts with state and local emergency response agencies;**
    b. **scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents; and**
    c. **procedures for notifying residents and recreational users within areas of potential hazard.**

    Port Arthur LNG should notify FERC staff of all planning meetings in advance and should report progress on the development of its ERP at 3-month intervals.

- **Prior to initial site preparation, Port Arthur LNG should file 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. This comprehensive plan should include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. Port Arthur LNG should notify FERC staff of all planning meetings in advance and should report progress on the development of its Cost Sharing Plan at 3-month intervals**

- **Prior to construction of final design, Port Arthur LNG should file with the Secretary the final design package (e.g., structures and foundations drawings, design specifications, and calculations, etc.) and associated quality assurance and control procedures with the documents reviewed, approved, and stamped and sealed by the professional engineer of record in the State of Texas.**

- **Prior to construction of final design, Port Arthur LNG should file lighting drawings. The lighting drawings should show the location, elevation, type of light fixture, and lux levels of the lighting system and should illustrate adequate coverage, in accordance with federal regulations (e.g., 49 CFR 193, 29 CFR 1910, and 29 CFR 1926) and API 540 or equivalent, of the perimeter of the facility and along paths/roads of access and egress.**

- **Prior to construction of final design, Port Arthur LNG should file security camera and intrusion detection drawings. The security camera drawings should show the location, areas covered, and features of each camera (e.g.,**

fixed, tilt/pan/zoom, motion detection alerts, low light, mounting height, etc.) to verify coverage of the entire perimeter with redundancies and cameras interior to the facility to enable rapid and reliable monitoring of the facility. The intrusion detection drawings should show or note the location of the intrusion detection to verify coverage of the entire perimeter of the facility.

- **Prior to construction of final design, Port Arthur LNG should file change logs that list and explain any changes made from the front-end engineering design provided in Port Arthur LNG's application and filings. A list of all changes with an explanation for the design alteration should be filed and all changes should be clearly indicated on all diagrams and drawings.**

- **Prior to construction of the final design, Port Arthur LNG should file information/revisions pertaining to its responses to numbers 69, 72, 90, 92, 95, 96,, 99, 100,, 109, and 112 of the June 5, 2020 information request, which indicated features to be included or considered in the final design.**

- **Prior to construction of final design, Port Arthur LNG should file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems.**

- **Prior to construction of final design, Port Arthur LNG should file any changes in equipment capacity and spacing to ensure capacities and setbacks are maintained.**

- **Prior to construction of final design, Port Arthur LNG should file three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion.**

- **Prior to construction of final design, Port Arthur LNG should file an up-to-date equipment list, process and mechanical data sheets, and specifications. The specifications should include:**

    a. **building specifications (e.g., control buildings, electrical buildings, compressor buildings, storage buildings, pressurized buildings, ventilated buildings, blast resistant buildings);**
    b. **mechanical specifications (e.g., piping, valve, insulation, rotating equipment, heat exchanger, storage tank and vessel, other specialized equipment);**
    c. **electrical and instrumentation specifications (e.g., power system, control system, safety instrument system [SIS], cable, other electrical and instrumentation); and**
    d. **security and fire safety specifications (e.g., security, passive protection, hazard detection, hazard control, firewater).**

- **Prior to construction of final design, Port Arthur LNG should file up-to-date process flow diagrams (PFDs) and piping and instrument diagrams (P&IDs) including vendor P&IDs. The PFDs should include heat and material balances. The P&IDs should 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 size and set points.**
    i. **drawing revision number and date.**

- **Prior to construction of final design, Port Arthur LNG should file P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect subsequently constructed facilities with the operational facilities.**

- **Prior to construction of final design, Port Arthur LNG should file a car seal philosophy and a list of all car-sealed and locked valves consistent with the P&IDs.**

- **Prior to construction of final design, Port Arthur LNG should file the safe operating limits (upper and lower), alarm and shutdown set points for all instrumentation (e.g., temperature, pressures, flows, and compositions).**

- **Prior to construction of final design, Port Arthur LNG should verify that the recommendations from the front-end engineering design Hazard Identification study are complete and consistent with the requirements of the final design as determined by the engineering, procurement, and construction contractor.**

- **Prior to construction of final design, Port Arthur LNG should file cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system for review and written approval. The cause-and-effect matrices should include alarms and shutdown functions, details of the voting and shutdown logic, and set points.**

- **Prior to construction of final design, Port Arthur LNG should specify that all ESD valves are to be equipped with open and closed position switches connected to the Distributed Control System (DCS)/SIS.**

- **Prior to construction of final design, Port Arthur LNG should file an evaluation of ESD valve closure times. The evaluation should account for the time to detect an upset or hazardous condition, notify plant personnel, and close the ESD valve.**

- **Prior to construction of final design, Port Arthur LNG should file an evaluation of dynamic pressure surge effects from valve opening and closure times and pump startup and shutdown operations.**

- **Prior to construction of final design, Port Arthur LNG should file a HAZOP review of the final design P&IDs, a list of resulting recommendations, and action taken on the recommendations. In addition, Port Arthur LNG should file action taken on the recommendations resulting from the HAZID review. The issued for construction P&IDs should incorporate the HAZID and HAZOP recommendations and justification should be provided for any recommendations that are not implemented.**

- **Prior to construction of final design, Port Arthur LNG should file an evaluation assessing the minimum design metal temperature and material of construction needed for the deethanizer, depropanizer, reboiler, and piping during upset/settle out conditions.**

- **Prior to construction of final design, Port Arthur LNG should file process simulation results for the deethanizer, depropanizer depressurized conditions to ensure the associated deethanizer, deepropanizer, reboiler, piping, and other associated equipment are adequately designed for settle out and upset conditions to prevent brittle fracture of piping and associated equipment.**

- **Prior to construction of final design, Port Arthur LNG 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.**

- **Prior to construction of final design, Port Arthur LNG should file the sizing basis and capacity for the final design of the flares and/or vent stacks as well as the pressure and vacuum relief valves for major process equipment, vessels, and storage tanks.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should install thermal relief valves in piping segments that can be isolated by valves unless it can be demonstrated that thermal expansion would not overpressurize the piping or has other protective measures (e.g., car seals or locks).**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should file an evaluation of the need to install pressure relieving protection for flammable liquid piping segments (i.e., refrigerants, liquid hydrocarbons, condensate products) that can be isolated by valves in the event of a fire.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should specify that all drains from high pressure hazardous fluid systems are equipped with double isolation and bleed valves.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should specify that piping and equipment that may be cooled with liquid nitrogen is to be designed for liquid nitrogen temperatures, with regard to allowable movement and stresses.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should file detailed cooldown plans showing the piping flow paths, valve alignment, and instruments used to monitor the initial cooldown and filling of the LNG storage tanks.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should install fixed gas detection in areas that toxic concentration of H2S (i.e. , AEGL-1, -2, or -3) could reach people if there is a releases from loss of containment from the acid gas piping system and potential release points (i.e., vents, relief valves, vent stacks, and thermal oxidizer stack) unless it can be demonstrated through filed hazard modeling that toxic concentrations would not be reached where people could be located.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should include provisions to maintain stability and pressure of the regenerator in the event that the H_2S scavenger or thermal oxidizer are unavailable (e.g., change out, maintenance, startup, etc.).**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should include provisions to prevent cryogenic fluids accumulated in the dry flare knockout drum from reaching the wet flare knockout drum, which are connected by the dry flare knockout drum drain line to the blow case purge to the wet flare knockout drum.**

- **Prior to construction of final design, Port Arthur LNG should include details of the flare knockout drum heater and detailed procedures for draining flare knockout drums to a safe location.**

- **Prior to construction of final design, Port Arthur LNG should file detailed calculations for the flow rate of the jockey pumps accounting for flow rate losses due to leaks or when drain valves are opened to ensure that system losses do not exceed the specified design flow rate of the jockey firewater pumps.**

- **Prior to construction of final design, Port Arthur LNG should provide the final specifications for all equipment and a list of all applicable codes and standards and recommended practices referenced in the specifications that cross-references the specification(s) where those codes and standards and recommended practices are referenced.**

- **Prior to construction of final design, Port Arthur LNG should file an updated fire protection evaluation of the proposed facilities. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations shall be filed. The evaluation shall justify the type, quantity, and location of hazard detection and hazard control, passive fire protection, ESD and depressurizing systems, firewater, and emergency response equipment, training, and qualifications in accordance with NFPA 59A (2001). The justification for the flammable and combustible gas detection and flame and heat detection shall be in accordance with ISA 84.00.07 or equivalent methodologies that would demonstrate 90 percent or more of releases (unignited and ignited) that could result in an off-site or cascading impact would be detected by two or more detectors and result in isolation and de-inventory within 10 minutes, or less for impoundments that are not sized for 10 minute releases and de-inventory. The analysis shall take into account the set points, voting logic, wind speeds, and wind directions. The justification for firewater shall provide evaluation of the total area that may experience firewater demand due to each governing scenario; calculations for all firewater demands (including firewater coverage on the LNG storage tanks) based on design densities, surface area, and throw distance; and specifications for the corresponding hydrants and monitors needed to reach and cool equipment.**

- **Prior to construction of final design, Port Arthur LNG should file spill containment system drawings with dimensions and slopes of curbing, troughs, impoundments, and capacity calculations considering any foundations and equipment within impoundments. The spill containment drawings should show containment for all components that could contain hazardous liquids, including all liquids handled above their flashpoint and those with toxic or asphyxiant vapor hazards, from the largest flow from a single line for 10**

minutes, including de-inventory, and specifying a reliability equivalent to SIL 2 or higher for any pump interlock systems, or the maximum liquid from the largest vessel (or total of impounded vessels), or otherwise demonstrate that providing spill containment would not significantly reduce the vapor dispersion or radiant heat consequences of a spill - including for hot oil spills near the heater and train utility areas, as well as the condensate truck loading stations, and the flare knockout drums. Spill containment systems should be constructed of materials that can withstand the liquid hazards. Also, Port Arthur LNG should file an analysis demonstrating that an ignited sizing spill from the condensate truck loading line in the truck loading impoundment would not overflow due to firewater usage or subsequent release from the truck, unless providing additional impoundment capacity would not significantly reduce the vapor dispersion or radiant heat consequences of the initial spill.

- **Prior to construction of final design, Port Arthur LNG should file a technical review of facility design, using an up-to-date plot plan that includes facilities for both the Base and Expansion projects, that:**

    a. **identifies all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and**
    b. **demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices would isolate or shutdown any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency.**

- **Prior to construction of the final design, Port Arthur LNG should file a building siting assessment, using an up-to-date plot plan that includes facilities for both the Base and Expansion projects, demonstrating that occupied buildings and buildings critical to the safety of the LNG plant would be able to withstand radiant heats from pool fires, as well as jet fires and overpressures and projectiles from vapor cloud explosions from ignition of flammable vapors generated from a design spill release (e.g., 2-inch to 4-inch diameter). Alternatively, Port Arthur LNG should file an analysis demonstrating the occupied buildings and buildings critical to the safety of the LNG plant have been relocated or provided with passive and active measures that would prevent impacts.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should file the detailed design of the measures to prevent flammable vapors from accumulating underneath an LNG storage tank or plant building or demonstrate that ignition of any flammable vapors reaching underneath an LNG storage tank or plant building from a design spill release (e.g., 2-inch to 4-inch diameter) would not lead to cascading damage or significant safety hazards. Port Arthur LNG should also file an analysis demonstrating that ignition of flammable vapor in the pipe sleeves in the condensate truck loading impoundment could not produce overpressures that could cause cascading damage or significant safety hazards.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should file an analysis that demonstrates safety-related equipment (e.g., firewater pumps and other emergency equipment) as well as an analysis that the LNG storage tanks, refrigerant storage tanks, and berthed LNG ships would be able to withstand overpressures and projectiles from vapor cloud explosions from ignition of flammable vapors generated from a design spill release.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should file an analysis of the structural integrity of the outer containment of the full containment LNG storage tanks, demonstrating it can to withstand the heat flux from an adjacent tank top fire for 2 hours, considering representative target elevations.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should file details demonstrating that LNG storage tanks would be protected from radiant heat flux levels above the design specification from a spill impoundment fire for 2 hours by a system with a reliability equivalent to a SIL 3 system.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should file a detailed quantitative analysis to demonstrate that adequate thermal mitigation would be provided for each pressure vessel that could fail within the 4,000 BTU/ft^2-hr zone from a pool or jet fire; and each critical structural component and emergency equipment item that could fail within the 4,900 BTU/ft^2-hr from a pool or jet fire, including the firewater pumps and tank. Trucks at transfer stations should be included in the analysis of potential pressure vessel failures. Mitigation measures to protect the above facilities from radiant heat from a spill impoundment should be demonstrated to have a reliability equivalent to a SIL 3 system. A combination of passive and active protection for pool fires and passive and/or active protection for jet fires should be provided and effectiveness and reliability should be demonstrated. Effectiveness of passive mitigation should be supported by calculations or test results for the thickness limiting temperature rise over the fire duration, and active mitigation should be supported by reliability information by calculations or test results, such as demonstrating flow rates and durations of any cooling water would mitigate the heat absorbed by the component. The total firewater demand should account for all components that could fail due to a pool or jet fire.**

- **<u>Prior to construction of the final design</u>, Port Arthur LNG should file calculations demonstrating that the storm surge barrier would prevent adverse impacts (i.e., 1 psi overpressure) due to a potential vapor cloud ignition event within the plant from reaching highway users or shall install other mitigation that would prevent adverse impacts from reaching highway users.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should file all electrical area classification drawings.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should provide documentation justifying the use of API RP 500's Figure 51 as a representation of Detail 'B' of the Electrical Area Classification drawing using hazard modeling of various release rates from equivalent hole sizes (see NFPA 497 release rate of 1lb/min) or modify the electrical area classification drawings to be consistent with the most applicable Figure of API RP 500.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should file 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 (2001).**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should file details of 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, alarm the hazardous condition, and shut down the appropriate systems.

- **Prior to construction of final design, Port Arthur LNG should file a drawing showing the location of the ESD buttons. ESD buttons should be easily accessible, conspicuously labeled, and located in an area which would be accessible during an emergency.**

- **Prior to construction of final design, Port Arthur LNG should file specifications and vendor datasheets, fire safety specifications, including hazard detection, hazard control, and firewater systems of the final design.**

- **Prior to construction of final design, Port Arthur LNG should provide low oxygen detectors to notify operators of liquid nitrogen releases.**

- **Prior to construction of final design, Port Arthur LNG shall provide ventilation in buildings handling flammable and combustible fluids that limits concentrations below the LFLs (e.g., 25-percent LFL), including from off gassing of hydrogen in battery rooms, and shall also provide hydrogen detectors that alarm (e.g., 20- to 25-percent LFL) and initiate mitigative actions (e.g., 40- to 50 percent LFL) in accordance with NFPA 59A and NFPA 70, or equivalents. The adequacy of the ventilation to limit concentrations below the LFL shall be demonstrated through calculations or analysis of the buildings containing flammable and combustible fluids in accordance with NFPA 59A, NFPA 70, or equivalent.**

- **Prior to construction of final design, Port Arthur LNG should file complete 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 indication locations, and shutdown functions of the hazard detection equipment.**

- **Prior to construction of final design, Port Arthur LNG should file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of the hazard detectors when determining the lower flammable limit set points for methane, propane, butane, ethane, and condensate.**

- **Prior to construction of final design, Port Arthur LNG should file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of hazard detectors when determining the set points for toxic components such as aqueous ammonia, natural gas liquids, and H_2S.**

- **Prior to construction of final design, Port Arthur LNG shall provide hazard detection equipment suitable to detect high temperatures and smoldering combustion products in electrical buildings and control room buildings. This information shall be shown on filed hazard detection drawings.**

- **Prior to construction of final design, Port Arthur LNG should file an evaluation of the voting logic and voting degradation for hazard detectors.**

- **Prior to construction of final design, Port Arthur LNG should file facility plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Plan drawings should clearly show the location and elevation by tag number of all fixed dry chemical systems in accordance with NFPA 17, wheeled and handheld extinguishers location and travel distances are along normal paths of access and egress and in accordance with NFPA 10. The list should include the equipment tag number, manufacturer and model, agent type, agent capacity, discharge rate, and automatic and manual remote signals initiating discharge of the units, and equipment covered.**

- **Prior to construction of final design, Port Arthur LNG should file a design that includes clean agent systems in the instrumentation and electrical equipment buildings that serve safety and security systems.**

- **Prior to construction of final design, Port Arthur LNG should file facility plan drawings showing the proposed location of the firewater and any foam systems. Plan drawings should clearly show the location of firewater and foam piping, post indicator valves, and the location and area covered by, each monitor, hydrant, hose, water curtain, deluge system, foam system, water-mist system, and sprinkler. The drawings should demonstrate that each process area, fire zone, or other sections of piping with several users can be isolated with post indicator valves and that firewater coverage is provided by at least two monitors or hydrants with sufficient firewater flow to cool exposed surfaces subjected to a fire. In addition, the drawings should include piping and instrumentation diagrams of the firewater and foam systems. The firewater coverage drawings should illustrate firewater coverage by two or more hydrants or monitors accounting for obstructions (or deluge systems) for all areas that contain flammable or combustible fluids.**

- **Prior to construction of final design, Port Arthur LNG should specify remotely operated or automatic firewater monitors in areas that are inaccessible or difficult to access in the event of an emergency.**

- **Prior to construction of final design, Port Arthur LNG should demonstrate that the firewater tank would be in compliance with NFPA 22 or an equivalent or better level of safety.**

- **Prior to construction of final design, Port Arthur LNG should file detailed calculations to confirm that the final fire water volumes would be accounted for when evaluating the capacity of the impoundment system during a spill and fire scenario.**

- **Prior to construction of final design, Port Arthur LNG should specify that the firewater flow test meter is equipped with a transmitter and that a pressure transmitter is installed upstream of the flow transmitter. The flow transmitter and pressure transmitter should be connected to the DCS and recorded.**

- **Prior to construction of final design, Port Arthur LNG should specify that the firewater pump shelter is designed with a removable roof for maintenance access to the firewater pumps.**

- **Prior to construction of final design, Port Arthur LNG should file calculations for the firewater spray systems sized to provide cooling for mitigation of boiling liquid expanding vapor explosions.**

- **Prior to construction of final design, Port Arthur LNG shall demonstrate the firewater tank capacity is designed to account for the fire water required for foam generation in calculating the total fire water required for 2 hours of supply. This information shall be demonstrated through filing calculations of the firewater demand used to size the firewater tank and through filing of tank drawings.**

- **Prior to construction of final design, Port Arthur LNG should file drawings and specifications for the passive protection systems to protect equipment and supports from cold temperature releases.**

- **Prior to construction of final design, Port Arthur LNG should file calculations or test results for the structural passive protection systems to demonstrate that equipment and supports are protected from cryogenic releases.**

- **Prior to construction of final design, Port Arthur LNG should file drawings and specifications for the structural passive protection systems to demonstrate the equipment and supports are protected from pool and jet fires, including that the fireproofing material would remain effective after potential exposure to the cold temperature of pooling, jetting, or splashing liquids.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should use a model that can accommodate the actual liquid properties of a condensate fire to demonstrate the effectiveness of the active and passive mitigation protecting the refrigerant storage vessels from an adjacent condensate storage fire. Alternatively, provide documentation that demonstrates how the active and passive mitigation systems adequately protect the refrigerant storage vessels from the associated radiant heat emitted from the condensate storage impoundment.**

- **<u>Prior to the construction of final design</u>, Port Arthur LNG should relocate the Powerhouse (PH0-80002) and Firewater Tank to an area outside of the 4,900 BTU/ft^{2}-hr thermal radiant heat zone from any impoundment fire or demonstrate that active and passive mitigation systems are effective to address the potential radiant heat zones.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should file specifications and drawings demonstrating that cascading damage of transformers would be prevented (e.g., firewalls or spacing) in accordance with NFPA 850 or equivalent.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should file drawings of internal road vehicle protections, such as guard rails, barriers, and bollards to protect all equipment containing hazardous fluids or that are safety related (e.g., hydrants and monitors) to ensure that they are located away from roadway or protected from inadvertent damage from vehicles.**

- **<u>Prior to construction of final design</u>, Port Arthur LNG should file detailed final design and Flaring Load and Venting Capacities and Sizing study to ensure the ground flare systems sized adequately.**

- **<u>Prior to commissioning</u>, Port Arthur LNG should file 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. Port Arthur 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>, Port Arthur LNG should file detailed plans and procedures for: testing the integrity of on-site mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service.**

- **Prior to commissioning, Port Arthur LNG should file the procedures for pressure/leak tests which address the requirements of ASME BPVC section VIII and ASME B31.3. The procedures should include a line list of pneumatic and hydrostatic test pressures.**

- **Prior to commissioning, Port Arthur LNG should file 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 and should provide justification if not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing.**

- **Prior to commissioning, Port Arthur LNG should file the operation and maintenance procedures and manuals, as well as safety procedures, hot work procedures and permits, abnormal operating conditions reporting procedures, simultaneous operations procedures, and management of change procedures and forms.**

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

- **Prior to commissioning, Port Arthur LNG should file a plan to maintain a detailed training log to demonstrate that operating, maintenance, and emergency staff has completed the required training. In addition, Port Arthur LNG should file signed documentation that demonstrates training has been conducted, including ESD and response procedures, prior to the respective operation.**

- **Prior to introduction of hazardous fluids, Port Arthur LNG should complete and document all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the DCS/SIS that demonstrates full functionality and operability of the system.**

- **Prior to introduction of hazardous fluids, Port Arthur LNG should develop and implement an alarm management program to reduce alarm complacency and maximize the effectiveness of operator response to alarms.**

- **Prior to introduction of hazardous fluids, Port Arthur LNG should complete and document 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).**

- **Prior to introduction of hazardous fluids, Port Arthur LNG should complete and document a pre-startup safety review to ensure that installed equipment**

meets the design and operating intent of the facility. The pre-startup safety review should include any changes since the last hazard review, operating procedures, and operator training. A copy of the review with a list of recommendations, and actions taken on each recommendation, should be filed.

- **Port Arthur LNG should file a request for written authorization from the Director of OEP or the Director's designee prior to unloading or loading the first LNG commissioning cargo. After production of first LNG, Port Arthur LNG should file weekly reports on the commissioning of the proposed systems that detail the progress toward demonstrating the facilities can safely and reliably operate at or near the design production rate. The reports should include a summary of activities, problems encountered, and remedial actions taken. The weekly reports should also include the latest commissioning schedule, including projected and actual LNG production by each liquefaction train, LNG storage inventories in each storage tank, and the number of anticipated and actual LNG commissioning cargoes, along with the associated volumes loaded or unloaded. Further, the weekly reports should include a status and list of all planned and completed safety and reliability tests, work authorizations, and punch list items. Problems of significant magnitude should be reported to the FERC within 24 hours.**

- **Prior to commencement of service, Port Arthur LNG should notify the FERC staff of any proposed revisions to the security plan and physical security of the plant.**

- **Prior to commencement of service, Port Arthur LNG should label piping with fluid service and direction of flow in the field, in addition to the pipe labeling requirements of NFPA 59A (2001).**

- **Prior to commencement of service, Port Arthur LNG should provide plans for any preventative and predictive maintenance program that performs periodic or continuous equipment condition monitoring.**

- **Prior to commencement of service, Port Arthur LNG should develop procedures for handling off-site contractors including responsibilities, restrictions, and limitations and for supervision of these contractors by Port Arthur LNG staff.**

- **Prior to commencement of service, Port Arthur LNG should file a request for written authorization from the Director of OEP or the Director's designee. Such authorization would only be granted following a determination by the Coast Guard, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the MTSA of 2002, and the Safety and Accountability For Every Port Act, that appropriate measures to ensure the safety and security of**

the facility and the waterway have been put into place by Port Arthur LNG or other appropriate parties.

In addition, the following measures should apply throughout the life of the Port Arthur LNG's Expansion Project facilities, unless otherwise specified:

- **The facility should 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, Port Arthur LNG should file information in response 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 filed.**

- **Semi-annual operational reports should be filed with the Secretary to identify changes in facility design and operating conditions; abnormal operating experiences; activities (e.g., ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil off/flash gas); and plant modifications, including future plans and progress thereof. Abnormalities should include, but not be limited to, unloading/loading/shipping problems, potential hazardous conditions from offsite 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 fluids releases, fires involving hazardous fluids and/or from other sources, 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 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)" should be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance at the LNG facilities.**

- **In the event the temperature of any region of the LNG storage container, including any secondary containment and imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the**

Commission should be notified within 24 hours and procedures for corrective action should be specified.

- **Significant non-scheduled events, including safety-related incidents (e.g., LNG, condensate, refrigerant, or natural gas 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 that an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made immediately, 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 within 24 hours. This notification practice should be incorporated into the LNG Plant'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 from hazardous fluids transportation occurring at or en route to and from the LNG facility; 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 or the Director's designee 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 liquefaction 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.

2.7.10 Conclusions on LNG Facility and Carrier Reliability and Safety

As part of the NEPA review and NGA determinations, Commission staff assesses the potential impact to the human environment in terms of safety and whether the proposed facilities would operate safely, reliably, and securely.

As a cooperating agency, USDOT PHMSA assists the FERC by determining whether Port Arthur LNG's Expansion Project proposed design would meet PHMSA's 49 CFR 193 Subpart B siting requirements. On December 7, 2020, USDOT PHMSA provided an LOD on the Expansion Projects' compliance with 49 CFR 193 Subpart B for the commission to consider in its decision to authorize or deny the Project. If the Expansion Project facility is authorized and constructed, the facility would be subject to USDOT PHMSA's inspection and enforcement program and final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by USDOT PHMSA staff.

As a cooperating agency, the Coast Guard also assisted the FERC staff by reviewing the proposed LNG terminal and the associated LNG ship traffic. The Coast Guard reviewed a WSA submitted by Port Arthur LNG that focused on the navigation safety and maritime security aspects of LNG ship transits along the affected waterway. On May 17, 2019 Port Arthur LNG requested the Captain of the Port's consideration as to whether the waterway suitability assessment (WSA) completed on November 2017, for the Base Project, was broad enough to allow for the construction of Trains 3 and 4, without the need for updates to the Letter of Intent (LOI) or the WSA. On June 13, 2019, after reviewing the current WSA that was completed in November 2017, the Coast Guard determined that the original WSA was broad enough to allow for the construction of Trains 3 and 4 and the expected outcome of LNG ship traffic, based on construction

planned as of the date of the letter, fell within the scope of the original WSA. Therefore, the Coast Guard concluded that the Project did not need to update the current LOI or WSA. If the Expansion Project is authorized and constructed, the facilities would be subject to the Coast Guard's inspection and enforcement program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

On October 14, 2020 the DoD provided a letter on the Expansion Project stating the results of DOD's review indicated that the Expansion Project, located in Jefferson County, Texas, as proposed, will have minimal impact on military operations conducted in the area.

FERC staff conducted a preliminary engineering and technical review of the proposed Expansion Project, including potential external impacts based on the site location. Based on this review, we are recommending, in section 2.7.9, a number of mitigation measures to be implemented prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout the life of the facility, to enhance the reliability and safety of the facility. Based on our external impact analysis and preliminary evaluation of the engineering design, and with the incorporation of our recommended mitigation measures and oversight, we conclude that the Expansion Project's design would include acceptable layers of protection or safeguards that would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public.

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.

Expansion Project impacts would be primarily additive to the approved Base Project. The Expansion Project would be within the Base Project site, previously approved by the Commission, thereby minimizing additional temporary, permanent, and cumulative impacts. Potential cumulative impacts associated with current, proposed, or reasonably foreseeable future projects or activities in the resource-specific geographical scopes were identified and are listed in table 2.8-2. Although we were able to find the acreage affected by the majority of the projects listed in table 2.8-2, 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 Geographical Scope for Cumulative Impacts Analysis

The geographic scope considered in the cumulative effects analysis varies by project and by resource. The cumulative impact analysis area, or geographic scope, for a resource may be substantially greater than the corresponding project-specific area of impact in order to consider an area large enough to encompass likely effects from other projects on the same resource. The CEQ (1997) recommends setting the geographic scope based on the natural boundaries of the resource affected, rather than jurisdictional boundaries. The resource-specific geographic scopes used to assess cumulative impacts are provided in table 2.8-1.

TABLE 2.8-1
Resource-specific Geographic Scopes

Environmental Resource	Geographical Scope
Geology and Soils	Construction Workspaces
Surface Water and Aquatic Resources	HUC-12 Watershed
Wetlands, Vegetation, and Wildlife	HUC-12 Watershed
Threatened and Endangered Species	HUC-12 Watershed
Cultural Resources	Within the Area of Potential Effects
Socioeconomics	County
Land Use	1-mile-radius
Visual Resources	5-mile-radius
Noise	0.25-mile-radius for Construction; 1-mile-radius for Operations
Air Quality	0.25-mile-radius for Construction; 50 kilometers (about 31.1 miles) for Operations

TABLE 2.8-1 Resource-specific Geographic Scopes	
Environmental Resource	**Geographical Scope**
HUC = Hydologic unit code	

The resources that have the potential to be affected as result of the Expansion Project include surface water, aquatic resources; socioeconomics; visual resources; noise; and air quality. Even though the Expansion Project would be within the geographic scope of the Base Project (and other projects) for geologic resources, soils, wetlands, vegetation and wildlife, cultural resources, and land use, there would not be any cumulative impacts on these resources because they would not be impacted by the Expansion Project, and they will not be discussed further.

The majority of impacts from the Expansion Project would be contained within the boundaries of the Base Project construction, staging areas, and site boundaries. The implementation of Port Arthur LNG s Environmental Plan would help ensure that ground disturbance and site-stabilization activities would remain within work areas. The implementation of these plans would also limit the cumulative impacts on other resources. As described in the impact analysis, the impacts for the Expansion Project are generally localized and within previously disturbed areas. As the impacts from the Expansion Project would be localized, they would not be expected to contribute significantly to the cumulative impact in the region. As a result, we have related the scope of our analysis to the magnitude of the aforementioned environmental impacts described in the impact analysis.

Projects within the geographic scope of analysis are listed in table 2.8-2 and include the following: FERC-jurisdictional projects, other industrial facilities, government facilities and activities, commercial and residential developments, and road projects. These projects were identified through an independent review of publicly available information, aerial and satellite imagery, consultations with federal agencies, and information provided by Port Arthur LNG.

TABLE 2.8-2
Authorized, Planned, or Recently Completed Major Projects in the Vicinity of the Expansion Project Considered for Cumulative Analysis

Project	Description	Area of Disturbance	Wetland Disturbance	Construction Status	Location Relative to Expansion Project[b]	Permits and Authorizations	Environmental Resources with Potential Cumulative Impacts
INDUSTRIAL DEVELPOMENTS							
LNG Export Projects							
Sabine Pass Liquefaction Expansion Project FERC Dockets CP13-552 and CP13-553	Construction and operation of two liquefaction trains (Stage 3) at the existing SPLNG Terminal and approximately 104 miles of pipeline, including two loops, an extension, four laterals, four metering and regulating stations, and a new compressor station.	Construction: 401.20 acres Operation: 156.30 acres	Temporary Impacts: 153.5 acres Permanent Impacts: 153.5 acres	Under construction Train 5 in-service August 2019; Train 6 anticipated in-service November 2022	3 miles southeast of Expansion Project in Cameron Parish, LA	• FERC Prepared Environmental Assessment (EA) • Natural Gas Act (NGA) Section 3 Authorizations • Authorization to Export LNG • United States Coast Guard (USCG) Water suitability Assessment (WSA) • Clean Water Act (CWA) Section 404 Permit • Coastal Zone Consistency Permit • Endangered Species Act (ESA) Section 7 Consultation • Marine Mammal Protection Act (MMPA) and Essential Fish Habitat (EFH) Consultations • CWA Section 401 Water Quality Certification • National Pollutant Discharge Elimination System (NPDES) Construction Storm Water Permit • Prevention of Significant Deterioration (PSD) and Title V Operating Air Permits • National Historical Preservation Act (NHPA) Section 106 Consultation • Additional Minor Federal, State and Local Permits, Authorizations and Consultations	Visual; Air Quality (Operations)
Sabine Pass Third Berth Expansion Project (located within the existing Sabine Pass LNG Terminal) FERC Docket CP19-11	Construction of a third marine berth and supporting facilities used to load LNG ships for export at the Sabine Pass LNG Terminal.	Construction: 375.20 acres Operation: 171.56 acres	Temporary Impacts: 49.24 Permanent Impacts: 49.24	Construction is anticipated to begin in 2020.	3 miles southeast of Expansion Project in Cameron Parish, LA	• FERC Prepared EA • NGA Section 3 Authorization • USCG WSA • CWA Section 404 Permit • Rivers and Harbors Act (RHA) Section 408 Authorization • CWA Section 401 Water Quality Certification • Coastal Zone Consistency Permit • ESA Section 7 Consultation • MMPA and EFH Consultations • PSD Air Permit Revisions • NHPA Section 106 Authorization • Additional Minor Federal, State and Local Permits, Authorizations and Consultations	Visual; Air Quality (Operations)

TABLE 2.8-2
Authorized, Planned, or Recently Completed Major Projects in the Vicinity of the Expansion Project Considered for Cumulative Analysis

Project	Description	Area of Disturbance	Wetland Disturbance	Construction Status	Location Relative to Expansion Project[b]	Permits and Authorizations	Environmental Resources with Potential Cumulative Impacts
Golden Pass Export Terminal Project FERC Docket CP14-517	Construction and operation of three liquefaction process trains, each with a nominal throughput of 5.2 MTPA, associated treatment, power and utility systems, and interconnections to existing import facilities and controls.	Construction: 918.70 acres Operation: 738 acres	Temporary Impacts: 387.7 acres Permanent Impacts: 376.0 acres	Under Construction Proposed in-service date is anticipated to be 2025.	1 mile South of Expansion Project in Jefferson County, TX	• FERC Prepared EIS • NGA Section 3 Authorization • Authorization to Export LNG • USCG WSA • CWA Section 404 Permit • RHA Section 10 Permit • CWA Section 402 of the CWA Industrial Stormwater Permit and Process Waste Water Permit • CWA Section 401 Water Quality Certification • Coastal Zone Consistency Determination • ESA Section 7 Consultation • NOAA Fisheries – MMPA and EFH Consultations • Hydrostatic Test Water Discharge Permit • Operational Stormwater Permit • General Construction Stormwater Permit • PSD and Title V Operating Air Permits • NHPA Section 106 Consultation • Additional Minor Federal, State and Local Permits, Authorizations and Consultations	Socioeconomics; Visual; Noise (Operations); Air Quality (Operations)
Port Arthur Liquefaction Project (Base Project) FERC Docket CP17-20	Construction and operation of a new LNG and export facility on Sabine Neches Ship Channel, including feed gas pre-treatment facilities, two 6.73 MTPA capacity liquefaction trains, two 160,000-m3 LNG storage tanks, and condensate product storage.	Construction: 948 acres Operation: 898.10 acres	Temporary Impacts: 758.3 acres Permanent Impacts: 725.7 acres	Under Construction Anticipated completion date is in 2025.	The Expansion Project is located within the Port Arthur Liquefaction Project site.	• FERC Prepared EIS • NGA Section 3 Authorization • Authorization to Export LNG • USCG WSA • CWA Section 404 Permit • RHA Section 10 Permit • CWA Section 401 Water Quality Certification • Coastal Zone Consistency Determination • ESA Section 7 Consultation • MMPA and EFH Consultations • Hydrostatic Test Water Discharge Permit • Operational Stormwater Permit • PSD and Title V Operating Air Permits • NHPA Section 106 Consultation • Additional Minor Federal, State and Local Permits and Authorizations	Surface Water Resources; Socioeconomics; Visual; Noise (Operations); Noise (Construction); Air Quality (Operations); Air Quality (Construction)
Pipeline System Facilities							

TABLE 2.8-2
Authorized, Planned, or Recently Completed Major Projects in the Vicinity of the Expansion Project Considered for Cumulative Analysis

Project	Description	Area of Disturbance	Wetland Disturbance	Construction Status	Location Relative to Expansion Project[b]	Permits and Authorizations	Environmental Resources with Potential Cumulative Impacts
Golden Pass Pipeline Expansion Project FERC Docket CP14-518	Construction of 2.6 miles of 24-inch-diameter pipeline loop in Calcasieu Parish, Louisiana; three new compressor stations in Jefferson and Orange Counties, Texas, and Calcasieu Parish, Louisiana; and modifying existing interconnections and metering facilities.	Temporary Impacts: 98.70 acres Permanent Impacts: 55.60 acres	Temporary Impacts: 13.10 acres Permanent Impacts: 9.70 acres	Under Construction Completion Date is Unknown	1 mile southeast of the Expansion Project in Jefferson County, TX	• FERC Prepared EIS (Included in the Golden Pass Export Project EIS) • NGA Section 7 Authorization • CWA Section 404 Permit • CWA Section 402 Industrial Stormwater Permit • CWA Section 401 Water Quality Certification • Coastal Zone Consistency Determination • ESA Section 7 Consultation • Hydrostatic Test Water Discharge Permit • Operational Stormwater Permit • General Construction Stormwater Permit • PSD and Title V Operating Air Permits • NHPA Section 106 Consultation • Additional Minor Federal, State and Local Permits, Authorizations and Consultations	Socioeconomics; Visual; Noise (Operations); Air Quality (Operations)
South Texas Expansion Project FERC Docket CP15-499	TETCO filed an application with FERC for authorization to construct, own, and operate the South Texas Expansion Project, which includes piping modifications at its existing Vidor Compressor Station in Orange County, Texas.	Temporary Impacts: 17.10 acres Permanent Impacts: 1.10 acres	None	The project commenced service in December 2018.	24 miles north of the Expansion Project in Orange, Chambers, and Brazoria Counties, TX	• FERC Prepared EA • NGA Section 7 Authorization • ESA Section 7 Consultation • Minor Source Air Permit • Oil and Gas Standard Air Permit Revisions • Unregistered Air Permit by Rule • Hydrostatic Test Waters Discharge Permit	Air Quality (Operations)
Louisiana Connector Project FERC Docket CP18-7	Construction and operation of approximately 130 miles of new 42-inch diameter natural gas pipeline, 0.5 mile of new lateral and tie-in pipelines, one (1) new compressor station, nine (9) meter stations, and auxiliary facilities in Louisiana and Texas.	Construction: 2,807 acres Operation: 771 acres	Temporary Impacts: 636.90 acres Permanent Impacts: 244.1 acres	Construction expected to begin in 2021. Proposed in-service date is anticipated to be 2023.	0 miles from the Expansion Project in Jefferson County, TX and Calcasieu and Cameron Parishes, LA	• FERC Prepared EIS (included in the Port Arthur Liquefaction Project EIS) • NGA Section 7 Authorization • CWA Section 404 Permit • RHA Section 10 of the RHA Permit • RHA Section 408 Review • CWA Section 401 Certification • Coastal Zone Consistency Determination • ESA Section 7 Consultation • Magnuson-Stevens Fishery Conservation and Management Act (MSA) and EFH Consultations • Hydrostatic Test Water Discharge Permit • PSD and Title V Operating Air Permits • NHPA Section 106 Consultation • Additional Minor Federal, State and Local Permits, Authorizations and Consultations	Surface Water Resources; Socioeconomics; Visual; Noise (Operations); Noise (Construction); Air Quality (Operations); Air Quality (Construction)

TABLE 2.8-2
Authorized, Planned, or Recently Completed Major Projects in the Vicinity of the Expansion Project Considered for Cumulative Analysis

Project	Description	Area of Disturbance	Wetland Disturbance	Construction Status	Location Relative to Expansion Project[b]	Permits and Authorizations	Environmental Resources with Potential Cumulative Impacts
Texas Connector Project FERC Docket CP18-7	Construction of 34.2 miles of 42-inch-diameter natural gas pipeline comprised of three (3) segments, two (2) new compressor stations, six (6) new meter stations, and associated auxiliary facilities.	Construction: 664.70 acres Operation: 186.10 acres	Temporary Impacts: 238.10 acres Permanent Impacts: 66.80 acres	Construction expected to start in 2021 Proposed in-service date is anticipated to be 2023.	0 miles from the Expansion Project in Jefferson and Orange Counties, TX and Cameron Parish, LA	• FERC Prepared EIS (included in the Port Arthur Liquefaction Project EIS) • NGA Section 7 Authorization • CWA Section 404 Permit • RHA Section 10 of the RHA Permit • RHA Section 408 Review • CWA Section 401 Certification • Coastal Zone Consistency Determination • ESA Section 7 Consultation • Magnuson-Stevens Fishery Conservation and Management Act (MSA) and EFH Consultations • Hydrostatic Test Water Discharge Permit • Standard Air Quality Permit for Oil and Gas Facilities • NHPA Section 106 Consultation • Additional Minor Federal, State and Local Permits, Authorizations and Consultations	Surface Water Resources; Socioeconomics; Visual; Noise (Operations); Noise (Construction); Air Quality (Operations); Air Quality (Construction)
GOVERNMENT FACILITIES/ACTIVITIES							
SNWW Channel Improvement Project (CIP)	Improvements to the SNWW, including deepening of the SNWW to Beaumont with an extension of the Entrance Channel, deepening and widening of Taylor Bayou Channel and turning basins, and tapering the Sabine Bank Channel, addition/enlargement of turning and anchorage basins along the Neches River Channel, and bend easing performed on the Sabine-Neches Canal and Neches River Channel.	2,000-square-mile study area	Permanent Impacts: 86 acres Creating 2,853 acres of emergent marsh vegetation, improving 871 acres of open water habitat, and nourishing 1,234 acres of existing marsh in Texas.	Construction began in September 2019, it is expected to take 7 to 10 years to complete the project.	0 miles from the Expansion Project in Jefferson and Orange Counties, TX	• EIS • ESA Section 7 Consultation • CWA Section 401 Water Quality Certification • Coastal Zone Consistency Determination • NHPA Section 106 Consultation	Surface Water Resources; Socioeconomics; Noise (Construction and Operation); Air Quality (Construction)
Port of Port Arthur Berth 5 Expansion Project	The Port of Port Arthur Navigation District is constructing a wharf deck, new bulkhead wall, existing bulkhead wall improvements, anchor wall, bulkhead return wall, low mast light poles and associated foundations, shoreline stabilization, dredging, filling of the Grannis Ditch, site fill, fencing, hydromulching, and other work associated with the extension of the existing dock located at the Port of Port Arthur.	Unknown	Unknown	Construction began in April 2019 Anticipated construction completion in 2020.	4 miles northeast of the Expansion Project in Jefferson County, TX	• CWA Section 404 Permit • RHA Section 10 Permit • CWA Section 401 Certificate • Coastal Zone Consistency Determination • NHPA Section 106 Consultation • Additional Minor Federal, State and Local Permits, Authorizations and Consultations	Surface Water Resources; Socioeconomics
COMMERCIAL AND RESIDENTIAL DEVELOPMENTS							

TABLE 2.8-2
Authorized, Planned, or Recently Completed Major Projects in the Vicinity of the Expansion Project Considered for Cumulative Analysis

Project	Description	Area of Disturbance	Wetland Disturbance	Construction Status	Location Relative to Expansion Project[b]	Permits and Authorizations	Environmental Resources with Potential Cumulative Impacts
RV Park in Port Arthur, TX	Proposed RV Park in Port Arthur, Texas	Unknown	Unknown	Construction status is unknown	10 miles north of the Expansion Project in Jefferson County, TX	Unknown	Air (Operations)
Hurricane Ike Replacement Home Project	Construction of new homes in Port Arthur, TX to replace homes damaged by Hurricane Ike. Locations unknown other than generally in the Port Arthur, TX area.	Unknown	Unknown	Construction status is unknown	Port Arthur, Jefferson County, TX (no exact locations known)	Unknown	Air (Operations)
420-Unit Apartment Complex in Port Arthur, TX	Proposed 420-unit apartment complex within an existing building in Port Arthur, TX.	Unknown	Unknown	Construction status is unknown	5 miles from the Expansion Project in Port Arthur, TX	Unknown	Air (Operations)
NON-JURISDICTIONAL FACILITIES							
Relocation of State Highway 87 and Third-party Pipelines and Other Utilities	The proposed location of Port Arthur LNG's marine berth on the Port Arthur Canal requires 3.3 miles of existing utilities to be relocated around the western side of the liquefaction site prior to construction of the liquefaction facilities. Following relocations, the respective owners of each utility would be responsible for interconnecting the new facilities with the old, abandoning the unused utility and pipeline segments per industry and regulatory requirements, and future operations of the facilities.	Temporary Impacts: 121 acres Permanent Impacts: 45.2	Temporary Impacts: 112.50 Permanent Impacts: 42.4 acres	Construction began in November 2019 and is expected to take 18 to 20 months to complete.	0 miles from the Expansion Project in Jefferson County, TX	Project was permitted as part of the Port Arthur Liquefaction Project.	Surface Water Resources; Socioeconomics; Visual; Noise (Operations); Noise (Construction); Air Quality (Operations); Air Quality (Construction)

[a] This table lists those projects that are most likely to contribute to the cumulative impacts within the vicinity of the proposed Expansion Project; it is not intended to provide an all-inclusive listing of projects in the region.
[b] Approximate distance listed represents the feature or facility closest to the Expansion Project.

2.8.2 Potential Cumulative Impacts of the Proposed Action

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

Surface Water and Aquatic Resources

The geographic scope for surface water resources was considered to be the hydrologic unit code (HUC) - 12 watershed. Several of the projects listed in table 2.8-2 could be under construction at the same time as the Expansion Project, and while the Expansion Project does not propose any in-water work there is potential for cumulative impacts on water quality within the HUC-12 watershed from accidental spills of hazardous fluids that reach nearby waterbodies, sediment transport, or increased shipping traffic.

Construction and operation of the Base Project, the Texas and Louisiana Connector Pipelines, Golden Pass Export Terminal and Export Pipeline Projects, the Berth 5 Expansion Project, SNWW Channel Improvement Project, and the Relocation of State Highway 87 Project could cumulatively impact surface waters and aquatic resources within the HUC-12 watershed. Surface water discharges related to hydrostatic testing could also temporarily impact these resources. Many of these projects are under the jurisdiction of the FERC and would be required to adhere to the *FERC Upland Erosion Control, Revegetation, and Maintenance Plan* (Plan) and *FERC Wetland and Waterbody Construction and Mitigation Procedures* (Procedures), and all projects would be required to adhere to applicable federal or state permit regulations. Implementation of the Applicant's Environmental Plan and any applicable federal or state regulations would minimize impacts on surface waterbodies through incorporation of best management practices and the installation of temporary and permanent erosion controls (*e.g.*, silt fence, hay bales) designed to manage stormwater runoff. In addition, each project proponent would be required to implement a SPCC Plan during construction to prevent spills, leaks, or other releases of hazardous materials that could impact surface waters. Hazardous materials entering surface waters as a result of spilled materials could have an impact on water quality and aquatic organisms. For the operation of each of the facilities, SPCC Plans would be developed or modified to incorporate the newly constructed facilities. With the implementation of these measures, cumulative impacts on surface water and aquatic resources are expected to be temporary and minor.

The Expansion Project's proposed 180 LNG ships (in addition to the Base Project's 180 LNG ships) annually during operations could impact water quality in the Port Arthur Canal and SNWW, from the resuspension of sediments by propeller wash or wave action and ballast water discharges. The additional ship traffic would not represent a significant change to ongoing activities in the Port Arthur Canal and SNWW. All

ballast water discharges would be done in accordance with federal regulations. As part of the Base Project, erosion control measures including riprap and other prevention measures would be installed along the entire length of the Base Project shoreline. Any impacts on water quality within the Port Arthur Canal or SNWW from temporary sediment resuspension, ballast water discharge, or ship hoteling are expected to be temporary and localized. Further, all LNG ships would be required to maintain and operate a Ship Oil Pollution Emergency Plan in the event of a spill. Therefore, cumulative impacts on surface water and aquatic resources as a result of increased vessel traffic would not be significant.

Socioeconomics

All the projects listed in table 2.8-2 have or would generate temporary construction jobs. Most of these projects would overlap the Expansion Project's proposed construction timeline (June 2022- the end of 2026). 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. No major impacts on local housing markets are expected during construction of the Expansion Project because the majority of the workforce hired for the Base Project would continue to work on the Expansion Project, the duration of the construction would just be expanded by about 18 months.

All the projects listed in table 2.8-2 have or would generate temporary construction jobs. 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 Expansion Project would add 84 full-time staff to the Base Project, making the total operations staff approximately 284 full-time positions. The facility would operate 24 hours/day and the 284 staff would not all work the same shift. The estimated day shift would be about 185 staff and the night shift would be about 99 staff. Additionally, condensate sales would add about 2 trucks per day. Assuming each staff drives separately, this would represent about 288 round trips per day on SH 87 during operation of the Base Project and 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 2.8-2 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.

Positive cumulative economic benefits from these projects 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. However, these impacts would not be significant.

Visual Resources

The Expansion Project, Base Project, Texas Connector and Louisiana Connector Pipeline Projects, Sabine Pass Liquefaction Expansion Project, Sabine Pass Third Berth Project, and the Golden Pass Export Terminal are the most likely projects to add visual impacts within the visual resource geographical scope. The SNWW, Port of Port Arthur, and Apartment Complex projects may also contribute to visual impacts.

The Expansion Project facilities would be constructed within the approved footprint of the Base Project site, and thus add cumulatively to the visual impact of the Base Project. However, the Expansion Project does not include the construction of a new LNG storage tank (typically the most visible LNG project component), and the Expansion Project facilities would be consistent with those of the Base Project. For these reasons, cumulative impacts as a result of the Expansion Project on visual resources are not anticipated to be significant.

Air Quality

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 geographical scope for air quality during construction of the Expansion Project is a 0.25-mile radius from the project site. Construction of the authorized Base Project is currently underway and portions would be constructed simultaneously with the Expansion Project facilities. The other projects within a 0.25-mile radius of the Terminal Expansion that would be constructed in a similar timeframe as the proposed Expansion Project are the Louisiana Connector, Texas Connector and the SNWW Channel Improvement Project; the Golden Pass Export Project is the next nearest project that would be constructed in the same timeframe at about one mile from the Expansion Project. The construction-related impacts of the authorized facilities at the Base Project and the Expansion Project would be concurrent, but these impacts would be temporary and the Applicant would minimize combustion emissions and fugitive dust as described in section 2.6.1. Because construction of the Louisiana Connector, Texas Connector and SNWW Channel Improvement Project would be linear and move from one project area to another, air emissions associated with these projects would be intermittent. Based on the intermittent and temporary nature of construction of these projects, we believe that construction of the Expansion Project 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 31.1 miles (50 km). This area encompasses Golden Pass Export Project, the Sabine Pass Liquefaction Expansion Project, the Sabine Pass Third Berth Expansion Project and other projects noted in table 2.8-2 are in this area and could to contribute to cumulative impacts on air quality in combination with the proposed Expansion Project.

Although the region in the vicinity of the Expansion Project is currently in attainment with air quality standards, increases in industrial point sources could affect local and regional air quality. Under TCEQ 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 was performed to quantitatively demonstrate that the Expansion Project operational impacts, in addition to existing major sources of air emissions in the geographic scope, 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 2.8-2) 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 TCEQ would enforce operational limitations or require emissions controls that ensure the facility's compliance with the SIP and attainment with the NAAQS. In addition, the Applicant 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 impacts on air quality as a result of the Expansion Project.

Climate Change

We received comments from the Sabin Center for Climate Change Law expressing concern about the Project's contribution to global climate change. Climate change is the variation in climate (including temperature, precipitation, humidity, wind, and other meteorological variables) over time, whether due to natural variability, human activities, or a combination of both, and cannot be characterized by an individual event or anomalous weather pattern. For example, a severe drought or particularly hot summer in a particular region is not an indication of climate change. However, a series of severe droughts or warm years that statistically alter the trend in average precipitation or temperature over decades may indicate climate change. Recent research has begun to

attribute certain extreme weather events to climate change (U.S. Global Change Research Program [USGCRP], 2018).

The leading U.S. scientific body on climate change is the USGCRP, composed of representatives from 13 federal departments and agencies.[41] The Global Change Research Act of 1990 requires the USGCRP to submit a report to the President and Congress no less than every four years that "1) integrates, evaluates, and interprets the findings of the USGCRP; 2) analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and 3) analyzes current trends in global change, both human-induced and natural, and projects major trends for the subsequent 25 to 100 years." These reports describe the state of the science relating to climate change and the effects of climate change on different regions of the United States and on various societal and environmental sectors, such as water resources, agriculture, energy use, and human health.

In 2017 and 2018, the USGCRP issued its Climate Science Special Report: Fourth National Climate Assessment, Volumes I and II (Fourth Assessment Report) (USGCRP, 2017; and USGCRP, 2018, respectively). The Fourth Assessment Report states that climate change has resulted in a wide range of impacts across every region of the country. Those impacts extend beyond atmospheric climate change alone and include changes to water resources, transportation, agriculture, ecosystems, and human health. The U.S. and the world are warming; global sea level is rising and acidifying; and certain weather events are becoming more frequent and more severe. These changes are driven by accumulation of GHG in the atmosphere through combustion of fossil fuels (coal, petroleum, and natural gas), combined with agriculture, clearing of forests, and other natural sources. These impacts have accelerated throughout the end of the 20th and into the 21st century (USGCRP 2018).

GHGs were identified by the EPA as pollutants in the context of climate change. GHG emission do not cause local impacts, it is the combined concentration in the atmosphere that causes global climate change and these are fundamentally global impacts that feedback to localized climate change impacts. Thus, the geographic scope for cumulative analysis of GHG emissions is global rather than local or regional. For example, a project 1 mile away emitting 1 ton of GHGs would contribute to climate change in a similar manner as a project 2,000 miles distant also emitting 1 ton of GHGs.

[41] 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.

Climate change is a global phenomenon; however, for this analysis, we will focus on the existing and potential cumulative climate change impacts in the Expansion Project area. The USGCRP's Fourth Assessment Report notes the following observations of environmental impacts are attributed to climate change in the Southern Great Plains and South Texas region (USGCRP, 2017; USGCRP, 2018).

- the region has experienced an increase in annual average temperature of 1°-2 °F since the early 20th century, with the greatest warming during the winter months;
- over the past 50 years, significant flooding and rainfall events followed drought in approximately one-third of the drought-affected periods in the region when compared against the early part of the 20th century;
- the number of strong (Category 4 and 5) hurricanes has increased since the early 1980s; and
- global sea level rise over the past century averaged approximately eight inches; along the Texas coastline, sea levels have risen 5-17 inches over the past 100 years depending on local topography and subsidence.

The USGCRP's Fourth Assessment Report notes the following projections of climate change impacts in the Expansion Project region with a high or very high level of confidence[42] (USGCRP, 2018):

- annual average temperatures in the Southern Great Plains are projected to increase by 3.6°–5.1 °F by the mid-21st century and by 4.4°-8.4 °F by the late 21st century, compared to the average for 1976-2005;
- the region is projected to experience an additional 30 to 60 days per year above 100 °F than it does currently;
- tropical storms are projected to be fewer in number globally, but stronger in force, exacerbating the loss of barrier islands and coastal habitats;
- southern Texas is projected to see longer dry spells, although the number of days with heavy precipitation is expected to increase by mid-century;
- longer periods of time between rainfall events may lead to declines in recharge of groundwater, which would likely lead to saltwater intrusion into shallow aquifers and decreased water availability; and
- sea level rise along the western Gulf of Mexico during the remainder of the 21st century is likely to be greater than the projected global average of 1-4

[42] The report authors assessed current scientific understanding of climate change based on available scientific literature. Each "Key Finding" listed in the report is accompanied by a confidence statement indicating the consistency of evidence or the consistency of model projections. A high level of confidence results from "moderate evidence (several sources, some consistency, methods vary and/or documentation limited, etc.), medium consensus." A very high level of confidence results from "strong evidence (established theory, multiple sources, consistent results, well documented and accepted methods, etc.), high consensus." https://science2017.globalchange.gov/chapter/front-matter-guide/

feet or more, which would result in the loss of a large portion of remaining coastal wetlands.

It should be noted that while the impacts described above taken individually may be manageable for certain communities, the impacts of compound extreme events (such as simultaneous heat and drought, wildfires associated with hot and dry conditions, or flooding associated with high precipitation on top of saturated soils) can be greater than the sum of the parts (USGCRP, 2018).

The GHG emissions associated with construction and operation of the Expansion Project were identified and quantified in section 2.6.1 of the EA. Construction and operation of the Expansion Project would increase the atmospheric concentration of GHGs in combination with past, current, and future emissions from all other sources globally and contribute incrementally to future climate change impacts.

Currently, there is no universally accepted methodology to attribute discrete, quantifiable, physical effects on the environment to the Expansion Project's incremental contribution to GHGs. We have looked at atmospheric modeling used by the EPA, National Aeronautics and Space Administration, the Intergovernmental Panel on Climate Change, and others, and we found that these models are not reasonable for project-level analysis for a number of reasons. For example, these global models are not suited to determine the incremental impact of individual projects, due to both scale and overwhelming complexity. We also reviewed simpler models and mathematical techniques to determine global physical effects caused by GHG emissions, such as increases in global atmospheric CO_2 concentrations, atmospheric forcing, or ocean CO_2 absorption. We could not identify a reliable, less complex model for this task and we are not aware of a tool to meaningfully attribute specific increases in global CO_2 concentrations, heat forcing, or similar global impacts to project-specific GHG emissions. Similarly, it is not currently possible to determine localized or regional impacts from GHG emissions from the Expansion Project.

Absent such a method for relating GHG emissions to specific resource impacts, we are not able to assess potential GHG-related impacts attributable to the Expansion Project. Additionally, we have not been able to find any GHG emission reduction goals established either at the federal level[43] or by the State of Texas.[44] Without either the ability to determine discrete resource impacts or an established target to compare GHG

[43] The national emissions reduction targets expressed in the EPA's Clean Power Plan were repealed, Greenhouse Gas Emissions From Existing Electric Utility Generating Units; Revisions to Emissions Guidelines Implementing Regulations, 84 Fed. Reg. 32,250, 32,522-32, 532 (July 8, 2019) and the United States withdrew from the Paris climate accord in November 2020.

[44] We reviewed the U.S. State Greenhouse Emission Targets site for individual state requirements at: https://www.c2es.org/document/greenhouse-gas-emissions-targets/

emissions against, we are unable to determine the significance of the Expansion Project's contribution to climate change.

Noise

The geographic scope for cumulative effects of construction-related noise was estimated to be a 0.25-mile-radius for construction and a 1-mile-radius for operations. Present and/or reasonably foreseeable projects that are within these areas and with a similar schedule as the Expansion Project include:

- For construction: the Louisiana Connector Project, the Texas Connector Project, the SNWW Channel Improvement Project, and the relocation of State Highway 87.
- For operation: SNWW Channel Improvement Project, the Golden Pass Export Terminal Project, the Golden Pass Pipeline Expansion Project, the Louisiana Connector Project, the Texas Connector Project, the relocation of State Highway 87.

Construction of the Expansion Project would require the use of heavy equipment, marine vessels, pile driving equipment, and other equipment and vehicles, all of which would generate noise. Other actions in the geographic scope of the Expansion Project would also generate noise, and cumulative impacts could occur where the location and timing of those noise effects overlap the Expansion Project noise effects. It is not known what the noise contribution would be from the SNWW Channel Improvement Project or relocation of State Highway 87; however, these projects and the Louisiana Connector Project and Texas Connector Project are transient in nature and construction would likely not overlap the entire time of the Expansion Project construction. Further, based on the analysis above, the temporary nature of construction, and that the Expansion Project's noise contribution from construction noise would generally be below the ambient noise measured at the nearby NSAs, we conclude that the Expansion Project's construction noise would not have a significant cumulative impact on nearby NSAs.

Noise decreases logarithmically with increasing distance from a noise source; therefore, cumulative operational noise impacts would only occur where other facilities or activities would occur very close to the Expansion Project's noise-emitting facilities, i.e., the liquefaction facility. Also, the cumulative noise during operation of some of the projects and facilities identified above would likely be less than during construction because they would generate little to no noise after they are built. While the South Compressor Station (part of the Texas Connector Project) is within the Base Terminal property, this electric driven station has minimal noise contribution to the Base Terminal. The project most likely to result in and contribute to cumulative noise impacts based on its proximity to the Liquefaction Project is the SNWW Channel Improvement Project. While the channel improvement project and any maintenance dredging of the SNWW

could contribute to the cumulative noise impact of NSAs near the liquefaction site, the effect would be temporary and limited to when dredging is occurring very close by. There could be cumulative noise impacts from the proposed Expansion Project, the Golden Pass Export Terminal Project, and the Golden Pass Pipeline Expansion Project at NSA #2; however, the noise attributable to the proposed Expansion Project would not be perceptible and therefore would not result in a significant cumulative impact. As such, we conclude that operation of the projects would not contribute significantly to existing noise in the area.

2.8.3 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 2.8-2 is likely to have impacts on a wide variety of environmental resources. However, construction of the Expansion Project would not significantly contribute to cumulative impacts because most of the Expansion Project's impacts are minor and temporary and would be within the previously disturbed Base Project 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.

Cumulative benefits would include enhancing the local economy through taxes, jobs, wages, and purchasing of goods and materials, but these impacts are also not expected to be significant.

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 the Applicant, 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, the Applicant 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 the Applicant to meet the purpose and need as described in section 1.3 and could require that potential end users make different arrangements to obtain LNG from other existing or planned sources, which could require an expansion similar in scope to the proposed project. 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.

Although multiple facilities have been approved by the Commission and are in various stages of development and/or construction, there are only three existing LNG export terminals in operation in the Gulf region, including: the Sabine Pass LNG Terminal near Sabine Pass, Texas; the Cameron LNG Terminal near Hackberry,

Louisiana; and the Corpus Christi LNG Terminal near Corpus Christi, Texas. Each of these operating LNG export terminals have expansion projects under construction, and in the case of Cameron LNG has an approved expansion, but it is not yet under construction.

Several companies are seeking or have obtained authorizations to construct and operate LNG liquefaction facilities and to export LNG. Table 3.3-1 lists the proposed projects and approved projects within the vicinity of the Expansion Project area, their location, capacity, and whether the project would be co-located with existing LNG facilities. Twenty-one such projects have been identified within the vicinity of the Expansion Project area: 12 are at existing LNG terminals, and 9 are at new, or greenfield, LNG liquefaction facilities. The projects, assuming all are built, would liquefy 34.4 billion cubic feet per day (Bcf/d) of natural gas. Natural gas for all the projects would come from the interstate pipeline system, allowing gas to be supplied from any location. But the supply of gas to the liquefaction facilities may be limited by pipeline capacity in a given area.

Sufficient liquefaction capacity may be available in the region if all projects are built as proposed; however, unlike common carrier natural gas, LNG cannot be accessed with an off-take connection and traded readily. Currently each project has its own load out facility designed to complement plant output and has or would have natural gas pipeline infrastructure connected to it.

As part of the Expansion Project, the Applicant requested approval from the DOE FE to export 13.5 MTPA of LNG to FTA and non-FTA nations. The DOE granted the FTA authorization on July 14, 2020. The non-FTA application is currently under review (see discussion in section 1.2). For the Applicant's customers to obtain LNG from other LNG terminals that have DOE approval for export, those terminals would need to construct additional LNG facilities to meet the export capacity proposed by Port Arthur LNG, or as approved by the DOE authorizations, when applicable. We recognize that LNG capacity may not be fully subscribed at all facilities based on contracts executed as of the writing of this EA. However, because the DOE's export approval is a determination that the export is in the public interest, we will not speculate that any portion of other LNG terminals' LNG capacity is in "excess" or available for use by Port Arthur LNG to meet the objectives of the Expansion Project.

Therefore, the other LNG export facilities listed in table 3.3-1 would have to construct facilities similar to the proposed Expansion Project to accommodate the additional volumes of LNG needed to accomplish the Expansion Project's purpose. An expansion of approved facilities would need a similar scope of facilities proposed for construction by Port Arthur LNG. Adding, or expanding, LNG facilities at other LNG terminals to accommodate Port Arthur LNG's purpose and need would result in environmental impacts that are less than, equal to, or greater than the environmental

impacts of the proposed action and may not provide a significant environmental advantage over the proposed Expansion Project. Each of the planned, proposed, or authorized projects along the Gulf Coast are listed below. We assume that each project has an equal chance of being constructed and would therefore be available as a potential alternative. However, future Commission review and market forces will ultimately decide which and how many of these facilities are built and placed into service. Expansion of these facilities to meet the Applicant's purpose for the Expansion Project would likely result in similar or greater (as all construction would be within the Base Terminal) environmental impacts as the proposed action and would not provide a significant environmental advantage. Furthermore, the Expansion Project would not result in any significant impacts. Therefore, we do not recommend any system alternatives.

TABLE 3.3-1
Gulf Coast System Alternatives

Project	Liquefaction Plant Location (Parish or County, State)	Plant Capacity a/ (Bcf/d)	Formerly LNG Regasification Unit
Operating LNG Export Terminals in the Gulf of Mexico			
Cameron LNG (Trains 1 - 3)	Cameron Parish, LA	1.8	Yes
Sabine Pass LNG (Trains 1-5)	Cameron Parish, LA	2.92	Yes
Corpus Christi (Train 1 - 2)	Corpus Christi, TX	1.43	Yes
Freeport LNG (Trains 1 – 3)	Freeport, TX	2.14	Yes
Approved LNG Export/Expansion Projects in the Gulf of Mexico Under Construction			
Sabine Pass LNG (Train 6)	Cameron Parish, LA	0.70	Yes
Corpus Christi LNG (Train 3)	Corpus Christi, TX	0.71	Yes
Venture Global Calcasieu Pass	Cameron Parish, LA	1.41	No
Golden Pass LNG	Sabine, TX	2.1	Yes
Project or Expansion Approved and Not Under Construction			
Lake Charles LNG (Trunkline LNG)	Lake Charles, LA	2.2	Yes
Driftwood LNG	Calcasieu Parish, LA	4.0	No
Magnolia LNG	Lake Charles, LA	1.08	No
Cameron LNG (Trains 4 & 5)	Cameron Parish, LA	1.41	Yes
Freeport LNG (Train 4)	Freeport, TX	0.72	Yes

TABLE 3.3-1 Gulf Coast System Alternatives			
Project	**Liquefaction Plant Location (Parish or County, State)**	**Plant Capacity a/ (Bcf/d)**	**Formerly LNG Regasification Unit**
Corpus Christi LNG (Stage 3 Project)	Corpus Christi, TX	1.4	Yes
Venture Global Plaquemines LNG	Plaquemines Parish, LA	3.4	No
Projects in the FERC Application Review or Pre-Filing Process			
Commonwealth LNG	Cameron Parish, LA	1.18	No
Fourchon LNG	Lafourche Parish, LA	0.65	No
Galveston Bay LNG	Galveston Bay, TX	1.2	No
Pointe LNG	Plaquemines Parish, LA	0.9	No
Venture Global Delta LNG	Plaquemines Parish, LA	2.8	No

3.3 Alternative Configurations and Designs

Alternative configurations of the Expansion Project site were evaluated within the Base Project site, but the number of possible alternatives was limited by the siting requirements of 49 CFR 193 and NFPA-59A and other industry or engineering standards. Regulatory requirements stipulate that potential thermal exclusion and vapor dispersion zones remain on site, or if the zones extend beyond the property lines, those areas must either be under applicant control or not be available for development. These restrictions 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. We have reviewed the Applicant's filings and believe their current configuration is a reasonable one.

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 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. Port Arthur LNG shall follow the construction procedures and mitigation measures described in its application and supplements, including responses to staff data requests and as identified in the EA, unless modified by the Order. Port Arthur 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 the OEP, or the Director's designee, **before using that modification**.

2. The Director of OEP, or the Director's designee, has delegated authority to address any requests for approvals or authorizations necessary to carry out the conditions of the Order, and take whatever steps are necessary to ensure the protection of life, health, property, and the environment during construction and operation of the Expansion Project. This authority shall allow:

    a. the modification of conditions of the Order;
    b. stop-work authority and authority to cease operation; and
    c. the imposition of any additional measures deemed necessary to ensure continued compliance with the intent of the conditions of the Order as well as the avoidance or mitigation of unforeseen adverse environmental impact resulting from Expansion Project construction and operation.

3. **Prior to any construction,** Port Arthur LNG shall file an affirmative statement with the Secretary, certified by senior company officials, that all company personnel, EIs, and contractor personnel will be informed of the EI's authority and have been or would 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 plot plans and facility diagrams. **As soon as they are available, and before the start of construction,** Port Arthur LNG shall file with the Secretary any revised detailed plans and diagrams at a scale not smaller than 1:6,000 with station positions for all facilities approved 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 plans and diagrams.

5. Port Arthur LNG shall file with the Secretary detailed maps or 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 or 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. Use of each area must be approved in writing by the Director of OEP, or the Director's designee, **before construction in or near that area**.

   This requirement does not apply to extra workspace allowed by the Commission's *Upland Erosion Control, Revegetation, and Maintenance Plan* and/or minor field realignments per landowner needs and requirements which do not affect other landowners or sensitive environmental areas such as wetlands.

   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. **At least 60 days before construction begins**, Port Arthur LNG shall file an Implementation Plan with the Secretary for review and written approval by the Director of OEP, or the Director's designee. Port Arthur LNG must file revisions to the plan as schedules change. The plan shall identify:

    a. how Port Arthur 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 Port Arthur 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 Port Arthur 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 Port Arthur LNG's organization having responsibility for compliance;
    g. the procedures (including use of contract penalties) Port Arthur 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:

        i. the completion of all required surveys and reports;
        ii. the environmental compliance training of onsite personnel;
        iii. the start of construction; and
        iv. the start and completion of restoration.

7. Port Arthur LNG shall employ at least one EI for the Expansion Project. The EI(s) 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, Port Arthur LNG shall file updated status reports with the Secretary on a **monthly** basis until all construction and restoration activities are complete. Problems of a significant magnitude shall be reported to the FERC **within 24 hours.** 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 Port Arthur LNG's efforts to obtain the necessary federal authorizations;
   b. project schedule, including current construction status of the project and work planned for the following reporting period;
   c. a listing of all problems encountered, contractor nonconformance/deficiency logs, 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 and remedial actions implemented in response to all instances of noncompliance, nonconformance, or deficiency;
   e. the effectiveness of all corrective and remedial 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 Port Arthur LNG from other federal, state, or local permitting agencies concerning instances of noncompliance, and Port Arthur LNG's response.

9. Port Arthur LNG must receive written authorization from the Director of OEP, or the Director's designee, **before commencing construction of any Expansion Project facilities.** To obtain such authorization, Port Arthur LNG must file with the Secretary documentation that it has received all

applicable authorizations required under federal law (or evidence of waiver thereof).

10. Port Arthur LNG must receive written authorization from the Director of OEP, or the Director's designee, **prior to introducing hazardous fluids into the Expansion Project facilities**. Instrumentation and controls, hazard detection, hazard control, and security components/systems necessary for the safe introduction of such fluids shall be installed and functional.

11. Port Arthur LNG must receive written authorization from the Director of OEP, or the Director's designee, **before placing into service** the Expansion Project facilities. Such authorization will only be granted following a determination that the facilities have been constructed in accordance with FERC approval, can be expected to operate safely as designed, and the rehabilitation and restoration of areas affected by the project are proceeding satisfactorily.

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

    a. that the facilities have been constructed 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 Port Arthur 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.

13. **Prior to construction**, Port Arthur LNG shall file with the Secretary, for review and written approval by the Director of OEP, or the Director's designee, a project-specific Spill Prevention, Control, and Countermeasures Plan developed in accordance with federal and state spill regulations and addressing contingency planning, spill response procedures, training, reporting, agency communications, and best management practices to prevent and control the discharge of pollutants from spill events as a result of construction activities.

14. Port Arthur LNG shall **not begin** construction of the Expansion Project **until**:

    a. FERC staff receives comments from the FWS/NMFS regarding the proposed action;
    b. FERC staff completes formal consultation with the FWS/NMFS, if required; and
    c. Port Arthur LNG receives written notification from the Director of OEP, or the Director's designee, that construction or use of mitigation may begin.

15. Port Arthur LNG shall file with the Secretary a full load noise survey of the LNG terminal **no later than 60 days** after placing each liquefaction train in service. If a full load condition noise survey is not possible, Port Arthur LNG shall file an interim survey at the maximum possible load **within 60 days** of placing each liquefaction train in service and file the full load operational survey **within 6 months**. If the noise attributable to operation of all the equipment at the terminal, under interim or full load conditions, exceeds an L_{dn} of 55 dBA at any nearby NSA, Port Arthur 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. Port Arthur 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 additional noise controls.

16. **Prior to construction of final design**, Port Arthur LNG shall file with the Secretary the following information, stamped and sealed by the professional engineer-of-record, registered in Texas:

    a. site preparation drawings and specifications;
    b. a list of the foundation systems to be used for each structure;
    c. LNG terminal structures and foundation design drawings as well as associated calculations, including prefabricated and field constructed structures;
    d. seismic specifications for procured equipment; and
    e. quality control procedures to be used for civil/structural design and construction.

17. **Prior to construction of final design**, Port Arthur LNG shall provide concurrence from the USDOT PHMSA for the stormwater removal design for any hazardous liquid impoundments that would use a drainage system, rather than stormwater pumps, including for any local curbing used as an impounding area.

Information pertaining to the following specific conditions shall be filed with the Secretary for review and written approval by the Director of OEP, or the Director's designee, within the timeframe indicated by each condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 833 (Docket No. RM16-15-000), including security information, should be submitted as critical energy infrastructure information pursuant to 18 CFR 388.113. See Critical Electric Infrastructure Security and Amending Critical Energy Infrastructure Information, Order No. 833, 81 Fed. Reg. 93,732 (December 21, 2016), FERC Stats. & Regs. 31,389 (2016). Information pertaining to items such as offsite emergency response, procedures for public notification and evacuation, and construction and operating reporting requirements will be subject to public disclosure. All information shall be filed a minimum of 30 days before approval to proceed is requested.

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

19. **Prior to initial site preparation**, Port Arthur LNG shall file procedures for controlling access during construction.

20. **Prior to initial site preparation**, Port Arthur LNG shall file quality assurance and quality control procedures for construction activities.

21. **Prior to initial site preparation**, Port Arthur LNG shall develop or update the ERP (including evacuation) to include the Expansion Project facilities and coordinate procedures, as applicable, with the Coast Guard; state, county, and local emergency planning groups; fire departments; state and local law enforcement; and appropriate federal agencies. This plan shall include for the Expansion facilities at a minimum and changes or updates for:

    a. designated contacts with state and local emergency response agencies;
    b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents; and
    c. procedures for notifying residents and recreational users within areas of potential hazard;

    Port Arthur LNG shall notify FERC staff of all planning meetings in advance and shall report progress on the development of its ERP **at 3-month intervals**.

22. **Prior to initial site preparation**, Port Arthur LNG shall file 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. This comprehensive plan shall include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. Port Arthur LNG shall notify FERC staff of all planning meetings in advance and shall report progress on the development of its Cost Sharing Plan **at 3-month intervals**

23. **Prior to construction of final design**, Port Arthur LNG shall file with the Secretary the final design package (e.g., structures and foundations drawings, design specifications, and calculations, etc.) and associated quality assurance and control procedures with the documents reviewed, approved, and stamped and sealed by the professional engineer of record in the State of Texas.

24. **Prior to construction of final design**, Port Arthur LNG shall file lighting drawings. The lighting drawings shall show the location, elevation, type of light fixture, and lux levels of the lighting system and shall illustrate adequate coverage, in accordance with federal regulations (e.g., 49 CFR 193, 29 CFR 1910, and 29 CFR 1926) and API 540 or equivalent, of the perimeter of the facility and along paths/roads of access and egress.

25. **Prior to construction of final design**, Port Arthur LNG shall file security camera and intrusion detection drawings. The security camera drawings shall show the location, areas covered, and features of each camera (e.g., fixed, tilt/pan/zoom, motion detection alerts, low light, mounting height, etc.) to verify coverage of the entire perimeter with redundancies and cameras interior to the facility to enable rapid and reliable monitoring of the facility. The intrusion detection drawings shall show or note the location of the intrusion detection to verify coverage of the entire perimeter of the facility.

26. **Prior to construction of final design**, Port Arthur LNG shall file change logs that list and explain any changes made from the front-end engineering design provided in Port Arthur LNG's application and filings. A list of all changes with an explanation for the design alteration shall be filed and all changes shall be clearly indicated on all diagrams and drawings.

27. **Prior to construction of the final design**, Port Arthur LNG shall file information/revisions pertaining to its responses to numbers 69, 72, 90, 92, 95, 96,, 99, 100,, 109, and 112 of the June 5, 2020 information request, which indicated features to be included or considered in the final design.

28. **Prior to construction of final design,** Port Arthur LNG shall file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems.

29. **Prior to construction of final design**, Port Arthur LNG shall file three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion.

30. **Prior to construction of final design**, Port Arthur LNG shall file an up-to-date equipment list, process and mechanical data sheets, and specifications. The specifications shall include:

    a. building specifications (e.g., control buildings, electrical buildings, compressor buildings, storage buildings, pressurized buildings, ventilated buildings, blast resistant buildings);
    b. mechanical specifications (e.g., piping, valve, insulation, rotating equipment, heat exchanger, storage tank and vessel, other specialized equipment);
    c. electrical and instrumentation specifications (e.g., power system, control system, safety instrument system [SIS], cable, other electrical and instrumentation); and
    d. security and fire safety specifications (e.g., security, passive protection, hazard detection, hazard control, firewater).

31. **Prior to construction of final design**, Port Arthur LNG shall file up-to-date process flow diagrams (PFDs) and piping and instrument diagrams (P&IDs) including vendor P&IDs. The PFDs shall include heat and material balances. The P&IDs shall 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 size and set points.
    i. drawing revision number and date.

32. **Prior to construction of final design**, Port Arthur LNG shall file P&IDs, specifications, and procedures that clearly show and specify the tie-in

details required to safely connect subsequently constructed facilities with the operational facilities.

33. **Prior to construction of final design**, Port Arthur LNG shall file a car seal philosophy and a list of all car-sealed and locked valves consistent with the P&IDs.

34. **Prior to construction of final design**, Port Arthur LNG shall file the safe operating limits (upper and lower), alarm and shutdown set points for all instrumentation (e.g., temperature, pressures, flows, and compositions).

35. **Prior to construction of final design**, Port Arthur LNG shall verify that the recommendations from the front-end engineering design Hazard Identification study are complete and consistent with the requirements of the final design as determined by the engineering, procurement, and construction contractor.

36. **Prior to construction of final design**, Port Arthur LNG shall file cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system for review and written approval. The cause-and-effect matrices shall include alarms and shutdown functions, details of the voting and shutdown logic, and set points.

37. **Prior to construction of final design**, Port Arthur LNG shall specify that all ESD valves are to be equipped with open and closed position switches connected to the Distributed Control System (DCS)/SIS.

38. **Prior to construction of final design**, Port Arthur LNG shall file an evaluation of ESD valve closure times. The evaluation shall account for the time to detect an upset or hazardous condition, notify plant personnel, and close the ESD valve.

39. **Prior to construction of final design**, Port Arthur LNG shall file an evaluation of dynamic pressure surge effects from valve opening and closure times and pump startup and shutdown operations.

40. **Prior to construction of final design**, Port Arthur LNG shall file a HAZOP review of the final design P&IDs, a list of resulting recommendations, and action taken on the recommendations. In addition, Port Arthur LNG shall file action taken on the recommendations resulting from the HAZID review. The issued for construction P&IDs shall incorporate the HAZID and HAZOP recommendations and justification shall be provided for any recommendations that are not implemented.

41. **Prior to construction of final design**, Port Arthur LNG shall file an evaluation assessing the minimum design metal temperature and material of construction needed for the deethanizer, depropanizer, reboiler, and piping during upset/settle out conditions.

42. **Prior to construction of final design**, Port Arthur LNG shall file process simulation results for the deethanizer, depropanizer depressurized conditions to ensure the associated deethanizer, deepropanizer, reboiler, piping, and other associated equipment are adequately designed for settle out and upset conditions to prevent brittle fracture of piping and associated equipment.

43. **Prior to construction of final design**, Port Arthur LNG 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.

44. **Prior to construction of final design**, Port Arthur LNG shall file the sizing basis and capacity for the final design of the flares and/or vent stacks as well as the pressure and vacuum relief valves for major process equipment, vessels, and storage tanks.

45. **Prior to construction of final design**, Port Arthur LNG shall install thermal relief valves in piping segments that can be isolated by valves unless it can be demonstrated that thermal expansion will not overpressurize the piping or has other protective measures (e.g., drilled check valves) that will prevent overpressurization (e.g., car seals or locks).

46. **Prior to construction of final design**, Port Arthur LNG shall file an evaluation of the need to install pressure relieving protection for flammable liquid piping segments (i.e., refrigerants, liquid hydrocarbons, condensate products) that can be isolated by valves in the event of a fire.

47. **Prior to construction of final design**, Port Arthur LNG shall specify that all drains from high pressure hazardous fluid systems are equipped with double isolation and bleed valves.

48. **Prior to construction of final design**, Port Arthur LNG shall specify that piping and equipment that may be cooled with liquid nitrogen is to be designed for liquid nitrogen temperatures, with regard to allowable movement and stresses.

49. **Prior to construction of final design**, Port Arthur LNG shall file detailed cooldown plans showing the piping flow paths, valve alignment, and instruments used to monitor the initial cooldown and filling of the LNG storage tanks.

50. **Prior to construction of final design**, Port Arthur LNG shall install fixed gas detection in areas that toxic concentrations of H2S (i.e., AEGL-1, -2, or –3) could reach people if there is a release from loss of containment from the acid gas piping system and potential release points (i.e., vents, relief valves, vent stacks, and thermal oxidizer stack) unless it can be demonstrated through filed hazard modeling that toxic concentrations will not be reached where people could be located.

51. **Prior to construction of final design**, Port Arthur LNG shall include provisions to maintain stability and pressure of the regenerator in the event that the H_2S scavenger or thermal oxidizer are unavailable (e.g., change out, maintenance, startup, etc.).

52. **Prior to construction of final design**, Port Arthur LNG shall include provisions to prevent cryogenic fluids accumulated in the dry flare knockout drum from reaching the wet flare knockout drum, which are connected by the dry flare knockout drum drain line to the blow case purge to the wet flare knockout drum.

53. **Prior to construction of final design**, Port Arthur LNG shall include details of the flare knockout drum heater and detailed procedures for draining flare knockout drums to a safe location.

54. **Prior to construction of final design**, Port Arthur LNG shall file detailed calculations for the flow rate of the jockey pumps accounting for flow rate losses due to leaks or when drain valves are opened to ensure that system losses do not exceed the specified design flow rate of the jockey firewater pumps.

55. **Prior to construction of final design**, Port Arthur LNG shall provide the final specifications for all equipment and a list of all applicable codes and standards and recommended practices referenced in the specifications that cross-references the specification(s) where those codes and standards and recommended practices are referenced.

56. **Prior to construction of final design**, Port Arthur LNG shall file an updated fire protection evaluation of the proposed facilities. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations shall be filed. The evaluation shall

justify the type, quantity, and location of hazard detection and hazard control, passive fire protection, ESD and depressurizing systems, firewater, and emergency response equipment, training, and qualifications in accordance with NFPA 59A (2001). The justification for the flammable and combustible gas detection and flame and heat detection shall be in accordance with ISA 84.00.07 or equivalent methodologies that will demonstrate 90 percent or more of releases (unignited and ignited) that could result in an off-site or cascading impact will be detected by two or more detectors and result in isolation and de-inventory within 10 minutes, or less for impoundments that are not sized for 10 minute releases and de-inventory. The analysis shall take into account the set points, voting logic, wind speeds, and wind directions. The justification for firewater shall provide evaluation of the total area that may experience firewater demand due to each governing scenario; calculations for all firewater demands (including firewater coverage on the LNG storage tanks) based on design densities, surface area, and throw distance; and specifications for the corresponding hydrants and monitors needed to reach and cool equipment.

57. **Prior to construction of final design**, Port Arthur LNG shall file spill containment system drawings with dimensions and slopes of curbing, troughs, impoundments, and capacity calculations considering any foundations and equipment within impoundments. The spill containment drawings shall show containment for all components that could contain hazardous liquids, including all liquids handled above their flashpoint and those with toxic or asphyxiant vapor hazards, from the largest flow from a single line for 10 minutes, including de-inventory, and specifying a reliability equivalent to SIL 2 or higher for any pump interlock systems, or the maximum liquid from the largest vessel (or total of impounded vessels), or otherwise demonstrate that providing spill containment will not significantly reduce the vapor dispersion or radiant heat consequences of a spill - including for hot oil spills near the heater and train utility areas, as well as the condensate truck loading stations, and the flare knockout drums. Spill containment systems shall be constructed of materials that can withstand the liquid hazards. Also, Port Arthur LNG shall file an analysis demonstrating that an ignited sizing spill from the condensate truck loading line in the truck loading impoundment will not overflow due to firewater usage or subsequent release from the truck, unless providing additional impoundment capacity will not significantly reduce the vapor dispersion or radiant heat consequences of the initial spill.

58. **Prior to construction of final design**, Port Arthur LNG shall file a technical review of facility design, using an up-to-date plot plan that includes facilities for both the Base and Expansion projects, that:

a. identifies all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and
b. demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices will isolate or shutdown any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency.

59. **Prior to construction of the final design**, Port Arthur LNG shall file a building siting assessment, using an up-to-date plot plan that includes facilities for both the Base and Expansion projects, demonstrating that occupied buildings and buildings critical to the safety of the LNG plant will be able to withstand radiant heats from pool fires, as well as jet fires and overpressures and projectiles from vapor cloud explosions from ignition of flammable vapors generated from a design spill release (e.g., 2-inch to 4-inch diameter). Alternatively, Port Arthur LNG shall file an analysis demonstrating the occupied buildings and buildings critical to the safety of the LNG plant have been relocated or provided with passive and active measures that will prevent impacts.

60. **Prior to construction of final design**, Port Arthur LNG shall file the detailed design of the measures to prevent flammable vapors from accumulating underneath an LNG storage tank or plant building or demonstrate that ignition of any flammable vapors reaching underneath an LNG storage tank or plant building from a design spill release (e.g., 2-inch to 4-inch diameter) will not lead to cascading damage or significant safety hazards. Port Arthur LNG shall also file an analysis demonstrating that ignition of flammable vapor in the pipe sleeves in the condensate truck loading impoundment could not produce overpressures that could cause cascading damage or significant safety hazards.

61. **Prior to construction of final design**, Port Arthur LNG shall file an analysis that demonstrates safety-related equipment (e.g., firewater pumps and other emergency equipment) as well as an analysis that the LNG storage tanks, refrigerant storage tanks, and berthed LNG ships will be able to withstand overpressures and projectiles from vapor cloud explosions from ignition of flammable vapors generated from a design spill release.

62. **Prior to construction of final design**, Port Arthur LNG shall file an analysis of the structural integrity of the outer containment of the full containment LNG storage tanks, demonstrating it can to withstand the heat flux from an adjacent tank top fire for 2 hours, considering representative target elevations.

63. **Prior to construction of final design**, Port Arthur LNG shall file details demonstrating that LNG storage tanks will be protected from radiant heat flux levels above the design specification from a spill impoundment fire for 2 hours by a system with a reliability equivalent to a SIL 3 system.

64. **Prior to construction of final design**, Port Arthur LNG shall file a detailed quantitative analysis to demonstrate that adequate thermal mitigation will be provided for each pressure vessel that could fail within the 4,000 BTU/ft^2-hr zone from a pool or jet fire; and each critical structural component and emergency equipment item that could fail within the 4,900 BTU/ft^2-hr from a pool or jet fire, including the firewater pumps and tank. Trucks at transfer stations shall be included in the analysis of potential pressure vessel failures. Mitigation measures to protect the above facilities from radiant heat from a spill impoundment shall be demonstrated to have a reliability equivalent to a SIL 3 system. A combination of passive and active protection for pool fires and passive and/or active protection for jet fires shall be provided and effectiveness and reliability shall be demonstrated. Effectiveness of passive mitigation shall be supported by calculations or test results for the thickness limiting temperature rise over the fire duration, and active mitigation shall be supported by reliability information by calculations or test results, such as demonstrating flow rates and durations of any cooling water will mitigate the heat absorbed by the component. The total firewater demand shall account for all components that could fail due to a pool or jet fire.

65. **Prior to construction of the final design**, Port Arthur LNG shall file calculations demonstrating that the storm surge barrier will prevent adverse impacts (i.e., 1 psi overpressure) due to a potential vapor cloud ignition event within the plant from reaching highway users or shall install other mitigation that will prevent adverse impacts from reaching highway users.

66. **Prior to construction of final design**, Port Arthur LNG shall file all electrical area classification drawings.

67. **Prior to construction of final design**, Port Arthur LNG shall provide documentation justifying the use of API RP 500's Figure 51 as a representation of Detail 'B' of the Electrical Area Classification drawing using hazard modeling of various release rates from equivalent hole sizes (see NFPA 497 release rate of 1lb/min) or modify the electrical area classification drawings to be consistent with the most applicable Figure of API RP 500.

68. **Prior to construction of final design**, Port Arthur LNG shall file 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 (2001).

69. **Prior to construction of final design**, Port Arthur LNG shall file details of 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 will continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems.

70. **Prior to construction of final design**, Port Arthur LNG shall file a drawing showing the location of the ESD buttons. ESD buttons shall be easily accessible, conspicuously labeled, and located in an area which will be accessible during an emergency.

71. **Prior to construction of final design**, Port Arthur LNG shall file specifications and vendor datasheets, fire safety specifications, including hazard detection, hazard control, and firewater systems of the final design.

72. **Prior to construction of final design**, Port Arthur LNG shall provide low oxygen detectors to notify operators of liquid nitrogen releases.

73. **Prior to construction of final design**, Port Arthur LNG shall provide ventilation in buildings handling flammable and combustible fluids that limits concentrations below the LFLs (e.g., 25-percent LFL), including from off gassing of hydrogen in battery rooms, and shall also provide hydrogen detectors that alarm (e.g., 20- to 25-percent LFL) and initiate mitigative actions (e.g., 40- to 50 percent LFL) in accordance with NFPA 59A and NFPA 70, or equivalents. The adequacy of the ventilation to limit concentrations below the LFL shall be demonstrated through calculations or analysis of the buildings containing flammable and combustible fluids in accordance with NFPA 59A, NFPA 70, or equivalent.

74. **Prior to construction of final design**, Port Arthur LNG shall file complete 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 indication locations, and shutdown functions of the hazard detection equipment.

75. **Prior to construction of final design**, Port Arthur LNG shall file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of the hazard detectors when determining the lower

flammable limit set points for methane, propane, butane, ethane, and condensate.

76. **Prior to construction of final design**, Port Arthur LNG shall file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of hazard detectors when determining the set points for toxic components such as aqueous ammonia, natural gas liquids, and H_2S.

77. **Prior to construction of final design**, Port Arthur LNG shall provide hazard detection equipment suitable to detect high temperatures and smoldering combustion products in electrical buildings and control room buildings. This information shall be shown on filed hazard detection drawings.

78. **Prior to construction of final design**, Port Arthur LNG shall file an evaluation of the voting logic and voting degradation for hazard detectors.

79. **Prior to construction of final design**, Port Arthur LNG shall file facility plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Plan drawings shall clearly show the location and elevation by tag number of all fixed dry chemical systems in accordance with NFPA 17, wheeled and handheld extinguishers location and travel distances are along normal paths of access and egress and in accordance with NFPA 10. The list shall include the equipment tag number, manufacturer and model, agent type, agent capacity, discharge rate, and automatic and manual remote signals initiating discharge of the units, and equipment covered.

80. **Prior to construction of final design**, Port Arthur LNG shall file a design that includes clean agent systems in the instrumentation and electrical equipment buildings that serve safety and security systems.

81. **Prior to construction of final design**, Port Arthur LNG shall file facility plan drawings showing the proposed location of the firewater and any foam systems. Plan drawings shall clearly show the location of firewater and foam piping, post indicator valves, and the location and area covered by, each monitor, hydrant, hose, water curtain, deluge system, foam system, water-mist system, and sprinkler. The drawings shall demonstrate that each process area, fire zone, or other sections of piping with several users can be isolated with post indicator valves and that firewater coverage is provided by at least two monitors or hydrants with sufficient firewater flow to cool exposed surfaces subjected to a fire. In addition, the drawings shall include piping and instrumentation diagrams of the firewater and foam systems. The firewater coverage drawings shall illustrate firewater coverage by two

or more hydrants or monitors accounting for obstructions (or deluge systems) for all areas that contain flammable or combustible fluids.

82. **Prior to construction of final design**, Port Arthur LNG shall specify remotely operated or automatic firewater monitors in areas that are inaccessible or difficult to access in the event of an emergency.

83. **Prior to construction of final design**, Port Arthur LNG shall demonstrate that the firewater tank will be in compliance with NFPA 22 or an equivalent or better level of safety.

84. **Prior to construction of final design**, Port Arthur LNG shall file detailed calculations to confirm that the final fire water volumes will be accounted for when evaluating the capacity of the impoundment system during a spill and fire scenario.

85. **Prior to construction of final design**, Port Arthur LNG shall specify that the firewater flow test meter is equipped with a transmitter and that a pressure transmitter is installed upstream of the flow transmitter. The flow transmitter and pressure transmitter shall be connected to the DCS and recorded.

86. **Prior to construction of final design**, Port Arthur LNG shall specify that the firewater pump shelter is designed with a removable roof for maintenance access to the firewater pumps.

87. **Prior to construction of final design**, Port Arthur LNG shall demonstrate the firewater tank capacity is designed to account for the fire water required for foam generation in calculating the total fire water required for 2 hours of supply. This information shall be demonstrated through filing calculations of the firewater demand used to size the firewater tank and through filing of tank drawings.

88. **Prior to construction of final design**, Port Arthur LNG shall file drawings and specifications for the passive protection systems to protect equipment and supports from cold temperature releases.

89. **Prior to construction of final design**, Port Arthur LNG shall file calculations or test results for the structural passive protection systems to demonstrate that equipment and supports are protected from cryogenic releases.

90. **Prior to construction of final design**, Port Arthur LNG shall file drawings and specifications for the structural passive protection systems to demonstrate the equipment and supports are protected from pool and jet

fires, including that the fireproofing material will remain effective after potential exposure to the cold temperature of pooling, jetting, or splashing liquids.

91. **Prior to construction of final design**, Port Arthur LNG shall use a model that can accommodate the actual liquid properties of a condensate fire to demonstrate the effectiveness of the active and passive mitigation protecting the refrigerant storage vessels from an adjacent condensate storage fire. Alternatively, provide documentation that demonstrates how the active and passive mitigation systems adequately protect the refrigerant storage vessels from the associated radiant heat emitted from the condensate storage impoundment.

92. **Prior to the construction of final design**, Port Arthur LNG shall relocate the Powerhouse (PH0-80002) and Firewater Tank to an area outside of the 4,900 BTU/ft^2-hr thermal radiant heat zone from any impoundment fire or demonstrate that active and passive mitigation systems are effective to address the potential radiant heat zones.

93. **Prior to construction of final design**, Port Arthur LNG shall file specifications and drawings demonstrating that cascading damage of transformers will be prevented (e.g., firewalls or spacing) in accordance with NFPA 850 or equivalent.

94. **Prior to construction of final design**, Port Arthur LNG shall file drawings of internal road vehicle protections, such as guard rails, barriers, and bollards to protect all equipment containing hazardous fluids or that are safety related (e.g., hydrants and monitors) to ensure that they are located away from roadway or protected from inadvertent damage from vehicles.

95. **Prior to construction of final design**, Port Arthur LNG shall file detailed final design and Flaring Load and Venting Capacities and Sizing study to ensure the ground flare systems sized adequately.

96. **Prior to commissioning**, Port Arthur LNG shall file 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. Port Arthur 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.

97. **Prior to commissioning**, Port Arthur LNG shall file detailed plans and procedures for: testing the integrity of on-site mechanical installation;

functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service.

98. **Prior to commissioning**, Port Arthur LNG shall file the procedures for pressure/leak tests which address the requirements of ASME BPVC section VIII and ASME B31.3. The procedures shall include a line list of pneumatic and hydrostatic test pressures.

99. **Prior to commissioning**, Port Arthur LNG shall file a plan for clean-out, dry-out, purging, and tightness testing. This plan shall address the requirements of the American Gas Association's Purging Principles and Practice and shall provide justification if not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing.

100. **Prior to commissioning**, Port Arthur LNG shall file the operation and maintenance procedures and manuals, as well as safety procedures, hot work procedures and permits, abnormal operating conditions reporting procedures, simultaneous operations procedures, and management of change procedures and forms.

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

102. **Prior to commissioning**, Port Arthur LNG shall file a plan to maintain a detailed training log to demonstrate that operating, maintenance, and emergency staff has completed the required training. In addition, Port Arthur LNG shall file signed documentation that demonstrates training has been conducted, including ESD and response procedures, prior to the respective operation.

103. **Prior to introduction of hazardous fluids**, Port Arthur LNG shall complete and document all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the DCS/SIS that demonstrates full functionality and operability of the system.

104. **Prior to introduction of hazardous fluids**, Port Arthur LNG shall develop and implement an alarm management program to reduce alarm complacency and maximize the effectiveness of operator response to alarms.

105. **Prior to introduction of hazardous fluids**, Port Arthur LNG shall complete and document 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).

106. **Prior to introduction of hazardous fluids**, Port Arthur LNG shall complete and document a pre-startup safety review to ensure that installed equipment meets the design and operating intent of the facility. The pre-startup safety review shall include any changes since the last hazard review, operating procedures, and operator training. A copy of the review with a list of recommendations, and actions taken on each recommendation, shall be filed.

107. Port Arthur LNG shall file a request for written authorization from the Director of OEP or the Director's designee **prior to unloading or loading the first LNG commissioning cargo**. After production of first LNG, Port Arthur LNG shall file **weekly reports** on the commissioning of the proposed systems that detail the progress toward demonstrating the facilities can safely and reliably operate at or near the design production rate. The reports shall include a summary of activities, problems encountered, and remedial actions taken. The weekly reports shall also include the latest commissioning schedule, including projected and actual LNG production by each liquefaction train, LNG storage inventories in each storage tank, and the number of anticipated and actual LNG commissioning cargoes, along with the associated volumes loaded or unloaded. Further, the weekly reports shall include a status and list of all planned and completed safety and reliability tests, work authorizations, and punch list items. Problems of significant magnitude shall be reported to the FERC **within 24 hours**.

108. **Prior to commencement of service**, Port Arthur LNG shall notify the FERC staff of any proposed revisions to the security plan and physical security of the plant.

109. **Prior to commencement of service**, Port Arthur LNG shall label piping with fluid service and direction of flow in the field, in addition to the pipe labeling requirements of NFPA 59A (2001).

110. **Prior to commencement of service**, Port Arthur LNG shall provide plans for any preventative and predictive maintenance program that performs periodic or continuous equipment condition monitoring.

111. **Prior to commencement of service**, Port Arthur LNG shall develop procedures for handling off-site contractors including responsibilities, restrictions, and limitations and for supervision of these contractors by Port Arthur LNG staff.

112. **Prior to commencement of service**, Port Arthur LNG shall file a request for written authorization from the Director of OEP or the Director's designee. Such authorization will only be granted following a determination by the Coast Guard, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the MTSA of 2002, and the Safety and Accountability For Every Port Act, that appropriate measures to ensure the safety and security of the facility and the waterway have been put into place by Port Arthur LNG or other appropriate parties.

In addition, the following measures shall apply <u>throughout the life</u> of Port Arthur LNG's Expansion Project facilities, unless otherwise specified:

113. 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, Port Arthur LNG shall file information in response 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, shall be filed.

114. **Semi-annual** operational reports shall be filed with the Secretary to identify changes in facility design and operating conditions; abnormal operating experiences; activities (e.g., ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil off/flash gas); and plant modifications, including future plans and progress thereof. Abnormalities shall include, but not be limited to, unloading/loading/shipping problems, potential hazardous conditions from offsite 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 fluids releases, fires involving hazardous fluids and/or from other sources, 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)" shall be included in the semi-annual operational reports.

Such information would provide the FERC staff with early notice of anticipated future construction/maintenance at the LNG facilities.

115. In the event the temperature of any region of the LNG storage container, including any secondary containment and 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 shall be specified.

116. Significant non-scheduled events, including safety-related incidents (e.g., LNG, condensate, refrigerant, or natural gas 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 that 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 Plant'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 from hazardous fluids transportation occurring at or en route to and from the LNG facility; 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 or the Director's designee 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 liquefaction 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 shall include investigation results and recommendations to minimize a reoccurrence of the incident.

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