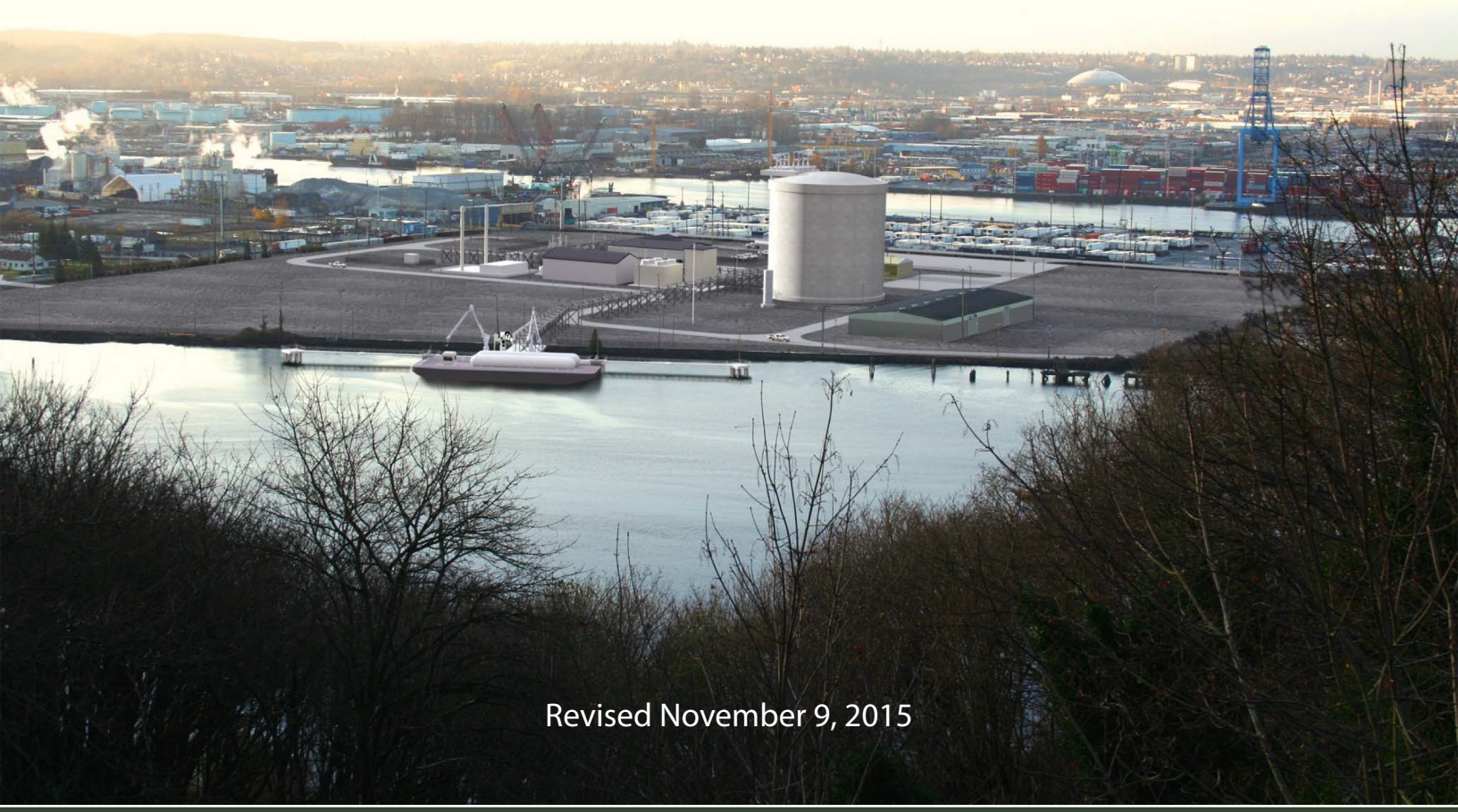
Section 3.5 – Health and Safety, Puget Sound Energy Proposed Tacoma Liquefied Natural Gas Project Final Environmental Impact Statement (Excerpt) (11/9/2015)

Puget Sound Energy
Proposed Tacoma Liquefied Natural Gas Project
Final Environmental Impact Statement

Prepared for:

Tacoma



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3.5 Health and Safety

This section describes potential health and safety impacts that may result from the proposed Tacoma Liquefied Natural Gas (LNG) Project and related natural gas pipeline (referred to herein as the Project) during its construction, operation, and decommissioning (herein referred to as the Proposed Action).

A description of LNG properties in general provides useful context for this discussion of health and safety as related to the proposed Project. LNG properties typically function as follows (see also Section 2.2.1.1 [Overview]).

- LNG is natural gas in its liquid state. To reach the liquid state, natural gas is cooled to -260 degrees Fahrenheit (°F). Similar to natural gas in a vapor state, LNG is odorless, colorless, noncorrosive, and nontoxic. LNG has a density of approximately 26.5 pounds per cubic foot and is neither flammable nor explosive. Upon conversion to liquid form, LNG collapses to occupy a volume that is 1/600 the original volume in its gaseous form. In a liquid form, LNG is stored at or near atmospheric pressure (less than 3 pounds per square inch gauge [psig]).
- LNG vaporizes rapidly on contact with a temperature greater than its own. At -259°F, LNG becomes a vapor. Between -259°F and -160°F, LNG vapor is heavier than air and pools at the ground level in collection pools or sumps. Vapor captured in the sumps continues to warm, and, at -160°F, becomes buoyant, rises, and rapidly disperses into the atmosphere.
- In the type of system that would be used by the proposed Project, LNG is produced using a mixed refrigerant design process. This closed loop system employs a specific, but adjustable, mixture of methane, ethylene, propane, isopentane, and nitrogen as the refrigerant. The refrigerant passes through heat exchangers to cool the gas stream to liquid (cryogenic) temperature.

3.5.1 Study Methodology

This section describes the methodology used to determine potential impacts to health and safety with the Proposed Action area. The Project would cross the jurisdictions of the City of Tacoma, City of Fife, and unincorporated Pierce County (see Figure 1-2 in Chapter 1 [Purpose, Need, and Alternatives Considered]). Potential impacts to health and safety were evaluated based on the applicable federal, state, and local regulations for both LNG facilities and natural gas pipelines. As discussed in Section 3.5.2 (Regulatory Framework), a review was conducted of the applicable health and safety regulations for these activities in both marine and terrestrial environments. This section examines the safety and health implications of delivering natural gas to the Tacoma LNG Facility and the processing of natural gas into its liquefied state. It also addresses handling of the product, including unplanned incidents of release of natural gas in a vapor or liquefied form and the release of other hazardous materials.

3.5.2 Regulatory Framework

3.5.2.1 Siting and Design of LNG Facilities

As detailed in Chapter 2 (Description of Proposed Action), Tacoma LNG would consist of three major components: (1) Tacoma LNG Facility, (2) Totem Ocean Trailer Express (TOTE) Marine Vessel LNG Fueling System, and (3) associated improvement to the existing Puget Sound Energy (PSE) Natural Gas Distribution System. Each major component would be subject to federal, state, and local regulations focused on siting, design, construction, operation, maintenance, and security for these components.

With regard to health and safety, these regulations and their referenced codes ensure that the facility would be (1) sited to minimize risk to the general public, (2) designed, operated, and maintained to minimize the risk of inadvertent release and to implement safety mechanisms for protecting worker and public safety, and (3) secured against threats of intentional acts of destruction. The federal, state, and local regulations

affect facility design and implementation across numerous elements of the natural and built environment, including the following:

- Siting, design, construction, operation, and maintenance of the Tacoma LNG Facility are federally regulated by the Pipeline Hazardous Materials Safety Administration (PHMSA) under LNG Facilities: Federal Safety Standards (49 *Code of Federal Regulation* [CFR] 193 et al.), which incorporate by reference the National Fire Protection Association (NFPA) Standard for the Production, Storage, and Handling of LNG (NFPA 59A), in addition to many other national standards.
- Design, construction, operation, and maintenance of the marine loading of LNG to vessels are federally regulated by the United States Coast Guard (Coast Guard) under Waterfront Facilities Liquefied Natural Gas (33 CFR 127 et. al.) and Liquefied Hazardous Gas (33 CFR 127 et. al.), as well as by the LNG Facilities: Federal Safety Standards (49 CFR 193).
- Facility security for the proposed Project is regulated by the USCG under Maritime Security: Facilities (33 CFR 105), as well as LNG Facilities: Federal Safety Standards (49 CFR 193).
- Tanker truck loading activities would be required to meet the United States Department of Transportation requirements under 49 CFR 172, 173, and 177.
- The Washington Utilities and Transportation Commission (WUTC) adopted by reference the federal LNG facility standards (49 CFR 193) under Washington Administrative Code (WAC) 480-93, Gas Companies - Safety. Under certification by PHMSA, the WUTC Pipeline Safety Office would provide oversight of the proper design and construction of the proposed Project, as well as ongoing oversight of Project operations.
- The City of Tacoma also implements NFPA 59A (currently the 2009 edition) through its adoption of the Washington State Fire Code adopted in the Tacoma City Code, Title 3 - Fire.

Tacoma LNG Facility and TOTE Marine Vessel LNG Fueling System

Proposed LNG development activities in relation to environmental health, safety, and security are federally regulated by PHMSA and the Coast Guard. In addition to federal regulations, there are also state and local regulations related to the health and safety aspects of the Tacoma LNG Facility and TOTE Marine Vessel LNG Fueling System.

Federal

The federal government is primarily responsible for developing and enforcing LNG facility safety and siting regulations. The following federal regulations apply to the Project:

- Title 49 CFR 193 – LNG Facilities: Federal Safety Standards. The Proposed Action must comply with the provisions of 49 CFR 193 and the numerous standards and codes that are incorporated by reference, including NFPA 59A Standard for the Production, Storage, and Handling of LNG. NFPA 59A incorporates by reference the requirements of more than 25 additional NFPA standards and requirements, including:
  - American Concrete Institute
  - American Petroleum Institute
  - American Society of Mechanical Engineers
  - American Society for Testing and Materials
- Compliance with these federal regulations and related standards and codes is under the jurisdiction of PHMSA. Enforcement authority is delegated to the WUTC, as an agent for PHMSA.
- Title 33 of the CFR, Parts 1 through 199, provide for the Coast Guard to exercise regulatory authority over various aspects of waterfront facilities. The most relevant sections of 33 CFR are as follows:

– Part 127 Subparts A and B - Waterfront Facilities Handling Liquefied Natural Gas and Liquefied Hazardous Gas. These subparts ensure that a minimum level of safety is provided for LNG transfer operations conducted between shore structures and marine vessels. The subparts outline requirements pertaining to general information, general design, equipment, operations, maintenance, firefighting, and security.

  As noted in "Tacoma LNG Facility and TOTE Marine Vessel LNG Fueling System," above, Coast Guard marine safety programs are described in Navigation and Vessel Inspection Circular 01-11 *Guidance Related to Waterfront Liquefied Natural Gas (LNG) Facilities*, dated January 24, 2011, and in 33 CFR 127. In compliance with these programs, new LNG waterfront projects (facilities transferring LNG to or from vessels) must perform a waterway suitability assessment (WSA) developed in collaboration with the Coast Guard, prior to the Coast Guard issuing a Letter of Recommendation to operate. In accordance with 33 CFR 127, the WSA must consist of a Preliminary WSA and a Follow-on WSA, as described in Section 3.11.6 (Avoidance, Minimization, and Mitigation).

  PSE submitted a Preliminary WSA in December 2014. The Coast Guard Safety and Security Risk Assessment Exercise was conducted over two days in March 2015. The WSA will be revised to incorporate comments received from the Coast Guard on the previous submittal, as well as to incorporate the results of the risk assessment. The next WSA revision is expected to be submitted in May or June 2015 and will be revised periodically over the life of the proposed Project, per Coast Guard requirements.

- Part 105 – Maritime Security: Facilities. This part requires vessels and port facilities to develop security plans and conduct assessments of facility vulnerabilities.
- 49 CFR 172, 173, 177 and 29 CFR 1910: These parts regulate the transport of LNG by highway, and provide safety standards applicable to various activities that would be conducted at the Tacoma LNG Facility.

See Table 3.5-1. for Key Elements in the Federal Regulations, Codes, Standards, and Guidelines.

Table 3.5-1 Key Elements Required Under Each Regulation, Code, Standard or Guidelines of EPA, PHMSA, and NFPA

Key Elements	Coast Guard 33 CFR 127	PHMSA 49 CFR 193	NFPA 59A
Emergency Response Program			
Emergency Response Program: Preplanning and training to make employees aware of, and able to execute, proper actions in the event of an emergency.	✓	✓	✓
Operations Manual			
Operating Manual: Comprehensive documentation addressing full scope of bunkering operations, including operating conditions, required equipment, equipment compatibility, mooring, prestart checks, connection, transfer, disconnection, shutdown, safety equipment, training, communications, simultaneous operations and emergency operations.	✓		✓
Operating Procedures: (Similar to Operating Manual and can be in a combined document) Documents providing clear instructions for safely conducting activities, which covers operating limits and steps for conducting each operating stage.		✓	✓

Table 3.5-1 Key Elements Required Under Each Regulation, Code, Standard or Guidelines of EPA, PHMSA, and NFPA

Key Elements	Coast Guard 33 CFR 127	PHMSA 49 CFR 193	NFPA 59A
Mechanical Integrity/Maintenance Program: Establish and implement written procedures to maintain the on-going integrity of pressure vessels, storage tanks, piping systems, valves, relief/vent systems, emergency shutdown systems, controls and pumps.		✓	✓
Training and Credentials: Establish training program to ensure all personnel are aware of hazards, safe work practices, and understand all tasks for normal, non-routine and emergency operations.	✓	✓	✓
Vessel Fuel Transfer Procedures: Documents providing clear instruction for safely conducting transfers from the facility to the vessel.		✓	✓
Compliance Audits: Periodic certification evaluating compliance with the provisions of the regulation. Audit must be developed and documented noting deficiencies that have been corrected.	✓		
Safe Work Practices: Documentation describing how to safely perform a task with minimum risk to personnel, equipment and the environment.		✓	
Contractor Safety Program			
Contractor Safety Program: Program to ensure contractor employees are trained in safe work practices, awareness of chemical hazards and emergency response.			
Non-routine Work Authorizations: Permit describing steps to personnel must follow to obtain the necessary clearance to start the job.			
Process Hazard Program			
Process Hazard Analysis: Thorough, orderly, systematic approach for identifying, evaluating, and controlling the hazards of processes involving highly hazardous chemicals.			
Process Safety Information: Compilation of written information on chemicals, technology, and equipment used in the process			
Risk Management Plan			
Risk Management Plan: Plan that includes: (1) an assessment of potential effects of an accidental chemical release, (2) a prevention program and (3) an emergency response program			
Waterways Suitability Assessment: Assessment of the safety and security risks associated with LNG vessel operations within the port and if necessary, recommendations to mitigate identified risks.	✓		
Incident Investigation Program			
Incident Investigation Program: Identification of the chain of events and causes of an incident that resulted in, or could reasonably have resulted in, a catastrophic release of highly hazardous chemicals in the workplace, so that corrective measures can be developed and implemented.			
Incident Investigation Team: Team consisting of at least one person knowledgeable in the process and other persons with appropriate knowledge and experience to investigate and analyze the incident.			

Table 3.5-1 Key Elements Required Under Each Regulation, Code, Standard or Guidelines of EPA, PHMSA, and NFPA

Key Elements	Coast Guard 33 CFR 127	PHMSA 49 CFR 193	NFPA 59A
System to Address Corrective Actions: Establish system to address and resolve the incident report findings and recommendations.			
Communication/Follow-up: Document resolutions and corrective actions for review by all affected personnel whose job are relevant to the incident findings.			
Incident Reporting: Notification of all security breaches, spill, safety incidents, and safety related conditions and annual pipeline summary data.		✓	
Security Planning			
Security Assessment: Documentation of security background information, on-scene survey, analysis of vulnerabilities and recommendations.		✓	
Security Plan: Plan that identifies Facility Security Officer addresses each vulnerability identified in the assessment and describes security measures.	✓		✓
Safety Management System			
Safety Management System: System enabling proactive identification, evaluation and mitigation or prevention of chemical releases that could occur as a result of failures in process, procedures or equipment that could expose employees and surrounding populations to serious hazards.			
Fire Hazard Evaluation			
Fire Hazard Evaluation/Risk Assessment: Assessment of the fire risk at an LNG terminal by identifying fire scenarios of interest, their likelihood of occurrence and their potential consequences, and if necessary, identification of risk reduction measures.			✓
Hot Work Permit: Issued for hot work operations conducted on or near a covered process.	✓		
Siting Study: Quantification of the risks to populations outside the facility to ensure they do not exceed acceptable levels.		✓	✓

Source: Adapted from ABS (not dated), Table 14 "Key Elements of Applicable Regulations, Codes, Standards, and Guidelines for Bunkering Facilities."
Key:
CFR = Code of Federal Regulations
EPA = United States Environmental Protection Agency
LNG = liquefied natural gas
PMHSA = Pipeline and Hazardous Materials Safety Administration

State

The WUTC, as referenced above, has been granted enforcement authority by PHMSA to ensure compliance with federal regulations governing LNG facilities located in Washington State (PHMSA 2014a,b). The WUTC participates in the federal/state cooperative gas and hazardous liquid pipeline safety program under 49 United States Code (USC) Section 60105(a) Certification and acts as an Interstate Agent. This designation of regulatory duties is codified in WAC 480-93-999.

For elements of facility design that do not meet the specific requirements of 49 CFR 193 but meet the intent of the regulations, the WUTC may issue a state waiver pursuant to the WUTC's participation in the pipeline safety program under its certification authorized by 49 USC Section 60105 (PHMSA 2014a,b) and WAC 480-

For elements of facility design that do not meet the specific requirements of 49 CFR 193 but meet the intent of the regulations, the WUTC may issue a state waiver pursuant to the WUTC's participation in the pipeline safety program under its certification authorized by 49 USC Section 60105 (PHMSA 2014a,b) and WAC 480-93-230 – Exemptions from Rules in WAC 480-93. The Proposed Action may need a waiver to address design of the underground pipeline to transfer LNG to TOTE, which would be done in compliance with the most recent NFPA 59A safety standards that are not yet adopted by 49 CFR 193.

City of Tacoma

Pursuant to the provisions of the Revised Code of Washington (RCW) 35.21.180, the City of Tacoma has adopted by reference the 2012 edition of the International Fire Code under Title 3 – Fire, together with Appendices B and C published by the International Code Council, including all amendments and revisions in the Washington State Fire Code, WAC Title 51, Chapter 54A, effective July 1, 2013, subject to the amendments of Tacoma City Code sections 3.02.010 through 3.02.410.

PSE Natural Gas Distribution System

PSE operates and maintains a natural gas distribution system throughout portions of western Washington, including Pierce County. PSE designs, constructs, and operates its natural gas system to meet or exceed the most stringent federal and state requirements. Federal regulations include 49 CFR Part 192 (Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards), which are administered by the United States Department of Transportation – Office of Pipeline Safety. The WUTC, under an annual certification from the Office of Public Safety, assumes intrastate regulatory, inspection, and enforcement responsibilities for the regulations and also adopts and enforces additional state requirements.

The WUTC regularly inspects PSE facilities to ensure compliance with WUTC regulations. In accordance with federal regulation, all natural gas distributed by PSE is odorized to ensure that a leak is readily detectable and natural gas pressure is regulated by mechanical equipment to ensure that system pressure is less than or equal to the maximum design pressure of the system. As with all pressure-regulating stations, the Golden Given Limit Station would have overpressure protection to ensure that the facility operates safely.

Bunkering Operations

Bunker vessels arriving at the Tacoma LNG Facility would not be under PSE's control, but they would be subject to various design requirements and regulations ensuring the safety of LNG transfer operations.

Transfers of LNG from the Tacoma LNG Facility to a bunker vessel would be conducted in accordance with the following regulations:

- 46 CFR 154 – Safety Standard for Self-Propelled Vessels Carrying Bulk Liquefied Gases: delineates requirements for vessels carrying LNG, such as inspection and testing requirements; design, construction, and equipment requirements; special design requirements; and operating requirements.
- 46 CFR Chapter I, Subchapter B – Merchant Marine Officers and Seamen: provides credentialing requirements for United States merchant mariners working on LNG bunkering vessels, including training requirements.

3.5.2.2 Worker Safety

Worker safety is governed by federal and state regulations. At a federal level, the Occupational Safety and Health Act established the Occupation Safety and Health Administration (OSHA) to govern worker safety. At the state level, the Washington Industrial Safety and Health Act (WISHA) delegated authority for governing worker safety to the Washington State Department of Labor and Industries (L&I). A summary of the regulatory scope of these two agencies is provided below.

Occupational Safety and Health Administration: OSHA ensures safe and healthful working conditions by setting and enforcing standards and providing training, outreach, education, and assistance to workers (OSHA 2014). Employers are required to provide a safe workplace for their employees by following all

relevant OSHA health and safety standards, identifying and addressing hazards, abiding by chemical hazard communication requirements, providing workers with personal protective equipment, and reporting and record-keeping consistent with OSHA requirements (OSHA 2014).

Washington Industrial Safety and Health Act: WISHA (RCW Chapter 49.17) was established to ensure that employers provide their workers with safe and healthy workplaces at a state level. WISHA is administered by L&I through the Division of Occupational Safety and Health (L&I 2013).

3.5.3 Affected Environment

3.5.3.1 Safety History of the LNG Industry

The Tacoma LNG Facility and TOTE Marine Vessel LNG Fueling System would be located on the Blair-Hylebos peninsula within the Port of Tacoma, an area that has been heavily developed for maritime and industrial use over the past 75 years.

Public safety is of paramount importance in siting, approving, constructing, and operating any LNG facility. The LNG industry, both in the United States and worldwide, has had an exceptionally good safety record, indicating that the regulations governing LNG siting and operation are effective.

In the 70+ year operating history of United States LNG facilities, only two LNG safety-related incidents have occurred that resulted in adverse effects to the public or environment: a fire at an LNG facility in Cleveland, Ohio, on October 20, 1944, and an ignition of enclosed vapors in Lusby, Maryland, in 1979. The LNG tank involved in the 1944 Cleveland incident was not constructed of 9 percent nickel steel because of a shortage of this metal during World War II, when the facility was built, and there was no berm or other containment to contain LNG released from the tank. The LNG tank failed, resulting in a release of LNG (Elliott et al. 1946). As a result of this incident, the codes were revised to specify the material used for tank construction and to require berms or containment for LNG tanks that are not fully contained. The proposed Project facilities would be designed, constructed, and operated in compliance with all applicable codes, use required materials for safe construction, and utilize a full-containment tank design.

In the more recent operational accident in 1979 at the Cove Point LNG facility in Lusby, Maryland, a seal failed on an LNG pump, resulting in gas vapors entering an electrical conduit. The conduit then conveyed this gas vapor to an enclosed electrical switchgear building. When a worker switched off a circuit breaker in the switchgear building, the gas ignited, resulting in damage to the building and a worker fatality. Lessons learned from this accident resulted in modifications to the National Electric Code, which is incorporated by reference in the local fire code. As noted above, the proposed Project facilities would be designed, constructed, and operated in compliance with applicable codes, including adopted fire codes.

The LNG industry has a strong commitment to public safety that is evidenced by the safety enhancements implemented as a result of lessons learned. With more than 110 functioning LNG facilities in the United States today, and an operational history beginning in the 1940s, the industry has a good safety record.

3.5.3.2 Tacoma LNG Facility and TOTE Marine Vessel LNG Fueling System

Potential health and safety impacts from the Tacoma LNG Facility include thermal radiation from a fire or a vapor cloud from a release of LNG. PHMSA regulations establish the potential credible events (i.e., “accident scenarios”) to be modeled for thermal and vapor events. The boundaries of potential impact areas would include the parcels containing the PSE plant and the portions of the TOTE site under the control of PSE, and specified areas extending over waterbodies where LNG is present, provided that they cannot extend to areas where groups of 50 or more people assemble. The regulations that define these boundaries include 49 CFR 193.2057 and by incorporation, section 2.2.3.2 of NFPA 59A for thermal radiation, and 49 CFR 193.2059 and by incorporation, sections 2.2.3.3 and 2.2.3.4 of NFPA 59A for a vapor cloud. The Tacoma Fire Department also has jurisdictional authority of NFPA 59A (currently 2009 edition) as it pertains to siting, design and construction of the facility.

Any thermal radiation is limited to 1,600 British thermal units per hour per square foot at the boundary limit. The vapor cloud cannot exceed 50 percent of the lower flammability limit at any property line that can be built upon. Seismic design criteria are discussed in the geotechnical report titled *Geotechnical Engineering Services, Tacoma LNG Project* (GeoEngineers 2015).

3.5.3.3 PSE Natural Gas Distribution System

The affected environment encompasses the distribution system owned and operated by PSE in Pierce County and beyond. Distribution pipelines form part of the core business of PSE, which is the state of Washington's largest provider of residential and commercial natural gas. The company maintains more than 12,000 miles of natural gas main in the state. PSE distribution pipelines must be designed, built, maintained, and operated to meet applicable federal and state safety standards. The Proposed Action includes installation of two pipeline segments that connect to PSE's existing distribution network in the city of Tacoma, city of Fife, and unincorporated Pierce County. In addition, a limit station is proposed near the intersection of 99th Street and Golden Given Road in unincorporated Pierce County to regulate pipeline pressure. Modifications to regulate pipeline pressure at the Frederickson Gate Station are also proposed as part of the Project.

3.5.4 Impacts of the Proposed Action

Construction and operation health and safety regulations applicable to the Proposed Action are those promulgated by OSHA pursuant to the Occupational Health and Safety Act, 29 USC Chapter 15; the Washington Industrial Safety and Health Administration pursuant to WISHA, RCW 49.17, and approved contractor safety plans.

3.5.4.1 Construction Impacts

Tacoma LNG Facility and TOTE Marine Vessel LNG Fueling System

As part of the Proposed Action, certified hazardous materials contractors would remove asbestos-containing material or lead-based paints in the World War II-era buildings to be demolished. Before demolishing the building, an asbestos, lead-based paint, and universal waste survey would be performed. The waste survey would be performed to identify the hazardous materials that could be encountered by the workers or released to the environment during demolition of the buildings. Both structural and nonstructural controls would be in place to protect workers from exposure to hazardous materials and to comply with the OSHA and WISHA regulations. In addition, L&I requires the asbestos abatement to be performed by a certified contractor, who must notify L&I 10 days prior to performing the abatement. All abatement would conform to the requirements of WAC-296-62-0777, which contains provisions for worker safety during asbestos abatement. In addition, the requirements set forth in WAC 365-230 would be adhered to during demolition should lead-based paint be encountered.

As discussed in Section 3.1.3.4 (Existing Contaminated Sites and Remedial Actions), a work plan would be developed outlining the actions that would be taken if contamination is encountered during construction activities. This plan would address necessary characterization of impacted media, protection of worker health and the environment, temporary storage of impacted media, and proper reuse or off-site disposal of contaminated soil in accordance with local, state, and federal regulations.

PSE has adopted "Nobody Gets Hurt Today" as one of the company's core values. The expectation that nobody will be injured applies to all PSE personnel, as well as contractors and subcontractors through the requirement that safety plans be included in all contracts for work with PSE. These safety plans require observance of construction standards designed to avoid injury on the work site, including injury from moving equipment.

PSE Natural Gas Distribution System

PSE operates and maintains a natural gas distribution system throughout portions of western Washington, including Pierce County. PSE designs, constructs, and operates the natural gas system to meet or exceed the

most stringent federal and state requirements. Federal regulations include CFR Title 49, Part 192 (*Transportation of Natural and other Gas by Pipeline: Minimum Federal Safety Standards*), which are administered by the United States Department of Transportation Office of Pipeline Safety. The WUTC adopts and enforces additional state requirements. As noted above, the WUTC regularly inspects PSE facilities to ensure compliance with WUTC regulations. In accordance with federal regulation, all natural gas distributed by PSE is odorized to ensure that a leak is readily detectable, and natural gas pressure is regulated by mechanical equipment to ensure that system pressure is less than or equal to the maximum design pressure of the system. As with all pressure-regulating stations, the Golden Givens Limit Station would have a 100 percent redundancy backup regulator system to ensure that the facility operates safely.

In addition to the safety plans associated with PSE's "Nobody Gets Hurt Today" policy, standardized construction protocols (see Appendix XX, Selected Standard Protocols for PSE Construction Contracts) include developing routing plans that locate and avoid all existing utilities. In areas of brownfield development, construction plans contain methods for handling hazardous materials if encountered. Once all utilities are located and design plans are complete, the company applies for and acquires all permits needed for installation. This includes traffic control plans and other environmental impact avoidance and mitigation plans. The WUTC may conduct safety inspections at any time during the construction process. Completed pipe is subjected to and must pass pressure testing before placement into service.

Standard construction techniques within jurisdictional rights-of way (ROWs) encompass excavation, removal, and 100-percent haul-off of subsurface material; pipeline preparation, including welding and placement in the excavation; followed by proper backfill placement and compaction. Construction would occur beneath or within the paved surface or graveled road shoulder of the ROW as appropriate in consultation with the jurisdiction. The *Manual on Uniform Traffic Control Devices* would be utilized to minimize traffic impacts and provide safe working conditions (FHWA 2009). PSE would strictly adhere to local jurisdictional traffic control requirements to minimize traffic impacts, which may include nighttime work or reduced-duration daytime schedules to avoid rush hour traffic. Horizontal directional drill installation under Interstate 5 would not impede freeway traffic as the drilling and receiving pits would be located outside of the Interstate 5 ROW.

3.5.4.2 Operations Impacts

Tacoma LNG Facility and Tote Marine Vessel LNG Fueling System

Potential safety hazards that could occur at the Tacoma LNG Facility relate to the specific characteristics of LNG and the conditions under which it would be handled and stored, and associated operations that are conducted involving other hazardous materials used at the facility. As described in Section 2.2.1.1 (Overview), LNG consists of natural gas that has been pretreated to remove impurities and liquefied to cryogenic temperatures. The potential hazards of most concern at the Tacoma LNG Facility are those related to the potential flammability of any vapors released from an LNG spill and the cryogenic liquid nature of LNG.

Operation, Maintenance, and Emergency Procedures

Operation of the Tacoma LNG Facility would not pose a potential public hazard if strict design and operational measures to control potential accidents were applied. The primary concerns regarding public safety are events that could lead to an LNG spill of sufficient magnitude to create an off-site hazard. Stringent requirements are in place for the design, construction, operation, and maintenance of the facility, as well as the extensive safety systems to detect and control potential hazards. In addition to the operation and maintenance procedures that are required by both 49 CFR 193 Subpart F and NFPA 59A, emergency procedures are also required. All of the procedures (operation, maintenance, emergency) would be developed and documented prior to commissioning. With specific reference to the emergency procedures, elements that would be addressed include recognizing an emergency situation, responding to an emergency, and issuing the appropriate notifications to emergency responders. The overarching goal of all

of these procedures would be to ensure the safety of personnel through sound operation and maintenance procedures and monitoring of the various safety systems located throughout the facility.

Subpart F provides prescriptive requirements for operating procedures, emergency procedures, personnel safety, operating records, and other requirements for the ongoing operation of the facility. PSE would prepare all procedures in advance of plant operation. Each procedure would be reviewed and approved by the WUTC Pipeline Safety Office as the duly-appointed delegate of PHMSA. These procedures and records would be subject to ongoing audits by the WUTC for the life of the Project.

LNG Hazards

LNG's principal hazards result from its low temperature (-260°F), asphyxiation potential, and flammability. Each of these hazard characteristics is described in the following sections. Often, the hazards associated with LNG are compared with, and mistakenly assumed to be more severe than, diesel fuel, gasoline, propane, and compressed natural gas. This is not an accurate assessment because LNG vapor is lighter than air above temperatures of -160°F, which means that vapor at ambient temperature will rise and dissipate, thereby reducing vapor concentration such that ignition is not possible.[8] In contrast, gasoline and diesel vapors, and any other hydrocarbon vapor, are much heavier than air at ambient or normal temperatures, and so remain concentrated with a higher potential for ignition.

Low Temperatures

Although LNG can cause "freeze burns" and, depending on the length of exposure, more serious injury, its low temperature does not present a significant hazard to the public because all low temperatures are confined to the site. As a cryogenic liquid, LNG will quickly cool materials it contacts and may cause thermal stress and brittleness in materials not specifically designed for cryogenic temperatures.[9] These hazards, however, are not substantially different from the hazards associated with the storage and transportation of liquid oxygen (-296°F), liquid nitrogen (-321°F), and several other cryogenic gases that are routinely produced, used, maintained, and transported safely in the United States.

Areas with potential for cryogenic spill would all be located on the LNG plant site and in areas under PSE's control at the TOTE terminal. As described in Section 2.2.1.7 (Other Process Facilities), in the unlikely event of an LNG spill, LNG would be directed to various spill containments consisting of below-grade, open-top concrete sumps. LNG spills on the loading platform at the end of the pier would be collected in a concrete curbed area under the loading arms or hoses and piping, which would gravity-drain to a concrete trench that runs the length of the pier back ashore. Sumps would be sized for a maximum design spill pursuant to federal regulations. There would be no public access to either of these facilities.

Asphyxiation

Methane, the primary component of LNG, is colorless, odorless, and tasteless, and its vapor is classified as a simple asphyxiant. As such, methane can cause health hazards, including death from lack of oxygen at concentrations above 50 percent, as described on OSHA's website.[10] Asphyxiation, like low temperature, is a risk only in confined spaces and, as a result, normally represents a minimal risk to employees and even less risk to the public, which has no access to the facility. The facility design includes strategically placed gas detection devices that are monitored on a continuous basis and trigger alarms at levels well below those that could pose a human health hazard. Further, the siting and design of the facility are configured so that, however unlikely, any vapor cloud forming would stay on site. Operating procedures and training would address this risk to employees.

[8] For ignition to occur, vapors must be at a concentration of 5 to 15 percent of ambient air.

[9] Concrete, nickel steel, and stainless steel can withstand cryogenic temperatures without damage.

[10] https://www.osha.gov/dts/chemicalsampling/data/CH_250700.html

Thermal Radiation, and Vapor Dispersion

To define the extent of thermal vapor dispersion and thermal radiation exclusion zones to ensure the public's safety requires quantitative modeling. When LNG is released from a container and comes in contact with air, it vaporizes and produces methane vapor. For any methane vapor to ignite (not only LNG, but any fuel containing methane), two conditions must simultaneously occur: (1) the methane vapor must be at a concentration of 5 to 15 percent in air, and (2) an ignition source must be present. If such a methane vapor-air mixture from an LNG spill ignites, the LNG flame front will either burn back to the release location (if the vapor concentration along this path is sufficiently high to support the combustion process) or, if the vapors dissipate quickly enough, the flame will burn out for lack of fuel.

For Tacoma LNG, vapor dispersion analyses have been conducted for credible spill scenarios, using the methodologies and computational models prescribed by PHMSA and approved on similar facilities. The modeling conclusively demonstrates that exclusion zones defined by federal regulation 49 CFR. § 193.2059 and, by reference NFPA 59A (2001), remain within the property lines of the proposed site. Keeping all spilled LNG (and any potential resulting flammable vapor clouds) within the property boundary eliminates the risk of off-site ignition.

LNG is not explosive in the manner that it is normally transported and stored. Any flammable vapor will develop an overpressure if ignited while in a confined space, but there is no evidence suggesting that LNG vapor will develop an overpressure in unconfined, open areas (ABS Consulting 2004). Experiments to determine if unconfined methane-air mixtures can explode have all demonstrated that, even for combustion initiated with a blasting cap, the shockwave (the characteristics of an explosion) quickly dies out, as unconfined methane combustion and flame front will not support overpressures (ABS Consulting 2004). In other words, unconfined methane-air mixtures will burn but will not explode.

A rapid-phase transition (RPT) can occur when a portion of LNG spilled onto water changes from liquid to gas, virtually instantaneously. Unlike an explosion that releases energy and combustion products from a chemical reaction as described above, an RPT is the result of heat transferred to LNG, inducing a change to the vapor state. The rapid expansion of LNG from the liquid to vapor state can cause locally large overpressures. RPTs have been observed during LNG test spills onto water. In some test cases, the overpressures generated were strong enough to damage test equipment in the immediate vicinity of the LNG release point. However, the sizes of the overpressure events have generally been small. Such a small overpressure is not expected to cause significant local damage, nor is it expected to endanger the public. With regard to testing, RPTs have not been observed when methane content is greater than 95 percent. The LNG to be produced by the proposed facility is expected to have methane content greater than 95 percent (Cleaver et al. 2013).

A common misconception of the flammability of LNG with respect to LNG tanks damaged by impact or impinged directly by flames is that this scenario has the potential to create a boiling liquid expanding vapor explosion (BLEVE). LNG storage tanks are not susceptible to BLEVEs (Ditali and Fiore 2008). The LNG storage tank is a tank within a tank with 3 feet of insulation between the two. Even with direct flame impingement on the outer tank, the inner tank would not experience an increase in temperature. Further, LNG stored in the tank is at or near atmospheric pressure; LNG stored in the tank would be less than 3 psig.

The primary safety concern of an LNG terminal is a fire from the release of LNG caused by equipment failure or spill. The siting and design of the facility would incorporate containment features, such as sumps to which a release of LNG would be directed. If a release and subsequent ignition were to occur, the fire hazard would be localized. LNG vaporizes rapidly on contact with a temperature greater than the LNG itself. At -259°F, LNG becomes a vapor. Between -259°F and -160°F, LNG vapor is heavier than air and pools at the ground level in collection pools or sumps. In the unlikely event of an LNG spill at the Project site, LNG would be directed to various spill containments consisting of below grade open top concrete sumps. LNG spills on the loading platform at the end of the pier would be collected in a concrete curbed area under the loading arms or

hoses and piping, which would gravity drain to a concrete trench that runs the length of the pier back ashore. Sumps would be sized for a maximum design spill pursuant to federal regulations.

At -159°F, LNG vapor is lighter than air. Any spilled LNG not collected in a sump would rise. LNG is flammable as a vapor, as stated above, between approximately 5 and 15 percent concentration of gas in air. LNG is less flammable than other fuels such as propane and gasoline and requires a higher ignition temperature (1,004°F). If a flammable vapor-air mixture from an LNG spill is ignited, it may result in a flash fire, which is a short-duration fire that burns the vapors already mixed with air in flammable concentrations. The flame front will burn back through the vapor cloud to the spill site, provided the vapor concentration along this path is high enough to continue burning (AcuTech 2007).

PSE Natural Gas Distribution System

PSE would operate proposed Pipeline Segments A and B of the natural gas distribution system in the affected jurisdictions at pressures of up to 250 and 500 psig. Pipeline Segment A would consist of approximately 4 miles of 16-inch pipe, and Pipeline Segment B would consist of approximately 1 mile of 12-inch pipe. Both the 16-inch pipe and the 12-inch pipeline segments would operate at a hoop stress below 20 percent Specified Minimum Yield Strength. This constitutes a safety factor of 5, which exceeds the applicable federal and state requirements.

All natural gas in distribution lines is odorized for ready detection in the event of a leak. The building density in the area where a pipeline is proposed determines the required safety factor to which a pipeline must be built. These standards are determined by Class Location 1 through 4, with the lower number representing less densely developed locations, and the highest number representing heavily urbanized locations. Pipeline Segments A B would be built to exceed the highest design factor for a Class 4 location.

With regard to minimum depth of cover over high-pressure distribution lines, federal standards require at least 24 inches. PSE designs to meet a minimum cover of 36 inches over high-pressure distribution mains.

For the operational lifetime of distribution pipelines, federal and state regulations require that leak surveys be conducted every five years unless the pipelines are located within business districts, where they undergo a leak survey annually. PSE conducts leak surveys annually on all business district pipelines and higher-pressure distribution mains; all other locations undergo leak surveys every three years.

The pressure of the gas at the proposed Golden Given Limit Station would be reduced to less than 250 psig to match the downstream pipeline. The Frederickson Gate Station is where natural gas is delivered from Northwest Pipeline to PSE. At this location, the gas is measured for custody transfer, the pressure is regulated to system pressure, and the gas is odorized so that any unintended release can be detected by the public. PSE operates its facilities, including the proposed Golden Given Limit Station and Frederickson Gate Station, in accordance with all applicable federal and state regulations.

3.5.4.3 Decommissioning Impacts

This section describes the procedures proposed to address potential decommissioning impacts associated with the end of the design life of the Project. Accounting for each Project component, the estimated total design life of the Project is 50 years. Decommissioning of the Project components would generate impacts similar to those discussed in Section 3.5.4.1 (Construction Impacts).

Tacoma LNG Facility and TOTE Marine Vessel LNG Fueling System

Decommissioning activities would require construction worker safety training and safety plans designed to prevent workers' exposure to vapors or other contaminated media that may pose an unacceptable risk exposure scenario. Similar safety training and safety plans would be appropriate to construction workers operating in and around equipment at the decommissioning site.

During decommissioning of the facility, hazardous materials would be stored, handled, and used in accordance with plans prepared for the safe management of such materials.

Decommissioning the plant would involve removing all aboveground equipment to its foundations and demolishing the LNG tank. At the discretion of the property owner (Port of Tacoma), buildings and foundations could also be demolished. Underground utilities (e.g., stormwater, firewater) typically are abandoned in place. Any decommissioning would be conducted following consultation with the Port of Tacoma, as the removal and decommissioning of the facilities are covered in the lease between PSE and the Port of Tacoma. All necessary permits would be obtained prior to activities subject to regulatory requirements, including environmental review as required at that time.

PSE Natural Gas Distribution System

It is unlikely that the pipelines would be removed following decommissioning of the LNG liquefaction facility. The pipeline is an integral part of an existing natural gas distribution system serving both commercial and residential natural gas customers.

3.5.5 Impacts of No Action

Under the No Action Alternative, the Project would not be built, current conditions would remain unchanged, and Proposed Action–related impacts to health and safety would not occur. Under this scenario, there would be no new, economically feasible, and consistent supply of cleaner fuel. If the Tacoma LNG facility is not constructed, vessels reliant on LNG as a fuel in the Port of Tacoma would have to either use more costly modes of delivery or relocate their fueling activities outside of the Port of Tacoma. Relocation of fueling infrastructure and activities outside the Port of Tacoma would carry with it the attendant evaluation of relocation of other enterprise activities for entities whose operations are dependent on completion during the fueling time frame.

3.5.6 Avoidance, Minimization, and Mitigation

3.5.6.1 Design and Construction

This section describes the primary construction mitigation measures that would be implemented to address health and safety during Project construction.

Tacoma LNG Facility and TOTE Marine Vessel LNG Fueling System

- A Fire Protect Evaluation per the requirements of NFPA 59A 9.1.2 has been submitted to the City of Tacoma for review.
- To ensure evacuation routes (including Alexander Avenue, 11th Street and Taylor Way) in the vicinity of the project will remain open in the event of an LNG release, the facility design will incorporate mitigation measures to ensure that thermal radiation and vapor dispersion do not extend beyond the land portions of the PSE and TOTE property lines.
- A construction worker health and safety plan would be developed to conform to the applicable federal and state regulations for worker health and safety
- A Contaminated Media Management Plan would be developed that outlines the proper protocol that would be implemented should contaminated media be encountered during excavation or grading activities.
- Lead-based paint and asbestos abatement would be completed in accordance with applicable federal and state regulations and would be performed only by qualified and certified contractors. Hazardous materials would be stored, handled, and used in accordance with best practices for storage and management of hazardous materials. These best practices include, as appropriate, storing materials in a centralized construction staging area within secondary containment.
- Fueling and routine maintenance of construction-related equipment would occur within dedicated areas equipped with spill kits.

- The LNG storage tank would be a full-containment design, including a concrete roof and an outer, secondary concrete tank.
- Piping connections to the LNG storage tank would be from the top, with no penetrations of the inner or outer tank below the liquid level.
- LNG-containing piping would be designed as primarily all-welded construction with a minimum number of flanges.
- Piping would be either pneumatically or hydrostatically tested in accordance with appropriate codes and procedures before placement into service.
- Piping and equipment containing any liquids (e.g., LNG, refrigerant, lubricating oil) would be provided with spill-collecting troughs and area curbing to direct any potential spills to spill collection basins.
- Mixed-refrigerant components would be stored in tanks mounded in sand to prevent fire impingement.

PSE Natural Gas Distribution System

- Trench boxes, bracing, sump pumps, and other associated construction safety equipment and procedures would be utilized as required by applicable federal and state regulations, such as WAC 296-155 (Safety Standards for Construction Work).
- Appropriate engineering and construction techniques would ensure that the proposed natural gas main is properly installed.
- A construction worker health and safety plan would be developed in accordance with applicable federal and state worker health and safety regulation.
- A Contaminated Media Management Plan would be developed, outlining the proper protocol that would be implemented should contaminated media be encountered during installation of the distribution system.
- Hazardous materials would be stored, handled, and used in accordance with best practices for storage and management of hazardous materials. These best practices may include, as appropriate, storing materials in a centralized construction staging area within secondary containment.
- Fueling and routine maintenance of construction-related equipment would occur within dedicated areas equipped with spill kits.

3.5.6.2 Operations

This section describes the primary mitigation measures that would be implemented prior to or during operations to address health and safety, as follows:

- Cooperatively develop a Joint Emergency Response Plan for local first responders (e.g., local fire department, emergency medical services, and law enforcement agencies) and facility owners/operators that would include, at minimum:

  Section 1.0 Introduction

  Section 2.0 Incident Command Organization

  Section 3.0 Response Procedures

  Section 4.0 Detection, Shutdown, and Suppression Systems

  Section 5.0 Emergency Notification and Communication Systems

Section 6.0 Notifications Required

Section 7.0 Site Management of Media/Public

Section 8.0 Incident Termination

Section 9.0 Emergency Response Plan Reviews, Updates, and Training

Section 10.0 Identifying and Preventing Specific Emergencies

Section 11.0 Procedures for Responding to Specific Emergencies

Section 12.0 Public Evacuation and Mutual Aid Association

- During LNG fueling in the Blair Waterway or barge loading activities on the Hybelos Waterway PSE should consider establishing public exclusion zones around the operating area.
- The facility would be installed with a variety of fire and gas monitoring systems throughout the facility that would provide detection of flammable gas releases or fires. The monitoring system would include detectors for flammable gas, low temperature, ultraviolet/infrared flame, and smoke. The system would be strategically located in potentially affected areas. Fire and gas monitoring systems would be hard-wired from the field devices to the control room fire and gas panel.
- The facility would be provided with a fire protection system. The control building would be fully equipped with a fire sprinkler system, and numerous portable dry chemical extinguishers would be located throughout the plant. Sprinkler connections would be compatible with local municipal fire department equipment. The power distribution center (switchgear/motor control center room) would be equipped with fire suppressant systems.
- Critical operating parameters would be continuously monitored and controlled by means of a distributed control system that included programmable logic controllers and local control panels. This system would include alarms to notify operating personnel in the event of abnormal operations.
- The facility would be provided with a safety-instrumented system, independent of the main control system, to allow for the safe, sequential shutdown and isolation of the facility.
- The facility would be provided with an emergency shutdown system that included shutdown and control devices designed to leave the facility in a safe state. This system would be used for major incidents and would result in total plant shutdown, as well as shutdown of ship loading, sendout system, and individual pieces of equipment, depending on the type of incident.
- A diesel-driven standby generator would be provided to deliver back-up power for critical loads in the event of complete loss of external power. In the event of loss of normal power, the essential loads would automatically be transferred to the standby generator source.
- An uninterruptible power supply would be provided for critical instrumentation and controls in the event of a power failure. The uninterruptible power supply would allow for the orderly shutdown of the facility upon a power failure, as well the continued monitoring of critical parameters during the power outage.
- Underground metal structures and buried piping would be protected from corrosion through cathodic protection systems as required.
- A comprehensive quality control and quality assurance program would be implemented to ensure that all items installed in the facility meet the established quality standards.
- Facility maintenance procedures would be developed and implemented in accordance with Subpart G of 49 CFR 193, which delineates detailed requirements for maintenance manuals, recordkeeping, and inspections for certain plant elements.

- A maintenance program for the facility and its constituent parts would be developed with vendor and construction contractor input. The maintenance program would include a schedule for evaluating critical facility constituent parts to assess their condition, which would inform the need for possible overhaul or replacement. Detailed documentation of all work required, tested, and completed would be maintained.
- Operations and maintenance personnel training programs and appropriate documentation thereof would be developed and implemented in accordance with Subpart H of 49 CFR 193, delineating detailed requirements for personnel qualifications and training. These programs would be designed to maximize personnel involvement to decrease the opportunity for a hazardous situation to develop.
- Training would be validated through testing and certification.
- Regular safety meetings with operations and maintenance personnel would be conducted.
- Emergency procedures would be developed per the requirements of 49 CFR 193 and 33 CFR 127 to provide for responding to any emergency that may reasonably be expected to occur at the facility. These procedures include provisions for contacting and coordinating with local agencies as needed to protect public safety in the event of an incident at the facility.

3.5.6.3 Decommissioning

Tacoma LNG Facility and TOTE Marine Vessel LNG Fueling System

The relevant mitigation measures for protecting worker safety and hazardous material handling that may occur during the decommissioning of the facility are similar to the mitigation measures discussed in Section 3.5.6.1 (Construction), as decommissioning of the facility would utilize similar techniques.

PSE Natural Gas Distribution System

The distribution system infrastructure would not likely be decommissioned following the termination of the LNG liquefaction facility operation. However, relevant mitigation measures for protecting worker safety and hazardous material handling that could occur during the decommissioning of the distribution system would be similar to the mitigation measures discussed in Section 3.5.6.1, as decommissioning of the distribution system would employ similar techniques.

3.5.7 Conclusion

Siting, design, construction, operation, and maintenance of the Tacoma LNG Facility would be federally regulated by the PHMSA under the Federal Safety Standards (49 CFR 193 et al.) and also by the Tacoma Fire Department as the authority having jurisdiction under the stated adopted fire code which incorporate by reference the NFPA Standard for the Production, Storage, and Handling of LNG (NFPA 59A), in addition to many other national standards. The WUTC adopted by reference the federal LNG facility standards. Under certification by PHMSA, the WUTC Pipeline Safety Office would provide oversight of the proper design and construction of the Project, as well as ongoing oversight of Project operations. A variety of ongoing operations, maintenance, and emergency response trainings would be conducted throughout the lifetime operations of the facility to remain not only in compliance with applicable laws and regulations, but also to stay abreast of emergent industry- and agency-based information.

Potential impacts from the facility include thermal radiation from a fire or a vapor cloud from a release of LNG. PHMSA regulations establish the potential credible events (i.e., “accident scenarios”) to be modelled for thermal and vapor events. The boundaries of potential impact areas would include the parcels containing the LNG facilities, the portion of the TOTE site under the control of PSE, and specified areas extending over water bodies where LNG is present, provided that they cannot extend to areas where groups of 50 or more people assemble. The regulations that define these boundaries are 49 CFR 193.2057 and, by incorporation, Section 2.2.3.2 of NFPA 59A for thermal radiation, and 49 CFR 193.2059 and, by

incorporation, Sections 2.2.3.3 and 2.2.3.4 of NFPA 59A for a vapor cloud. There will be no public access to the proposed facilities, and defined impacts will be limited to the controlled areas.

Washington, as a jurisdictional state, the WUTC, Office of Pipeline Safety (OPS) has been delegated PHMSA authority for siting and technical assessment of the design, construction, and operational compliance as specified in the 2001 edition of NFPA 59A. The Coast Guard has responsibility for a design review of the ship to shore interface, marine transportation and maritime facility security. The City of Tacoma Fire Department (TFD) also has statutory authority to ensure that the Project meets the state adopted Fire Code that requires LNG facilities be sited and designed to the 2009 edition of NFPA 59A. Although the UTC and PHMSA siting, design, construction and operational criteria are based on the 2001 edition of NFPA 59A the UTC and the TFD may determine to use whichever edition has the most stringent criteria for the siting, design, construction and operations of the Tacoma LNG project. To coordinate efforts on the LNG facility, the UTC has identified four phases of the project that necessitate coordination meetings with TFD and will ensure staffs are available to answer questions and discuss the project as requested.

The four key phases are as follows:

I. Decision by PHMSA on underground pipeline waiver

The decision by PHMSA on the request by PSE to place the LNG pipe underground leading to the TOTE facility will be critical for PSE in the final design process and will need to be factored into the inspection process. The UTC and TFD will coordinate meetings, work with PSE and may require guidance from PHMSA on the waiver decision.

II. Receive and Review of Design Documents

After the UTC receives the design documents for the project from PSE, UTC will reach out to Tacoma to discuss key safety elements that are being reviewed. PHMSA and PSE may be consulted during this process as well.

III. Construction Process Coordination

The UTC will coordinate with TFD on its inspection schedule, findings and concerns during the construction process. As the UTC is meeting with TFD, there may be a need to ask PHMSA and/or PSE to attend the meetings to answer technical questions.

IV. Ongoing Communication on Life of Facility

If completed, the UTC will have the responsibility for continued inspections of the facility. The UTC will be available to TFD to answer any questions and will set up periodic meetings (as requested by TFD) to review recent inspection reports, any concerns found during inspection and any issues concerning inspection schedule.

Conclusions of Braemar Engineering Technical Review

Braemar Engineering and Ecology and Environment, Inc., conducted a review of the preliminary facility design and engineering and the results of the preliminary thermal radiation and vapor expansion modeling completed for the Project. The preliminary modeling for vapor dispersion used Phast Consequence Modeling software that depicts the maximum concentration cloud footprint (i.e., worst case footprint) and potential effect zone when considering a release in any direction.

Tacoma LNG and Chicago Bridge & Iron (CB&I) have given significant effort to design a code-compliant and safe LNG facility suited to the site and local conditions. Braemar Engineering's comments are based on the preliminary nature of the Project, and the level of detail has not reached the point where many of the issues are addressed in complete detail. However, it is likely that most will be addressed by Tacoma LNG and CB&I as the design progresses. Below, is a checklist of pending conditions to be confirmed when the design is complete; however, a few are recommendations of conditions noted for improving safety or reliability.

- The pipeline design, construction, and integrity testing are compliant with 49 CFR Part 192. The design should be reviewed when complete to confirm that all conditions for the installation have been met.
- Codes for new LNG facilities are held to a very high standard to avoid unsafe conditions within the facility and to the public. The permitting and review process is rigorous and thorough, and the stipulated requirements can be relied upon.
- Standards for civil site preparation are strict to prevent facility component settlement, flooding, and damage from wind and seismic events.
- The technical design of the Project was found to be sound engineering.
- The preliminary LNG design, construction, and integrity testing are compliant with 49CFR Part 193, NFPA 59A, and Coast Guard regulations. The design should be reviewed when complete to confirm that all conditions for the installation have been met.
- Preliminary siting studies were performed for Tacoma LNG using basic modeling tools: Degadis for vapor dispersion and LNG Fire III for thermal radiation. More advanced modeling is required later in detailed engineering when the design is further defined using Computational Fluid Dynamic (CFD) software. The updated CFD models should be reviewed when they are complete to confirm that all vapor dispersion and thermal radiation conditions for the installation have been met and accepted by PHMSA.
- The underground cased LNG corridor design concept was found to be acceptable and code compliant, but expensive, if installed as proposed.
- The aboveground pipe rack and TOTE dock are located in a congested area with vapor dispersion and thermal radiation (VTDR) going beyond the security fence to adjacent unrelated dock work areas. An LNG release vapor or fire incident at this location would have greater consequences due to crowding, as well as impacts on dock workers unaffiliated with the LNG facility operation. For an LNG incident scenario involving release of LNG at or near the dock, VDTR will extend beyond the security fence to the adjacent property. Workers entering this area will require an audible and visual warning system to alert them if an unsafe condition exists, training to know the extent of the high consequence area, and what they should do if an incident occurs. Automatic systems for emergency process shutdown, warning systems, and delineation of the high consequence areas should be reviewed when the design is complete to confirm that adequate layers of protection exists for the conditions at this location.
- The proposed dock east of the LNG facility on the Hylebos Waterway is lacking in design details and should be reviewed for compliance when the design is complete, ship size, and loading rates are better defined.
- The Tacoma LNG Fire Protection Study, Plant Safety Systems, and Emergency Response Plan should be reviewed for compliance when complete.