



4.9 ENVIRONMENTAL HEALTH – PIPELINE SAFETY

This section evaluates the human health, safety, and environmental risks associated with the existing Olympic Pipeline system within PSE’s corridor, and identifies the incremental change in these risks associated with the Energize Eastside project. The analysis in the Phase 2 Draft EIS included the following two components:

1. Risk assessment results
2. Long-term impacts on resources

The Phase 2 Draft EIS presented the results of a *probabilistic pipeline risk assessment* conducted by EDM Services, a firm specializing in pipeline safety, on the existing corridor and on the proposed 230 kV corridor. The risk assessment evaluated what could go wrong (causes of pipeline *incidents*), how likely those are to occur (*probability* of incidents), and what the consequences could be (estimated human fatalities) if there were an unintentional release from the pipelines. The results of an *electrical interference* study conducted by the firm DNV GL, an engineering consultant working for PSE on the Energize Eastside project (DNV GL, 2016), were considered in the risk assessment. The EIS Consultant Team retained Stantec Consulting Services Inc. (Stantec) to perform an independent technical review of the AC Interference Study completed by DNV GL. Based on Stantec’s experience and industry standards, it is their opinion that the technical approach used to achieve an optimal transmission line route and powerline conductor configuration to minimize the AC interference risks on the Olympic Pipeline system is consistent with industry practice. However, Stantec recommended that additional analysis be performed in the detailed design stage of the project to verify mitigation needs for the project prior to transmission line energization (Stantec, 2017). These measures were incorporated into Section 3.9.7.2 of the Phase 2 Draft EIS.

Key Changes from the Phase 2 Draft EIS

The results of the pipeline safety risk assessment completed for the Phase 2 Draft EIS apply equally to PSE’s Proposed Alignment and all other build alternatives. They likely overstate the potential risks associated with PSE’s Proposed Alignment due to the incorporation of recommendations included in the DNV GL report (2016), and additional measures recommended as part of Stantec’s independent technical review of the DNV GL report. Therefore, the risk assessment results are not repeated in the Final EIS. This section reflects the changes incorporated in PSE’s Proposed Alignment to minimize electrical interference, and further discussion has been included to illustrate the range of possibilities for a pipeline release, including a comparison of potential impacts by segment.

In addition to measures incorporated into alternatives evaluated during the Phase 2 Draft EIS, PSE’s Proposed Alignment as analyzed in the Final EIS incorporates the full set of recommendations included in the DNV GL report to reduce and control the risk of electrical interference to the pipelines. These include initially operating both lines at 230 kV rather than 230/115 kV, minimizing points of pipeline and transmission line divergence, using a delta conductor configuration, and locating poles and pole grounds at least 13 feet away from the pipeline(s). In addition to these design features, the Final EIS includes additional measures related to minimizing *arcing* risk. Because these changes would reduce electrical interference risks, no additional risk assessment was conducted for PSE’s Proposed Alignment. Therefore, the full risk assessment results presented in the Phase 2 Draft EIS are not repeated in this Final EIS but are

incorporated by reference. The pipeline safety analysis presented in this Final EIS describes how PSE's Proposed Alignment relates to the risk assessment conducted for the Phase 2 Draft EIS. In response to comments received on the Phase 2 Draft EIS, additional qualitative discussion of possible release scenarios resulting from a pipeline leak has been included in Section 4.9.6 in the Final EIS. Comments received on the analysis, and responses from the Partner Cites and the EIS Consultant Team, are included in Chapter 6, Appendix K, and Chapter 3 (*Errata*).

The Phase 2 Draft EIS describes long-term impacts to resources in the event of a pipeline incident related to the project, presented as a general overview by element of the environment. In response to comments on the Phase 2 Draft EIS, this Final EIS includes Section 4.9.7, *Impact Comparison by Segment*, describing the general conditions in each segment that could affect the extent of a fire resulting from a large spill as well as the resources that could be affected.

As described in the Phase 2 Draft EIS, one or both of the two petroleum pipelines (part of the Olympic Pipeline system) are generally co-located with PSE's existing corridor within all of the segments; through the Renton Segment, however, it is only co-located in the north part of the segment (see Figure 4.9-1). There are risks associated with pipelines that are independent of the presence of transmission lines, and there are risks related to the presence of transmission lines (electrical interference). The focus of the analysis is the incremental change in risk from the baseline condition (No Action Alternative, or existing 115 kV corridor with the existing pipelines) and PSE's Proposed Alignment, also co-located with the existing pipelines (referred in this section also as the proposed 230 kV corridor).

Although the probability of a leak or fire caused by the project is low, the potential damage from such an incident could be high, given the population density in the study area (as defined in Section 4.9.2, below). The potential magnitude of such an event, if it did occur, would be the same regardless of whether it were the result of construction or operation of the project. For this reason, the analysis of the environmental consequences of such an incident is presented in Section 4.9 along with a description of the operational concerns for the Energize Eastside project that affect pipeline safety. Section 5.9 addresses the construction aspects of the project that affect pipeline safety, and refers back to this section with regard to the consequences of a leak or fire.

4.9.1 Relevant Plans, Policies, and Regulations

As described in both the Phase 1 Draft EIS (Section 8.2) and the Phase 2 Draft EIS (Section 3.9.1), environmental health and safety issues related to pipeline safety are regulated at federal, state, and local levels. Appendix I-6 lists and summarizes the applicable laws and regulations addressing pipeline safety. Federal and state regulations apply to the operation of existing pipelines. Local regulations establish structure setbacks from hazardous liquid pipeline corridors. The regulations identified below apply to the Olympic Pipeline system located in the transmission line corridor.

Under federal and state law, the Olympic Pipe Line Company (Olympic), as the pipeline operator, is responsible for the safety of its pipelines in compliance with these federal and state safety requirements.

For PSE, national and state standards, codes, and regulations and industry guidelines govern the design, installation, and operation of transmission lines and associated equipment (see Section 4.9.8.1). For a detailed summary of the major pipeline safety regulations, see Section 3.9.1 of the Phase 2 Draft EIS.

4.9.2 Pipelines in the Study Area

4.9.2.1 Study Area Characteristics

The study area for pipeline safety focuses on the area potentially affected by an Olympic Pipeline system leak or fire caused by the construction or operation of the Energize Eastside project. The study area for this analysis is PSE's existing corridor and the surrounding area including human populations, urban environment, and natural resources that could be affected by an incident.

4.9.2.2 Petroleum Pipelines in the Study Area

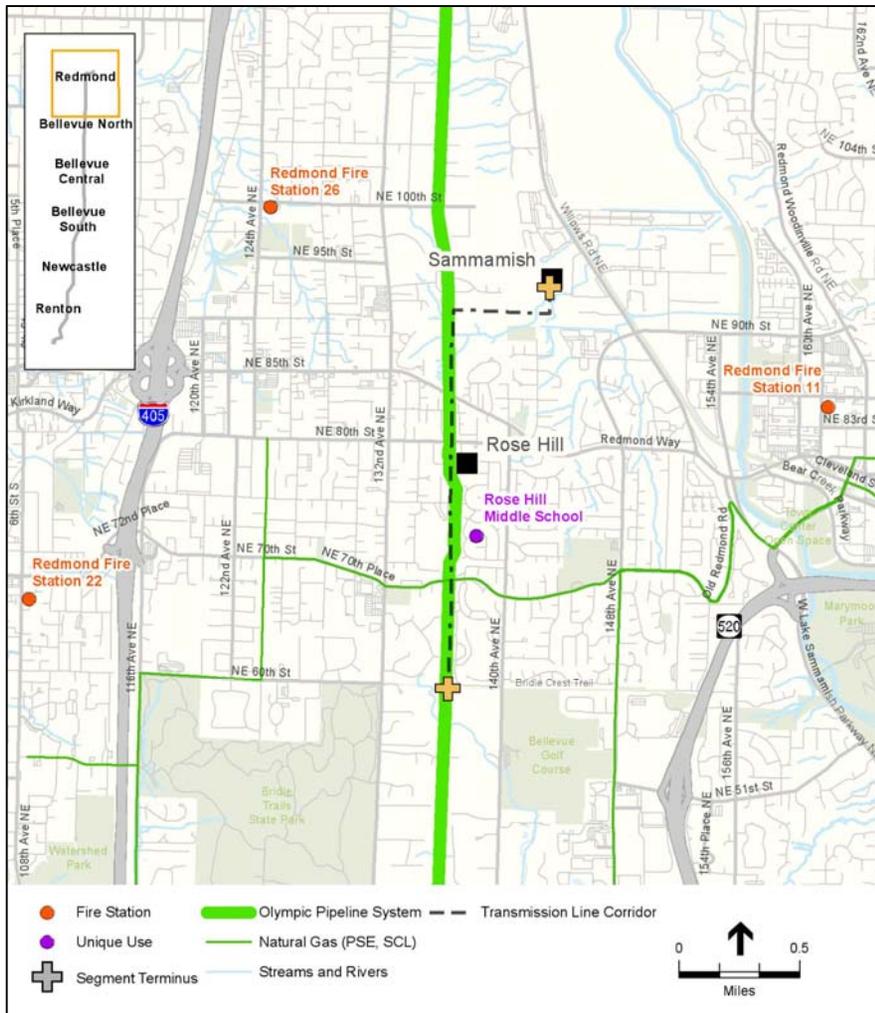
Petroleum pipelines in the study area include the Olympic Pipeline system. The Olympic Pipeline system consists of 400 miles of high-strength carbon steel underground pipeline located within a 299-mile corridor. The Olympic Pipeline system transports refined petroleum products, including diesel, jet fuel, and gasoline. It connects four refineries in northwest Washington near the Canadian border to markets throughout western Washington and Portland, Oregon. Approximately 4.5 billion gallons of refined petroleum products are transported through the pipelines on an annual basis. As described in Chapter 2, BP is the operator of the Olympic Pipeline system, and partial owner of the Olympic Pipe Line Company, with Enbridge, Inc. (Olympic, 2017a). In the EIS, the pipeline ownership and operator are collectively referred to simply as Olympic. Olympic has been working with PSE in connection with PSE's Energize Eastside project, sharing information and supporting requests for information about its facilities and operations. Olympic and PSE meet regularly to discuss, identify, and develop mitigation strategies for potential threats to the pipeline's *integrity*. Olympic has also been communicating with the EIS Consultant Team to provide information necessary in the preparation of the EIS, to the degree it is able to release information.



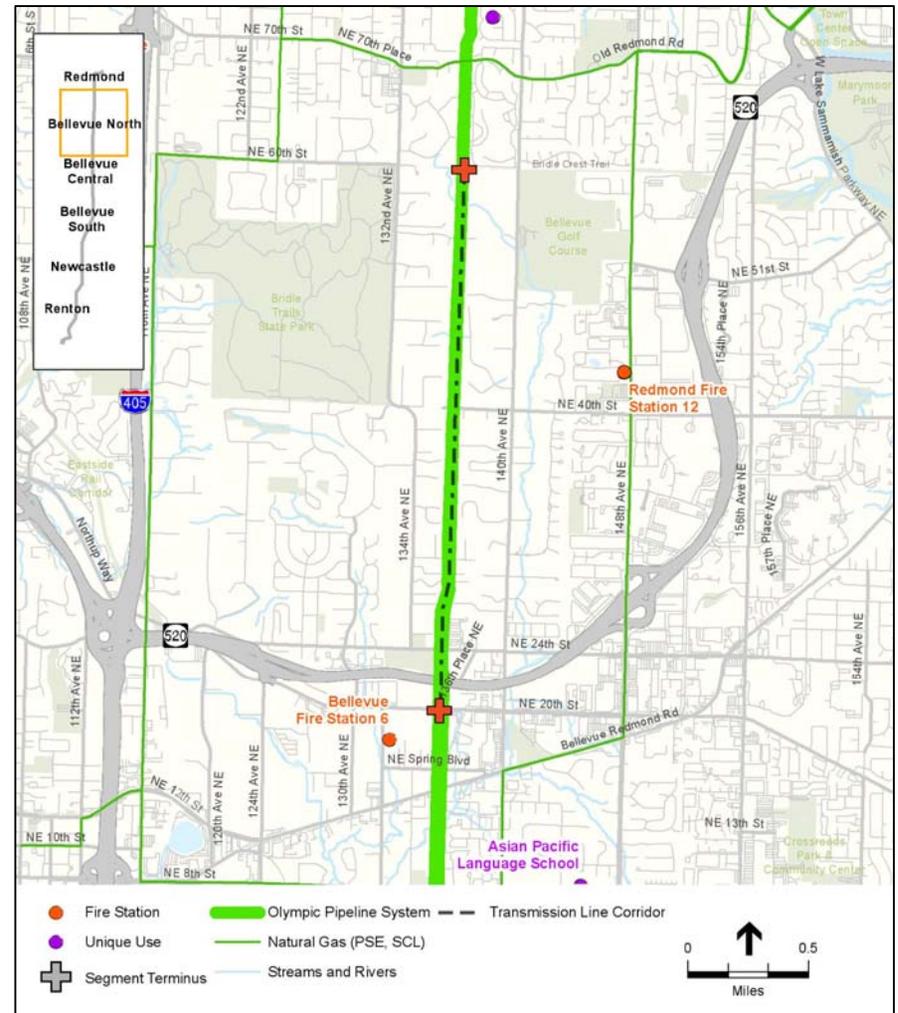
Buried hazardous liquids pipeline, similar to the Olympic Pipeline system



Pipeline warning sign in the project corridor



Redmond Segment



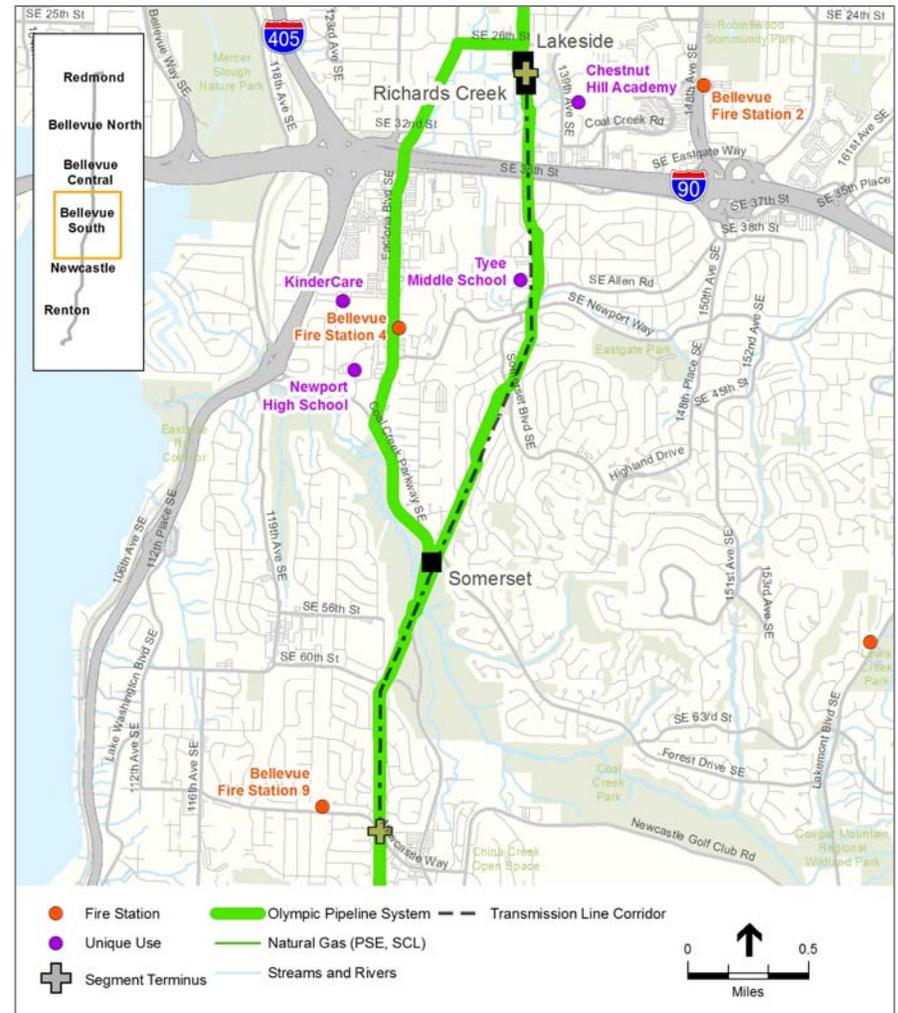
Bellevue North Segment

Source: King County, 2015; Ecology, 2014; PSE, 2015; SCL, 2015; UTC, 2015.

Figure 4.9-1. Existing Electric Transmission Lines and Natural Gas/Petroleum Pipelines in the Study Area



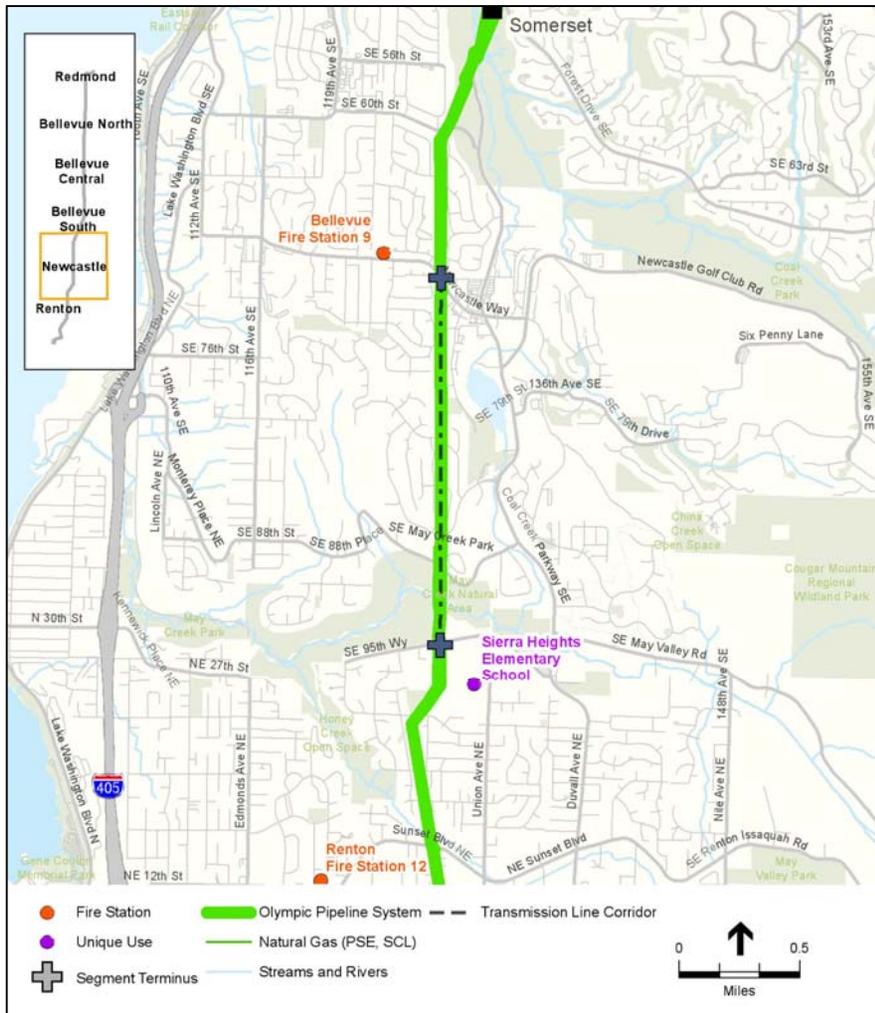
Bellevue Central Segment (Revised Existing Corridor Option)



Bellevue South Segment (Revised Willow 1 Option)

Source: King County, 2015; Ecology, 2014; PSE, 2015; SCL, 2015; UTC, 2015.

Figure 4.9-1. Existing Electric Transmission Lines and Natural Gas/Petroleum Pipelines in the Study Area (continued)



Newcastle Segment (Both Options)



Renton Segment

Source: King County, 2015; Ecology, 2014; PSE, 2015; SCL, 2015; UTC, 2015.

Figure 4.9-1. Existing Electric Transmission Lines and Natural Gas/Petroleum Pipelines in the Study Area (continued)

In the Energize Eastside study area, the Olympic Pipeline system includes two pipelines (16-inch and 20-inch diameter). One or both of the pipelines are generally co-located with PSE's transmission line within all of the segments, although in the Renton Segment it is only co-located in the north part of the segment and crosses the pipeline once in south portion of the segment (Figure 4.9-1). The transmission line corridor predates the pipeline by approximately three decades. In most of the segments, the pipelines are along either the east or west side of the right-of-way, crisscrossing the right-of-way from east or west in numerous locations. In parts of the corridor (especially the Newcastle Segment), however, the pipelines are in the center of the right-of-way. In the Bellevue South Segment, only one of the pipelines (16-inch) is along PSE's existing corridor.

Both pipelines are constructed of welded carbon steel and were generally installed at depths of 3 to 4 feet. They carry diesel, jet fuel, and gasoline and operate about 95 percent of the time (West, pers. comm., 2016).

Preventing Unintentional Releases

As the pipeline operator, Olympic is responsible for operating and maintaining its pipelines in accordance with or to exceed U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) Minimum Federal Safety Standards in 49 CFR 195. The regulations are intended to protect the public and prevent pipeline accidents and failures. PHMSA specifies minimum design requirements and protection of the pipeline from *internal and external corrosion*. In addition, 49 CFR 195 established the following broad requirements that apply to Olympic as the pipeline operator:

- 49 CFR 195.577(a) requires, “*For pipelines exposed to stray currents, you must have a program to identify, test for, and minimize the detrimental effects of such currents.*”
- 49 CFR 195.401 (b) (1) requires, “*Non Integrity Management Repairs, whenever an operator discovers any condition that could adversely affect the safe operation of its pipeline system, it must correct the condition within a reasonable time. However, if the condition is of such a nature that it presents an immediate hazard to persons or property, the operator may not operate the affected part of the system until it has corrected the unsafe condition.*”

In response to these federal requirements, Olympic has a number of programs and systems in place to prevent unintentional releases, as summarized below.

Integrity Management Program. Pipelines and high voltage AC transmission lines often share the same corridor. As a result, the pipeline industry implements numerous practices and guidelines to mitigate potential electrical interference-related-corrosion on pipelines. In connection with the governing federal safety requirements, including 49 CFR 195, Olympic has an Integrity Management Program to monitor and, where necessary, mitigate the impact of electrical interference on its pipelines. In accordance with program requirements, Olympic patrols the pipeline corridor on a weekly basis and periodically inspects its pipelines using *in-line inspection*, pressure testing, and other direct inspection methods. The last in-line inspections of the 16-inch and 20-inch pipelines were in April 2014, and the next planned in-line inspections are in early 2019 (West, pers. comm., 2016). In addition to the inspections, Olympic conducts cathodic protection testing, voltage testing, and close interval survey testing at frequencies that meet or exceed regulatory interval requirements (Olympic, 2017b).

Electrical Interference Protection. Federal regulations also require control of *external corrosion via cathodic protection*. Electrical interference, external corrosion, and cathodic protection are described below in Section 4.9.4 (and in Section 3.9.3.3 of the Phase 2 Draft EIS). Additional information is provided in Appendix I-5 of the Phase 2 Draft EIS, *Pipeline Safety Technical Report* (EDM Services, 2017).

Pipeline Leak Detection System and Controls. Olympic monitors system pressures, flows, and customer deliveries on its entire system. The 16-inch and 20-inch pipelines in the study area are within the coverage area for Olympic's Pipeline Leak Detection System, which is a real-time pipeline simulation in Olympic's Control Center that detects and locates leaks in accordance with state and federal requirements for pipeline leak detection. If an unexpected loss of pressure is detected, block valves will close off each affected pipeline segment. The control center analyzes pressure differential on either side of a block valve to isolate the location of the leak. Olympic personnel will then be dispatched to the area for visual inspection (Olympic, 2017a).

General Construction Requirements. Olympic has a general list of requirements as part of *BP Pipelines (North America) General Construction Requirements* (BP and Olympic, 2016) for all work proposed near the pipelines (see Appendix I-2). These include specific requirements related to excavation near the pipelines and transport of construction materials or equipment over the pipelines. The requirements also prohibit the placement of foreign (non-Olympic) utility lines underground within the pipeline easement. It also includes specific notification and monitoring requirements, consistent with federal, state, and local requirements.

Protections in Place to Prepare for and Respond to an Incident

Frameworks for preparing for and responding to emergency incidents (including pipeline incidents) are specified in each local jurisdiction's Comprehensive Emergency Management Plan (City of Bellevue, 2013; City of Newcastle, 2008; City of Redmond, 2015; and City of Renton, 2012). As the pipeline operator, Olympic is required to maintain an oil spill contingency plan under state and federal law that provides guidelines to prepare for and respond to a spill from its system. Olympic's *Facility Response Plan*, which received final 5-year approval by Ecology in 2016, serves as Olympic's oil spill contingency plan under WAC 173-182. For security reasons, this document is not publicly available.

Olympic's emergency response plans address a variety of scenarios and involve coordination with federal, state, and local agencies and first responders. Olympic's response plans involve spill isolation, containment, and remediation, with the goals of protecting the environment and the public's health, safety, welfare, and property. The unique circumstances surrounding an event that results in pipeline damage or a leak would dictate the appropriate scale and type of response. Olympic regularly participates in emergency response exercises in coordination with local responders. Olympic conducts annual deployment and worst-case drills for each portion of its pipeline system, and invites members of affected local responders to participate. Olympic also periodically participates in drills conducted by local responders (Olympic, 2017a).

As described in Chapter 15 of the Phase 1 Draft EIS (Section 15.3.1.3), in the event of an incident requiring evacuation along the pipeline right-of-way, local first responders and the Olympic Pipeline response team would set up exclusion zones to evacuate and prevent public access in potentially unsafe areas. Affected homeowners may be notified door-to-door if appropriate staffing levels are available and the area would be safe to access. The City of Bellevue, City of Renton, and King

County recently acquired an emergency notification system (referred to, respectively, as Bellevue Inform, ALERT Renton, and ALERT King County) that permits phone, text, and email alerts to be sent to specific geographical areas very quickly. In most cases, the local first responders would use this tool to contact people should a large-scale event occur. Air monitoring would be conducted and documented throughout the entirety of the incident to ensure that the exclusion zones are properly identified in accordance with the conditions of the day (wind speed, direction, etc.). Olympic maintains a 24-hour Emergency Hotline (1-888-271-8880).

Chapter 15 of the Phase 1 Draft EIS provides additional information on emergency response procedures of local jurisdictions within the corridor.

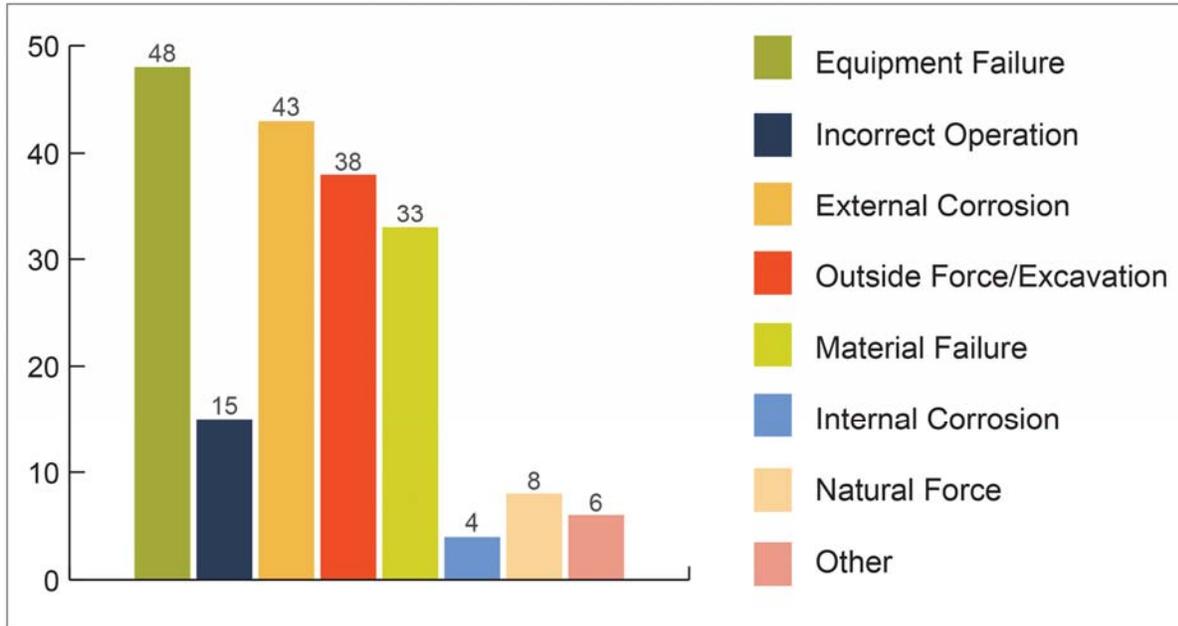
4.9.3 Reported Causes of Unintentional Pipeline Damage

In addition to incident frequency, the risk assessment considered major causes of unintentional pipeline damage as included in the PHMSA incident database for refined petroleum product pipeline releases. The dominant causes of pipeline incidents are equipment failure (25 percent of incidents), *external corrosion* (22 percent), outside force/excavation (20 percent), and *material failure* (17 percent). Figure 4.9-2 shows the distribution of these incidents by cause. Figure 4.9-3 shows the volume (barrels) of reported incidents by cause. This is the same information as presented in the Phase 2 Draft EIS.

Of the causes of unintentional pipeline damage identified, the Energize Eastside project could affect pipeline safety primarily in three ways: outside force/excavation, external corrosion of the pipeline, and natural forces. These causes could result in unintentional releases from the pipeline, placing the public at risk. Natural forces, specifically lightning strikes or wires downed by extreme weather events, present risks of *arcing* from the transmission lines to the pipelines. For the risk assessment, the causes of unintentional pipeline damage associated with external corrosion and natural forces were included under the topic of electrical interference. The ways that the Energize Eastside project could affect pipeline safety are described in more detail below.

Hazardous Liquid Pipeline Incident Data

The baseline data used for the risk assessment are described in Sections 3.9.3 and 3.9.4 of the Phase 2 Draft EIS, and include information on the frequency, major causes, and major risks associated with pipeline releases. The primary source of baseline data used for the risk assessment is reported unintentional release incidents (in the PHMSA database) for hazardous liquid pipelines from the most recent data range under current rules (PHMSA, 2016). Section 3.9.3 of the Phase 2 Draft EIS also includes data on releases from the Olympic Pipeline system provided by the PHMSA incident database for hazardous liquid pipeline releases and Washington Utilities and Transportation Commission (UTC) inspection report data for Olympic's facilities in Washington State for the years 2012 through 2016 (UTC, 2017). Neither the reason for using these data nor the information presented has changed since the publication of the Phase 2 Draft EIS and is incorporated by reference in the Final EIS.



Note: this data set excludes incidents that were limited to pipeline facilities (e.g., tank farm, station equipment, pump station, appurtenance piping, and valve station); the Energize Eastside project would not affect pipeline facility operation.

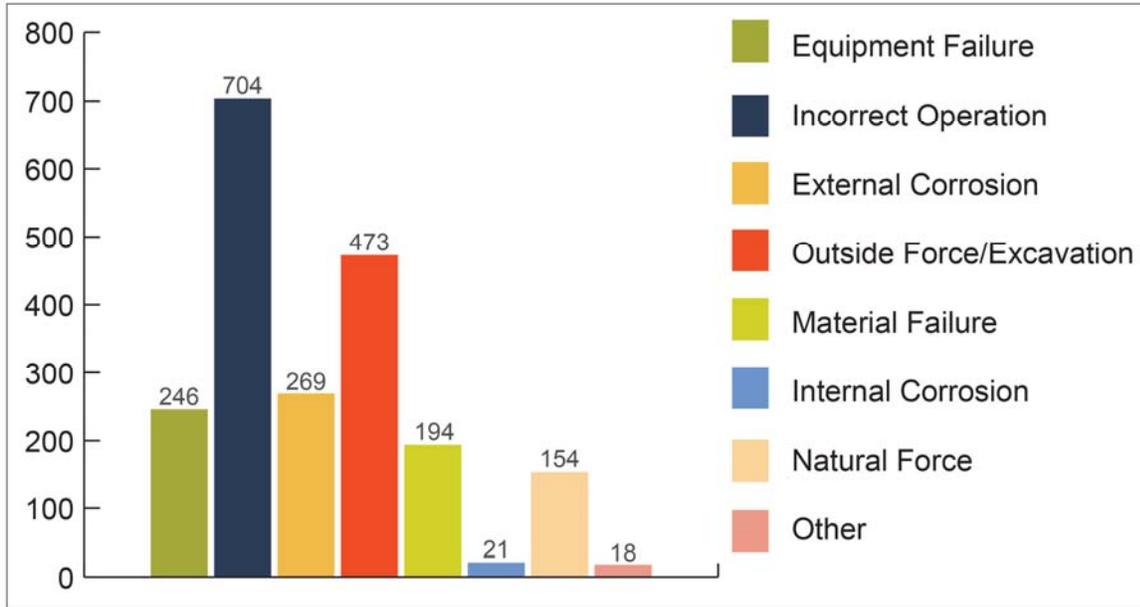
“Equipment failure” can occur on any part of the system, including valve stations, junctions, pump stations, or the pipeline itself. This includes items such as defective or loose components, malfunction of control or relief equipment, and other equipment failures.

“Incorrect operation” includes items such as incorrectly installed equipment, over-pressure, overfill tank or vessel, valve left in wrong position, wrong equipment installed, etc.

“Natural force” includes earthquakes, floods, lightning, extreme temperature, etc.

Source: EDM Services, 2017.

Figure 4.9-2. Number of Reported Pipeline Incidents by Cause, 2010–2015



Note: this data set excludes incidents that were limited to pipeline facilities (e.g., tank farm, station equipment, pump station, appurtenance piping, and valve station); the Energize Eastside project would not affect pipeline facility operations.

Source: EDM Services, 2017.

Figure 4.9-3. Average Volume (Barrels) Per Incident by Cause, 2010–2015

Outside Force/Excavation

Outside force/excavation hazards generally relate to construction activities near pipelines. Commonly referred to as *third-party damage*, pipelines can be damaged by excavation and other heavy equipment operation near pipelines. Excavation or construction near a hazardous liquid pipeline carries a risk that a pipeline could be directly hit or damaged. Also, equipment operating over or near a pipeline can cause pipe stresses due to *surcharge loading*.

The Energize Eastside project would involve excavation and heavy equipment to construct the project, and occasional truck activity during operation for maintenance and repair (as currently occurs within the corridor). Risks to pipeline safety associated with construction of the project are addressed in Section 5.9 of the Final EIS.

Surcharge Loading

Equipment and other loads on the soil surface (surcharge loads) can place stress on the underlying substructures, including pipelines. These stresses can over-stress the pipe, causing damage.

Electrical Interference

In the study area, the existing transmission lines and substations can cause *electrical interference*. This includes areas immediately under and adjacent to PSE's existing 115 kV transmission lines, as well as areas near the Sammamish, Rose Hill, Lakeside, Somerset, and Talbot Hill substations. Electrical interference can occur during normal high voltage AC transmission line (steady-state) operation, which can contribute to accelerated external corrosion damage on the pipeline, or as a result of *fault conditions*. Fault conditions, usually initiated by lightning, result in the transfer of electrical power indirectly from one or more AC powerline conductors (i.e., wire) via the metallic transmission line pole to the ground, or directly to the ground as a result of an overhead conductor falling to the ground. Fault conditions can result in damage to the pipeline coating or directly to the pipeline itself.

External corrosion occurs when the metal of the pipeline reacts with the environment, causing the pipeline to corrode (or rust) on the outside of the pipe. It can be influenced by a number of conditions, including soil conditions and electrical interference.

AC current density is a measure of electrical interference adjacent to the pipeline. AC current density levels less than 20 amps per square meter do not cause AC-induced corrosion. The AC current density is related to soil conditions, voltage, and the presence and size of any flaws in the pipeline's protective coating (DNV GL, 2016).

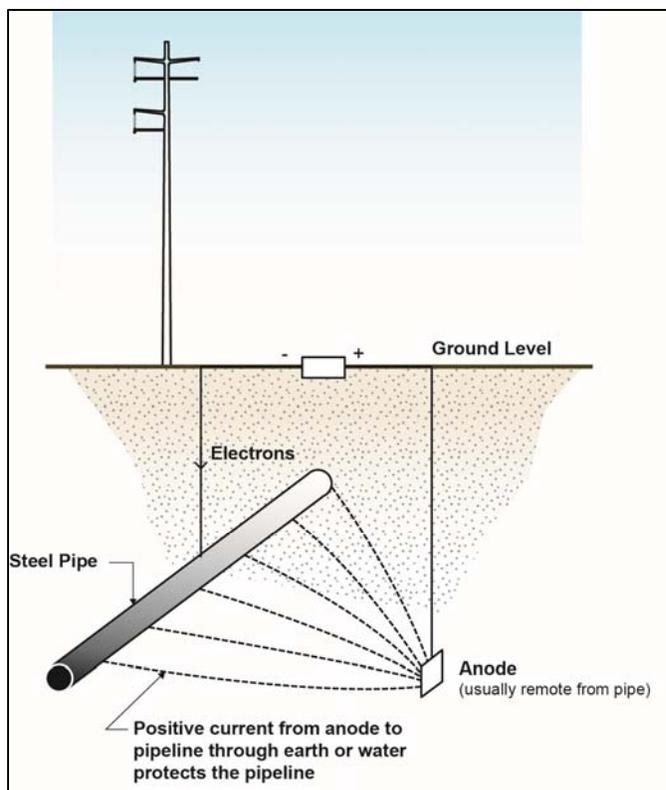
Cathodic protection systems are used to reduce the potential for corrosion from occurring on the exterior of pipes, by substituting a new source of electrons, commonly referred to as an anode (Figure 4.9-4). Throughout the study area, the Olympic Pipeline system is externally coated and cathodically protected, primarily with *overlapping impressed current systems* (West, pers. comm., 2016). These systems consist of an array of metallic anodes buried in the ground along the pipelines with a connection to a source of electric direct current (DC) to drive the protective electrochemical reaction.

Soil Conditions

The moisture, temperature, and chemical content of soil, also referred to as soil resistivity, can have an effect on external corrosion. Typically, the lower the soil resistivity, the higher the potential for corrosion. Soil resistivity generally decreases with increasing water content and the concentration of ionic species (chemically identical ions). For example, sandy soils are high on the resistivity scale and therefore considered the least corrosive, while clay soils, especially those contaminated with saline water, are low on the resistivity scale and considered the most corrosive.

AC Current Density

AC current densities below 20 amps per square meter do not cause AC corrosion; AC current densities between 20 and 100 amps per square meter may or may not cause AC corrosion.



Representative photograph from PHMSA report showing hole in a pipe wall caused by electrical fault (not Olympic Pipeline system)

Figure 4.9-4. Cathodic Protection System Components

Fault Damage. Faults (or *fault currents*) are an abnormal current flow from the standard intended operating conditions. These faults are typically caused by lightning, insulator failure, mechanical failure, and transformer failure. For example, a lightning strike on a pole can cause current to travel through the pole and into the soil, where it may transfer to an adjacent steel pipeline.

Under fault conditions, elevated electric currents can lead to fault damage (related to *coating stress*) or direct arcing damage (see arc damage below) to the pipeline.

The Olympic Pipeline system has an exterior coating to protect against corrosion. The susceptibility of this coating to breakdown is based on the type and thickness of the coating and the voltage on the pipeline coming from the transmission lines (*coating stress voltage*).

In many cases, a shield wire on transmission poles is used to provide multiple pathways to carry a fault current to the ground, thereby diffusing the strength of the current (Figure 4.9-5). In the absence of a shield wire, the entire fault current returns to ground at a single location where it could arc through the ground to the pipeline, causing damage to the pipeline over time. While other protective measures are in place along the Olympic Pipeline system, such as exterior coating, the existing transmission lines do not have a shield wire.

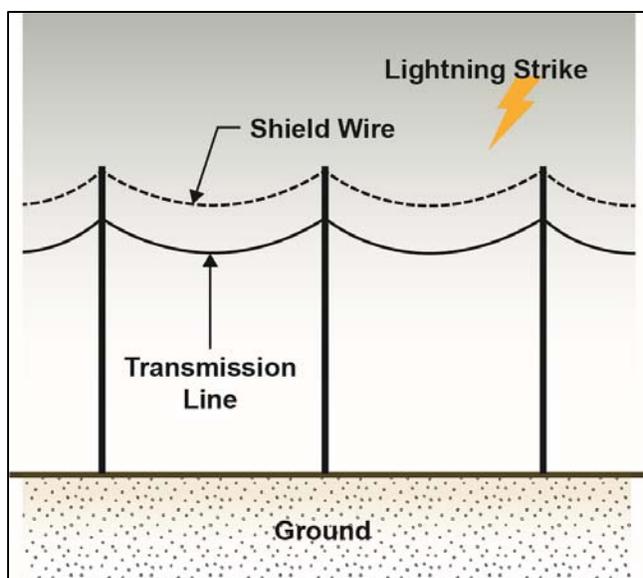


Figure 4.9-5. Shield Wire

Arc Damage. High currents from a fault condition can cause arcing damage to a pipeline. The distance the current can travel to the ground (the *arc distance*) can be calculated based on pole configurations and shield wire characteristics. As noted previously, soil conditions also influence the amount of current that travels through the ground to the pipeline. If a pipeline is within the arc distance of transmission line poles, pole grounds (and sometimes ground wires or other grounding systems) are typically installed to provide adequate separation between the transmission line and the pipelines.

Additional information on external corrosion is provided in Appendix I-5 of the Phase 2 Draft EIS (*AC Interference Study* [DNV GL, 2016]).

4.9.4 Major Risks to Public from Unintentional Pipeline Release

Major risks to the public from unintentional pipeline releases relate to the characteristics of the pipeline product, the presence of ignition sources, and the release setting. For descriptions of the pipeline product characteristics, see Section 3.9.4 of the Phase 2 Draft EIS. Depending on these characteristics and conditions, pipeline releases can result in a *pool fire*, *flash fire*, or explosion, which are clarified below from the Phase 2 Draft EIS.

Pool Fires

For a buried pipeline transporting refined petroleum product, the greatest risk to the public is posed by *pool fires*. When a release occurs, the pipe contents are released into the soil. Depending on the release rate, soil conditions, groundwater level, and other factors, the released material may come to the surface. Depending on local terrain, it may flow for some distance away from the location of the release. If an ignition source is present, the accumulated pool could catch fire (the pipeline itself would not be expected to catch on fire, just the released material).

Pool Fire

A pool fire occurs when flammable liquid pools on the ground and comes in contact with an outside ignition source.

EDM Services (2017) used a number of reasonable assumptions and data inputs, including the estimated release rate and pipe contents of the Olympic Pipeline system, to model a release and subsequent pool fire as described in Sections 7.1 and 8.3 of their report (see Appendix I-5 of the Phase 2 Draft EIS). Based on these inputs, EDM Services estimated the following maximum release volume: 372,162 gallons.

Figure 4.9-6 is a schematic representation of the estimated pool fire size based on the maximum release volume (yellow circle) and the resulting *heat flux* zones. For this conceptual representation, the yellow, orange, blue, and green heat flux zones are where the heat from the fire would cause fatalities. The area outside of these rings would be hot and could result in injury or property damage but typically would not result in fatalities due to the fire.

For the modeled release volume, the estimated maximum downward distance to potentially fatal impacts, measured from the center of the pool fire, is 113 feet. This distance represents the area where released pipe contents would spread (or pool) and result in a fire (if an ignition source is present).

This schematic figure is a simplistic representation and does not show site-specific conditions. For example, this figure is presented for flat terrain and illustrates a release where no hills, water bodies, or catch basins are present. If sloping terrain, water bodies, catch basins, or impervious surfaces were present, the pipe contents could flow away from the site of the release and form a pool some distance from the pipeline, or the pool may be elongated instead of round, or the pool area might be smaller or larger. In sloping terrain, a pool may not form at all due to evaporation and percolation as the fluid flows away from the release site. This figure also does not show where the fire could spread to if adjacent vegetation or structures caught on fire. A larger pool fire and heat flux areas could have a higher degree of harm to the environment.

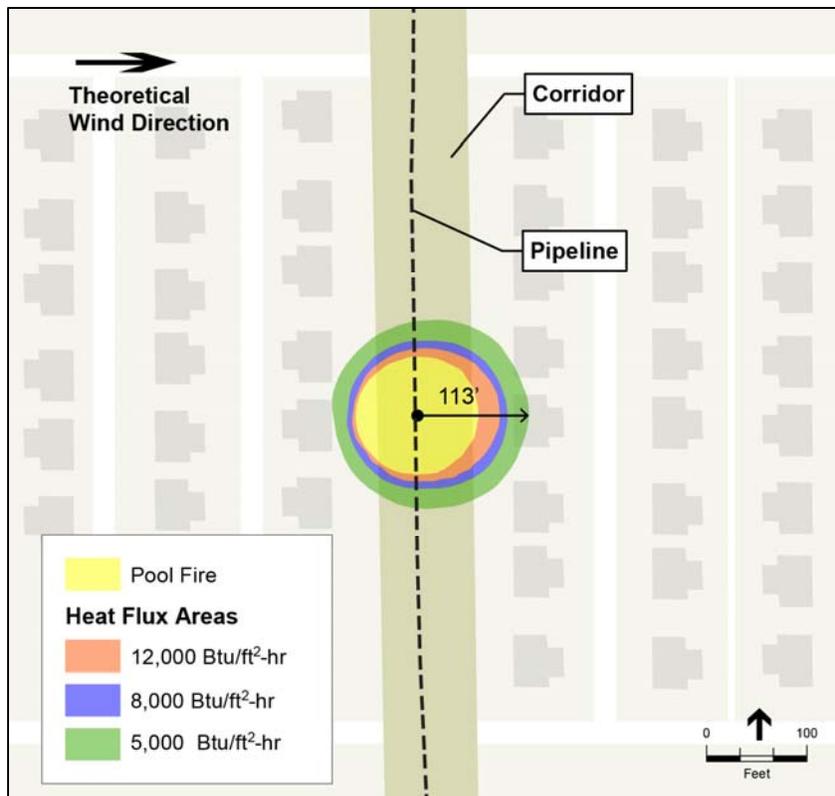
The schematic represents the calculated heat flux endpoints that were used by EDM Services to estimate potential fatalities for the pipeline risk assessment. Although the pool fire and heat flux areas could be larger under variable or site-specific conditions, this diagram provided the basis for calculating the number of potential fatalities assuming a worst-case release volume, and informed the risk assessment results presented in Section 3.9.5 of the Phase 2 Draft EIS. Additional information on how pool fire size was estimated is included in Section 7.1 of Appendix I-5 of the Phase 2 Draft EIS. As acknowledged in Section 7.1, there are literally thousands of possible pool size configuration scenarios based on local conditions. In response to comments received on the Phase 2 Draft EIS, additional qualitative discussion of possible scenarios in the communities along the corridor has been included in Section 4.9.7, *Impact Comparison by Segment*, of the Final EIS. They all result in potential fatalities under a worst-case release.

Spill Release Volume

For reference, the Bellingham incident of June 10, 1999 released about 237,000 gallons of gasoline. Because the release migrated along a water body, pool fire characteristics were different than the depiction in Figure 4.9-6. See the discussion in Section 4.9.7 for characteristics of each segment that could contribute to the spread of a pool fire.

Heat Flux

Humans in the vicinity of a fire receive heat from the fire in the form of thermal radiation. Radiant heat flux decreases with increasing distance from a fire. Those close to the fire would receive thermal radiation at a higher rate than those farther away.



Note: This diagram is meant to be a conceptual representation of where released pipe contents would spread (or pool) and result in a fire (if an ignition source is present) if the terrain at the spill site is flat and no water bodies or catch basins are present. This diagram does not show site-specific conditions. See Sections 7.1 and 8.3 of the EDM Services report in Appendix I-5 of the Phase 2 Draft EIS for more information on assumptions and data inputs used to develop this diagram.

Source: EDM Services, 2017.

Figure 4.9-6. Typical Pool Fire and Heat Flux Areas Diagram

The effects of radiant heat flux to humans are summarized below. The following three endpoints are commonly used to evaluate the risk of public fatalities (CDE, 2007).

- 12,000 Btu (British thermal unit)/ft²-hr (combined yellow pool and orange band) – 100% mortality after 30-second exposure.
- 8,000 Btu/ft²-hr (blue band) – 50% mortality after 30-second exposure.
- 5,000 Btu/ft²-hr (green band) – 1% mortality after 30-second exposure.

Flash Fires

Flash fires can occur when a vapor cloud is formed, with some portion of the vapor cloud within the combustible range, and the ignition is delayed. To be in the combustible range, the fuel vapor must be sufficiently concentrated; therefore, flash fires only occur when the liquid fuel has a high enough evaporation rate and the vapor cloud is not dispersed by wind. In a flash fire, the portion of the vapor cloud within the combustible range burns very quickly, minimizing the potential impact to humans. For gasoline, diesel fuel, and jet fuel, the potential for extensive vapor migration is limited by their relatively low evaporation rates when in liquid pools.

Explosions

Gasoline, jet fuel, and diesel fuel generally do not explode, unless the vapor cloud is confined in some manner, called a *vapor cloud explosion*. For the most recent PHMSA incident database (2010–2015), there were no reported explosions for refined petroleum product pipelines. Impacts for vapor cloud explosions are expressed in terms of a shock wave measured as overpressure (pounds per square inch) above atmospheric pressure. EDM Services modeled the potential releases from each of the refined petroleum products transported by the Olympic Pipeline system within the project corridor. The resulting peak overpressure level was 0.38 pounds per square inch due to the relatively open environment (medium fuel reactivity and low obstacle density). Although this level is sufficient to result in window breakage, it is not high enough to pose potentially fatal risks to the public. Outdoors, an explosion overpressure level of 2.4 pounds per square inch is necessary to cause mortality for 1 percent of an exposed population. As a result of the low estimated peak overpressure level in the project corridor, explosions are not described further in the EIS. For additional information on explosions, see the *Pipeline Safety Technical Report* (Appendix I-5 of the Phase 2 Draft EIS).

In response to comments received on the Phase 2 Draft EIS, it is acknowledged that specific release scenarios could result in an explosion. EDM modeled release scenarios based on the releases occurring on flat terrain and with no catch basins, storm drain, culverts, or other man-made conveyances present. If refined petroleum product were to flow into a storm drain or other pipe where the atmosphere was confined, then an explosion could result due to the confinement. A deeply incised creek bed might also be sufficient to provide adequate confinement to pose some explosion risk to humans.

4.9.5 Risks During Operation

As described in the Phase 2 Draft EIS, there are risks associated with the Olympic Pipeline system that are independent of the presence of transmission lines within the corridor. If one or both of the pipelines were damaged, refined petroleum product could be released. If the fluid reached a combustible mixture and an ignition source were present, a fire could occur, resulting in possible injuries and/or fatalities. The presence of transmission lines in the corridor could increase the risk of this occurring as a result of electrical interference, which is the focus of this analysis.

To quantify this risk for the Phase 2 Draft EIS, EDM Services conducted a probabilistic pipeline risk assessment for the following conditions:

Vapor Cloud Explosion

Occurs when there is a sudden release of flammable vapor, it mixes with air, and then is ignited by an outside source. Note: The Bellingham incident of June 10, 1999 was technically a pool fire, and not an explosion. The pipeline release flowed into a creek and ignited approximately 1.5 hours after the pipeline rupture.

Methods for Assessing Risks During Operation

To evaluate changes in pipeline safety risk that would occur as a result of the Energize Eastside project, EDM Services was retained to conduct a probabilistic pipeline risk assessment. The *Pipeline Safety Technical Report* (Appendix I-5 of the Phase 2 Draft EIS) describes the current risks of an incident happening along the corridor. It describes these risks with consideration of fuel type, pipe parameters, safety features, and other factors. The primary data source used was the PHMSA Incident Report database and information obtained from Olympic. Modeling was used to show the probability of a potential leak or fire. Estimated existing pipeline safety risk was then compared to estimated pipeline safety risk with the new 230 kV corridor.

- Olympic Pipelines Co-located with Existing Transmission Lines (No Action, *or existing 115 kV corridor*).
- Olympic Pipelines Co-located with Proposed Transmission Lines (Alternative 1 as evaluated in the Phase 2 Draft EIS, *or the proposed 230 kV corridor*).

A probabilistic pipeline risk assessment is a type of risk assessment used to estimate event frequencies or probabilities, for a specified time period, associated with specific, measurable consequences. The pipeline industry commonly uses such assessments to rank and manage risk, and to establish priorities for inspection, testing, and repairs.

Section 3.9.4 of the Phase 2 Draft EIS included detailed descriptions of the pipeline safety risk assessment and methodology, including risk assessment steps, discussion of limitations of the baseline data, and risk terminology definitions. These descriptions have not changed since the publication of the Phase 2 Draft EIS and are incorporated by reference in the Final EIS. Additional information on the risk assessment can be found in Appendix I-5 of the Phase 2 Draft EIS, *Pipeline Safety Technical Report* (EDM Services, 2017).

The risk assessment conducted by EDM estimated the potential risk of human fatalities occurring as a result of a pipeline leak and pool fire. The risk assessment was not a comprehensive assessment of specific risks in specific communities or locations along the corridor. It estimated the probability of a catastrophic release from the pipelines over the length of the co-located pipelines (for estimates of *Individual Risk*) and along a sample 1-mile segment of the pipelines (for estimates of *Societal Risk*). It described this in a manner commonly used for pipeline risk assessments, taking into account the quantity and characteristics of the fuel that could be released in a single event, as well as population density along the corridor. Given the variations in population, land cover, and topography, there are countless variations of circumstances in which releases could occur.

Individual Risk

Annual probability of fatality resulting from a pipeline failure and release for an individual, at a specific location.

Societal Risk

The annual probability that a specified number of people will be affected by a given pipeline release event.

The discussion of impacts presented in the Final EIS provides the same information included in the Phase 2 Draft EIS, but has been revised to focus on PSE's Proposed Alignment. PSE's Proposed Alignment as presented in the Final EIS incorporates the recommendations included in the DNV GL report to reduce and control the risk of electrical interference to the pipelines. These include initially operating both lines at 230 kV rather than 230/115 kV, minimizing points of pipeline and transmission line divergence, using a delta (triangular) conductor configuration, and locating pole grounds away from the pipeline(s). Because electrical interference risks would be reduced, no additional risk assessment was conducted for PSE's Proposed Alignment. The pipeline safety risk under PSE's Proposed Alignment would be expected to be no greater (and likely less) than the estimated pipeline safety risk under Alternative 1 in the Phase 2 Draft EIS.

4.9.5.1 Magnitude of Impact

For this analysis, project-related risks are classified as being significant or less-than-significant as follows:

Less-than-Significant

- With implementation of mandatory safety standards and design measures, there would be no substantial increase in risk of a pipeline release or fire as a result of project operation that could result in public safety impacts or damage to property and environmental resources.

Significant

- Even with the implementation of mandatory safety standards and design measures, there would be a substantial increase in risk of pipeline release or fire as a result of project operation that could result in public safety impacts or damage to property and environmental resources.

4.9.5.2 Risk Assessment Results

The results of the risk assessment conducted for the Phase 2 Draft EIS remain relevant for PSE's Proposed Alignment, and likely overstate the potential risks associated with PSE's Proposed Alignment. This is due to the incorporation of recommendations included in the DNV GL report into the proposed project. Therefore, the risk assessment results presented in the Phase 2 Draft EIS still apply to PSE's Proposed Alignment and are incorporated by reference in the Final EIS.

4.9.5.3 No Action Alternative

This section describes the potential pipeline safety risks that could occur under the No Action Alternative.

The pipeline safety risks within the existing 115 kV corridor are associated with refined petroleum products that are currently transported in the Olympic Pipeline system. Safety risks to the public from these materials could occur due to incidents caused by pipeline failure from electrical interference (external corrosion, fault damage, and arc damage), outside force/excavation, or other causes either related to (or unrelated to) co-location with the existing 115 kV PSE transmission lines. Depending on the circumstances of an incident and the properties of the pipeline product, incidents could result in the potential for pool fire, flash fire, or explosion. Safety risks related to outside force/excavation are addressed in Section 5.9 of this Final EIS.

Key Assumptions

To address the lack of available data related to coating stress and arc distance information for the existing 115 kV corridor, several assumptions were used in the risk assessment. For the pipeline risk assessment, instead of modeling existing conditions to calculate existing risk, worst-case assumptions were used to ensure that project impacts relative to the No Action Alternative were not understated. To estimate the maximum, or worst-case incremental change in risk from the No Action Alternative to the proposed 230 kV corridor, the risk assessment included an assumption that the coating stress voltages and resulting coating stress caused pipeline releases for the existing 115 kV corridor are the same as those for the proposed 230 kV corridor. Similarly, the risk assessment included an assumption that the ground fault arc distances and arc caused frequency of unintentional releases for the existing 115 kV corridor are the same as those for the proposed 230 kV corridor. **Using these assumptions likely understates the existing risk (No Action), thereby possibly overstating the actual difference in risk between the No Action Alternative and PSE's Proposed Alignment.**

As described in Section 3.9.5.1 of the Phase 2 Draft EIS, the risk assessment estimated the likelihood of potential impacts occurring as a result of the operation of the pipelines co-located with the existing 115 kV transmission lines for the three ways a transmission line can interact with a pipeline to cause damage: (1) external corrosion (related to *AC density*), (2) fault damage (related to coating stress), and (3) arcing damage (related to arc distances). These conditions are described above in Section 4.9.4 of this Final EIS. The estimated incident frequencies (or estimated incidents per 1,000 mile years) for individuals (individual risk) and groups of people (societal risk) are presented in Section 3.9.5.2 of the Phase 2 Draft EIS.

External Corrosion. As described in the AC Interference Study (DNV GL, 2016), AC current density levels less than 20 amps per square meter do not cause AC-induced corrosion, and the corrosion impacts arising from AC current density levels above 20 amps per square meter are difficult to accurately predict (i.e., they are unpredictable). There are two short segments in the study area where the estimated AC current density under existing peak winter loads exceeds 20 amps per square meter. These include a location in Somerset where the 16-inch pipeline diverges from the transmission line corridor, and a location near the Lake Hills Connector where the 20-inch pipeline crosses from the east side of the corridor to the west side. Typically, peaks in theoretical AC current density occur at points of divergence between a transmission line and a pipeline. The current densities in these areas are estimated to range from 22 to 35 amps per square meter. The incident frequencies presented in the Phase 2 Draft EIS employ worst-case assumptions about the length of pipeline affected and the duration of peak winter voltages. Winter peak loading scenarios represent the maximum current loading scenarios expected on the transmission lines, scenarios expected to be limited to 1 week or less per year.

Fault Damage. When the risk assessment was completed for the Phase 2 Draft EIS, no data were available from Olympic to estimate the coating stress voltages on the existing Olympic Pipeline system within the existing 115 kV corridor. As a result, the existing pipelines were assumed to have the same coating stress voltages and potential for coating stress-caused pipeline releases as for the proposed 230 kV lines. See Section 4.9.5.4 of this Final EIS (*PSE's Proposed Alignment*) for information on fault damage. Using this assumption in the risk assessment calculation likely overstates the overall change in risk associated with the proposed 230 kV lines because the proposed design would include a shield wire to limit the risk of fault damage, while the existing system does not.

Arcing Damage. Because Olympic did not provide data to estimate the arc distances for the existing Olympic Pipeline system within the existing 115 kV corridor, the existing pipelines were assumed to have the same ground fault arc distances and potential for arc-caused pipeline releases as for the proposed 230 kV transmission lines. See Section 4.9.5.4 of this Final EIS (*PSE's Proposed Alignment*) for information on arcing damage. Using this assumption in the risk assessment calculation could understate the overall risk associated with the existing 115 kV lines relative to the proposed lines, because the proposed lines have features that could provide greater protection from arcing than provided by the existing lines. The existing transmission line does not have a shield wire, and although other protective measures are in place, information provided by Olympic was insufficient to determine potential arcing distances for the existing pipelines.

Total individual risk and total societal risk are not presented for the No Action Alternative due to the lack of available data from Olympic and uncertain assumptions for the current pipelines related to coating stress and arc distances, as described above. Instead of modeling existing conditions to

calculate existing risk, worst-case assumptions were used to ensure that project impacts relative to the No Action Alternative were not understated.

For additional details about the analysis of risks under the No Action Alternative, see Appendix I-5 of the Phase 2 Draft EIS (*Pipeline Safety Technical Report* [EDM Services, 2017]).

No Action Alternative Impacts Conclusion

Using low estimates of existing risk (to present a worst-case change in risk associated with the project), the risk of external corrosion is expected to stay the same under the No Action Alternative. Because no data were available to estimate the likelihood of damage as a result of fault conditions on the Olympic Pipeline system within the existing 115 kV corridor, the existing pipelines were assumed to have the same risk as the proposed 230 kV corridor. Under the No Action Alternative, the likelihood of a pipeline rupture and fire is low, due primarily to safety precautions taken by the pipeline operator, as required by federal and state regulations. Under the No Action Alternative, PSE would continue to operate its existing 115 kV transmission lines as described in Chapter 2 of this Final EIS (Section 2.1.1). The arrangement and spacing of lines and voltage would stay the same and there would be no change in risk. Therefore, under the No Action Alternative, impacts would be less-than-significant.

4.9.5.4 PSE's Proposed Alignment

This section describes the potential pipeline safety risks under PSE's Proposed Alignment, focusing on how these risks would change compared to the No Action Alternative. This section provides the same information presented in the Phase 2 Draft EIS (for Alternative 1), but has been revised to focus on PSE's Proposed Alignment. PSE's Proposed Alignment incorporates the recommendations included in the DNV GL report to reduce and control the risk of electrical interference on the pipelines (DNV GL, 2016). These include operating both lines at 230 kV rather than 230/115 kV, minimizing points of divergence between the pipelines and transmission lines, using a delta conductor configuration, and locating poles and pole grounds away from pipelines. In addition to these design features, PSE would verify arc distances once the poles are installed and, where necessary, ground wires or other grounding systems will be installed to ensure that pole grounds are all adequately separated from the pipelines. The effects that these design and operational features have on pipeline safety risk are described further below.

Divergence

Electrical interference commonly occurs where a transmission line and a pipeline diverge. Under PSE's Proposed Alignment, the transmission lines would remain in the same position relative to the pipelines as the existing transmission lines, thereby not increasing the number of points of divergence with the pipelines.

As described in Section 3.9.5 of the Phase 2 Draft EIS, the risk assessment estimated the likelihood of potential impacts from the operation of the pipelines co-located with the proposed 230 kV transmission lines for the three ways the proposed 230 kV transmission lines can interact with a pipeline to cause damage: (1) external corrosion (related to AC density), (2) fault damage (related to coating stress), and (3) arcing damage (related to arc distances). The potential risk and potential impacts were estimated for individuals (individual risk) and groups of people (societal risk) for each of these conditions. In addition, this section describes the design requirements for transmission lines related to extreme weather events and *seismic hazards*. Because ongoing maintenance activities during operation of PSE's Proposed Alignment are expected to be the same as the No Action Alternative, no change in risk related to ongoing maintenance activities is anticipated.

The Phase 2 Draft EIS concluded the following with regard to pipeline safety risk associated with Alternative 1:

- For external corrosion (related to AC density), without consideration of potential mitigation, the project could increase AC-induced corrosion risk in two areas where modeled current densities would be at levels that could cause corrosion.
- For fault damage (related to coating stress), no increase in potential risk of damage was estimated for the proposed 230 kV lines because PSE's plans to use a shield wire on the new transmission lines.
- For arcing damage (related to arc distances), without consideration of potential mitigation measures, there could be an increase in potential risk of damage to the pipelines.

The AC Interference Study was limited by the lack of available data, as described in Section 4.9.5.3 of this Final EIS. The lack of available data for existing conditions required the risk assessment to assume certain conditions in order to provide a worst-case analysis of the proposed 230 kV transmission lines. Using these assumptions likely understates the existing risk (No Action) relative to the project, thereby possibly overstating the actual difference in risk between the No Action Alternative and Alternative 1 in the Phase 2 Draft EIS.

PSE's Proposed Alignment incorporates mitigation for pipeline safety risk; therefore, the expected risks would be even lower than for Alternative 1 as analyzed in the Phase 2 Draft EIS.

External Corrosion. For PSE's Proposed Alignment, there are no locations along the corridor where the estimated AC current density would exceed 20 amps per square meter. The estimated current density would be below 20 amps per square meter under peak winter loads. These levels do not cause AC-induced corrosion.

Note that the incident frequencies presented in Section 3.9.5.2 of the Phase 2 Draft EIS were based on Alternative 1, a route with more points of pipeline and transmission line divergence and with the transmission lines initially operating at 230 kV/115 kV. These incident frequencies do not reflect the reduced AC current density levels predicted for PSE's Proposed Alignment.

Fault Damage. PSE plans to use a shield wire on the new transmission lines (see also Section 4.9.8, *Mitigation Measures*).

As a result, coating degradation is not anticipated along the corridor (DNV GL, 2016). Given that no shield wire is currently present under the No Action (115 kV) condition, PSE's Proposed Alignment would likely improve conditions related to fault conditions because the shield wire would reduce the risk of fault damage to the pipelines (Fieltsch and Winget, 2014).

Arcing Damage. Based on the DNV GL recommendations, PSE revised the design from that presented in the Phase 2 Draft EIS to ensure that all poles would be at least 13 feet from the pipelines, because this was the maximum calculated arc distance necessary to prevent arcing between the poles and the pipelines, based on soil conditions in the corridor. If the modeled conditions are

AC Interference Study

The *AC Interference Study* (DNV GL, 2016) investigated the possibly for electrical interference effects and recommended design considerations to PSE in order to minimize these effects. Sensitivity studies were conducted related to AC-induced corrosion (AC current density) and fault analysis (coating stress voltage and arc distance) that evaluated varying pole configurations and shield wire types to aid in the design of the transmission line layout.

correct, there would be no risk of arcing damage. However, soil conditions are quite variable; therefore, actual arc distances could vary. Actual arc distances will be measured at each pole once the poles are installed. Where necessary, pole grounds would be installed to provide adequate separation from the pipelines.

Installation of the shield wire on the proposed 230 kV transmission lines would also substantially reduce the fault current flowing into the soil from the faulted structure by distributing the current to multiple structures. This would also reduce the arcing distance; therefore, the arc damage risk from PSE's Proposed Alignment would be reduced compared to the No Action Alternative.

As described in Section 3.9.3.3 of the Phase 2 Draft EIS, the existing transmission lines do not have a shield wire, and although other protective measures are in place, information provided by Olympic was insufficient to determine potential arcing distances for the existing pipelines. Because no data were available to estimate the arc distances for the existing Olympic Pipeline system within the existing 115 kV corridor, for purposes of the risk assessment conducted for the Phase 2 Draft EIS, the existing pipelines were assumed to have the same ground fault arc distances and potential for arc-caused pipeline releases as for the proposed 230 kV transmission lines. Using this assumption in the risk assessment calculation likely overstates the overall change in risk associated with the proposed 230 kV transmission lines because the proposed design includes a shield wire, pole distance, and commitment to measuring arcing actual distance and adjusting grounding distances, if needed, after installation.

Note that the incident frequencies presented in Section 3.9.5.2 of the Phase 2 Draft EIS were based on worst-case estimates of average pole spacing and pipeline configuration at the grounding rods. For example, EDM Services estimated that 4 percent of the pipelines would be within 13 feet of a grounding rod (see Section 9.3.4 of the *Pipeline Safety Technical Report* [EDM Services, 2017]); under PSE's Proposed Alignment, no portion of the pipelines would be closer than 13 feet to a transmission pole. The risk assessment results presented in the Phase 2 Draft EIS therefore do not reflect the measures to mitigate potential arc damage to the pipelines that are included in the PSE's Proposed Alignment.

Extreme Weather Events and Seismic Hazards. Based on the results of the Phase 1 analysis, the Phase 2 Draft EIS did not include additional analysis on Earth resources (e.g., seismic hazards). In response to comments received on the Phase 2 Draft EIS, the Final EIS includes additional information on Earth resources, and seismic risks specifically (see Section 4.11, *Earth*, of the Final EIS).

Safety measures would be incorporated into the project design to address the extreme weather and seismic conditions that occur in western Washington, to prevent poles from falling and damaging the buried pipelines. Final structural design for electrical utility structures must comply with the National Electrical Safety Code (NESC) 2017 as adopted by the UTC. For transmission lines, NESC 2017 states that the structural requirements necessary for wind/ice loadings are more stringent than seismic requirements and sufficient to resist anticipated earthquake ground motions. In addition, according to the American Society of Civil Engineers (ASCE) Manual No. 74, “*transmission structures need not be designed for ground-induced vibrations caused by earthquake motion because historically, transmission structures have performed well under earthquake events, and transmission structure loadings caused by wind/ice combinations and broken wire forces exceed earthquake loads*” (ASCE, 2009).

In the event of a large seismic event that ruptures the Olympic Pipeline system, there could be immediate life safety concerns along the alignment if the spilled fuel were to ignite. Such a seismic event would likely have widespread, regional impacts with multiple demands on emergency responders and issues related to access because of damaged transportation infrastructure. However, based on the results of the analysis of seismic risks in Section 4.11, these risks exist currently and are not expected to increase with PSE's Proposed Alignment.

Impact Conclusion for PSE's Proposed Alignment

Based on the results of the risk assessment, the probability of a pipeline release and fire occurring and resulting in fatalities remains low under PSE's Proposed Alignment. However, the potential public safety impacts would be significant if this unlikely event were to occur.

Under PSE's Proposed Alignment, including mitigation for corrosion and arc risk incorporated into the design, the probability of a significant pipeline safety incident would likely be the same or lower than the No Action Alternative. Because of the variability of soils, it is possible that the arcing risk could be slightly higher in some locations when compared with the No Action Alternative. In these areas, testing, monitoring, engineering analysis, and implementation of mitigation measures would lower these risks. See Section 4.9.8, *Mitigation Measures* for measures that would lower the risks.

The individual and societal risks described in Section 3.9.5.2 of the Phase 2 Draft EIS would be similar across all segments of PSE's Proposed Alignment. The risk would be proportional to the distance that the transmission lines are co-located with the Olympic Pipeline system. For PSE's Proposed Alignment, the Renton Segment has the lowest number of co-located miles. Table 4.9-1 lists the length of the Olympic Pipeline system (both the 20-inch and 16-inch diameter pipelines) co-located with the transmission lines in each segment.

As described above, the lack of available data for existing fault and arc distance conditions required the risk assessment to use certain assumptions for the No Action Alternative condition that would allow for a worst-case analysis of the proposed 230 kV lines. Using these assumptions likely understates the existing risk (No Action), thereby possibly overstating the actual difference in risk between the No Action Alternative and PSE's Proposed Alignment. The likelihood of a pipeline rupture and fire would remain low, with no substantial change in risk. As a result, the potential impact on environmental health with regard to pipeline safety is not considered significant. With implementation of the mitigation described in Section 4.9.8 of this Final EIS, conditions related to potential for fault damage due to coating stress and arc distances would likely improve under PSE's Proposed Alignment over the existing operational baseline condition (No Action Alternative) (DNV GL, 2016).

For additional details about the analysis of risks under Alternative 1, see the *Pipeline Safety Technical Report* (EDM Services, 2017).

Table 4.9-1. Miles of Transmission Line and Olympic Pipelines Co-location in Study Area with PSE’s Proposed Alignment, by Segment

Segments	Miles of Co-location		Highest and Lowest Number of Co-located Miles
	20-inch diameter	16-inch diameter	
Redmond	1.6	1.6	
Bellevue North	2.3	2.3	
Bellevue Central, Existing Corridor	2.9	2.9	Highest number of co-located miles
Bellevue South, Existing Corridor	1.2	3.3	
Newcastle	1.5	1.5	
Renton	0.4	0.4	Lowest number of co-located miles

4.9.6 Long-term Impacts on Resources

Implementation of the regulatory requirements identified in Section 4.9.1 of this Final EIS, *Relevant Plans, Policies, and Regulations*, and the mitigation measures described for pipeline safety in Section 4.9.8 of this Final EIS, will reduce the chances of a pipeline incident. However, some level of risk would remain, and it is possible that petroleum products transported through the Olympic Pipeline system could still enter the environment, or a fire could occur, as a result of proximity to the transmission lines under either the No Action Alternative or PSE’s Proposed Alignment.

In addition to the public safety risks described above, natural resources and other elements of the environment could be significantly affected if an unintentional release or fire were to occur. This section describes the potential impacts of a spill or a fire on the natural and built environment in the unlikely event that a pipeline release were to occur. It describes the types of impacts on each element of the environment addressed in the Phase 2 Draft EIS.

The impacts of a spill depend on the magnitude of the spill (i.e., volume of material released and extent of area affected); the type of material released; and the location (e.g., near a sensitive area). Because the Energize Eastside project would not affect pipeline pressure and flow rates, or other operating parameters of the pipeline system, the potential characteristics of a spill or fire would be the same regardless if it occurred under the No Action Alternative or PSE’s Proposed Alignment.

Methods for Assessing Long-Term Impacts on Resources

To determine long-term impacts on resources in the event of a pipeline spill or fire caused by construction or operation of the proposed project, the EIS Consultant Team considered the types of impact and potential extent of damage. The length (miles) of pipeline co-located with the proposed transmission lines by segment was considered in the assessment, as well as the impact distance identified in the *Pipeline Safety Technical Report* for a fire.

The greatest potential for environmental harm would be if a release enters or directly occurs in a water body as spilled materials can spread more quickly, can be difficult to contain and remove, and can be toxic. A release could enter a water body in a number of ways, such as through surface or subsurface flow, through a catch basin, or across impervious surfaces. The Olympic Pipeline system carries diesel, jet fuel, and gasoline, which are very light or light oils. Gasoline breaks down very quickly, usually lasting only days to weeks in the environment; jet fuel usually lasts days to weeks in the environment; and diesel fuel is somewhat persistent lasting 1 month to a year in the environment (Ecology, 2016; NOAA, 2016).

A pool fire (fire) could result from a spill, but not all spills would result in a fire. For a fire to occur, an ignition source would be needed. The potential risk of a fire from a pipeline rupture is described Section 4.9.4 of this Final EIS, *Major Risks to Public from Unintentional Pipeline Release*, and Section 5.9.1 of this Final EIS, *Risks During Construction*. Potential impacts would depend on how and if the fire spreads, which would depend on vegetation, structures, and other conditions at the site. The nature and extent of the environmental damage from a fire can be quite varied. For example, the pool fire diagram in Figure 4.9-6 shows an area of approximately 1 acre that could have temperature high enough to cause fatalities. A spill of the same volume could spread over a larger area due to topography, especially if the spill reached a water body. Although the spill would not be as concentrated, the extent of damage could extend to several acres. If in a wooded area and during dry season, a pool fire could spread even farther if not contained by firefighters. Because of these variables, the impacts of a fire on resource areas are described here in general terms. Section 4.9.7 describes conditions specific to each segment.

Land Use and Housing

A release of material from the Olympic Pipeline system could foul buildings, contaminate soil, and damage vegetation. If residential buildings are fouled by the spill, structures may need to be demolished, which could temporarily reduce available housing units.

Depending on the location, size, and extent, a fire could destroy or damage houses, commercial buildings, other structures, and vegetation. This would reduce the amount of available housing until structures are rebuilt, displace businesses, and potentially change neighborhood character.

Planned future development consistent with policies adopted by affected cities may not occur if contaminated properties are not promptly remediated. Depending on the time it takes to remediate the soil and rebuild damaged buildings, there may be a long-term displacement of businesses and residents.

Impacts on land use and housing associated with pipeline spills or fires would be highest if they occurred in areas with high population or employment density, areas with unique land uses (such as hospitals or schools), or areas planned for redevelopment or intensification of land uses.

Scenic Views and Aesthetic Environment

A spill has the potential to negatively affect the aesthetic environment, in particular the natural environment (e.g., vegetation). Spilled material can damage vegetation, negatively affecting the visual quality of the area. See the *Plants and Animals* section below for further explanation. The reduction in visual quality would depend on the type of material spilled, location, and size of the release.

A fire from a pipeline release could substantially degrade the visual quality of surrounding landscape. Visual effects of a fire can include areas with extensive burn damage to structures, facilities, and vegetation. This type of physical damage would alter and degrade the visual quality of the affected area until the landscape is restored. The extent of impact would depend on the size and location of the fire. Areas of higher visual quality would be most susceptible to aesthetic impacts from spills or fires, such as undeveloped wooded areas or areas with orderly urban form.

Water Resources

Materials from a spill can directly or indirectly (e.g., through catch basins) enter streams, wetlands, and lakes or could be washed into those water bodies by stormwater. The spills could degrade water quality and contaminate sediments, which can be toxic to aquatic plants and animals. Materials could also move downstream, spreading quickly and contaminating a larger area than if a spill occurred on land. Spills also have the potential to infiltrate and contaminate groundwater. Air quality near a stream affected by a spill could be degraded to an extent that people and animals could be harmed or killed. In Renton, the drinking water supply comes from groundwater, and aquifer contamination would require expensive cleanup or finding an alternate water supply.

Depending on the location, size, and extent, a fire could destroy or damage vegetation in and adjacent to wetlands and streams. This could expose soils and increase erosion of sediments, which could negatively affect water quality. Damage to vegetation could change the function and extent of wetlands. Reduced riparian vegetation could also increase water temperature in streams. Additionally, byproducts from the fire, or chemicals used in firefighting or cleanup efforts, could contaminate water resources. Byproducts or chemicals also have the potential to enter the groundwater and contaminate drinking water.

Impacts on water resources associated with pipeline spills or fires would be highest if they occurred in areas with rivers or streams and associated riparian areas or aquifer recharge areas, or if they occurred in drainage pipes, culverts, or other piped conveyances where the atmosphere was confined. In these situations, an explosion could result due to the confinement. A deeply incised creek bed may also be sufficient to provide adequate confinement to pose some explosion risk. In addition to risks to humans in the explosion area, an explosion could substantially degrade ecological conditions within the water body where the explosion occurred, or nearby water bodies.

Plants and Animals

Vegetation can be damaged by direct physical and chemical interactions associated with a spill. The nature of impacts depends on the duration of exposure, the type and quantity of the material spilled, location of the release, the potential for ignition (described below), and the sensitivity of species. Full restoration to original conditions can take many years. If a spill entered a watercourse, it could damage aquatic vegetation and terrestrial vegetation along the shoreline downstream. If the fuel were to persist in the environment, it can affect the long-term ability of vegetation to recover (Hoffman et al., 2003).

A spill can affect terrestrial and aquatic animals by physical smothering or toxic effects. Animals that contact spilled material could be physically coated by petroleum products, inhale vapors, or ingest oil when foraging or grooming. Aquatic-oriented species (including fish, wading birds, waterfowl, frogs, and salamanders) are more susceptible when oil enters a water body because the spill would spread throughout the water body or downstream. Sensitive areas or species as identified in Section 4.4 of this Final EIS, *Plants and Animals*, are particularly susceptible (Ecology, 2016).

Impacts to plants from a fire would depend on the vegetation species and communities exposed, as well as the duration and temperature that plants are exposed to. Low-lying ground cover and shrubs would recover much quicker than forested areas with mature trees. The longer the exposure and the higher the temperature, the more likely injury or death of plants would occur. The loss of vegetation can also provide an opportunity for invasive non-native species to become established and spread. Also, trees that survive may be more susceptible to disease, fungus, or insects.

Animals can be injured or killed by a fire if they are close enough to the event. Animals that can will move away from a fire; however, some animals with limited mobility, such as newly hatched birds, may not be able to move, and others react to danger by hiding and would be more susceptible to injury or death (USDA, 2000).

Impacts on plants and animals associated with pipeline spills or fires would be highest if they occurred in forested areas with mature trees or aquatic and terrestrial habitats, or during a season critical for the life cycle of a certain species (for example, spawning season for fish).

Greenhouse Gases

Activities that release GHGs contribute to the accumulation of GHGs in the atmosphere, a driving force in global climate change. After a spill, gasoline, diesel, and jet fuel would begin to evaporate, releasing greenhouse gases, primarily CO₂, N₂O, and CH₄. The resulting GHG impacts would depend on the amount of GHGs released into the atmosphere.

A fire would also result in the release of GHGs, primarily from burning structures and trees. The resulting GHG impacts would depend on the amount released and amount ignited. The highest amount of GHGs released would occur if the fire damaged a forested area with mature trees.

Recreation Resources

If a spill occurred near a recreation site, it could affect recreation opportunities, depending on the scale of the spill. Small spills may have a temporary impact on access to a site during clean-up efforts. Larger spills may directly harm or kill vegetation. The loss of or damage to vegetation would negatively impact the recreation user experience. People may avoid a site or be prohibited from entering a contaminated area. Recreation sites downstream of the pipeline could be affected if a large spill entered a watercourse.

If a fire occurred near a recreation site, it could substantially degrade the environment and affect recreation opportunities. Impacts on recreational resources would include the destruction or physical damage by the fire to the resource itself. The loss of or damage to vegetation would detract from the aesthetic quality of a recreation site and negatively impact the recreation user experience, or preclude its use altogether. A recreation site may be temporarily closed during cleanup efforts or if the fire caused the site to be unsafe (e.g., damaged trees).

Impacts on recreation associated with pipeline spills or fires would be highest if they occurred in parks or near recreational facilities that receive the highest number of visitors of the parks along the corridor, or parks with mature vegetation that is part of a recreation user's experience, or occur during a park's peak visiting season.

Historic and Cultural Resources

If material were released in an area where historic or cultural resources are located, these resources could be impacted. Impacts from seepage may damage a resource's integrity of design, setting, materials, workmanship, and feeling, or its depositional context. Impacts on the depositional integrity of a subsurface cultural resource would be a permanent loss, as these resources are non-renewable. Incident response or cleanup activities such as excavation or other ground disturbance may impact historic and cultural resources, but could be mitigated through a state-issued emergency excavation permit. Damage to elements of vegetation or the natural environment that contribute to the historical significance of a resource could negatively affect these resources.

If a fire were to occur near historic and cultural resources, it could destroy or damage historic structures, buildings, or objects and change the historic character of a landscape. Although structures can be rebuilt, destruction of a historic or cultural resource would be a permanent loss, as the original resources are non-renewable. Damage to the surrounding environment and vegetation could impact a resource's integrity of setting, and may minimize the resource's ability to convey its historic significance. Soil disturbance from restoration efforts could also impact the integrity of subsurface cultural resources. Impacts from these efforts may be mitigated through a state-issued emergency excavation permit.

Impacts on historic and cultural resources associated with pipeline spills or fires would be highest if they occurred in areas with a concentration of historic and cultural resources, such as in a historic district.

Transportation

If significant damage to the pipeline system occurred, petroleum products normally transported in the pipelines would be transported by other means, primarily by trucks using interstate highways. This would be expected to generate up to a few thousand truck trips per day, distributed throughout the day and across the interstate highway system. Impacts would be greatest at major distribution points and major end users, and could cause local congestion such as near refineries or at airports. If an accidental shutdown occurred, short-term disruption would occur to airports or other customers of the Olympic Pipeline system until transportation could be arranged. No long-term disruption in petroleum product supply would be anticipated for any planned temporary shutdown or relocation.

Economics (Ecosystem Services)

If a spill or fire damaged a large number of trees, the ecosystem services associated with those trees (stormwater regulation, pollutant removal, and carbon sequestration) would no longer be available. Impacts on ecosystem services would be highest if a spill or fire occurred in a forested area with mature trees.

Conclusion

As stated above, impacts on these sensitive resources described in Section 4.9.6 of this Final EIS could be significant if a pipeline incident occurred. However, the likelihood of a pipeline rupture and release remains low under PSE's Proposed Alignment, and implementation of regulatory requirements (Section 4.9.1 of this Final EIS) and mitigation measures (Sections 4.9.8 and 5.9.4 of this Final EIS) would further reduce the probability of a pipeline incident occurring.

4.9.7 Impact Comparison by Segment

Section 4.9.5.4 of this Final EIS describes the potential for the project to increase pipeline safety risks, and Section 4.9.6 of this Final EIS describes the general consequences in the event of a spill or a fire on the pipeline. As noted, conditions within each segment vary, and these can influence both the possibility of an incident adversely affecting the pipelines and the consequences in that location. This section (which is new for the Final EIS and was not presented in the Phase 2 Draft EIS) provides a segment-level discussion of these two sets of variables. Factors affecting the possibility of an accident include the presence of a co-located pipeline, the segment location relative to the Seattle Fault, landslide hazard areas, and *liquefaction* zones. Factors affecting the potential consequences include the presences of slopes and streams, crossings of impervious areas, the types and density of land uses, and types and sensitivity of vegetation and habitat present. For specific information about the affected environment, other sections of the EIS provide greater detail. For more information regarding co-location of the project with the Olympic Pipeline system, see Section 4.9.2 of this Final EIS (including Figure 4.9-1), as well as Table 4.9-1.

4.9.7.1 Richards Creek Substation

One of the pipelines crosses through the middle of the Richards Creek substation site (see Figure 2-2).

- **Adjacent Land Uses:** The predominate types of structures surrounding the site are the Lakeside substation and Chestnut Hill Academy to the north, industrial warehouses to the west and south, and multi-family residential and commercial buildings to the east. These structures are relatively dispersed and surrounded by parking lots.
- **Land and Vegetation Cover:** The Richards Creek substation site is comprised of 80 percent vegetation cover. However, after development of the site, tree removal would result in less vegetation cover. The site is primarily comprised of, and surrounded by, trees.
- **Seattle Fault, Landslide Hazard Areas, and Liquefaction Hazards:** The Richards Creek substation site is entirely within the Seattle Fault Zone. The site has small pockets of landslide hazard areas, but these would be re-graded during construction of the project.
- **Topography and Nearby Water Bodies:** Topographically, the site generally slopes downhill to the west. One stream is just outside the western property boundary and traverses the southwest portion of the site. Another stream is located in the northeast corner of the property. Wetlands are also located on the property.
- **Road Crossings and Impervious Surfaces:** The site would not cross any roadways, but an existing access road turns into SE 30th Street. A spill on the site could potentially flow down the access road (and into the stormwater system) or into one of the streams on-site.

4.9.7.2 Redmond Segment

- **Adjacent Land Uses:** The predominate types of structures along the segment are detached single-family homes and multi-family buildings. Rose Hill Middle School is adjacent to the segment, and commercial warehouses are adjacent to the Sammamish substation.
- **Seattle Fault, Landslide Hazard Areas, and Liquefaction Hazards:** The segment is entirely outside of the Seattle Fault Zone. The northern 0.85 mile of the corridor is located primarily within landslide hazard areas.
- **Land and Vegetation Cover:** Land cover is forested for the northernmost 0.8 mile. Along the rest of the corridor, the land cover is developed with varying amounts of vegetation (20–80 percent land cover).
- **Topography and Nearby Water Bodies:** The Redmond Segment generally slopes downhill to the east. Swan Lake, a constructed lake associated with the Sixty-01 condominium complex, is approximately 450 feet to the east of the corridor with an 11 percent slope in between. A spill could flow downhill and into Swan Lake. The segment crosses several wetlands and streams.
- **Road Crossings and Impervious Surfaces:** The segment crosses five roadways and a parking lot behind the Sixty-01 condominium complex, where a release from the pipelines could reach an impervious surface and flow into the stormwater system or Swan Lake.

4.9.7.3 Bellevue North Segment

- **Adjacent Land Uses:** Portions of the corridor passing through single-family neighborhoods are generally lined with tall trees. Structure types along the segment are primarily detached single-family residences. Approximately 0.5 mile before the segment terminates, it passes Westminster Chapel, crosses Viewpoint Park and SR 520, and traverses a car dealership.
- **Seattle Fault, Landslide Hazard Areas, and Liquefaction Hazards:** The segment is entirely outside of the Seattle Fault Zone. A small landslide hazard area is located north of NE 24th Street.
- **Land and Vegetation Cover:** Land cover along the segment is a mosaic of forested areas and developed areas, with vegetation coverage ranging from 50 to 80 percent.
- **Topography and Nearby Water Bodies:** The topography along the Bellevue North Segment generally slopes downhill to the south and east. Valley Creek is approximately 0.3 mile to the east of the transmission line corridor with a 9 percent slope in between. A spill could potentially flow downhill and intercept the creek. The segment crosses several wetlands.
- **Road Crossings and Impervious Surfaces:** The segment crosses seven roadways, as well as parking lots associated with commercial properties north of NE 20th Street, where a release from the pipelines could reach an impervious surface and flow into the stormwater system.

4.9.7.4 Bellevue Central Segment

- **Adjacent Land Uses:** Single- and multi-family homes are the predominate structures along the segment. However, there are commercial and industrial structures in the BelRed area and near the Lakeside substation. Chestnut Hill Academy, also near the Lakeside substation, is the only school adjacent to the corridor in this segment. In addition, three major open spaces are adjacent to the segment: Glendale Country Club, Kelsey Creek Park, and a cemetery near the Lakeside substation.
- **Seattle Fault, Landslide Hazard Areas, and Liquefaction Hazards:** The segment is entirely outside of the Seattle Fault Zone. However, the southern terminus of the Bellevue Central Segment borders the northern boundary of the zone. There are pockets of landslide hazard areas between approximately SE 3rd Street and SE 16th Street.
- **Land and Vegetation Cover:** Vegetation coverage ranges from 20 to 80 percent along the corridor in this segment. More heavily vegetated areas include Kelsey Creek Park and the open space in Richards Valley (west of the corridor). Portions of the corridor passing through single-family neighborhoods are generally lined with ornamental trees of varying heights.
- **Topography and Nearby Water Bodies:** The north portion of the segment is on a slight ridge, with the underlying topography sloping downhill slightly to the east and more steeply to the west. South of Bel-Red Road, the topography general slopes downhill to the west. The portion of the corridor along the Glendale Country Club and the Kelsey Creek Park experiences a sharp depression with a 20 percent slope to the west from the easement. Therefore, spills could flow down into Kelsey Creek Park, which includes Kelsey Creek and its tributaries. The segment crosses several wetlands and streams.
- **Road Crossings and Impervious Surfaces:** The northern 0.43 mile of the segment is entirely on impervious surfaces (parking lots and roadways), where a release from the pipelines could reach an impervious surface and flow into the stormwater system. Throughout the corridor, the segment crosses nine roadways.

4.9.7.5 *Bellevue South Segment*

- **Adjacent Land Uses:** Portions of the corridor passing through single-family neighborhoods are generally lined with ornamental trees of varying heights. Structures along the corridor are primarily single-family homes; however, commercial buildings with large parking lots line I-90, and Tyee Middle School is just north of SE Newport Way.
- **Seattle Fault, Landslide Hazard Areas, and Liquefaction Hazards:** The entire segment is within the Seattle Fault Zone. There are small, scattered areas of landslide hazard between the Richards Creek substation site and I-90, as well as along Somerset Hill. However, the largest landslide area crossed by the corridor is south of the Somerset substation and surrounding the Coal Creek ravine.
- **Land and Vegetation Cover:** Vegetation coverage ranges from 20 to 80 percent. The segment traverses the heavily forested Coal Creek ravine.
- **Topography and Nearby Water Bodies:** The topography generally slopes downhill to the south and west, with the steepest slopes along the Coal Creek ravine. Because there are few flat areas, slopes contribute to the risk of a release from the pipeline spreading. Depending on where it originates, a spill could potentially flow into Coal Creek. The segment crosses several wetlands and streams.
- **Road Crossings and Impervious Surfaces:** There are 19 road crossings, as well as parking lots associated with commercial development south of I-90, where a release from the pipelines could reach an impervious surface and flow into the stormwater system.

4.9.7.6 Newcastle Segment (both Options)

- **Adjacent Land Uses:** Portions of the corridor passing through single-family neighborhoods are generally lined with ornamental trees of varying heights. Typical structures along the segment are predominately single-family homes; however, there are some commercial buildings and townhouses near Coal Creek Parkway, as well as Newcastle City Hall.
- **Seattle Fault, Landslide Hazard Areas, and Liquefaction Hazards:** The entire segment is within the Seattle Fault Zone. The portion of the segment that crosses the May Creek Natural Area is located within a landslide hazard area. There are no liquefaction hazard areas along the segment.
- **Land and Vegetation Cover:** The land cover is developed with varying degrees of vegetation cover (20–80 percent). More heavily vegetated areas exist where the segment traverses the forested area within and around the Newcastle Cemetery and the ravine at May Creek Park.
- **Topography and Nearby Water Bodies:** The transmission line corridor passes through mostly moderately sloping areas with a high point approximately 500 feet south of SE 80th Street. Steep slopes (greater than 40 percent) are concentrated in two areas: near Coal Creek (from Coal Creek Parkway SE to SE 60th Street) and near May Creek (between about SE May Creek Park Drive and SE 95th Way). Because there are few flat areas, slopes contribute to the risk of a release from the pipelines spreading. It is possible that, depending on where a spill originates, it could intersect with one of these two water bodies. Lake Boren is approximately 600 feet east of the transmission line and at a 10 percent slope downhill. A spill could potentially flow into Lake Boren. The segment crosses several small wetlands and streams.
- **Road Crossings and Impervious Surfaces:** There are eight road crossings where a release from the pipelines could reach an impervious surface and flow into the stormwater system.

4.9.7.7 Renton Segment

- **Adjacent Land Uses:** The predominate types of structures surrounding the co-located utilities are single-family homes and Sierra Heights Elementary School.
- **Seattle Fault, Landslide Hazard Areas, and Liquefaction Hazards:** The entire segment is outside of the Seattle Fault Zone. However, the north portion of the segment borders the southern boundary of the zone. The portion of transmission lines that is co-located with the pipelines does not cross landslide hazard areas or liquefaction hazard areas. There is a landslide hazard area along Honey Dew Creek and a moderate to high liquefaction hazard area located along the Cedar River.
- **Land and Vegetation Cover:** Along the co-located portion of the segment, the land cover is forested.
- **Topography and Nearby Water Bodies:** The topography along the co-located section of the Renton Segment slopes downward to the north into the Honey Dew Creek ravine. Therefore, a spill could travel downhill and reach Honey Dew Creek. The co-located portion of the segment does not cross wetlands or streams.
- **Road Crossings and Impervious Surfaces:** The co-located portion of the segment crosses two roadways, where a release from the pipelines could reach an impervious surface and flow into the stormwater system. From approximately NE 4th Street to NE 7th Street, and from the NE 11th Place to NE Sunset Blvd, the corridor crosses numerous parking lots associated with commercial development and multi-family residences.

4.9.8 Mitigation Measures

This section describes the mitigation measures that would be used during operation of the project, and recommends additional measures to avoid, minimize, and mitigate environmental health and safety impacts related to pipeline safety. See Section 5.9.4 of this Final EIS for mitigation measures applicable during construction. A substantial set of federal, state, and local regulations and practices are in place to minimize the potential for pipeline incidents that could occur as a result of electrical interference from the Energize Eastside project. The design features and BMPs that PSE proposes to use to avoid or minimize impacts during operation have been considered in assessing the environmental impacts to environmental health and safety.

Mitigation measures would be determined during the permitting process, but may be applied prior to construction, at project start-up, or during operation of the project. For instance, PSE has added some mitigation measures, such as pole locations, layout, and configuration as part of the refined design. In addition to these design features, PSE would verify arc distances once the poles are installed and, where necessary, install ground wires or other grounding systems to ensure that pole grounds are all adequately separated from the pipelines. Other mitigation measures would need to be implemented after the project is energized or during peak winter load conditions in order to take into account measured field conditions.

For the Phase 2 Draft EIS, the EIS Consultant Team retained Stantec Consulting Services Inc. (Stantec) to perform an independent, technical review of DNV GL's AC Interference Study. Based on Stantec's experience and industry standards, it was Stantec's opinion that the technical approach used to achieve an optimal transmission line route and powerline conductor configuration to minimize the *AC interference* risks on the Olympic Pipeline system is consistent with industry practice. However, Stantec recommended that additional analysis be performed in the detailed design stage of the project to verify mitigation needs for the project prior to transmission line energization (Stantec, 2017). These measures are listed below.

Olympic, as pipeline operator, is responsible for operating and maintaining its pipelines in accordance with federal standards. PSE, as project applicant, has responsibilities (some of which may be imposed by jurisdictions with permit authority) to coordinate and cooperate with Olympic, but has limited authority to influence specific mitigation measures undertaken by Olympic related to pipeline operation or monitoring. This section first describes the regulatory requirements and responsibilities of PSE for implementing mitigation measures, and of Olympic for operating and maintaining its pipelines in accordance with safety standards and applicable laws. Next, the section identifies additional potential mitigation measures for ensuring that public safety concerns are addressed. As part of ongoing coordination between PSE and Olympic, additional mitigation measures may be identified during final design.

4.9.8.1 Regulatory Requirements

PSE Responsibilities and Requirements

PSE is responsible for the Energize Eastside project's design, construction, and operational parameters within the shared corridor with the Olympic Pipeline system. For PSE, national and state standards, codes, and regulations, and industry guidelines govern the design, installation, and operation of transmission lines and associated equipment. The NESC 2017, as adopted by the UTC, provides the safety guidelines that PSE follows. The NESC contains the basic provisions necessary for worker and public safety under specific conditions, including electrical grounding, protection

from lightning strikes, extreme weather, and seismic hazards. PSE would use these in developing final design. The final design of the project has not been completed; therefore, the exact specifications and standards that would be incorporated into the project have not been identified.

To address concerns about potential interaction between the Energize Eastside transmission lines and Olympic Pipeline system, PSE and Olympic have coordinated regarding the project since 2012, and both have indicated they would continue their coordination through final design and construction. PSE and Olympic meet regularly to discuss, identify, and mitigate potential threats to the integrity of the pipelines. Over the course of these ongoing discussions, the project plans have evolved to minimize the potential for impact. PSE's Proposed Alignment presented in the Final EIS now incorporates the recommendations included in the DNV GL report to reduce the risk of electrical interference to the pipelines. These include the following engineering aspects: initially operate both lines at 230 kV rather than 230/115 kV; minimize points of pipeline and transmission line divergence along the corridor; use a delta conductor configuration; and locate poles and pole grounds away from the pipeline(s). PSE also plans to perform an AC interference study prior to construction that incorporates the final powerline route, configuration, and operating parameters to confirm that current densities would remain within acceptable levels, and inform Olympic of any locations where additional measures may be needed to protect the pipelines.

Olympic Responsibilities and Requirements

As the pipeline operator, Olympic is responsible for operating and maintaining its pipelines in accordance with or to exceed PHMSA's Minimum Federal Safety Standards in 49 CFR Part 195 (and Washington State UTC's adopted and enhanced regulations contained in WAC, Title 480). The regulations are intended to ensure adequate protection for the public and to prevent pipeline accidents and failures. PHMSA specifies minimum design requirements and protection of the pipeline from internal, external, and atmospheric corrosion. In addition, 49 CFR 195 established the following broad requirements that are imposed on Olympic as the pipeline operator:

- 49 CFR 195.577(a) requires, *“For pipelines exposed to stray currents, you must have a program to identify, test for, and minimize the detrimental effects of such currents.”*
- 49 CFR 195.401 (b) (1) requires, *“Non Integrity Management Repairs, whenever an operator discovers any condition that could adversely affect the safe operation of its pipeline system, it must correct the condition within a reasonable time. However, if the condition is of such a nature that it presents an immediate hazard to persons or property, the operator may not operate the affected part of the system until it has corrected the unsafe condition.”*

Because Olympic, as the pipeline operator, is responsible for the safety of its pipeline in compliance with federal safety requirements, measures to be used will be determined by Olympic in coordination with PSE and based on a review of final design, site-specific conditions, and field measurements. Certain mitigation measures, such as measures to reduce AC density, necessarily must correspond to specific design and site conditions. Olympic has indicated it will identify specific measures, or a suite of measures, following the detailed engineering analysis of the final design and based on site-specific conditions and field measurements conducted at project start-up and during peak loading scenarios, and in consideration of the AC interference study that incorporates the final powerline route, configuration, and operating parameters. For example, Olympic has informed PSE that after energization, it plans to perform a site survey to ensure that all AC interference risks have been fully mitigated under steady-state operation of the powerline.

4.9.8.2 Potential Mitigation Measures

Potential mitigation measures are summarized below based on results and recommendations of DNV GL's AC Interference Study (2016); Stantec's independent, technical review of DNV GL's AC Interference Study (Stantec, 2017); measures PSE has indicated it will use; and measures the EIS Consultant Team has proposed to provide additional safety assurances. The applicable measures are organized based on the stage at which they would be applied (i.e., before construction, at project start-up, and during operation).

Prior to Construction

- Continue to coordinate with Olympic and include safeguards in the project design to protect nearby pipelines from interaction with the new transmission lines due to AC current density, faults caused by lightning strikes, mechanical/equipment failure, or other causes.
- Perform an AC interference study incorporating the final powerline route, configuration, and operating parameters to confirm that current densities would remain within acceptable levels, and inform Olympic of any locations where additional measures may be needed to protect the pipelines.
- Obtain and incorporate all of the pipeline parameters required for detailed modeling and study (i.e., locations and details of above-grade pipeline appurtenances/stations, bonds, anodes, mitigation, etc.). This should include a review of the annual test post cathodic protection survey data.
- Fully assess the safety and coating stress risks for phase-to-ground faults at powerline structures along the entire area of co-location, including both inductive and resistive coupling.
- Fully assess the safety and AC corrosion risks under steady state operating conditions on the powerline.
- Reassess the safe separation distance at each pole location to minimize arcing risk based on NACE SP0177-2014 and considering the findings in CEA 239T817 (Stantec, 2017).
- Ensure that the separation distance between the pipelines and the powerline structures exceeds the safe distance required to avoid electrical arcing by installing pole grounds at appropriate distance from the pipeline based on engineering analysis.
- File a mitigation and monitoring report with the Partner Cities demonstrating that sufficient safety factors have been incorporated into design, and documenting all consultations with Olympic, including the sharing of modeling and engineering information with Olympic to assist Olympic in its monitoring and mitigation responsibilities. The report should include a plan that identifies the process for conducting additional field surveys and data collection for identifying mitigation measures following project start-up, and proposed monitoring to ensure that mitigation related to operational issues is followed.
- Install Optical Ground Wire (OPGW) shield wire on the transmission line poles.

At Project Start-up

- Work with Olympic to evaluate and implement appropriate mitigation measures to reduce electrical interference on the Olympic Pipeline system to safe levels. (Olympic has informed PSE that, after the system is energized, it plans to collect field data to assess the necessity for the installation of AC grounding or similar systems to address steady-state conditions. Olympic has informed PSE that it plans to implement appropriate mitigation measures to the extent needed based on its analysis of field data collected following system energization. AC grounding systems are commonly installed in connection with power transmission poles to dissipate any energy to ground.)
- Verify arc distances once poles are installed and, where necessary, install ground wires or other grounding systems to ensure that pole grounds are all adequately separated from the pipelines.
- Mitigation that Olympic could provide based on the results of the analysis may include the installation of additional protective measures such as grounding mats, horizontal surface ribbon, and/or deep anode wells based on a detailed mitigation study, as appropriate.

During Operation

- If indicated by the AC interference study conducted for final design, inform Olympic when the electrical system is expected to operate at or near winter peak loading so as to provide Olympic a reasonable opportunity to take appropriate steps to measure actual AC current densities.
- To detect any unexpected changes between the pipeline and transmission line, provide information to Olympic as necessary for Olympic to record AC pipe-to-soil potentials and DC pipe-to-soil potentials during their annual cathodic protection survey.
- Provide Olympic with as much advance notice as practical of when outages are planned on the individual circuits, as the AC induction effects on the pipelines may be magnified when only one circuit (of the double-circuit transmission lines) is energized.
- Provide the Partner Cities with PSE monitoring data on maximum currents under peak winter operating conditions.