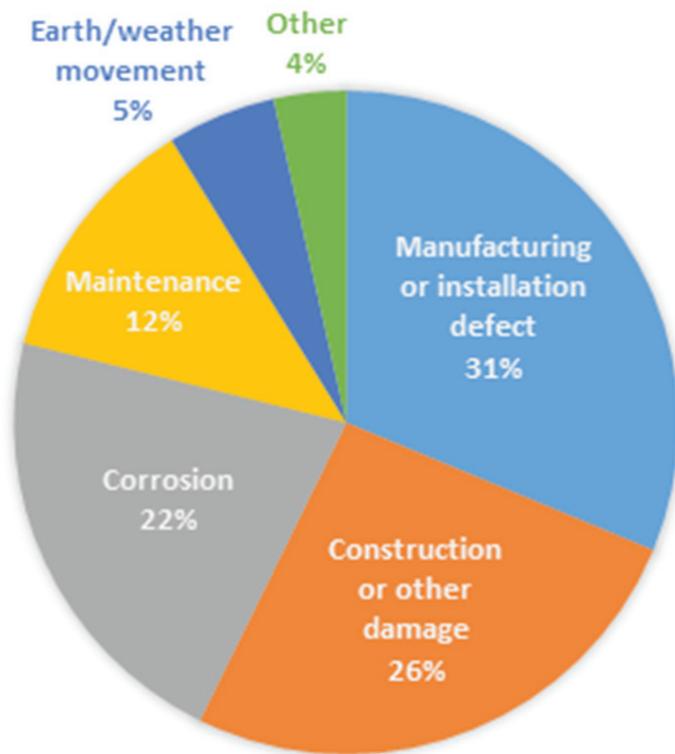


# Safety first!

## Causes of Pipeline Failure

Puget Sound Energy proposes to build a 230 kV transmission line through 18 miles of mostly residential neighborhoods. These transmission lines would share a narrow utility corridor with two high-pressure petroleum pipelines operated by the Olympic Pipeline Company.<sup>1</sup> The public asks, "Is this safe?"

During the past 16 years, almost 400 pipeline leaks and fires have occurred in the U.S. resulting in dozens of lives lost and millions of dollars in property damage.<sup>2</sup> The chart below compares the different types of failure for 227 incidents with an identified cause.



The sources of pipeline leaks include:

- defects in seams and welds, and damage caused during transportation or installation,
- damage inflicted by construction equipment and other kinds of forceful contact,
- internal and external corrosion,
- accidents during maintenance or insufficient maintenance programs,
- stresses caused by weather, water, and earth movement,
- other causes such as malicious acts, lightning, and high-voltage arcing.

*"[Olympic violated three safety regulations] by failing to correct identified deficiencies in corrosion control within a reasonable time and to take prompt action to address all anomalous conditions."*

-- Final Order from Office of Pipeline Safety, Jan. 13, 2016

1 Nearly 13 million gallons of fuel flow through the pipelines daily.

[http://www.bp.com/content/dam/bp-country/en\\_us/PDF/Pipelines/olympic-map.pdf](http://www.bp.com/content/dam/bp-country/en_us/PDF/Pipelines/olympic-map.pdf)

2 [https://en.wikipedia.org/wiki/List\\_of\\_pipeline\\_accidents\\_in\\_the\\_United\\_States\\_in\\_the\\_21st\\_century](https://en.wikipedia.org/wiki/List_of_pipeline_accidents_in_the_United_States_in_the_21st_century)

## History of Pipeline Accidents in the Puget Sound Area

The Puget Sound area has local experience with pipeline accidents. In 1999, the Olympic Pipeline exploded in Bellingham, claiming the lives of three children.<sup>3</sup> The pipeline had been nicked by a construction worker five years earlier. Although the damage was repaired, the patch failed during a pipeline shutdown on that fateful day. The breach spewed over 200,000 gallons of gasoline into Whatcom creek. The ensuing fire incinerated trees for more than a hundred feet on each side of the creek.



*Olympic pipeline explosion in Bellingham in 1999*



*Post-explosion damage along Whatcom Creek*

Five years later, a stress-induced pinhole leak occurred in Renton, shooting flames twenty feet into the air and sending three firefighters to the hospital.<sup>4</sup>

To ensure that the Environmental Impact Study for PSE's Energize Eastside transmission line project adequately evaluates the safety of this project, CENSE is submitting 15 questions on these topics:

- Separation requirements
- Construction
- Corrosion
- Arcing
- Lightning
- Consequences of an accident
- Emergency response

<sup>3</sup> <http://www.bellinghamherald.com/news/local/article22200432.html>

<sup>4</sup> <http://www.seattlepi.com/local/article/Wear-caused-gas-leak-in-Olympic-pipeline-1145599.php>

# Questions

## Separation requirements

PSE has stated that there is no mandated separation distance between high-voltage power poles and petroleum pipelines. The lack of municipal and state regulations may be due to the relatively recent revelations regarding the dangers of collocating power lines and pipelines. A complete understanding of the risks is still emerging. A thorough analysis was performed by the respected safety analyst, DNV-GL, as recently as October 2015. The authors summarized their findings as follows:

*Collocated pipelines paralleling high voltage power line rights-of-way may be subject to electrical interference from electrostatic coupling, electromagnetic inductive, and conductive effects. If the interference effects are high enough, they may pose a safety hazard to personnel or the public, or may compromise the integrity of the pipeline. [Many] future projects propose collocating high voltage power lines and pipelines in shared corridors, worsening the threat.<sup>5</sup>*

### **Q1** What is a safe separation between power poles, transmission lines, and high-pressure petroleum pipelines?

The Bonneville Power Administration, the federal agency responsible for regional transmission in the Pacific Northwest, recommends a 50-foot separation between power poles and pipelines:

*Pipes and cables should not be installed closer than 50 feet to a BPA tower, any associated guy wires or grounding systems.<sup>6</sup>*

### **Q2 a** Are there any significant differences in electrical conductivity between the steel monopoles proposed by PSE and a “BPA tower?”

### **b** Are there other differences between PSE and BPA transmission lines that would justify collocation closer than BPA’s recommendation (50 feet)?

• • • • •  
<sup>5</sup> <http://www.ingaa.org/File.aspx?id=24732>

<sup>6</sup> <https://www.bpa.gov/news/pubs/GeneralPublications/lusi-Living-and-working-safely-around-high-voltage-power-lines.pdf>

## Construction

The root cause of the Bellingham explosion was a small nick in the pipeline that was accidentally inflicted by a city-certified contractor.

PSE says that every safety precaution will be taken, but there will be many opportunities for mishaps along the 18-mile route. PSE contractors will dig at least 100 foundation holes up to 6 feet wide and 25 feet deep. PSE claims that it is safe to excavate these foundations very close to the pipelines.



*More than 100 large foundations holes will be excavated.*

Even if direct impacts are avoided, excavation will induce vibrations on the pipelines. Heavy equipment will be driven on top of the pipelines. The latter is specifically addressed by the Chevron Company in its safety brochure, which warns that construction equipment should be 15,000 pounds or less, and that the pipeline should be buried at least 4 feet.<sup>7</sup> The depth of the Olympic Pipeline varies from 2.5 to 4 feet throughout the corridor.

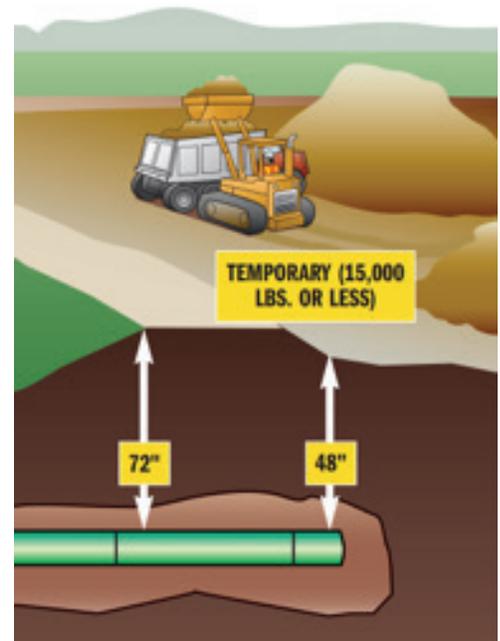
We believe it would be prudent to avoid running construction equipment over these pipelines since:

- both pipelines are approximately half a century old,
- previous incidents during the last 20 years have demonstrated the potential to inflict death and destruction,
- breach of the pipeline would be extraordinarily destructive in such a densely residential area.

**Q3 a** What specific safety assurances can PSE provide the public regarding the construction of the transmission line? In particular, how can digging vibration be minimized in close proximity to the pipelines?

**b** Will construction vehicles drive over the pipelines, and what is the upper limit on their combined weight?

**Q4** In past years, PSE has evacuated nearby homes when excavation is done near the pipelines. Please describe PSE's specific plans for evacuation during construction, including duration as well as the number of houses, businesses, schools, and churches that will be affected.



*Chevron has guidelines for vehicle weight and pipeline depth to avoid indirect damage.*

<sup>7</sup> [http://www.chevronpipeline.com/pdf/Guidelines\\_for\\_Property\\_Development.pdf](http://www.chevronpipeline.com/pdf/Guidelines_for_Property_Development.pdf)

## Corrosion risk

The previously mentioned paper by DNV-GL describes 4-5 risk factors for accelerated corrosion of the pipeline due to collocated power lines:<sup>8</sup>

- **Distance to power lines**

A separation of less than 100 feet is judged to be high risk. In parts of the Somerset neighborhood, the separation will be as low as 60 feet. This is alarming because the electric field strength increases exponentially as the distance decreases.

- **Amount of current**

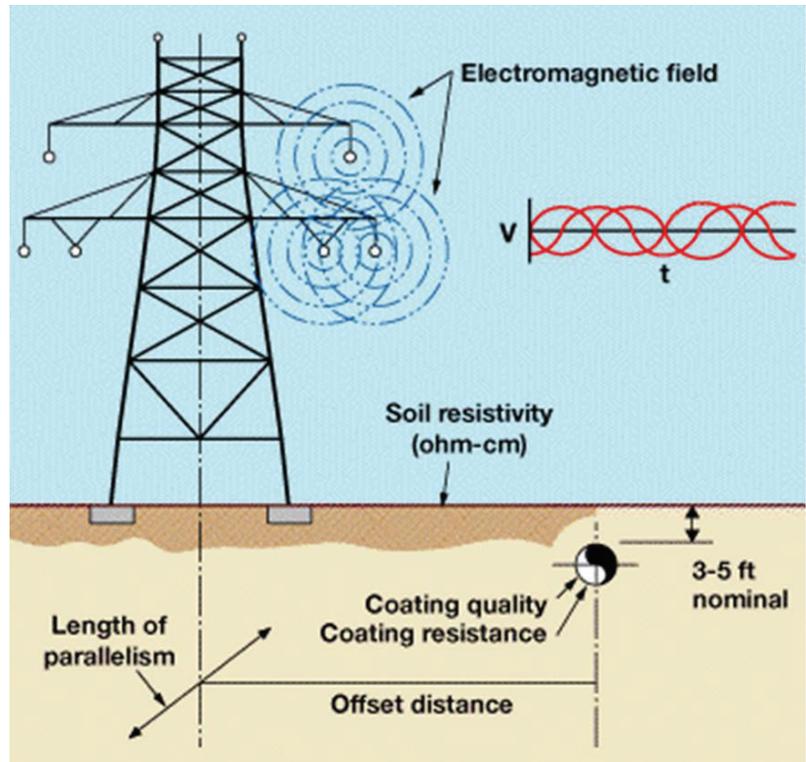
Current magnitude greater than 1000 amps is judged high risk. PSE says the transmission lines will have a capacity of approximately 1500 amps, 50% higher than DNV-GL cites in its risk table.

- **Length of parallel collocation**

The authors of the DNV-GL paper evaluated risk for infrastructure collocated for distances up to 5000 feet, which was considered high risk. PSE's lines will be collocated with the pipeline for at least 16 miles, greatly exceeding DNV-GL's risk tables.

- **Soil resistivity**

CENSE has not obtained this measurement for the proposed project.



**Q5** How do these risk factors specifically apply to the Energize Eastside project?

**Q6** Please verify the numbers cited in the above list of risk factors and provide specific comment for each one.

**Q7** Assuming the soil resistivity changes along the 18-mile route, please provide soil resistivity measurements for the length of the project in 1/8 mile increments.

8 <http://www.ingaa.org/File.aspx?id=24732>



## Arcing risk

An electric current flowing through a downed high-voltage power line can arc into a pipeline and rupture the casing. This risk is described in the DNV-GL report:

*[A] direct arc to a collocated pipeline is possible, which can result in coating damage, or arc damage to the pipe wall up to the point of burn-through. Even if an arc is not sustained long enough to cause burn through, a short duration elevated current can cause molten pits on the pipe surface that may lead to crack development as the pipe cools.*

Bellevue resident Lloyd Arnesen describes an accident that occurred near his backyard in the Bridle Trails neighborhood. A 115 kV transmission line operated by PSE fell during a windstorm, and an electric current arced into the Olympic pipeline. When it was later inspected, the damage to the pipeline was severe enough to warrant shutting down the 400-mile pipeline so the damaged section could be replaced.

Mr. Arnesen and his neighbors were fortunate. Residents of Mamaroneck, New York and Shively, Kentucky have experienced pipeline ruptures due to electric arcing in recent years. DNV-GL says the risk of rupture increases for higher voltage and current, both of which will significantly increase under PSE's proposal.

### **Q11 What steps will PSE take to minimize the possibility of potentially catastrophic pipeline rupture due to arcing of a downed electric pipeline?**

Arcing is a particular concern during a large earthquake in the Puget Sound region, an event with an 80% chance of occurring during the lifetime of this infrastructure.<sup>11</sup> The Seattle Fault runs roughly parallel to the I-90 freeway, perpendicular to the path of both the pipelines and PSE's transmission line.



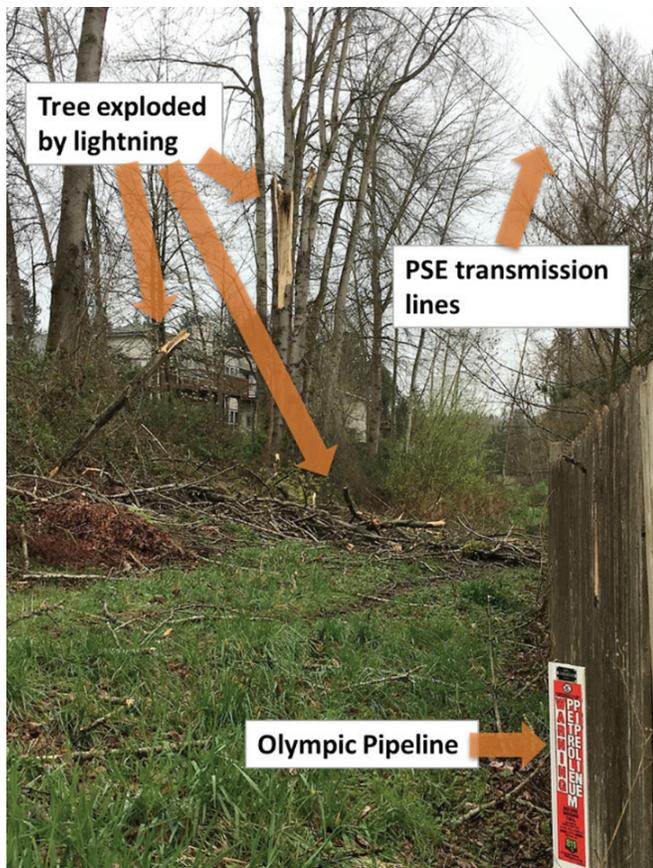
*Seattle Fault running perpendicular to the power line and pipeline corridor*

During a big quake, this fault could slip by at least 6 feet, shearing the pipelines and snapping the power lines. The resulting spill and briefly live wires could create a catastrophic explosion. An emergency response may be hindered by other emergencies and chaotic roadways following a large quake. The adverse impacts of the earthquake could be significantly magnified by an out-of-control fire fueled by thousands of gallons of jet fuel.

### **Q12 What specific steps can PSE and the Olympic Pipeline Company take to defend our community against potentially catastrophic fires following a significant earthquake? Can this project be designed to reduce the existing danger rather than increasing it?**

11 <http://www.seattletimes.com/seattle-news/science/the-really-big-one-get-ready-now-quake-experts-advise/>

## Lightning



*Lightning exploded a tree near the Olympic Pipeline earlier this year.*

Safety experts are becoming more aware of the risk that lightning poses to pipelines. On June 12, 2010, lightning struck a pipeline in Utah and spilled over 25,000 gallons of crude oil into Red Butte Creek. On September 29, 2013, a leak was discovered in an underground pipeline in North Dakota. Over half a million gallons of oil leaked through a quarter-inch hole caused by lightning.<sup>12</sup>

Although lightning is not common in the Eastside area, the risks were demonstrated on March 13 of this year when a single lightning bolt exploded a tree in the Somerset neighborhood within 100 feet of the Olympic Pipeline. If a metal pole had been nearby, it is likely that the lightning would have discharged into it and subsequently flowed from the base of the pole into the pipeline.

PSE says the company will mitigate this risk using grounding wires and other strategies. These mitigations have not been described in detail or included in the visual simulations of the project.

- Q13 a** Please describe in detail how the public will be protected from pipeline accidents stemming from lightning striking nearby steel poles.
- b** If grounding wires are used, will they stay within the corridor? What will they look like?
- c** Do these strategies offer complete protection or partial mitigation?

12 <http://fuelfix.com/blog/2013/10/31/lightning-may-have-caused-north-dakota-oil-spill/>

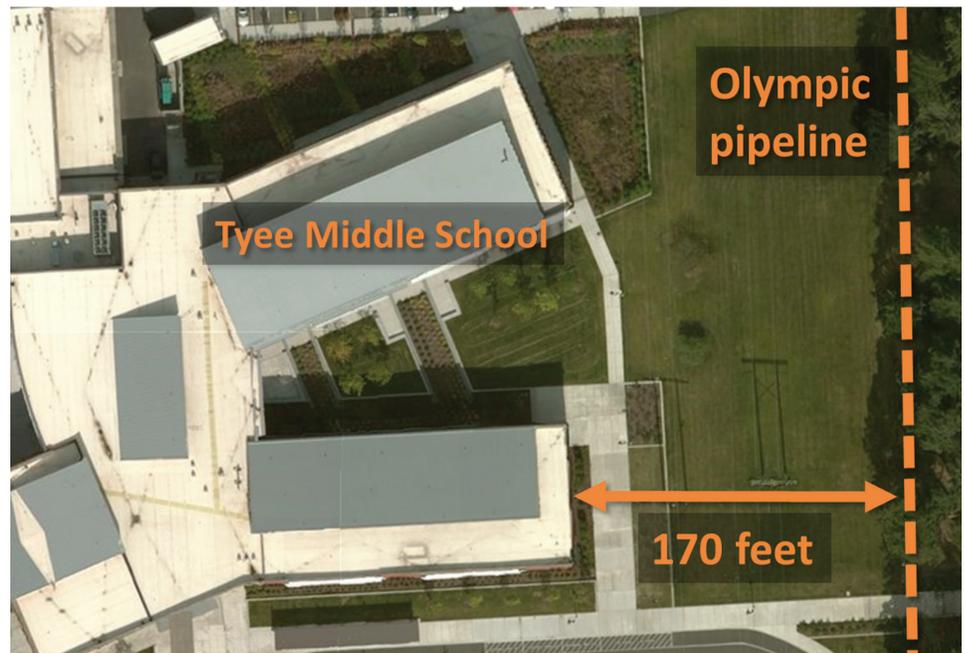
## Consequences of an accident

The consequences of a pipeline explosion anywhere along the densely populated route of the new transmission lines is difficult to imagine. Although the Bellingham fire provided a hint of the potential devastation, it occurred in a lightly populated area and was somewhat contained by the topography of a creek bed.

The proximity of ten schools and day care centers to the proposed route is of special concern. According to a 2014 survey by PSE, nearly 15,000 students attend schools that are within 600 feet of the transmission lines and pipelines.<sup>13</sup> To put that in perspective, the California Code of Regulations will not allow a school to be sited within **1,500 feet** of a hazardous liquid pipeline:

*Safety is the first consideration in the selection of school sites. CCR Title 5, Section 14010(h) states: "the site shall not be located ... within 1,500 feet of the easement of an above ground or underground pipeline that can pose a safety hazard as determined by a risk analysis study, conducted by a competent professional."<sup>14</sup>*

As illustrated in the satellite view to the right, Bellevue's Tyee Middle School is located less than 200 feet from the pipeline. Parents need to know that their children can be safely evacuated from the second story of the school within seconds after a pipeline discharge occurs, especially if the discharge is caused by an earthquake or extreme weather event.



*Tyee Middle School is one of the schools that is perilously close to the Olympic Pipeline.*

**Q14** What extra precautions and evacuation procedures are planned or in place for schools near the pipeline, considering the fact that collocation of transmission lines and power lines appears to increase the risk of accidents?

13 See data tables under the "#2 series" of workshops at <http://www.energizeeastside.com/MeetingMaterials>  
14 [www.cde.ca.gov/ls/fa/sf/documents/v1prtocolsec1.doc](http://www.cde.ca.gov/ls/fa/sf/documents/v1prtocolsec1.doc)

## Emergency response

The nation has witnessed many devastating explosions of natural gas pipelines, such as the one that destroyed three Seattle businesses and injured nine firefighters on March 9, 2016.<sup>15</sup> However, the ignition of a liquid fuel pipeline has greater destructive potential because tens of thousands of gallons of burning liquid don't stay in one place. A river of fire could flow through the neighborhood, igniting everything in its path.

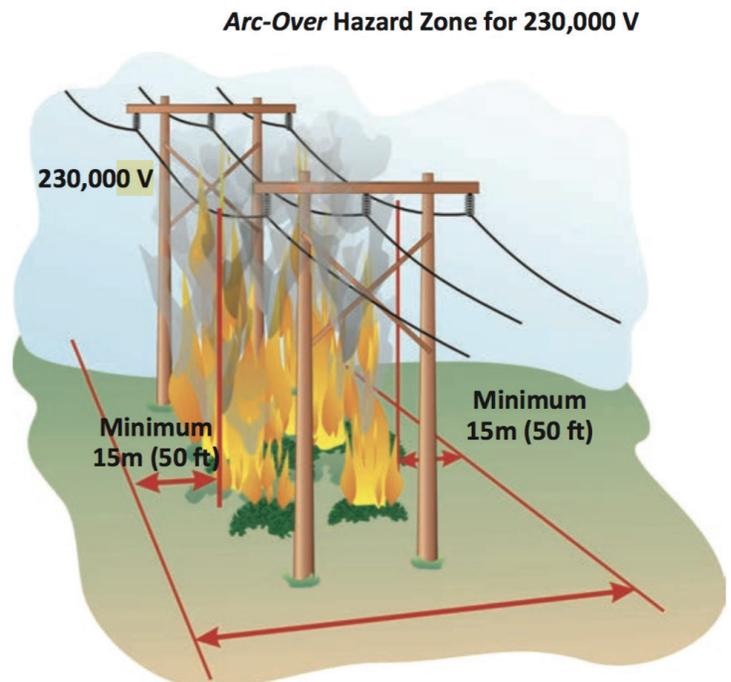
Burning jet fuel is particularly troublesome, because it can't be extinguished with water. A special kind of foam called "AFFF" is required. AFFF is not as readily available as water, which could lengthen response times and expand the radius of damage. However, as the excellent guidelines published by the New Mexico Public Regulations Commission make clear, foam cannot be used near electric infrastructure because it is conductive, posing risk of electrocution to firefighters.<sup>16</sup>

The possible paths to disaster are numerous. For example, consider what might happen if a fire starts, for whatever reason, in the utility corridor. Smoke has higher conductivity than air, increasing the danger of electric arcing from the lines to the ground and into the pipeline. Arcing has been implicated in pipeline failures. A breach would add staggering amounts of fuel to the burning fire. Firefighters would not be able to approach the transmission lines closer than 50 feet to avoid electrocution due to smoke arcing. New Mexico illustrates this concern with the diagram shown at the right.

If firefighters aren't allowed to approach the transmission lines closer than 50 feet, what about residents who live only 25 feet from the line in many places (especially in Newcastle)? Will they need to watch their homes burn from a distance to avoid electrocution?



*Firefighters attempt to extinguish burning jet fuel with AFFF.*



15 <http://www.seattletimes.com/seattle-news/greenwood-explosion-destroys-buildings-injures-9-firefighters/>

16 [http://www.nmprc.state.nm.us/transportation/pipeline/docs/Electrical\\_Safety\\_Handbook\\_for\\_Emergency\\_Responders\\_2013.pdf](http://www.nmprc.state.nm.us/transportation/pipeline/docs/Electrical_Safety_Handbook_for_Emergency_Responders_2013.pdf)

The Bellevue Fire Department is well-acquainted with the risk posed by the Olympic Pipeline running through Eastside neighborhoods, as described in the department's Standards of Response Coverage:

*Given that pipeline incidents continue to occur in this country, and many for undetermined reasons, the community is still at risk. The combination of: a highly flammable liquid, in large quantities, and in urban environment translates into a significant consequence risk that approaches the 'catastrophic' level.*<sup>17</sup>

However, unlike New Mexico, the Bellevue Fire Department does not describe any special risks of fighting fires near transmission lines. The department makes no mention of heightened risks or more careful response when transmission lines and pipelines are collocated in a narrow corridor close to houses.

**Q15 We ask that the EIS include detailed statements from the Bellevue Fire Department and the Olympic Spill Response team informing the public about what risks are posed to the public and emergency responders by the close proximity of power lines and pipelines. We want to know what programs and special training will be undertaken to reduce the safety risk.**

The Olympic Pipeline Company has been relatively silent about the impact of higher-capacity transmission lines on the safe operation of their pipelines. However, when PSE's project was first announced, an Area Maintenance Engineer named Kim West wrote the following to a homeowner's association in Newcastle:

*The route selection will be our prime concern for a variety of reasons including safety, impact to landowners, future maintenance, and customer impacts to name just a few. Therefore we feel that segments B, F, H, and L best address the concerns mentioned above. Should the pipeline be required to relocate, the pipeline design and precise impacts cannot be determined until PSE selects a final route and develop a final design.*

It is unclear who would be required to pay for any such relocation and where it would be relocated.

## Conclusion

PSE has proposed the Energize Eastside project to address a worst-case scenario for the Eastside electric grid. In PSE's scenario, reliability would improve in a very rare situation in which peak demand is being served during a few hours on a very cold winter evening (less than 23 degrees F), at the same time that multiple simultaneous failures have occurred in the grid and nearly all local generation has been turned off. PSE has provided no estimate of the likelihood that these conditions will occur during the next couple of decades.

If a rare worst-case scenario is used to justify the project, it's fair to consider worst-case scenarios involving the Olympic Pipeline and the consequences of accidental failure due to collocation of the transmission lines. We have described numerous sources of concern in this document.

The collocation of very high voltage transmission lines and aging petroleum pipelines presents real risks of catastrophe for residents, businesses, and students in the vicinity of the pipeline. Aside from the potentially devastating impact an accident would have on our communities, the harm to our reputation as a safe, enlightened place to live would take decades to repair. Continued operation of the pipeline might be jeopardized, with huge economic implications for the Seattle and Portland airports.

Although the risk of an accident was acknowledged in Phase 1 of the Energize Eastside EIS, a full description of the causes of risk and appropriate mitigations has not been described in any detail. Without a proper accounting, it is difficult to properly evaluate the costs and benefits of the Energize Eastside proposal in relation to modern alternatives proposed by CENSE.

Phase 2 must assure the public that our safety is secure, and the risks incurred by PSE's project are commensurate with the nearly negligible improvement in electrical reliability that the company is promising.

# Appendix A: List of questions

- Q1** What is a safe separation between power poles, transmission lines, and high-pressure petroleum pipelines?
- Q2a** Are there any significant differences in electrical conductivity between the steel monopoles proposed by PSE and a “BPA tower?”
- Q2b** Are there other differences between PSE and BPA transmission lines that would justify collocation closer than BPA’s recommendation (50 feet)?
- Q3a** What specific safety assurances can PSE provide the public regarding the construction of the transmission line? In particular, how can digging vibration be minimized in close proximity to the pipelines?
- Q3b** Will construction vehicles drive over the pipelines, and what is the upper limit on their combined weight?
- Q4** In past years, PSE has evacuated nearby homes when excavation is done near the pipelines. Please describe PSE’s specific plans for evacuation during construction, including duration as well as the number of houses, businesses, schools, and churches that will be affected.
- Q5** How do these risk factors specifically apply to the Energize Eastside project?
- Q6** Please verify the numbers cited in the above list of risk factors and provide specific comment for each one.
- Q7** Assuming the soil resistivity changes along the 18-mile route, please provide soil resistivity measurements for the length of the project in 1/8 mile increments.
- Q8** Soil chemistry can corrode pipelines independent of electrically induced corrosion. Are corrosion risks due to soil chemistry and electrical coupling additive? Please explain the total risk in terms that will allow the public to understand the risk incurred next to their homes and schools.
- Q9** Will Olympic’s cathodic protection program be redesigned to counter the corrosive effects of the proposed 50% increase in current?
- Q10** Given past violations, what assurances does the public have that Olympic will remain vigilant in its implementation of the cathodic protection program?
- Q11** What steps will PSE take to minimize the possibility of potentially catastrophic pipeline rupture due to arcing of a downed electric pipeline?
- Q12** What specific steps can PSE and the Olympic Pipeline Company take to defend our community against potentially catastrophic fires following a significant earthquake? Can this project be designed to reduce the existing danger rather than increasing it?

- Q13a** Please describe in detail how the public will be protected from pipeline accidents stemming from lightning striking nearby steel poles.
- Q13b** If grounding wires are used, will they stay within the corridor? What will they look like?
- Q13c** Do these strategies offer complete protection or partial mitigation?
- Q14** What extra precautions and evacuation procedures are planned or in place for schools near the pipeline, considering the fact that collocation of transmission lines and power lines appears to increase the risk of accidents?
- Q15** We ask that the EIS include detailed statements from the Bellevue Fire Department and the Olympic Spill Response team informing the public about what risks are posed to the public and emergency responders by the close proximity of power lines and pipelines. We want to know what programs and special training will be undertaken to reduce the safety risk.