CHAPTER 8. ENVIRONMENTAL HEALTH

8.1 HOW WAS ENVIRONMENTAL HEALTH EVALUATED FOR THE COMBINED STUDY AREA?

This chapter provides a high-level discussion of four types of environmental health concerns raised during the scoping period:

1. Hazardous materials and the potential to encounter, handle, or generate them;
2. Public safety risks associated with activities near pipelines (including those carrying flammable petroleum products) during construction or operation;
3. Public safety risks posed by the project related to natural phenomena such as earthquakes or lightning; and
4. Health effects from *electric and magnetic fields* (EMF) and *corona ionization*.

Regulations and policies addressing these topics were investigated to confirm how these issues and materials are managed.
This chapter provides basic descriptive information about EMF and corona ionization, including what they are, how they are generated, and where they can be found in the environment. This topic is included to respond to public concern on the topic.
This chapter includes information on the state of the science regarding potential health effects.

Environmental Health Key Findings

Hazardous Materials: Compliance with federal, state, and local regulations would likely prevent construction or operational impacts related to potential releases of hazardous materials from occurring, resulting in a minor potential for impacts.

Public Safety: Compliance with safety policies, regulatory requirements, and industry standards would likely prevent construction or operational impacts related to pipeline proximity or natural phenomena, resulting in a minor potential for impacts. Further, impacts related to natural phenomena have a low probability of occurrence.

EMF or Corona Ionization: No impacts are anticipated.

8.2 WHAT ARE THE RELEVANT PLANS, POLICIES, AND REGULATIONS?

8.2.1 Hazardous Materials

Hazardous materials and wastes, including contaminated soils and groundwater, are addressed through laws and regulations that address handling, transport, storage, and disposal of hazardous materials and wastes, as well as management and cleanup of contaminated sites. Other types of state and local regulations, such as those for stormwater management described in Chapter 5, also indirectly control hazardous materials. The following list of the primary state and federal regulations that apply to hazardous materials demonstrates the breadth of the overall regulatory framework.

8.2.1.1 Code of Federal Regulations (CFR)

- 40 CFR, Sections 761.60 – 761.79 (Toxic Substances Act Regulations)
- 40 CFR Sections 260 and 280 (Resource Conservation and Recovery Act Regulations)
- 40 CFR Part 300 (CERCLA)
- 40 CFR Part 112 (All Appropriate Inquiries)
- 40 CFR, Part 112 (Oil Pollution Prevention)
- 29 CFR 1910.1200 (Occupational Safety and Health Administration [OSHA] hazard communication standard and requirement for Material Safety Data Sheets for hazardous chemicals)

8.2.1.2 Washington Administrative Code (WAC)

- Chapter 173-303 WAC (Dangerous Waste Regulations)
- Chapter 173-340 WAC (Model Toxics Control Act)
- Chapter 173-204 WAC (Sediment Management Standards)
- Chapter 173-360 WAC (Underground Storage Tank Regulations)
- Chapter 173-200 WAC (Water Quality Standards for Groundwaters of the State of Washington)
- Chapter 173-201A WAC (Water Quality Standards for Surface Waters of the State of Washington)
- Chapter 296-62 WAC (General Occupational Health Standards)

8.2.1.3 Local Codes

Local regulations exist in all of the study area communities that would indirectly address hazardous material management by regulating water pollution or runoff from construction sites and spill containment for operating sites. These types of regulations are discussed in Chapter 5.

8.2.2 Public Safety Risks

8.2.2.1 Activities Near Pipelines

Appendix M provides a list of identified regulations that apply to pipelines, along with response plans implemented by the Olympic Pipeline Company (OPLC) in particular, since OPLC's facilities were identified as a source of concern during EIS scoping. Some of the regulations are described here.

Congress passed the *Natural Gas Pipeline Safety Act* in 1968 (now called the Pipeline Safety Law, 49 USC Section 60101 et seq.). The law gave the federal government authority over pipeline safety for transporting hazardous liquids, natural gas, and other gases. The law left responsibility for intrastate pipeline safety in the hands of the states, with the U.S. Department of Transportation, Research and Special Programs Administration, Office of Pipeline Safety (OPS) (a federal agency) retaining responsibility for interstate pipeline safety. The OPS developed minimum pipeline safety regulations for natural gas transportation (Title 49 CFR, Part 192). Implementing regulations are in Chapter 480-93 WAC.

> **Where is the Olympic Pipeline addressed in this EIS?**
>
> A number of chapters in this EIS address potential impacts associated with the Olympic Pipe Line Company's petroleum pipelines through the combined study area. See Chapter 3 (Earth - seismic conditions), Chapter 10 (Land Use – compatibility and policy consistency), Chapter 15 (Public Services - emergency response), and Chapter 16 (Utilities - potential impacts to pipelines and transmission lines).

An explosion related to an OPLC pipeline in Bellingham in 1999 led local governments in Washington to look more closely at pipeline safety issues and led to changes in federal and state regulations (Bellingham Herald, 2009).

In 2000, the Pipeline Safety Act of 2000 was enacted in Washington, enabling the Utilities and Transportation Commission (UTC) as the interstate agent for pipelines. The act made the UTC able to enforce federal laws on pipelines in Washington State. The UTC has authority for inspections of interstate pipelines (UTC, 2015) and oversees the Pipeline Safety Program. This program provides standards for natural gas pipeline operations and inspects natural gas and hazardous liquid pipelines (such as the OPLC pipelines) operating in Washington.

The UTC participates with OPS in the certification program for intrastate gas companies and regulates interstate pipelines under 49 CFR, Part 195. These regulations address safety in design, construction, testing, operation, maintenance, and emergency response for pipeline facilities.

The UTC has adopted the American Standard Association Code for Pressure Pipeline (B31.8), requiring gas companies to have operating and maintenance plan provisions for periodic leak surveys (UTC, 2015).

In 2002 the federal Pipeline Safety Improvement Act (49 USC 60101) was passed. It applies to pipelines transporting both natural gas and hazardous liquids in interstate commerce. Some of the most important aspects of the act are as follows:

- **Federal inspection and safety requirements:** To help prevent leaks and ruptures, mandatory inspections of all U.S. oil and natural gas pipelines within 10 years, with more problematic pipelines to be inspected within the next 5 years and all pipelines re-inspected every 7 years following the 10-year interval.
- **Safety orders:** Secretary of the Department of Transportation is allowed to require corrective action of pipeline facilities.
- **Risk analysis:** Operators of natural gas pipelines required to conduct analysis of their pipeline facilities' risks where located in high-density areas and adopt and implement integrity management programs for such facilities within 2 years.

- **Increase in penalties:** Civil penalty to pipeline operators established for safety violations in an amount between $25,000 and $100,000 for each violation, and between $500,000 and $1,000,000 for a related series of violations.
- **One-call notification program:** Department of Transportation to encourage operators to adopt and implement certain best practices for notification of leaks and ruptures.
- **Public education programs**: Pipeline facilities to establish public education programs within one year to advise municipalities, schools, and other entities on the use of the one-call notification system, possible hazards from unintended releases from a pipeline facility, and what to do in the event of a release.
- **Environmental reviews:** Structure established for development of a coordinated environmental review and permitting process to enable pipeline operators to conduct any necessary pipeline repairs.
- **Research and development:** National Institute of Standards and Technology and Departments of Transportation and Energy directed to work with an advisory committee to develop a plan addressing critical research and development needs to ensure pipeline safety.
- **Whistle-blower protection:** Prohibits pipeline operators from firing or taking adverse action against an employee for providing information regarding pipeline safety to the employer or to the federal government.

Pipeline safety improvements that have been instituted in the past 10 years include the following (Pipeline Safety Trust, 2016):

- Integrity management and inspections;
- Greater transparency in pipeline safety information;
- Increased fines;
- Public pipeline maps;
- Whistle blower protections;
- 811 – Call Before You Dig;
- Community technical assistance grants;
- Excess-flow valves on distribution pipelines;
- Control room management;
- State Pipeline Safety Advisory Committees; and
- Initiatives on local land use and pipelines.

To comply with federal regulations, the Olympic Pipe Line Company has an integrity management program, including requirements to regularly inspect and monitor both natural gas and petroleum pipelines. Inspections are performed using a combination of tools to determine the suitability of the pipeline based on any anomalies detected, including corrosion, dents, or actual *wall loss* (loss of material on the inside or outside of the pipeline due to corrosion) (West, personal communication, 2015).

The State of Washington's Underground Utilities Damage Prevention Law (RCW 19.122) requires pipeline companies, underground facility owners, and excavators to participate in protecting the public health and safety when excavating, with civil penalties for violation. The law also provides that any excavator who willfully or maliciously damages a field-marked underground facility may be liable for triple the cost incurred in repairing or relocating the facility.

In 2006, the federal government enacted the Pipeline Inspection, Protection, Enforcement and Safety (PIPES) Act, which addresses the following:

- Enhanced communication between operators and excavators;
- Support for and partnership of all stakeholders;
- Operator's use of performance measures for locators;
- Partnership in employee training;
- Partnership in public education;
- Enforcement agencies' role to help resolve issues;
- Fair and consistent enforcement of the law;
- Use of technology to improve the locating process; and
- Data analysis to continually improve program effectiveness.

A federally supported effort brought together a large stakeholder group to make recommendations for procedures and regulations related to land uses and land development near pipelines. That group, known as the Pipelines and Informed Planning Alliance (PIPA), produced a report in 2010 that is available for local governments to consider and use in comprehensive planning and development of land use regulations. The report includes recommended practices for local governments, property developers and owners, transmission pipeline operators, and real estate boards to be aware of and to implement as appropriate.

The combined study area communities (Alternatives 1, 2, and 3 as depicted on Figure 1-4 in Chapter 1) do not directly regulate pipeline safety, but they have the authority to regulate land uses near pipelines within their jurisdictions to protect public health and safety. Some communities encourage co-location of pipelines with other utilities where safe, while others specifically discourage co-location of critical utilities with hazardous fluid pipelines like the Olympic Pipeline.

Appendix F includes some of the planning policies of King County and the Eastside cities that directly address co-location of gas pipelines and other developments. The study area communities would interpret and apply their policies to the project when PSE applies for permits. Some examples of policies that could address co-location are as follows:

- To reduce the likelihood of pipeline-related safety hazards, King County's comprehensive plan restricts land uses within hazardous liquid and gas transmission pipeline rights-of-way (King County, 2013).

- The City of Bellevue's comprehensive plan requires that the City administer regulations and franchise agreement authority over both the Seattle City Light and Olympic Pipeline infrastructure in their jurisdiction (City of Bellevue, 2015).

- The City of Kirkland's comprehensive plan includes policies that: establish standards to minimize pipeline damage, prohibit new high consequence land uses[1] from locating near a hazardous liquid pipeline corridor, support coordination with the pipeline operator when developments are proposed near the pipeline corridor, and require maintenance of the hazardous liquid pipeline corridor through their franchise agreement and other mechanisms (City of Kirkland, 2015).

- The City of Redmond's comprehensive plan has policies related specifically to pipeline safety, addressing required setbacks for adjacent land uses and structures, mitigation for certain types of adjacent land uses, and prohibition of new high consequence land uses near pipelines (City of Redmond, 2015).

- The City of Renton's plan includes a goal promoting safe transport and delivery of fuels and one policy encouraging co-location of utilities with rights-of-way and utility corridors. The City also has a code (RMC 4-3-070) requiring notice on title regarding proximity to hazardous pipelines (City of Renton, 2015).

- The City of Newcastle encourages combining utilities into single corridors where safe (City of Newcastle, 2015).

8.2.2.2 Natural Phenomena

Local governments have regulations in place to address structural design and stability, including earthquakes as discussed in Chapter 3. Each study area community also implements codes conforming to International Building, Mechanical, and Fire Codes, which have been enacted to safeguard public health, safety, and general welfare. These codes address issues such as structural strength, stability, and protection of life and property from fire and other hazards. Projects in known seismic hazard areas require special geotechnical review.

The National Electrical Safety Code (NESC, 2012) provides the safety guidelines that PSE follows during the installation, operation, and maintenance of transmission lines and

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[1] High Consequence Land Use: A land use that if located in the vicinity of a hazardous liquid pipeline represents an unusually high risk in the event of a pipeline failure due to characteristics of the inhabitants or functions of the use. High consequence land uses include:

1. Land uses that involve a high-density on-site population that are more difficult to evacuate. These uses include:
    - Schools (through grade 12).
    - Hospitals, clinics, and other facilities primarily for use by the elderly or handicapped, other than those within single-family residences.
    - Stadiums or arenas.
    - Day care centers, and does not extend to family day care or adult family homes.
2. Land uses that serve critical "lifeline" or emergency functions, such as fire and police facilities, utilities providing regional service, or water supplies if exposed to a significant risk that will curtail its lifeline function for a critical period of time.
3. Uses with similar characteristics as determined by the Planning Official.

associated equipment. The NESC contains the basic provisions considered necessary for worker and public safety under specific conditions, including electrical grounding and protection from lightning strikes.

8.2.3 Electric and Magnetic Fields

The City of Bellevue has adopted comprehensive plan policies that encourage City and utility involvement with regional or statewide agencies when and if they are developing policies regarding exposure to EMF. The policies also address intent to stay abreast of new accepted scientific research of potential health impacts, revise policies if the situation warrants, and require a reasonable balance between potential health effects and costs of mitigating for such impacts in the planning, siting, and construction of electrical infrastructure.

Only two states (Florida and New York) have enacted their own standards related to EMF that are applicable to parties other than electrical workers. These two states have standards for magnetic fields from overhead transmission lines. The foundation of these standards was to make the field levels from new overhead transmission lines similar to those from existing overhead lines. Table 8-1 presents a summary of the state standards for magnetic fields permitted (National Institute of Environmental Health Science [NIEHS], 2002).

Table 8-1. State Transmission Line Magnetic Field Standards and Guidelines

State	Magnetic Field at ROW Edge
Florida	150 mG (*max load*)[1] 200 mG (max load)[2] 250 mG (max load)[3]
New York	200 mG (max load)

Notes:
[1]For lines of 69-230 kV.
[2]For >230 and ≤500 kV lines.
[3]For >230 and 500 kV lines on certain existing ROW.
ROW = right-of-way (or in Florida standard, certain additional areas adjoining the right-of-way).
mG = milligauss
max load = maximum load-carrying conditions
Source: NIEHS, 2002

Guidelines and standards have been developed by three organizations for limiting magnetic field exposure for the general public and/or workers (Tables 8-2, 8-3, and 8-4). Guidelines and standards developed for limiting EMF exposure are based on known biological effects from very high fields, such as occur in some occupations.

The guidelines are published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP); the guidelines of the American Council of Governmental Industrial Hygienists (ACGIH), which apply to workers in the United States; and the International Committee on Electromagnetic Safety (ICES), operating under the oversight and rules of the Institute of Electrical and Electronics Engineers (IEEE) Standards Association (IEEE guidelines).

Table 8-2. Summary of ICNIRP Exposure Guidelines

Exposure (60 Hz)	Magnetic Field
Occupational	10 G (10,000 mG)
General public	2.00 G (2,000 mG)

G = gauss; Hz = hertz; ICNIRP = International Commission on Non-Ionizing Radiation Protection; mG = milligauss
Source: ICNIRP, 2010

Table 8-3. Summary of ACGIH Exposure Guidelines

Exposure (60 Hz)	Magnetic Field
Occupational exposure should not exceed:	10 G (10,000 mG)
Prudence dictates the use of protective clothing above:	___
Exposure of workers with cardiac pacemakers should not exceed:	1 G (1,000 mG)

ACGIH = American Council of Governmental Industrial Hygienists; G = gauss; Hz = hertz; mG = milligauss
Source: ACGIH, 2009

Table 8-4. IEEE Exposure Levels for 60 Hz Magnetic Fields

Exposure (60 Hz)	Magnetic Field
General public should not exceed:	9,040 mG (9.04 G)
Controlled environments should not exceed:	27,100 mG (27.1 G)

G = gauss; Hz = hertz; IEEE = Institute of Electrical and Electronics Engineers; mG = milligauss
Source: IEEE, 2002

8.2.4 Corona Ions

There are no known policies, regulations, or standards addressing corona ionization.

8.3 WHAT HAZARDS ARE PRESENT IN THE COMBINED STUDY AREA OR COULD BE ASSOCATED WITH THE PROJECT?

8.3.1 Hazardous Materials

Hazardous materials are generally defined as any substance or material that could adversely affect the safety of the public, handlers, or carriers during transportation. Hazardous materials would only be considered to generate environmental impacts if they were spilled or released in an uncontrolled fashion. A range of hazardous materials could be used in the construction and operation of any of the alternatives. Gasoline and oil would be used in construction equipment discussed in Chapter 2, and other chemicals such as solvents or paint may be brought onto and used on the project sites during construction.

Operating and maintaining any of the newly constructed PSE-owned facilities would also involve use of some hazardous materials. Gasoline, paint, or pesticides could be used for site maintenance. The operation of Alternative 1 or 3 would involve transformers with insulating oil or sulfur hexafluoride (SF_6) and possibly high-pressure fluid-filled (oil-containing) (HPFF) conductors. (Alternative 1, Option D would likely use only *cross-linked polyethylene (XLPE)* type cable rather than HPFF type.) The transformers would be installed without their insulating oils or SF_6, which would be brought onto the site and added to the equipment once it is in place. Energy storage (batteries) installed with Alternative 2 would likely contain some type of acid. Operation of any the distributed generation components would involve gasoline, diesel, or other types of fuel.

It is possible that contaminated soils or groundwater could already exist where the alternatives would be constructed. Historical land uses (logging, agriculture, industry, or others) may have discharged materials now known to be hazardous in nature. These types of materials can accumulate in soils or groundwater. Existing land uses in the combined study area also handle or store hazardous materials, including gas stations or automotive service stations, and residential properties where paints or pesticides may be used.

Electrical infrastructure already existing on the Eastside includes transformers and other electrical equipment and transmission lines. PSE does not operate any HPFF or self-contained fluid filled (SCFF) lines on land through the combined study area. These types of lines contain pressurized gas or fluid (usually nitrogen or synthetic oil) and may contain polychlorinated biphenyls (PCBs). PSE does operate two SCFF marine cables that cross Lake Washington to Mercer Island (Strauch, personal communication, 2015).

Small “distribution” transformers are found on transmission line poles around the Eastside. These devices step down the voltage being sent along distribution lines to the level that can be used by customers. All of these distribution transformers contain some amount of insulating oil (usually highly refined petroleum/mineral oil), and older ones may contain PCBs. The larger transformers at substations also usually contain insulating oil, and there may be some older ones in operation throughout the Eastside with insulating oil containing PCBs. Newer transformers may also contain an insulating gas, sulfur hexafluoride (SF_6), rather than oil.

As described in Chapter 16, high-pressure natural gas mains and distribution pipelines are found throughout the area. The Olympic Pipe Line Company (OPLC) operates two underground fuel pipelines carrying petroleum products under pressure. These two petroleum lines traverse the Eastside from north to south and are located primarily in the same corridor as existing 115 kV transmission lines operated by PSE. These types of pipelines are described in Chapter 16 and shown on

PCBs were historically widely used as *dielectric (poor conductor of electricity)* and coolant fluids in electrical equipment and by industries such as machining operations. According to the U.S. Environmental Protection Agency, PCBs cause cancer in animals and are probable human carcinogens. The production of PCBs has been banned in the U.S. and elsewhere.

SF_6 is used in the electrical industry as a gaseous dielectric medium for high-voltage circuit breakers, switchgear, and other electrical equipment, often replacing oil filled circuit breakers (OCBs) that can contain harmful PCBs. SF_6 is a highly toxic gas.

Figure 16-1. Damage to these pipelines could release materials they carry to the environment. These materials (natural gas, gasoline, diesel, and aviation fuel) have the properties listed in Table 8-5 (the specific properties can vary somewhat depending on formulation and additives).

Table 8-5. Properties of Materials Carried by Fuel Pipelines

Material	Typical Properties and Their Effect on Human and Aquatic Health
Diesel	Combustible liquid. Contact with this product may cause skin and eye irritation. Prolonged or repeated contact may cause skin irritation, defatting, drying, and dermatitis. Inhalation of this product may cause respiratory tract irritation and central nervous system depression, symptoms of which may include weakness, dizziness, slurred speech, drowsiness, unconsciousness and, in cases of severe overexposure, coma and death. Ingestion of this product may cause gastrointestinal irritation. Aspiration of this product may result in severe irritation or burns to the respiratory tract.
Gasoline	Extremely flammable liquid and vapor. Vapor can cause flash fire. Cancer hazard. Causes skin and eye irritation. Can enter lungs and cause damage.
Aviation Fuel	Flammable liquid and vapor. Can be ignited by heat, sparks, flames, or other sources of ignition (e.g., static electricity, pilot lights, mechanical/electrical equipment, and electronic devices such as cell phones, computers, calculators, and pagers that have not been certified as intrinsically safe). Vapors may travel considerable distances to a source of ignition where they can ignite, flash back, or explode. May create vapor/air explosion hazard indoors, in confined spaces, outdoors, or in sewers. This product will float and can be reignited on surface water. Vapors are heavier than air and can accumulate in low areas. If container is not properly cooled, it can rupture in the heat of a fire. Causes skin irritation. May be fatal if swallowed and enters airways. May cause drowsiness or dizziness. Toxic to aquatic life with long-lasting effects.
Natural Gas	Extremely flammable gas. Can be ignited by hot surfaces, sparks, vehicles, lights, electronic devices, or other sources of ignition. Overexposure to this gas can result in shortness of breath, drowsiness, headaches, confusion, decreased coordination, visual disturbances and vomiting; these symptoms are reversible if exposure is ended. Continued exposure can lead to inadequate oxygen (hypoxia), rapid breathing, discoloration of the skin (cyanosis), numbness of extremities, unconsciousness, and death. If natural gas leaks underground, it can permeate through the soil and accumulate in confined spaces such as basements or sewers.

Note: Specific properties can vary somewhat depending on formulation and additives.
Source: Material Safety Data Sheets (MSDSOnline, 2015)

Operation of the project over time could generate hazardous or dangerous[2] wastes needing special management. Site lighting with any of the alternatives could contain mercury ballasts

[2] In Washington, the term "dangerous waste" is used, while the federal rules use the term "*hazardous waste*." The state rules are more protective than the federal rules, so dangerous waste includes more wastes than the federal definition. The Washington Dangerous Waste Regulations (Chapter 303 WAC) are based on the federal Resource Conservation and Recovery Act, but Washington requires businesses to follow additional rules.

that would be regularly changed out and need proper disposal. Mineral oil or SF_6 of the transformers in Alternatives 1 or 3 could need to be recharged over time. Operation of anaerobic digesters for the distributed generation component of Alternative 2 leaves a byproduct known as digestate (the solid remnants of the original input material to the digesters) that must be properly characterized for disposal. Operating the engines and turbines of Alternative 2 may generate sludge materials that would be cleaned out. All of these waste materials would need to be characterized and disposed of properly.

8.3.2 Public Safety Risks – Activities Near Pipelines

If ruptured or damaged, fuel pipelines mentioned in Section 8.1.1 could pose a risk to public safety and the environment due to high operating pressure and/or the highly flammable, explosive, and toxic properties of the transported products. If damage prevention measures were not employed and any of these pipelines were damaged, and standard pipeline safety protocols and mechanisms were then to fail, there would be a risk of explosion and fire. Other pipelines (natural gas in particular as described in Chapter 16) are found throughout the area and could have some of the same risks as the OPLC pipelines.

8.3.3 Public Safety Risks – Natural Phenomena

As described in Chapter 3, the Eastside is located in a seismically active region. Existing infrastructure (substations, transmission and distribution lines) is at risk of damage in the event of an earthquake. New infrastructure constructed for the Energize Eastside Project would be at the same risk. Damage to infrastructure from an earthquake poses a risk of fires, electrocution, and explosion that could potentially endanger nearby populations. Similarly, electrical infrastructure could experience fires after damage by lightning strikes, leading to potential public safety risks. Both earthquakes and lightning strikes could also lead to damage to fuel pipelines described above.

8.3.4 Electric and Magnetic Fields and Corona Ionization

There has been substantial research into the possibility of health effects from EMF, as well as potential effects from corona ionization. There is substantial agreement among experts that there are no confirmed adverse health impacts from 60 hertz (Hz) [3] EMF exposure. Scientific evidence remains inconclusive on risk of childhood leukemia in homes with stronger *magnetic fields*, and research on this topic continues. However, while it does not appear that EMF and corona ionization are in fact a hazard, they are discussed in this document due to public concerns raised during EIS scoping.

Transmission lines, electrical wiring, and appliances all produce EMF. Corona ionization is associated with transmission lines. It is the electrical breakdown of air in very strong *electric fields*. Corona ionization can be a source of audible noise, *electromagnetic* radiation, and sometimes visible light from transmission lines. Sections 8.3.5 and 8.3.6 provide background information about these topics.

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[3] Electricity is transmitted in North America at 60 cycles per second, or 60 Hz.

8.3.5 Electric and Magnetic Fields

Electric and magnetic fields each have different origins and different properties. Electric fields are produced by the voltage in use, and magnetic fields are produced by current. Figure 8-1 demonstrates voltage and current and how they relate.

Most electrical equipment has to be turned on (current must be flowing) for a magnetic field to be produced. Electric fields are often present even when the equipment is switched off, as long as it remains connected to the source of electric power. Brief bursts (sometimes called transients) can also occur when electrical devices are turned on or off.

Electric fields are shielded or weakened by materials that conduct electricity, even materials that conduct poorly, including trees and buildings. Magnetic fields, however, pass through most materials without change.

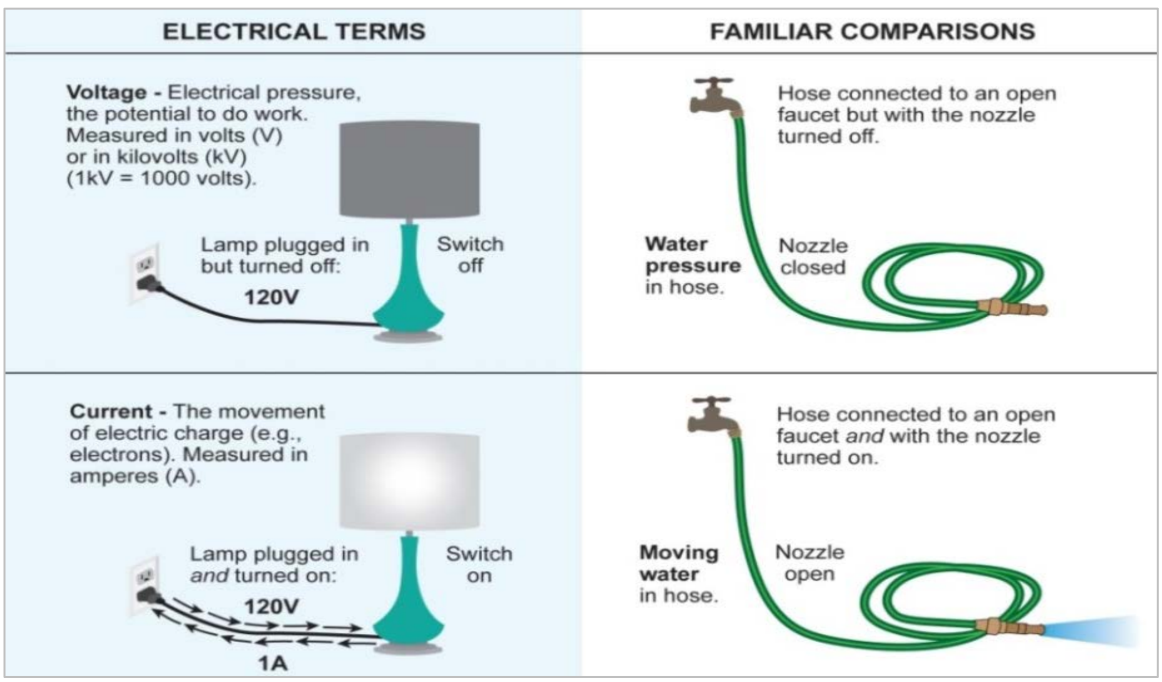
The amount of current, and therefore magnetic field strength, varies with the amount of electrical power being used at any moment (see Figure 8-2). Magnetic fields are commonly measured in milligauss (mG) or gauss (G), and microtesla (µT) or tesla (T). The terms in this chapter include milligauss, gauss, and microtesla. For non-magnetic materials such as air, one tesla is equivalent to 10,000 gauss.

Information on EMF fundamentals provided in this chapter is based primarily on documents prepared by the NIEHS (2002) and the Electric Power Research Institute (EPRI) (2012). Some information about magnetic field levels for specific types of proposed project facilities was also provided by Enertech Consulting as noted in the section.

The NIEHS is one of 27 research institutes and centers that compose the National Institutes of Health (http://www.nih.gov/), U.S. Department of Health and Human Services. The mission of the NIEHS is to discover how the environment affects people in order to promote healthier lives.

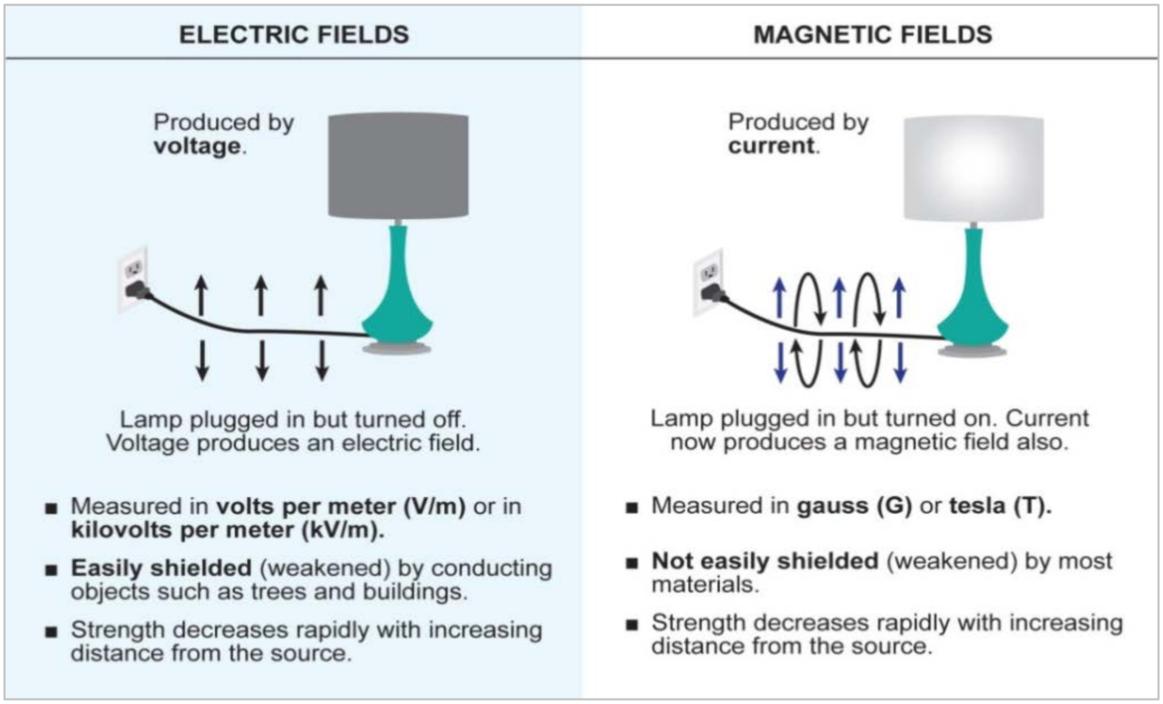
The EPRI is a nonprofit institution that conducts research, development, and demonstration relating to the generation, delivery, and use of electricity.

Figure 8-1. Two Electrical Terms: Voltage and Current



Source: NIEHS, 2002

Figure 8-2. Electrical and Magnetic Fields Produced by Voltage and Currents

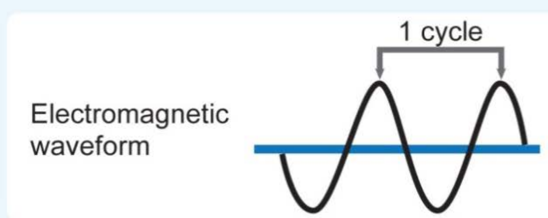


Source: NIEHS, 2002

Electric fields and magnetic fields are characterized by their *wavelength, frequency,* and amplitude (strength). Figure 8-3 shows the waveform of an alternating electric or magnetic field[4]. The direction of the field switches from one polarity to the opposite and back to the first polarity in a period of time called one cycle. Wavelength is the distance between a peak on the wave and the next peak of the same polarity. The frequency of the field describes the number of cycles that occur in 1 second and is measured in hertz (Hz).

Figure 8-3. Frequency and Wavelength

Frequency is measured in **hertz (Hz)**.
1 Hz = 1 cycle per second.



Examples

Source	Frequency	Wavelength
Power line (North America)	60 Hz	3100 miles (5000 km)
Power line (Europe and most other locations)	50 Hz	3750 miles (6000 km)

Source: NIEHS, 2002

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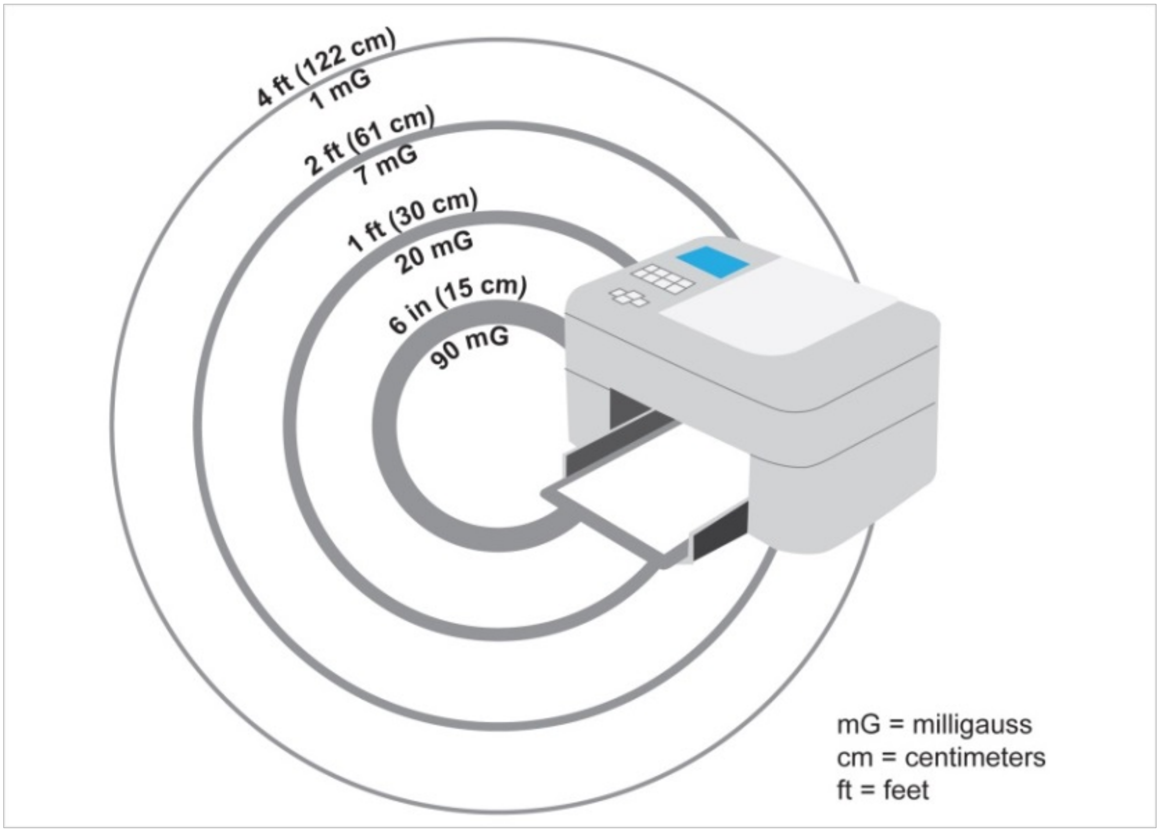
[4] The term electromagnetic is generically used in Figure 8-3. However, this EIS refers to electric fields and magnetic fields separately because they are not coupled or interrelated the same way at extreme low frequencies (60 Hz) as they are at higher frequencies.

A range of frequencies of EMF can occur. The terms EMF and ELF are both used in this discussion. Electricity generation, transmission and use in North America is almost entirely at 60 Hz, a frequency that falls in the extremely low frequency (ELF) range of 3 to 3,000 Hz, at the low end of the overall frequency spectrum. ELFs include the power-frequency fields of 50 or 60 Hz associated with generation, transmission, and use of electric power. The overall term of EMF includes ELFs and higher frequency fields. At the other end of the frequency spectrum from ELF is ionizing radiation, such as x-rays and gamma rays, with frequencies in the range of a billion-billion cycles per second. In the middle of the spectrum (millions to billions of cycles per second) are the radio-frequency fields used for TV, radio, cell phones, and microwaves. The higher frequency or radiofrequency magnetic fields are generated by many different technologies, including broadcast TV and radio, cell phones, and other radio communications.

Even though electrical equipment, appliances, and transmission lines produce both electric and magnetic fields, most recent research has focused on potential health effects of magnetic field exposure. This is because some epidemiological studies have reported an increased cancer risk associated with estimates of magnetic field exposure. No similar associations have been reported for electric fields; many of the studies examining biological effects of electric fields were essentially negative. Since there have been no observed health effects related to electric fields, the discussion of EMF from this point forward focuses on the magnetic field component only.

As noted above, electric fields are easily shielded or weakened by conducting objects such as buildings; as they pass through these objects, their energy is quickly dispersed. Magnetic fields generated by electrical equipment and appliances are not shielded or weakened by such objects. Magnetic fields found very close to electrical appliances and power tools are often much stronger than those near other sources, such as magnetic fields directly under transmission lines. However, the fields surrounding appliances and electric motors decrease in strength with distance more quickly than transmission line fields because of the confined wiring configuration in appliances and motors. Figure 8-4 provides a sample of how a magnetic field related to a common type of household equipment changes over distance (also see Table 8-6).

Figure 8-4. Magnetic Field Strength Decreases with Distance



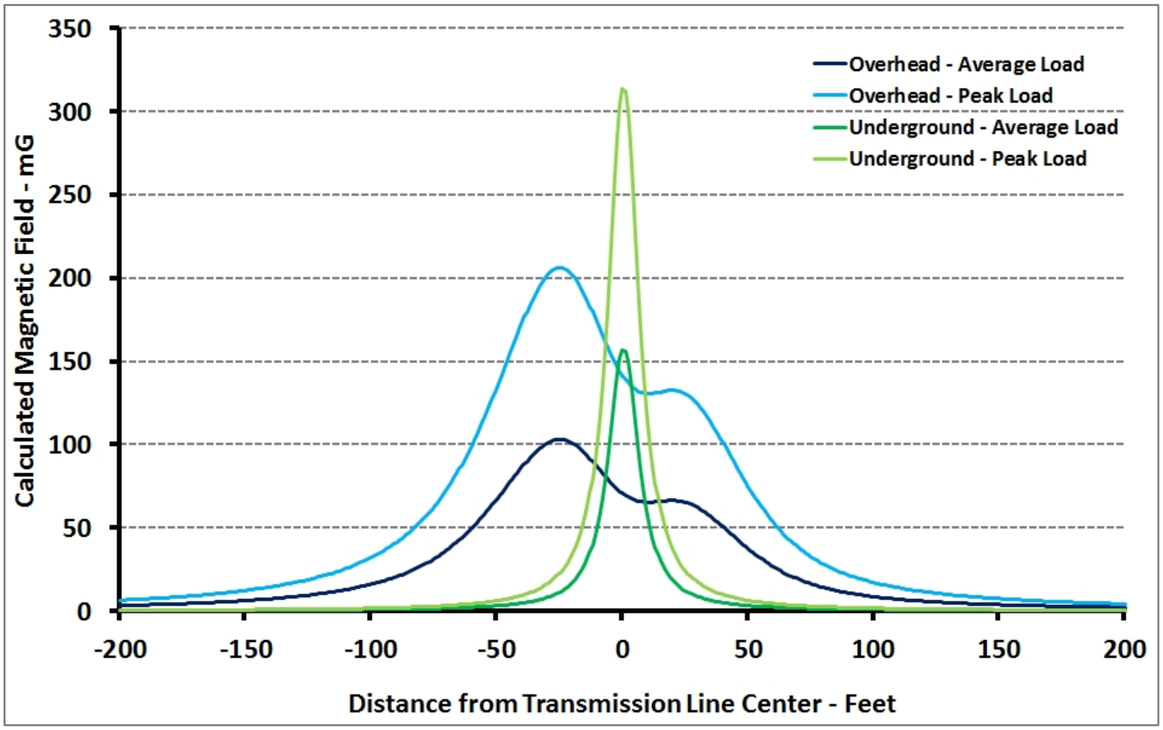
Source: NIEHS, 2002

Magnetic field strength from a transmission line (or other electrical infrastructure) also reduces in strength (attenuates) rapidly with distance. The rate of magnetic field attenuation is different for an overhead line configuration versus an underground (or underwater) line configuration. Figure 8-5 presents a generalized diagram of calculated magnetic field strength as a function of distance away from a transmission line, for both overhead and underground line configurations.

For underground lines, the conductors are encased with insulating material. Conductors can therefore be placed very close to one another (often bundled together within a common pipe or duct). Whenever energized conductors are close together, the magnetic field cancellation between these conductors is increased significantly. For underground lines, the magnetic field typically decreases in strength as a function of $1/d^3$ (where d = distance) in distance from the transmission line (Enertech, 2016).

For overhead lines, the air is used as an insulator between each of the phase conductors, resulting in a larger distance separation between the conductors than with underground lines. Whenever energized conductors are spread farther apart, the magnetic field cancellation between the conductors is diminished. For overhead lines, the magnetic field typically decreases in strength with the square of distance ($1/d^2$) from the transmission line (Enertech, 2016).

Figure 8-5. Sample of Magnetic Field Diminishing at Distance from Transmission Lines



Source: Enertech Consulting
Note: This graphic does not include data for underwater lines. Water, like earth, does not reduce magnetic fields; therefore underwater cables can be considered the same as underground lines for purposes of this EIS.

For overhead lines, the conductor (at midspan) is farther away from the ground surface than the underground cables are below ground. Underground cables are potentially closer to people than overhead lines. Therefore, the magnetic field is generally higher directly above an underground cable than it is below an overhead line. However, because the underground cables are close to one another, the magnetic field strength decreases very rapidly with distance away from the cables due to their magnetic field cancellation. This is different from overhead lines, where the magnetic field strength persists farther away from the line since the conductors are spread farther apart than with underground lines, and the magnetic strength decreases more slowly over the distance (Enertech, 2016). People walking directly over the center of underground transmission lines would experience higher magnetic fields than if they were walking directly underneath overhead lines, but if walking several feet away from the center of the line, magnetic fields from underground lines would drop off more quickly.

Underwater transmission line cables have magnetic field attenuation characteristics similar to underground cables. The magnetic field typically decreases in strength as a function of $1/d^3$ in distance from the underwater cable. However, the public is unlikely to be near underwater cables in deep water (at the bottom of Lake Washington). In shallow water, magnetic field levels would be comparable to underground cables.

8.3.5.1 Status of Scientific Research on Electric and Magnetic Fields

8.3.5.1.1 Magnetic Field Exposure

Most people in the United States are exposed to magnetic fields that average less than 2 milligauss (mG) in strength, although exposures for each individual vary. Average magnetic field levels within rooms have been found to be approximately 1 mG based on several large surveys, while in the immediate area of appliances, the measured values ranged from 9 to 20 mG (Severson et al., 1988; Silva et al., 1998). Another study of 992 homes reported the average residential magnetic field value at 0.9 mG (Zaffanella, 1993). The closest local participants in this study were the City of Seattle and Seattle City Light.

> This section describes the scope and findings of studies published through mid-November 2015 by organizations that continue to examine the possible health effects from power-frequency EMF, such as the World Health Organization (WHO), NIEHS, Advisory Group on Non-Ionizing Radiation of the Health Protection Agency of England, and International Agency for Research on Cancer (IARC) (Sheppard, 2015).

Table 8-6 lists the median magnetic field levels in mG generated by electrical appliances typically found in households. The strength of the magnetic field does not depend on the complexity, size, or power of the appliance. Large appliances often have weaker magnetic fields than small devices.

Table 8-6. Median Magnetic Fields Generated by Household Appliances in Milligauss (mG)

Appliance	Distance from Source	
	6 inches	4 feet
Bathroom		
Hair dryers	300	-
Electric shavers	100	-
Family Room		
Ceiling fans	3	-
Window air conditioners	3	-
Televisions[1]	7	-
Bedroom		
Digital clock[2]	1	-
Baby monitor	6	-
Laundry/Utility		
Dryer	3	-

Appliance	Distance from Source	
Washing machine	20	-
Iron	8	-
Portable heaters	100	-
Vacuum cleaner	300	1
Kitchen		
Blender	70	-
Can opener	600	2
Coffee maker	7	-
Dishwasher	20	-
Food processer	30	-
Garbage disposal	80	-
Microwave oven[3]	200	2
Mixer	100	-
Electric oven	9	-
Electric range	30	-
Refrigerator	2	-
Toaster	10	-
Workshop		
Battery charger	30	-
Drill	150	-
Power saw	200	-

Source: *EMF in Your Environment*, U.S. Environmental Protection Agency, 1992, as cited in NIEHS, 2002.

Notes:

Dash (-) means that the magnetic field at this distance from the operating appliance could not be distinguished from background measurements taken before the appliance had been turned on.

[1] Some appliances produce both 60 Hz and higher frequency fields. For example, televisions produce fields at 10,000 to 30,000 Hz (10 to 30 kHz) as well as 60 Hz fields.

[2] Most digital clocks have low magnetic fields. In the example in this table, the clocks are electrically powered using alternating current, as are all the appliances described in this table.

[3] Microwave ovens produce 60 Hz fields of several hundred milligauss, but they also create microwave energy inside the appliance that is at a much higher frequency (about 2.45 billion Hz). Users are shielded from the higher frequency fields but not from the 60 Hz fields.

8.3.5.1.2 Research Background

Over the last 40 years, hundreds of scientific studies have been carried out around the world to determine whether exposure to EMF can have harmful health effects. In order to draw valid scientific conclusions, the same or similar results must be seen by different investigators, who may employ different scientific approaches addressing the same question.

Studies of potential adverse health effects from EMF associated with electric power systems began in the early 1960s as electric power systems moved to higher transmission line voltages of 345 kV and above. Research initially was focused on effects of strong electric fields to which workers could be exposed, though by the 1980s public and scientific interest shifted to weak magnetic fields, the area in which EMF research continues to date. While research on both electric and magnetic fields has answered many questions and brought consensus on certain topics, uncertainty remains as a result of contradictory and inconclusive research results.

8.3.5.1.3 Research Methods

A number of scientific methods and topics in biology, human disease, biophysics, and engineering feed into answering questions bearing on public health. Research falls into these general categories:

- Epidemiology;
- Laboratory studies of humans, animals, tissues, and cells; and
- Theoretical analyses.

Epidemiology is the study of patterns and possible causes of diseases in human populations. Epidemiologists study short-term health conditions, such as outbreaks of food poisoning, as well as long-term diseases such as cancer and heart disease. Results of these studies are reported in terms of statistical associations between various factors and disease. Epidemiological studies often drive public health discussion and risk assessment because the research directly concerns humans.

Epidemiology has the significant challenge of determining whether statistical findings reflect a true causal association or whether other factors (notably, confounders) are involved. To a non-expert the language of epidemiology can appear more precise and definitive than it is. A *statistically significant* finding indicates a probability that the finding occurred above a certain level of chance, and regardless of statistical probability, a positive association does not itself provide proof of a cause-and-effect relationship. Typically, supplemental data are needed from multiple epidemiologic approaches and other study methods before a causal relationship can be established. The other study methods that bear on whether an agent such as EMF causes disease include clinical studies of humans, and laboratory studies with animals, biological tissue, and cells.

A recurrent feature of EMF science is that effects tend to be small and difficult to reproduce even after undertaking considerable effort to match experimental conditions. This is an important limitation that prevents drawing firm conclusions. It is noteworthy that there has been difficulty in replicating animal studies that have reported adverse effects. Taken together with the inconclusive nature of the epidemiological research, there is consequently a high level of skepticism among many scientists that the positive associations of some epidemiological analyses are scientifically valid. There is therefore skepticism about the role, if any, that ELF magnetic fields play in human health. Skepticism also is promoted by studies indicating that environmental ELF fields are too weak to produce effects in cells, tissues, organs, animals, or humans.

8.3.5.1.4 Ongoing Research and Unresolved Issues

Work is still underway to find answers to questions about EMF and possible health effects. Some examples include the following:

- **Research on childhood leukemia –** Large studies continue, with one being conducted in California sponsored by the Electric Power Research Institute.
- **Research on co-carcinogenesis –** Questioning whether one or more agents, such as EMF plus a biochemical, environmental, chemical, or physical agent, act together to exacerbate the growth and expansion of tumor cells, while alone one such agent may not have an effect.
- **Research on neurodegenerative diseases –** There are suggestive findings of a connection between neurodegenerative diseases, particularly amyotrophic lateral sclerosis (ALS), and magnetic fields, though there is no known mechanism for such an effect. Worker studies are in process to examine the possibility that frequent electric shock may increase the risk of ALS, rather than EMF.
- **Research on EMF interference with implanted medical devices –** Longstanding research has concerned possible interference with the functioning of implanted devices such as cardiac pacemakers, which is of most concern within occupational environments. However, certain devices in use close to very high-voltage electric fields remain a potential concern for the general public. Exposure guidelines have been developed for workers, and manufacturer data sheets provide limitations on device performance during EMF exposure. Work is continuing to develop laboratory bench testing and a more precise understanding of EMF tolerances of these devices.

8.3.5.1.5 Summary of Research Findings on EMF

Conclusions on public impacts of EMF exposure cannot be obtained from a single study or a small number of studies. Such conclusions require a considerable body of evidence placed in the context of biological knowledge, obtained from laboratory experiments and physical principles. To meet the challenge of fairly assessing the information, public health analysts assemble evidence from the entire body of science using established measures and techniques. The methods of the "Weight of the Evidence for *Carcinogenicity*" developed by the U.S. Environmental Protection Agency (EPA) (2005), and a method developed for the International Agency for Research on Cancer (IARC) Monographs Program (IARC, 2006), are prominent mainstream approaches for risk assessment. IARC is an agency of the World Health Organization and draws upon top research scientists throughout the world. Both EPA and IARC methodologies have been used by other agencies worldwide and have been adapted for assessing diseases other than cancer.

After more than 40 years of research, unresolved questions about ELF magnetic field exposure and childhood leukemia that surfaced in 1979 (Wertheimer and Leeper, 1979) continue to drive risk assessment. This is indicated by publications, comments, and conclusions from various scientific bodies including the following:

- IARC (2002) conducted an extensive review of the literature in epidemiology, animal, and cell laboratory studies and a review of biophysical principles. Their conclusion was that power-frequency magnetic fields fell into the category of "possible carcinogens" based on "limited evidence in humans for the carcinogenicity of extremely low-frequency magnetic fields in relation to childhood leukemia." For leukemia and all other cancers among adult populations (both residential and occupational), evidence was not considered sufficient to support classification of EMF as a possible causal factor. More information is available at: http://monographs.iarc.fr/ENG/Monographs/vol80/index.php.

- IARC's conclusions and classifications closely resemble those of an earlier National Institute of Environmental Health Sciences (NIEHS) evaluation that found that ELF magnetic fields were possible carcinogens. NIEHS drew this conclusion based on the "limited evidence" from childhood epidemiology and evidence concerning one type of adult leukemia among workers exposed occupationally. More information is available at: http://www.niehs.nih.gov/health/assets/docs_a_e/emf1.pdf (NIEHS, 1998).

- In response to inquiries on The Health Council of the Netherlands (2008) interpretation of the research, this organization offered the following perspective: "Epidemiological studies showed an increased risk of leukemia among children living in locations where the field strength was higher than 0.3 – 0.4 microtesla (μT). However no indications of a causal mechanism have been found in experimental research. The possibility cannot be excluded that a factor other than exposure to a low-frequency magnetic field could explain the association found in epidemiological research." More information is available at: http://www.gezondheidsraad.nl/en/publications/high-voltage-power-lines-0.

- The Health Protection Agency of the United Kingdom has published opinions on EMF human health effects in recent years. The last full Health Protection Agency report on power-frequency EMF was in 2001. In 2013, the Agency stated: "At present there is insufficient new information that would justify the development of an update to the 2001 report, although it will be needed at some point in the future" (HPA, 2013).

- The most recent update to the European Union position prepared by the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR, 2009) presented conclusions similar to those above.

8.3.6 Corona Ions

Corona effects are the result of the ionization of the air by the strong electric fields present at the surface of sharp metallic points, such as small-diameter wires, when they are raised to a high voltage. Generation of corona ions is dependent on the strength of the electric field on the transmission line's fittings and conductors—called the surface voltage gradient. Water droplets can cause increases in the conductor's surface voltage gradient, increasing the likelihood of corona discharges occurring. This may occur during very moist atmospheric conditions, such as fog or rain, but the effect is temporary. The corona appears as a faint (filamentary) discharge radiating outward from its source, and is the cause of the faint crackling noise sometimes heard in the vicinity of transmission lines. The corona ions produced by the line are carried by the wind and disappear with distance from the line as the charged particles recombine or are deposited.

> The source of information on corona ionization in this section (8.3.6) is information produced by the Energy Networks Association (ENA) (2009).
>
> ENA represents the "wires and pipes" transmission and distribution network operators for gas and electricity in the UK and Ireland. Members are utilities that control and maintain the national energy infrastructure.

The health concern with corona ions is related to how they may combine with airborne pollutants to create health impacts. As airborne pollutants enter the body by inhalation, they may be deposited in the respiratory system. The extent to which inhaled particles deposit in the various regions of the respiratory system depends upon physical factors such as their size, shape, and density, as well as charge. The extent of effects of corona ions on health will depend upon the increase in individuals' exposure to pollutants and the extent to which these pollutants are causes of disease.

Professor Denis Henshaw of Bristol University in the United Kingdom has developed a corona ion hypothesis, based on work proposing a theoretical mechanism involving the effect of electric fields producing corona ions, against an extensive background of research into the effects of magnetic fields on health. However, Professor Henshaw's theoretical mechanisms involving corona ions and pollutant particles have not been proven by health studies on populations near transmission lines.

8.4 HOW WERE POTENTIAL ENVIRONMENTAL HEALTH IMPACTS ASSESSED?

The analysis considered the general potential to encounter preexisting site contamination during construction, and how that type of material would be addressed if encountered. The potential to use hazardous materials or generate hazardous waste during project construction and operation was considered, along with how these materials would be managed. The analysis includes the potential for public safety risks related to earthquake, lightning strike, or explosions related to natural gas or petroleum pipelines. Finally, the scientific findings regarding EMF and corona ionization were evaluated to consider what they would mean relative to operation of this project.

8.5 WHAT ARE THE LIKELY CONSTRUCTION IMPACTS RELATED TO ENVIRONMENTAL HEALTH?

8.5.1 Construction Impacts Considered

As previously described, there are four types of potential environmental health impacts considered in this chapter. Because of the different types of impacts considered, each potential impact category includes a specific set of impact classification criteria.

8.5.1.1 Hazardous Materials

Constructing any of the action alternatives would be likely to involve use of the hazardous materials described in Section 8.3.1 (e.g., gasoline, oil, solvents, paint). Improper management of those materials or accidental spills that are not properly cleaned up could release hazardous materials to air or water, which could create an environmental impact. Construction activities are not expected to generate any hazardous/dangerous wastes.

Each alternative and option or component has the potential to be constructed in or near sites already contaminated with hazardous materials. The types of hazardous materials that could be encountered would depend on previous site uses. When contained in place these materials may pose little active risk to the environment. However, these types of materials may become mobile if they are disturbed during construction, at which point they would be more likely to have a negative impact on human health and the environment. Disturbance of these materials during construction could create an environmental impact by releasing hazardous materials to the air or water, or exposing construction workers to hazardous substances, if proper handling methods were not used. Existing site contamination could occur in water as well as on land.

The magnitude of potential hazardous material related impacts during construction is classified as minor, moderate, or significant and has been defined for this EIS as follows:

Minor- If small quantities of hazardous materials could be released but could be cleaned up in accordance with regulations such that sites could be restored to full function with no adverse health impacts to the public, impacts would be considered minor.

Moderate–If substantial quantities of hazardous materials could be released to the environment but could be cleaned up and restored to full function in accordance with applicable regulations with no adverse health impacts to the public, impacts would be considered moderate.

Significant–If hazardous materials would be likely to be encountered with the potential for uncontrollable chemical releases, or large quantities of hazardous materials could be released in a sensitive environment (such as a water resource, wetland, residential area or near a school) with limited or no ability for cleanup and possible adverse public health impacts, impacts would be considered significant.

8.5.1.2 Public Safety Risks – Activities Near Pipelines

Construction of the project could theoretically damage the hazardous liquid pipelines operated by OPLC and other gas lines mentioned in Section 8.3.2, creating an explosion risk if safety policies and regulations were not implemented as required.

The UTC identifies five major reasons why gas pipelines leak or fail, potentially creating a public safety hazard: (1) third-party excavation damage; (2) corrosion; (3) construction defects; (4) material defects; and (5) outside forces resulting from earth movement, including earthquakes, washouts, landslides, frost, lightning, ice, snow, and damage done by authorized on-site personnel. The UTC also notes that other causes of failure can include cast-iron bell joint leaks and human error (UTC, 2015). Holes in pipelines can also be created by electrical *arcing* from downed transmission lines, leading to gas leaks and potential explosions (UTC, 2012). Construction equipment can create pipe gouges, dents, scrapes, and cracks in the pipeline. This type of damage can grow and lead to a catastrophic failure (UTC, 2015).

The magnitude of potential project construction impacts related to activities near pipelines is classified as follows for this EIS:

Minor - If damage to pipelines could lead to leaks of materials that could be cleaned up and sites fully restored in accordance with applicable regulatory requirements, impacts would be considered minor.

Moderate - If implementation of regulatory requirements and project design would address most potential adverse impacts, but there is a reasonable potential for some damage to pipelines that could result in impacts to property or human health, impacts would be considered moderate.

Significant–Even with implementation of regulatory requirements and design measures, if substantial damage, injury, or death would likely occur associated with pipeline damage, leaks, or explosions, impacts would be considered significant.

8.5.1.3 Public Safety Risks – Natural Phenomena

Lightning strikes would not be a particular concern or lead to adverse impacts to the public during construction. Members of the public would not be allowed to be in the vicinity of the construction site, and therefore, would not be exposed to any additional environmental health risk.

As discussed in Chapter 3, an earthquake could occur during construction, resulting in embankment slope failures, liquefaction, ground settlement, and possibly associated equipment destabilization. The risk of seismic hazards during construction is considered low because of the relatively low probability that an earthquake would coincide with the actual limited construction period. If a large earthquake were to occur, the major risk would be to the ongoing construction activities or injury to workers.

The magnitude of potential construction impacts related to public safety risks from natural phenomena is classified as follows for this EIS:

Minor –If earthquakes or seismic activity occurred during construction that could cause disruption of equipment and construction activities, but would not cause risks to human health or property, impacts would be considered minor.

Moderate - If an earthquake during construction would have a reasonable potential to disrupt construction activities, and risk human health and property, impacts would be considered moderate.

Significant -If an earthquake during construction would result in substantive damage to property, injury, death, or substantive property loss, impacts would be considered significant.

8.5.1.4 EMF and Corona Ionization

Although small motors in construction equipment generate some level of magnetic fields, these fields are very small and would be indistinguishable from background levels for the public outside of the construction site. Workers within the construction site would experience magnetic fields from this equipment as they would from working on any similar construction site (these fields would be at lower levels than those investigated as potentially causing health impacts). As described above, there is not a consensus in the scientific community on the environmental health risks from EMF, particularly at the frequencies that would be expected to result from the proposed transmission line. EMF is a concern that has been identified by the public, but based on the available scientific information there does not appear to be a potential environmental health impact associated with the proposed transmission line. PSE will continue to comply with all applicable regulations, including requirements that may emerge in the future.

Corona ionization would not be generated by construction. As with EMF, there is no scientific consensus that it is an environmental health risk, and while this issue has been identified as a concern by the public, it is not considered to be an impact to environmental health.

8.5.2 No Action Alternative

Under the No Action Alternative, maintenance activities at existing facilities would occur and could intensify, but they would not involve work on new sites or involve use of large quantities of hazardous materials. Occasional conductor replacement, implementation of new technologies not requiring discretionary permits, and installation of distributed generation facilities under PSE’s conservation program would require minor construction activities. Construction impacts related to hazardous materials, public safety risks, or EMF and corona ionization would be negligible.

8.5.3 Alternative 1: New Substation and 230 kV Transmission Lines

Impacts are discussed associated with transmission line construction, followed by substation construction where differences in impacts could be encountered.

8.5.3.1 Option A: New Overhead Transmission Lines

8.5.3.1.1 Hazardous Materials

Construction of Alternative 1, Option A would likely require the types of equipment described in Chapter 2, including those for earth movement (dump trucks, bulldozers, or backhoes), cranes, concrete trucks, and delivery and worker vehicles. Overall construction duration could be up to 18 months (not at all locations). All of these vehicles and types of equipment would use some type of fuel, which if not handled and managed properly could spill or leak.

The transmission lines installed for this alternative could use either the HPFF-type cable or XLPE cable, which does not contain oil. If HPFF cable were chosen and were damaged during installation, oil from the lines could leak. Spills of transformer insulating oil or gas (SF_6) could occur during installation of this equipment at one of the three substation sites. Without containment and immediate cleanup, these materials could potentially generate an adverse environmental impact. However, regulations (including those for water quality protection during construction described in Chapter 5) require spill prevention, site containment, and cleanup measures. Compliance with these regulations would reduce impacts to a minor level.

In keeping with applicable regulations, PSE has an Emergency Spill Response Program to ensure that accidentally released substances are contained. This program incorporates a 24-hour contact number for reporting spills. The number is widely distributed to PSE and its contractor's employees through training, facility signs, Spill Prevention, Control, and Countermeasure (SPCC) plans, office bulletin board posters, internal mailings and company vehicle dashboard stickers (Strauch, personal communication, 2016). Upon receiving notification of a release, PSE initiates a spill response process, which includes providing notification of the releases to state or federal agencies. Smaller incidental releases can often be addressed by internal PSE staff. Releases that are larger or more complex or involve regulatory oversight from state or federal agencies are directed by an environmental consultant that is contracted to provide 24-hour emergency spill response services. PSE contracts with a number of emergency response contractors that have the necessary equipment and personnel to remediate the sites per the appropriate state or federal regulations (Strauch, personal communication, 2016). It is acknowledged that unforeseen circumstances can occur during construction. However, compliance with all applicable local, state and federal regulations and adherence with PSE's existing processes would reduce the probability for leaks or spills to occur, and if spills did occur, potential impacts would be reduced to a minor level.

Federal regulations would require PSE to determine the location and types of preexisting soil or groundwater contamination on-site when purchasing property (40 CFR Part 112). If contaminated sites were purchased for either substation improvements (transformer) or transmission lines, they would need to be cleaned up to appropriate standards, with the appropriate cleanup level determined based on likely future use of the site. Once a particular project site or alignment is chosen, an assessment can be conducted of the potential to encounter existing contamination.

Hazardous materials on property already owned by PSE would also need to be addressed if it were likely the hazardous materials would be disturbed. Releases (or threatened releases) of such materials would need to be reported to the Washington State Department of Ecology under the Model Toxics Control Act (MTCA). These notification requirements also apply to historical releases once a property owner is aware they have occurred. Cleanup actions could be initiated under MTCA; the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA); or the Resource Conservation and Recovery Act (RCRA).

If hazardous materials in soils or groundwater were not known to exist prior to the start of construction, but were encountered during the work, federal and state regulations (primarily WAC 173-340) would require PSE to ensure appropriate site management to avoid displacement of the materials and to conduct appropriate cleanup and disposal. The standard practice when a contractor finds previously unknown hazardous materials is to stop work in the immediate area until the materials can be categorized and the extent/nature of the release determined. PSE would also need to report the release of any hazardous substances that may be a threat to human health or the environment to Ecology per WAC 173-340-300. Given the extensive regulatory framework in place for contaminated site management, negligible to minor impacts related to preexisting contamination are expected.

8.5.3.1.2 Public Safety Risks – Activities Near Pipelines

Construction could occur in the vicinity of regional natural gas pipelines or those that supply natural gas to homes and businesses. In addition to distribution gas lines throughout the area, the transmission lines could be constructed near the two OPLC regional pipelines.

Regulations such as those described in Section 8.2 (and Appendix M) require that pipelines must be properly identified and located prior to construction (through review of utility maps, coordination with utilities, or fieldwork to precisely locate them).

In addition to federal and state regulations, local governments in the combined study area have also adopted land use policies or regulations regarding co-location of other development with hazardous material pipelines such as the OPLC pipelines (Section 8.2.2.1). The OPLC pipelines extend through six of the study area communities (Kirkland, Redmond, King County, Bellevue, Newcastle, and Renton) all of which have planning policies addressing such facilities, including safety considerations in siting and co-locating utilities. These communities also have other codes addressing related public safety which would guide facility siting and design.

Careful coordination with potentially affected utilities during the design process, along with compliance with applicable regulatory requirements, will help to avoid potential construction conflicts with existing underground pipelines. Compliance with current safety requirements and regulations would minimize the probability that an existing pipeline could be damaged during construction and spill or leak petroleum products. Should a spill occur, the risk would depend in part on the location of the accident and the amount of product released. Materials could enter area storm drains or watercourses, pool on-site, soak into the ground and potentially reach groundwater, or drain across land onto private property or public rights-of-way. Depending on other activities occurring in the area, in a worst case scenario these materials could possibly ignite, leading to explosion and potential loss of life and property.

Compliance with applicable regulations would be expected to reduce the potential impact to a minor level.

In addition to injuries or loss of life that might result from an explosion of any type of pipeline, human health effects could occur after inhaling smoke from fires or coming in contact with the spilled petroleum materials. If petroleum products were to reach a drinking water aquifer, significant adverse impacts to human health could occur if these materials were ingested.

Although a significant adverse impact to public safety could occur if a leak or an explosion of any of these types of gas lines resulted from the project, this type of event would not be likely to occur because PSE would comply with all applicable regulations and requirements in place for pipeline safety, including local land use requirements for siting facilities of this type. Site-specific investigations would be conducted during design to avoid existing gas lines by maintaining appropriate separation between existing and proposed facilities. Close coordination with potentially affected utilities would also be done, and the design and construction would be conducted consistent with all applicable requirements. Given these safeguards, the probability of a pipeline disruption resulting in an explosion is low, but the potential magnitude of the impact is potentially significant if this unlikely event were to occur. Because compliance with all applicable requirements would help to reduce the probability of an occurrence to a very low likelihood, potential adverse impacts associated with construction of the project are characterized as minor.

Pipeline Safety

The UTC has investigated a few gas pipeline incidents that were caused by the failure of underground facility owners to mark, or excavators' failure to call or precisely locate gas pipeline facilities. The UTC has referred violations to the State Attorney General Office for enforcement. The UTC's recommendations for enforcement have included technical assistance, education, training, and penalties (UTC, 2015).

8.5.3.1.3 Public Safety Risks – Natural Phenomena

No public safety impacts related to lightning strikes would be anticipated during construction; however, construction workers could be exposed during tower construction. Transmission pole design includes features to reduce the potential for lightning strikes, described in more detail in Section 8.6.2.3 below. Earthquakes during construction would not be expected to create adverse impacts in terms of public safety risks specific to the project construction. As described in Chapter 3, the risk of seismic hazards during construction is considered low because of the relatively low probability that an earthquake would coincide with the limited construction period. If a large earthquake were to occur, the major risk would be to the ongoing construction activities, and construction workers. Risks to workers on the Energize Eastside project would not be greater than the risks to workers on other construction projects in the region, and would be considered minor.

8.5.3.1.4 EMF and Corona Ionization

As noted in Section 8.5.1.4, corona ionization would not be generated by construction activities, and EMF would not be an issue during construction for Alternative 1, Option A or any of the other options or alternatives.

8.5.3.2 Option B: Existing Seattle City Light 230 kV Transmission Corridor

8.5.3.2.1 Hazardous Materials

Alternative 1, Option B would likely use the same types of hazardous materials in construction and mostly similar equipment to Option A (see Appendix B). The construction period for Option B would likely be longer than Option A (24 months), extending the period during which accidental spills of materials could potentially occur. Option B also includes the potential for use of HPFF lines, which could be damaged and spill oil. In addition, for purposes of this evaluation, the potential for preexisting contamination within the Seattle City Light corridor was considered equally likely to that of any other location. Option B is likely to have negligible to minor construction impacts related to hazardous materials, the same as Option A, because PSE would comply with all applicable permit requirements prior to and during construction.

8.5.3.2.2 Public Safety Risks - Activities Near Pipelines

As with Alternative 1, Option A, construction could occur in the vicinity of regional natural gas pipelines or smaller pipelines that supply natural gas to homes and businesses. Although the PSE lines would in large part be located in or near the existing Seattle City Light corridor, that corridor crosses a PSE gas main and the two regional petroleum product pipelines operated by OPLC several times (as described in Chapter 16). Other gas utilities may also be present. As with Option A, in the unlikely event that construction activities result in a rupture, leak, or explosion of a nearby pipeline, impacts could be significant. However, conformance with existing regulations and industry standards would help to ensure that impacts are not likely. Given the low probability of occurrence, the potential impact is considered minor.

8.5.3.2.3 Public Safety Risks – Natural Phenomena

Alternative 1, Option B would have the same potential for minor adverse impacts as described for Option A with regard to lightning strikes and earthquakes during construction.

8.5.3.3 Option C: Underground Transmission Lines

8.5.3.3.1 Hazardous Materials

The potential for spills of hazardous materials at substations would be the same as described for Alternative 1, Options A and B although slightly different types of construction equipment would be used (see Appendix B). Duration of construction would also be longer than Option A, at approximately 36 months. The same type of HPFF lines described for Option A could be used, which could leak during construction. The underground transmission lines of Option C could have a higher potential to encounter contaminated materials than the overhead transmission of Option A due to the larger extent of ground disturbance. PSE would perform site-specific evaluations during facility design, including geotechnical evaluations to determine the potential for contaminated materials to be present. Where possible, the facilities would avoid areas of contamination. The potential magnitude of impacts is expected to be minor, because it is anticipated that PSE would attempt to avoid areas of contamination and where that is not possible would comply with all applicable permit requirements, cleaning up any disturbed contaminated sites to meet regulations.

8.5.3.3.2 Public Safety Risks - Activities Near Pipelines

As with Alternative 1, Options A and B, construction could occur in the vicinity of regional natural gas pipelines, or those that supply natural gas to homes and businesses, or near the linear alignment of the two regional petroleum product pipelines operated by OPLC. The potential to encounter these facilities would be higher than described for Options A and B, because more excavation would be required. As noted for Option A, PSE would comply with all applicable requirements during facility design and construction to avoid potential conflicts with these facilities. Due to the increased area of ground disturbance, the probability of impacts would be somewhat higher than described for Options A and B, but still considered low, and anticipated impacts are expected to be minor to moderate.

8.5.3.3.3 Public Safety Risks – Natural Phenomena

This option would have the same or lower potential for minor adverse impacts as described for Alternative 1, Options A and B with regard to lightning strikes and the same potential impacts from earthquakes during construction.

8.5.3.4 Option D: Underwater Transmission Lines

8.5.3.4.1 Hazardous Materials

Construction of Alternative 1, Option D would require equipment similar to that described for Option A, plus a submarine cable laying vessel (a specialized type of barge). Spills from the equipment are not considered likely to occur, although if they did occur, they would likely have a minor adverse impact if in water[5]. As described in Chapter 2, approximately 8 months would be needed for the underwater portion plus additional time for the land-based portions of the line and the new transformer.

As with Alternative 1, Option C, the submerged transmission lines of Option D (and possible underground segments on land) have greater potential to encounter contaminated material than the overhead transmission of Option A due to the larger extent of ground disturbance. This option could also encounter contaminated sediments within Lake Washington[6] along the alignment. These sediments could be disturbed through burying the cable at relatively shallow depth underneath the lake bed or by laying cable on the lake bed. Ground disturbance could also occur if the lines were placed underground at the point where they come ashore. As with Options A, B, and C, compliance with permit and regulatory requirements would help to ensure that adverse impacts related to site contamination would likely not occur. Impacts, if they occurred, would be temporary and would be expected to be mitigated in accordance with applicable regulatory requirements.

Potential hazardous material impacts would be the same as described for Alternative 1, Option A (negligible to minor).

[5] This analysis assumed that neither fluid-filled cable would likely be used in Lake Washington PSE's *Lake Washington Submarine Cable Alternative Feasibility Study* (Power Engineers, 2015) indicates that use of SCFF cable in Lake Washington is not recommended, and HPFF cable was not considered as an option in their feasibility analysis.
[6] Contamination of lake-bottom sediments is known to exist in some locations in Lake Washington (Ecology, 2014).

8.5.3.4.2 Public Safety Risks – Activities Near Pipelines

This option would have lower potential for minor adverse impacts related to construction activities near gas pipelines, compared to Alternative 1, Options A, B and C.

8.5.3.4.3 Public Safety Risks - Natural Phenomena

This option would have the same potential for minor adverse impacts as described for Alternative 1, Options A, B, and C with regard to lightning strikes and earthquakes during construction.

8.5.4 Alternative 2: Integrated Resource Approach

8.5.4.1 Energy Efficiency and Demand Response Components

8.5.4.1.1 Hazardous Materials

Hazardous materials are not likely to be used in any quantity, or otherwise encountered or generated, in constructing energy efficiency measures. No adverse impacts related to hazardous materials are likely.

8.5.4.1.2 Public Safety Risks – Activities Near Pipelines and Natural Phenomena

Public safety risks related to proximity to gas lines, earthquakes, or potential for lightning strikes during construction are not likely from this component of Alternative 2. Energy efficiency measures do not involve major infrastructure or substantial construction, and would not likely be located near pipelines or gas lines.

8.5.4.1.3 EMF and Corona Ionization

Construction of all components of Alternative 2 would not likely have any adverse impacts, the same as Alternative 1.

8.5.4.2 Distributed Generation Component

8.5.4.2.1 Hazardous Materials

Some of the same types of equipment and vehicles used to construct portions of Alternative 1 could be used for installation of distributed generation measures. The construction period, during which materials could potentially spill, would likely be shorter than the larger, more complex facilities and sites of the energy storage and peak generation plant components. Adverse impacts related to accidental spills or encounters with previous site contamination are expected to be negligible to minor.

8.5.4.2.2 Public Safety Risks – Activities Near Pipelines

As with Alternative 1, construction of distributed generation facilities could occur in the vicinity of regional natural gas pipelines or those that supply natural gas to homes and businesses. The likelihood of an explosion would be similar to or lower than Alternative 1 (extremely low potential for occurrence). The risks during construction of distributed generation facilities would be lower than with Alternative 1 because there would be greater flexibility in locating the facilities away from pipelines.

8.5.4.2.3 Public Safety Risks – Natural Phenomena

This component would have the same or lower potential for minor adverse impacts as Alternative 1 with regard to lightning strikes and earthquakes during construction.

8.5.4.3 Energy Storage Component

8.5.4.3.1 Hazardous Materials

In addition to construction equipment and vehicles, which would contain or use hazardous materials, it is assumed that the battery units would contain some type of acid. Any of these types of materials could spill in the event of an accident during construction, which would potentially take approximately six months to complete. Battery systems would be expected to be shipped in spill-proof containers. Construction of new facilities like this would be expected to comply with local codes for stormwater management and spill prevention and cleanup to avoid impacts to surface waters or groundwater that might occur with accidental spills during construction. Overall, construction impacts related to hazardous materials are expected to be negligible to minor.

8.5.4.3.2 Public Safety Risks – Activities Near Pipelines

As with the distributed generation component, construction could occur in the vicinity of regional natural gas pipelines or those that supply natural gas to homes and businesses, with accompanying potential risks of accidental disruption. The likelihood of this occurrence is low, and potential impacts are considered to be minor.

8.5.4.3.3 Public Safety Risks – Natural Phenomena

This component would have the same potential for minor adverse impacts as Alternative 1 with regard to lightning strikes and earthquakes during construction.

8.5.4.4 Peak Generation Plant Component

8.5.4.4.1 Hazardous Materials

In addition to construction equipment and vehicles, which would contain or use hazardous materials for approximately 12 months to build this component, the plant would run on fuel, possibly natural gas, which would be delivered to the site prior to initial startup. Any of these types of materials could spill in the event of an accident during construction. However, as with the energy storage component, construction of this type of facility would be required to comply with local codes for hazardous material transport and storage, as well as construction site stormwater management and spill prevention and cleanup. Compliance with regulations would avoid impacts to surface waters or groundwater that might occur with accidental spills during construction. Therefore, impacts would be negligible to minor.

8.5.4.4.2 Public Safety Risks - Activities Near Pipelines

As with the distributed generation component, construction could occur in the vicinity of regional natural gas pipelines or those that supply natural gas to homes and businesses. As previously described, PSE would coordinate with potentially affected utilities to avoid potential conflicts or disruptions, and would comply with all applicable requirements during facility design and construction. Adverse impacts are not expected to occur.

8.5.4.4.3 Public Safety Risks – Natural Phenomena

This component would have the same or lower potential for minor adverse impacts as Alternative 1 with regard to lightning strikes and earthquakes during construction.

8.5.5 Alternative 3: New 115 kV Transmission Lines and Transformers

8.5.5.1.1 Hazardous Materials

Alternative 3 would likely use the same types of hazardous materials during construction as Alternative 1 but because the transmission line would be much longer, the construction area would cover a larger area than Alternative 1 or 2. Alternative 3 would require more transmission line poles to be installed to support a longer line than Alternative 1, potentially increasing the potential to encounter contaminated materials.

New transformers at three substations (many of which would require expansion or other work outside the existing facility footprint as described in Chapter 2) could also increase the potential to encounter contaminated soils. PSE would conduct site-specific investigations during facility siting and design to determine if contaminated soils are present, and would avoid contaminated areas to the extent possible. Should contaminated soils be encountered, PSE would comply with all applicable regulatory requirements regarding containment and cleanup, and impacts would be expected to be minor.

8.5.5.1.2 Public Safety Risks - Activities Near Pipelines

As with Alternative 1, construction could occur in the vicinity of regional natural gas pipelines or those that supply natural gas to homes and businesses. Construction could also occur near the linear alignment of the two regional petroleum product pipelines operated by OPLC. The increased length of Alternative 3 could result in an increased potential for conflicts with existing natural gas providers than described for Alternative 1, depending upon the alignment chosen. If existing pipelines were not properly identified and located prior to construction (through review of utility maps, coordination with utilities, or fieldwork to precisely locate them), or if proper safety precautions required by regulations were not taken during construction, the pipelines could be damaged during construction and leak. If leaked material encountered an ignition source, an explosion could occur. As with Alternative 1, this type of event could be a significant adverse impact (depending on specific size and location of the pipeline and the leak) if it occurred. However, PSE would comply with all applicable requirements during design and construction to avoid potential utility conflicts, and would coordinate closely with all potentially affected utilities, to clearly identify and avoid existing pipelines. Given conformance with existing regulations and industry standards and the low probability of occurrence, the potential impact is considered minor.

8.5.5.1.3 Public Safety Risks - Natural Phenomena

Alternative 3 would have the same potential for minor adverse impacts as described for Alternative 1, Option A with regard to lightning strikes and earthquakes during construction.

8.5.5.1.4 EMF and Corona Ionization

As described for Alternative 1, no impacts related to these issues are likely to occur with construction.

8.6 HOW COULD OPERATION OF THE PROJECT AFFECT ENVIRONMENTAL HEALTH?

8.6.1 Operation Impacts Considered

8.6.1.1 Hazardous Materials

Operating any of the action alternatives would likely involve use of the hazardous materials described in Section 8.3.1. Operation of some of the alternatives could generate hazardous/dangerous wastes over time. Improper management of any of these types of materials or wastes, or accidental spills that are not properly cleaned up, could potentially release hazardous materials or waste to air or water, creating an adverse environmental impact[7].

The magnitude of potential operational hazardous material related impacts is classified as minor, moderate, or significant and has been defined for this EIS as follows:

Minor – If small quantities of hazardous materials or waste could be released during operation but could be cleaned up in accordance with applicable regulatory requirements, with sites restored to full function and no adverse health impacts to the public, impacts would be considered minor.

Moderate – If substantial quantities of hazardous materials or waste would likely be released to the environment during operation, but sites could be cleaned up in accordance with applicable regulatory requirements, with no adverse health impacts to the public, impacts would be considered moderate.

Significant – If operations would be likely to lead to uncontrollable releases of hazardous materials or wastes, or likely releases of materials or wastes in a sensitive environment (wetlands, residential areas or schools) with no ability to clean up or restore sites if spills occurred and/or possible adverse public health impacts, impacts would be considered significant.

8.6.1.2 Public Safety Risks - Activities Near Pipelines

Ongoing maintenance activities during operation could theoretically damage or break the OPLC pipelines or other pipelines in the area, leading to a chemical release or explosion if safety policies and regulations were not implemented.

If transmission lines were improperly designed or located relative to pipelines, or if pipelines themselves were not properly designed with cathodic protection, pipelines could be damaged by stray electric current, leading to risk of chemical release or explosion.

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[7] Possible leaks of fuel from pipeline damage are described as a public safety risk.

The magnitude of potential operational impacts related to activities near pipelines is classified as minor, moderate, or significant and has been defined for this EIS as follows:

Minor – If damage to pipelines could occur leading to leaks of materials that could be cleaned up fully in accordance with applicable requirements, with minimal adverse risks to property or human health, impacts would be minor.

Moderate –If potentially substantial damage to pipelines could occur, but with no adverse impacts to human health or property damage, impacts would be considered moderate.

Significant – If operation of the project resulted in the potential to damage pipelines, leading to explosion or potential releases resulting in adverse impacts to human health or property damage, impacts would be considered significant.

Pipeline Design to Avoid Stray Current

In accordance with 49 CFR Part 195, OPLC has cathodic protection on all of its pipelines to protect against corrosion and inspects these systems annually. Criteria to determine the adequacy of cathodic protection are included in 49 CFR Part 195.571, which incorporates by reference industry standards and practices developed by the National Association of Corrosion Engineers (NACE) (2007).

8.6.1.3 Public Safety Risks - Natural Phenomena

Lightning strikes directly to electrical infrastructure could occur. Facilities are designed to direct electricity from lightning to the ground according to NESC guidelines. A mechanical means is installed to convey lightning to the ground and avoid equipment damage or fires (such as a system of lightning rods at substations, and static wires and grounding conductors at poles). Although unlikely, it is possible that, even with these protective measures in place, lightning strikes directly to electrical infrastructure could occur. Direct strikes to poles or lines could damage the pole, causing it to topple or drop transmission lines to the ground. Downed transmission lines could pose a safety risk to the public from electrocution or shock due to direct contact, or if electricity from the line were transferred to other metal utilities or structures. Lightning strikes to equipment at substations could create an electrical fault (abnormal electric current) within substation equipment, with subsequent fire or risk of electrocution of workers.

Static Wires and Grounding Conductors

The **static wire** is the pole's top wire which bleeds lightning surges off the transmission lines during a storm. Without a static wire, lightning induced voltage would otherwise build up on transmission line conductors during a lightning strike and cause damage. The static wire is connected to the grounding conductor.

The **grounding conductor** is a wire that connects the static wire to the ground rod. Visually recognizable as the wire running the entire length of the pole, top to bottom.

Transmission lines located near gas pipelines (such as in the existing corridor where PSE's 115 kV transmission line coexists with OPLC's petroleum lines) could pose a particular safety concern. Energized transmission lines on the ground after an earthquake, lightning strike (or accidents) could send electric current to anything else metal in the vicinity, such as utilities (including pipelines). In addition to electrocution or shock potential, this type of electrical contact could create holes in pipelines, leading to a risk of explosion if regulations were not followed by the pipeline (or other utility) owner or if facilities had not been designed properly.

As described in Chapter 3, seismic activity is likely to occur during the life of the project and could be substantial, resulting in significant damage, power outages, injury, and death, if facilities are not designed appropriately. Catastrophic failures of circuit breakers, transformer bushings, and disconnect switches at substations, or downed transmission lines, could result in widespread power outages.

The magnitude of potential operational public safety impacts related to natural phenomena is classified as minor, moderate, or significant and has been defined for this EIS as follows:

Minor – If lightning or earthquakes could result in minor damage to infrastructure, but there would be no adverse impacts to property of public safety, impacts would be considered to be minor.

Moderate – If lightning or earthquakes resulted in damage to infrastructure, leading to potential releases or safety risks that could be contained to the facility, impacts would be considered moderate.

Significant – If lightning or earthquakes caused damage to infrastructure, leading to explosion or electrocution risk on uncontained sites with substantial risk to public safety or property, impacts would be significant.

8.6.1.4 EMF and Corona Ionization

Potential[8] magnetic field strength was assessed for each of the action alternatives. The scientific findings regarding EMF and corona ionization described in Sections 8.3.4, 8.3.5, and 8.3.6 do not lead to a conclusion of a probable significant adverse health impact related to operation of this project. The potential health effects from EMF have been an area of controversy and scientific inquiry for several decades, but at this time, review of available research findings indicates that there are no confirmed adverse health impacts from the types of EMF exposure that electrical infrastructure such as this project generates**.** Scientific evidence remains inconclusive on risk of childhood leukemia in homes with stronger magnetic fields and, as described in Section 8.3.5.1, research on this topic continues. Therefore, impacts from EMF are not further characterized.

There is also no scientific evidence that corona ionization poses a health risk. The results of the available studies mentioned in Section 8.3.6 were inconclusive and do not lead to a finding of a probable significant adverse impact related to corona ionization with operation of this project (Sheppard, 2015) and as such, are not further characterized in this EIS.

[8] Potential magnetic fields were modeled by Enertech Consultants based on a set of design and operational assumptions provided by PSE. Full design of the facilities could lead to different fields; actual field levels will be dependent upon the line geometry and loading.

8.6.2 No Action Alternative

8.6.2.1 Hazardous Materials

Ongoing use of existing substation facilities would likely involve use of paints, solvents, and other hazardous materials described in Section 8.3.1 during equipment maintenance. Transformer oil or SF_6 is used in equipment and may need to be recharged or changed out over time. Accidental spills of any of these materials could occur and, depending on facility age and design[9], could enter the environment, including groundwater or surface waters. Transformer oil (some of which may contain PCBs) and light ballasts are types of hazardous wastes that could possibly be generated during equipment maintenance at existing sites or could spill in case of accident. Existing equipment at PSE's substations is operating on concrete foundations within gravel yards. Where PSE has determined it is required, spill containment structures or other measures are installed to contain potential equipment leaks so that they are not discharged directly to surface water or storm sewers. The same spill response procedures that are described for construction of Alternative 1 above would be used for operation of facilities.

The potential risk of transformer overheating associated with system overload during peak periods would be expected to increase under the No Action alternative, if system capacity is not increased. More frequent system overloading could increase the potential for transformers to catch fire or explode, with accompanying releases of materials and associated potential safety hazards. Under the No Action alternative, these hazards would be addressed through load shedding to avoid damaging the equipment, but the frequency of overloading would be expected to increase as the Eastside area grows.

Given PSE's operational controls, it is anticipated that spilled or leaked hazardous materials would be properly handled under existing regulations, and they would be cleaned up and abated in accordance with applicable regulations.

Transmission corridors would be maintained by PSE (and/or any other entity sharing the corridor with PSE). Maintenance of these areas would primarily involve control of vegetation that may interfere with transmission lines. PSE uses Integrated Vegetation Management (IVM) techniques to control vegetation on transmission line corridors. Selective application of herbicides is included in the IVM. PSE does not broadcast spray herbicides on transmission corridors, and when used, herbicides are applied directly to the vegetation by a Washington State licensed applicator. In general, PSE does not apply herbicides in maintained landscape settings, particularly in urbanized settings. However, in some instances, for example, a tree is removed and stump sprouting occurs, then direct application of herbicides may be used (Strauch, personal communication, 2016). Public health impacts associated with the IVM are not expected to occur, as all herbicides used are approved for use by appropriate regulatory agencies as safe for application.

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[9] Newer facilities would be expected to have oil containment or other design features to prevent surface water runoff from rainfall carrying hazardous materials offsite.

If proper management and disposal measures are followed for facility operations as required by federal and state regulations, impacts related to hazardous materials in the event of an accidental release would be expected to be negligible to minor.

8.6.2.2 Public Safety Risks - Activities Near Pipelines

It is possible, but unlikely, that maintenance activities associated with ongoing operation of PSE's existing transmission line in the OPLC corridor could damage or break the pipeline. If this did occur, it could create the same types of significant adverse impacts to public safety described in Section 8.5.3.1.2. An explosion could also affect electrical transmission, and substantial or long-term power outages could occur. These outages could potentially create significant public safety impacts if transportation systems were affected or if large numbers of homes were without power during cold periods (public facilities such as hospitals generally have backup power generators). However, as described in Section 8.5.3.1.2, such impacts are not likely to occur considering the regulatory framework for siting and design, and for post-construction pipeline monitoring, as well as stringent requirements during fieldwork to avoid contact with pipelines. The UTC, for instance, conducts inspections of hazardous liquid and natural gas pipeline companies; works to improve safety laws and regulations; provides technical assistance to pipeline operators, local governments, and communities; and enforces laws and regulations, among other activities (UTC, 2016). Given compliance with all applicable safety requirements during maintenance activities and operation of the facilities, impacts would be considered negligible.

8.6.2.3 Public Safety Risks – Natural Phenomena

With the No Action Alternative, although unlikely, existing transmission lines could fall during a natural disaster such as an earthquake (or accident), or if struck by lightning, creating a safety risk to the public. Downed lines pose a risk of electrocution if still energized and may also arc (send current to other metal structures such as pipelines), possibly damaging those facilities. Power poles include grounding equipment intended to guide electricity into the ground in the event of a strike, to prevent damage to poles or lines. It is possible that where electricity is conducted to ground, it could reach utilities such as pipelines. However, pipelines are designed with cathodic protection to minimize this possibility. Impacts to underground pipelines related to downed lines resulting from lightning strikes to poles are not likely and would be considered minor.

Some research indicates that, where overhead transmission lines share corridors with pipelines, the lightning risk to the pipeline would likely stay the same or be reduced under normal circumstances by the presence of the power lines and poles (Stantec, 2016). The lines would likely absorb any lightning strikes that might occur in an area, rather than lightning striking the pipeline directly. The Pacific Northwest has up to 10 days a year on average when thunderstorms are likely and when they occur, lighting is sparse (Mass, 2016). Since 1999, PSE recorded 23 power outages due to lightning strikes on transmission lines. The proposed 230 kV line would have a shield wire that would reduce the probability of potential outages arising from a lightning strike (Strauch, personal communication, 2016).

Lightning protection is provided at substations via a static mast[10] with shield wires or air terminals. Ground grids are installed for personnel protection, which also act as a grounding mat for lightning strikes. Some potential for fire at substations exists in the unlikely event of direct lightning strikes, or in case of earthquake damage, and the public safety impacts could be significant depending on specific location and size of a fire. At four substations (Hazelwood, Lakeside, Westminster, and Clyde Hill), residences or schools are located within approximately 100 feet of the facility. Chapter 15 discusses emergency response measures that would be employed in the event of fire at substations, whatever the cause.

While the poles used for overhead transmission structures would not likely have been specifically designed for ground-induced vibrations caused by earthquakes, they would have been designed to withstand structure loadings caused by wind/ice combinations and broken wire forces. These types of forces exceed earthquake loads (Chapter 3 provides more information on this topic).

Public safety impacts relating to lightning strikes and earthquakes are a low probability and negligible to minor impacts are expected to occur.

8.6.2.4 Electric and Magnetic Fields and Corona Ionization

With no health effects known from power-frequency EMF or corona ionization, no adverse impacts related to either of these issues would be expected related to existing infrastructure.

8.6.3 Alternative 1: New Substation and 230 kV Lines

Impacts are described associated with the major components.

8.6.3.1 Option A: New Overhead Transmission Lines

8.6.3.1.1 Hazardous Materials

Alternative 1 would add approximately 18 miles of new transmission lines, with some reconstruction of distribution power lines (and associated new pole-mounted transformers along the routes). The option would add more equipment containing hazardous materials to one of the three possible substations (Lakeside, Westminster, or Vernell). The transmission lines could be co-located with other utilities including gas pipelines. Chemical means would likely be used by one or more parties for vegetation management in the corridor. New pole-mounted transformers that might be installed would not include PCB-containing oil as required by law. Operation and maintenance of Alternative 1, Option A would carry the same or lower risk than the No Action Alternative. Minor impacts could occur in the event of releases or spills of hazardous materials, which would be expected to be contained in accordance with applicable regulations.

8.6.3.1.2 Public Safety Risks - Activities Near Pipelines

Alternative 1, Option A could be in operation near the OPLC regional pipelines or could share portions of the OPLC corridor or other utilities such as gas lines. Considering the federal and state regulatory framework and safety mechanisms in place (described in Section

[10] Static mast is a single, free-standing pole that creates a shield to protect all of the equipment inside a substation from lightning.

8.2.2.1), negligible adverse impacts related to improper design or pipeline safety are expected with operation of the project.

As described in Section 8.5.3.1.2, local governments have adopted land use policies regarding co-location of utilities and development adjacent to hazardous materials pipelines, which would ensure that the proposed transmission lines would be constructed in areas safe to maintain and operate.

8.6.3.1.3 Public Safety Risks – Natural Phenomena

The impacts of this alternative would be similar to the No Action Alternative. At substations, new equipment would be designed to meet current codes. As described in Chapter 3, for the substation expansions, design of structures to resist seismic forces and secondary effects such as liquefaction would be required by law. Following construction, risks would be very low. The required measures would encompass site preparation and foundation specifications. In addition, the state public utility commission has adopted seismic standards that utilities must follow, with structural requirements for poles that would be sufficient to resist anticipated earthquake ground motions.

Lightning strikes to new poles or substation equipment, leading to downed lines or fires, are not likely to occur. Poles would include the same type of grounding equipment described for the No Action Alternative, with the same issues relative to underground infrastructure such as pipelines. Impacts are not likely.

Either an earthquake or lightning strike could theoretically lead to fires at substations. The impacts would vary depending on specific location and size of the fire. The closest residence to any of the three substations where new equipment could be located with this option occurs at the Westminster substation where the nearest residential structure is approximately 30 feet away from the substation fence line. The distance to residences at the Vernell substation is approximately 1,200 feet and at Lakeside is approximately 90 feet.

Overall, negligible to minor impacts related to natural phenomena from operation of Alternative 1, Option A are anticipated.

8.6.3.1.4 EMF and Corona Ionization

With no health effects known from power-frequency EMF or corona ionization, no adverse impacts related to either of these issues would be expected from any of the options under Alternative 1.

8.6.3.1 Option B: Existing Seattle City Light 230 kV Transmission Corridor

8.6.3.1.1 Hazardous Materials

Operating and maintaining the PSE-owned facilities of this option would carry the same risk and have the same possibly minor impacts as Alternative 1, Option A (and No Action Alternative).

8.6.3.1.2 Public Safety Risks - Activities Near Pipelines

Alternative 1, Option B would be located near the OPLC petroleum pipelines in places and could be in operation near, or share corridors with, other utility infrastructure such as gas lines. The Seattle City Light corridor parallels the OPLC corridor through much of Newcastle and into Renton, and crosses the corridor in two locations in the Renton/Newcastle area (Figure 16-1). As with Option A, impacts to the OPLC pipelines or other gas lines in the area from operation of the project are not expected.

8.6.3.1.3 Public Safety Risks – Natural Phenomena

The potential safety issues relative to lightning, earthquakes, and accidental damage would be the same as Alternative 1, Option A and the No Action Alternative.

8.6.3.2 Option C: Underground Transmission Lines

8.6.3.2.1 Hazardous Materials

Operating and maintaining the PSE-owned facilities of Alternative 1, Option C would have the same types of issues as Options A and B with regard to hazardous materials and hazardous/dangerous wastes. No more than minor impacts would likely occur in the event of spills or other releases of hazardous materials for Option C.

8.6.3.2.2 Public Safety Risks - Activities Near Pipelines

Alternative 1, Option C could also be located near the OPLC petroleum pipelines in places and could be in operation near, or share corridors with, other utility infrastructure such as gas lines. As with Options A and B, impacts to the OPLC pipelines or other gas lines in the area from operation of the project are not expected.

8.6.3.2.3 Public Safety Risks – Natural Phenomena

The potential for lightning, earthquakes, and accidents to lead to fires or other risks would be less than with Alternative 1, Options A and B and the No Action Alternative since the line would be underground with Option C. No impacts are likely to occur.

8.6.3.3 Option D: Underwater Transmission Lines

8.6.3.3.1 Hazardous Materials

As with Alternative 1, Options A, B, and C, operating and maintaining Option D could have minor impacts if spills or releases occurred. The PSE transmission lines could be co-located with other utilities in the areas, where chemicals would likely be used for vegetation management. Oil-filled lines would not likely be used in Lake Washington, so no potential impacts related to that type of line are associated with Option D.

8.6.3.3.2 Public Safety Risks - Activities Near Pipelines

With Alternative 1, Option D, the risk of fire or explosion at substations, although unlikely to occur, would be the same as for Option A. The transmission line segments on land would have the same potential risks and impacts as Options A and B. The underwater transmission line would not likely be located near pipelines, so no related impacts could occur.

8.6.3.3.3 Public Safety Risks – Natural Phenomena

The submarine lines of Alternative 1, Option D would not be vulnerable to fires or lightning strikes. The risks and potential impacts on land would be the same as described for Option A (negligible to minor).

8.6.4 Alternative 2: Integrated Resource Approach

8.6.4.1 Energy Efficiency and Demand Response Components

8.6.4.1.1 Hazardous Materials

Small quantities of hazardous materials might have been used to install some energy efficiency or demand response measures. However, use or release of hazardous materials would be unlikely over time for measures such as windows, appliances, weatherproofing, or insulation once they are in place. There would be no likely operational impact related to hazardous materials.

8.6.4.1.2 Public Safety Risks - Activities Near Pipelines

The activities (changes in energy usage patterns), structural upgrades (windows, insulation, etc.), and meters for these components would not pose a threat to pipeline safety.

8.6.4.1.1 Public Safety Risks – Natural Phenomena

There would not likely be any particular fire or explosion risk or impacts related to lightning strikes or earthquakes with implementation of energy efficiency or demand response components.

8.6.4.1.2 EMF and Corona Ionization

With no health effects known from power-frequency EMF or corona ionization, no adverse impacts related to either of these issues would be expected under any of the components of Alternative 2.

8.6.4.2 Distributed Generation Component

8.6.4.2.1 Hazardous Materials

As with Alternative 1, accidental damage or leaks during maintenance of distributed generation equipment could lead to hazardous materials (primarily fuels or lubricants) leaving the site. However, if these facilities contained enough fuel to present a hazard, the facilities would likely be designed and installed with fuel containment to meet local codes. Adverse impacts would likely be minor if spills or leaks did occur.

8.6.4.2.2 Public Safety Risks – Activities Near Pipelines

The small-scale infrastructure installed on discrete sites would not pose a threat to pipeline safety.

8.6.4.2.3 Public Safety Risks – Natural Phenomena

Demand response facilities would not be uniquely susceptible to fire or explosion related to lightning strikes or earthquakes. Facilities would be installed in accordance with current codes, including electrical, spill containment as needed, and seismic and structural stability. New small-scale equipment would not be the tallest features on sites and not prone to lightning strikes. The presence of combustibles, such as fuel, increases the risk of fire and/or explosion, but the risk of a direct lightning strike on combustibles would be minimal due to shielding. No adverse public safety impacts are anticipated for this component.

8.6.4.3 Energy Storage Component

8.6.4.3.1 Hazardous Materials

The specific technology likely to be used for energy storage facilities is unknown. There may be types of systems that do not contain hazardous materials. This discussion assumes that a battery system containing some type of acid would be employed.

As with almost any chemical reaction, the energy stored and released by battery cells has the potential to cause overheating and, if undetected and unmitigated, eventually cause the battery to experience *thermal runaway* (a positive feedback loop where an increase in cell temperature and pressure leads to an uncontrolled heat reaction). Runaway could result in the destruction of the cell through melting or fire, which has the potential to spread to other cells (Strauch, personal communication, 2016). A primary concern with battery fires includes the release of toxic fumes from hazardous materials (varying by battery chemistry and enclosure materials), in addition to challenges and uncertainty with extinguishing battery fires by first responders as described in Chapter 15. In addition, accidental damage of the equipment could possibly lead to leaks or spills, with a potentially significant adverse impact if the materials were to reach area water bodies or locations where the public could come in contact with the acid. However, these types of systems would be constructed with the same type of containment as distributed generation facilities. Minor adverse impacts could occur.

8.6.4.3.2 Public Safety Risks - Activities Near Pipelines

The proximity of energy storage facilities to pipelines would not pose a particular type of threat to pipeline safety.

8.6.4.3.3 Public Safety Risks – Natural Phenomena

As with the distributed generation component, facilities would be installed in accordance with current codes for electrical, spill containment, and seismic and structural stability. There would not likely be any particular fire or explosion risk related to lightning strikes or earthquakes, or concern about proximity to pipelines, with operation of this component. No adverse public safety impacts are expected to occur.

8.6.4.4 Peak Generation Plant Component

8.6.4.4.1 Hazardous Materials

The potential for impacts associated with this component would likely be similar to that of the distributed generation component. Although fuel used to power these facilities could leak or spill, and there would be more fuel in one location with this type of larger-scale generation system than with distributed generation, these generation plants operating within existing substations would be required to have containment design. Adverse impacts related to potential releases of hazardous materials would be expected to be negligible to minor.

8.6.4.4.2 Public Safety Risks – Activities Near Pipelines

As with the distributed generation and energy storage components, no impacts would be expected to occur during operation.

8.6.4.4.1 Public Safety Risks – Natural Phenomena

The potential risks and level of likely impacts would be negligible, as described for the distributed generation and energy storage components.

8.6.5 Alternative 3: New 115 kV Transmission Lines and Transformers

8.6.5.1 Hazardous Materials

Operation of Alternative 3 is expected to have negligible to minor adverse hazardous material impacts. The 60 miles of new transmission lines (and possible reconstruction of area distribution power lines) would mean more pole-mounted transformers containing small quantities of oil installed in the area than with No Action or Alternative 1, with more potential for accidental spills. However, regulations are in place for facility design and for reporting and cleaning up spills when they occur, and there are relatively small quantities of hazardous materials involved with the lines. The new transformers at substations would be designed to current codes with spill protection measures in place to avoid accidental releases of materials, the same as Alternative 1.

8.6.5.2 Public Safety Risks - Activities Near Pipelines

The potential public safety risks would be the same as described for Alternative 1, including potential proximity to the OPLC pipeline. As with Alternative 1, adverse public safety impacts would not be likely.

8.6.5.3 Public Safety Risks – Natural Phenomena

The potential risks and impacts would be the same as described for Alternative 1.

8.6.5.4 EMF and Corona Ionization

With no health effects known from power-frequency EMF or corona ionization, no adverse impacts related to either of these issues would be expected.

8.7 WHAT MITIGATION MEASURES ARE AVAILABLE FOR POTENTIAL IMPACTS TO ENVIRONMENTAL HEALTH?

8.7.1 Hazardous Materials

For all alternatives, it is anticipated that PSE would comply with regulations intended to control potential hazardous materials-related impacts, applying industry best management practices such as the following:

- Conduct due diligence to identify any preexisting contamination on properties PSE may choose to purchase for the project.
- Conduct any site cleanups that may be required by law.

- Provide contamination-related information in construction contracts and to PSE workers, identifying locations and types of known contamination.
- Require training for agency and contractor staff to identify contamination when encountered unexpectedly during construction work; prepare and implement a health and safety plan that addresses construction work with contaminated soil and water.
- During construction, prepare and implement a Temporary Erosion and Sediment Control Plan to prevent wind and stormwater dispersal of any contaminated soil that may be encountered.
- Prepare and implement Spill Prevention, Control, and Countermeasures Plans to prevent releases of hazardous materials that may be used during project construction, and contain them and clean them up if a spill should occur.
- Design facilities with adequate spill containment where needed.
- Use industry best practices and safety protocols during operation. This would include equipment maintenance procedures to contain spills, and safety procedures and cleanup plans in place in the event of accidental spills.

While regulations are likely adequate to minimize impacts, PSE could also do the following:

- Conduct targeted characterization of soils prior to construction at identified high- and moderate- impact site locations.
- Prior to start of work, develop a remediation plan for sites known to be contaminated and that will be impacted by construction, and determine disposal requirements (including whether significant groundwater dewatering may be necessary).
- Prepare and implement a contaminated-media management plan to address unanticipated contaminated soil, groundwater, and surface water that might be found during construction.
- Design the project where feasible to avoid intercepting known soil and/or groundwater contamination.
- For the alternatives with transformers, if technically feasible, install vegetable-based oil in transformers rather than mineral oil or SF_6.
- Choose XLPE type cable, rather than SCFF or HPFF, to avoid bringing one type of hazardous material into the area where feasible, especially into Lake Washington.
- Select and use landscape and plants that minimize the need for pesticides (generally containing hazardous materials).
- In shared utility corridors, PSE could coordinate use of hazardous materials for corridor (vegetation) maintenance with the operations and uses of hazardous materials by the other utility if this is not already part of operation and maintenance plans or easement agreements.

8.7.2 Public Safety Risks

8.7.2.1 Activities Near Pipelines

For public safety during construction, PSE would follow regulatory requirements to correctly locate and plan for other utility locations such as gas lines or the OPLC pipelines prior to start of construction, including showing pipeline locations on plans and requiring contractors to field locate utilities.

PSE would comply with all applicable local requirements for siting of transmission lines and other electrical facilities.

PSE would site new transmission lines according to industry best practices, which includes proper positioning and design (separation and grounding) relative to other utilities.

PSE would ensure that staff or contractors working near pipelines fully understand the location of those features, have plans in place to avoid and protect those facilities, and have emergency response protocols in place in the event of a disruption of gas or petroleum lines.

Local governments and PSE would further evaluate the PIPA recommendations (discussed in Section 8.2.2.1) to determine if any additional safety practices could be implemented for the Energize Eastside Project.

8.7.2.2 Natural Phenomena

Standard substation facility design according to the NESC incorporates features that abate the risk of fire related to lightning strikes or earthquakes. If needed to meet applicable permit requirements, PSE could investigate the feasibility of alternative design options for transformer foundations, to provide increased seismic stability and further abate risk of fire at substations.

8.7.3 EMF and Corona Ionization

No adverse impacts relative to these issues are expected; therefore no mitigation is proposed.

8.8 ARE THERE ANY CUMULATIVE IMPACTS TO ENVIRONMENTAL HEALTH AND CAN THEY BE MITIGATED?

No cumulative adverse impacts to environmental health are anticipated. The project would not contribute to a cumulative impact with regard to public safety risks since regulations are expected to ensure that facilities are designed to avoid such risks and that appropriate safety measures are conducted in case of such events. Further, local planning policies and development regulations are expected to ensure that new infrastructure is located appropriately to protect public health and safety. As the combined study area increases in developmental density, increased risks to public safety would be expected to occur, however, implementation of the Energize Eastside project would not significantly contribute to those risks.

8.9 ARE THERE ANY SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS TO ENVIRONMENTAL HEALTH?

There would not likely be any significant unavoidable adverse impacts related to environmental health from any of the alternatives if construction and operations adhere to regulations, safety protocols and industry practices. There is a risk of damage and subsequent explosion whenever construction or operations and maintenance occur near buried natural gas lines or the Olympic Pipeline. However, that risk is not considered an unavoidable significant impact because the probability of damage occurring is minimized by conformance with industry standards, regulatory requirements, and construction and operational procedures that address pipeline safety.