PSE on bainbridge island

Transmission Line Routing Community Sounding Board

Information Meeting #2
Electromagnetic Fields & Undergrounding Transmission lines

September 17, 2020

PUGET SOUND ENERGY

We'll begin at 5:00pm—all participants will be muted.
Technical difficulties? Please call or text Darcy Edmunds

Welcome

Community Sounding Board Members

PSE PUGET SOUND ENERGY

Safety Moment

PUGET SOUND ENERGY

Safety Moment: Air Quality

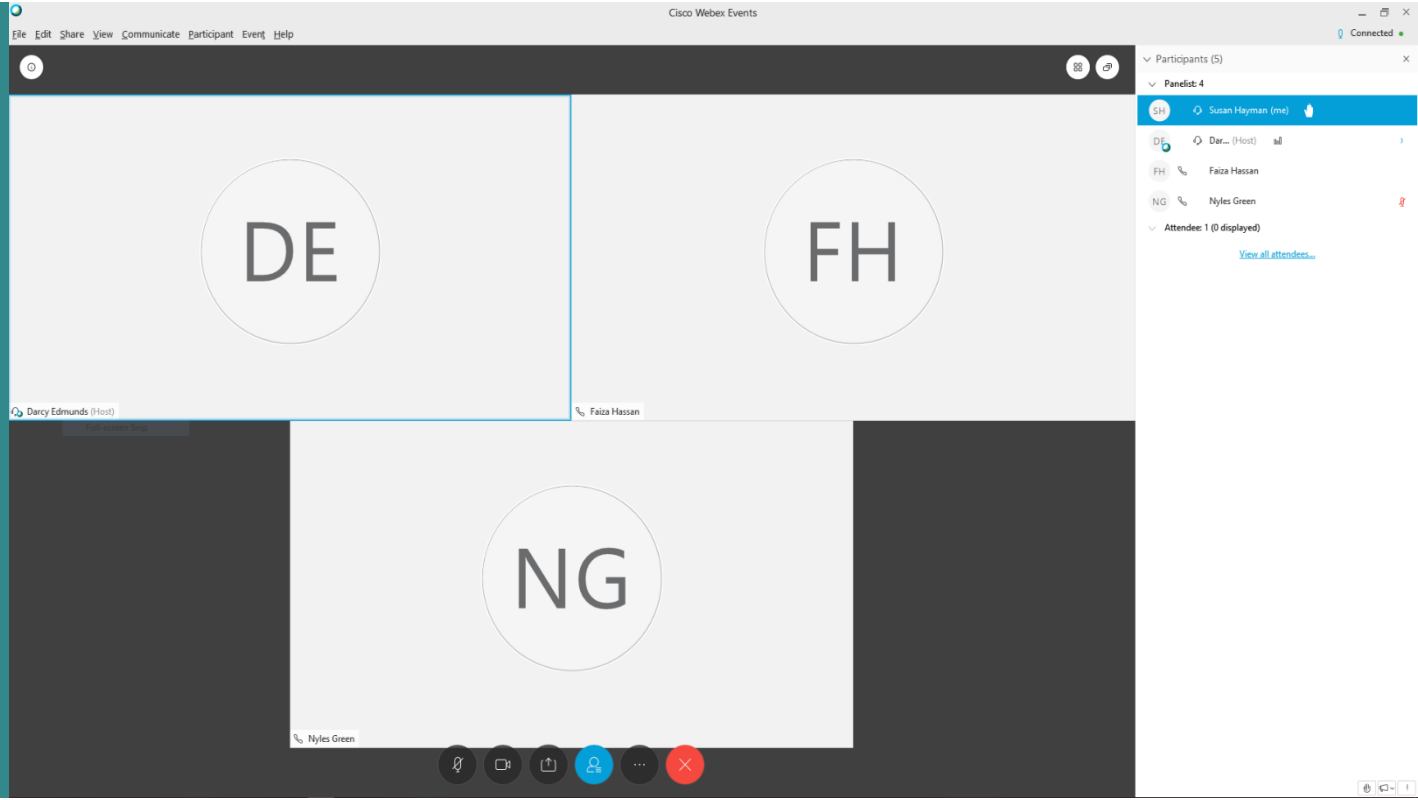
Air Quality Index

Levels of Health Concern	Numerical Value	Meaning
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	100 to 151	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health warnings of emergency conditions. The entire population is more likely to be affected.
Hazardous	301 to 500	Health alert: everyone may experience more serious health effects.

PSE PUGET SOUND ENERGY

Panelist Screen Controls

- *Use the microphone icon to unmute*
- *Use the camera icon to manage your video*
- *Use the person icon to manage other settings.*
- *Slides appear in the main window.*



For today

Darcy Edmunds is our meeting host.

Please text/call Darcy if you have technical difficulties

- Attendees are in listen-only mode.
- A brief public comment opportunity will be available at the end of the meeting.
- CSB members:
  - Listen to and appreciate the diversity of views and opinions.
  - Actively participate in the group.
  - Behave constructively and courteously towards all participants.
  - Respect the role of the facilitator to guide the group process.

Meeting Agenda

Time	Item	Presenter(s)
5:00 p.m.	**Opening** • Welcome and safety moment • Agenda overview • Meeting conduct • Introduction of presenters	**Kierra Phifer**, PSE **Susan Hayman**, Facilitator
5:10 p.m.	**Presentation:** Electromagnetic fields **Q&A, discussion**	**Drew Thatcher**, Consulting Health Physicist
5:50 p.m.	**Break**	
6:00 p.m.	**Presentation:** Undergrounding transmission lines **Q&A, discussion**	**Lowell Rogers, P.E.,** Infrastructure Development Advisor **Andy Swayne**, PSE
6:50 p.m.	**Observer comment**	**Susan Hayman**, Facilitator
6:55 p.m.	**Wrap up, next steps**	**Susan Hayman**, Facilitator
7:00 p.m.	**Adjourn**	

Electromagnetic frequencies

Andrew H. Thatcher
Certified Health Physicist

COMMUNITY SOUNDING BOARD, INFO SESSION #2
MURDEN COVE – WINSLOW "MISSING LINK" TRANSMISSION LINE
SEPTEMBER 2020

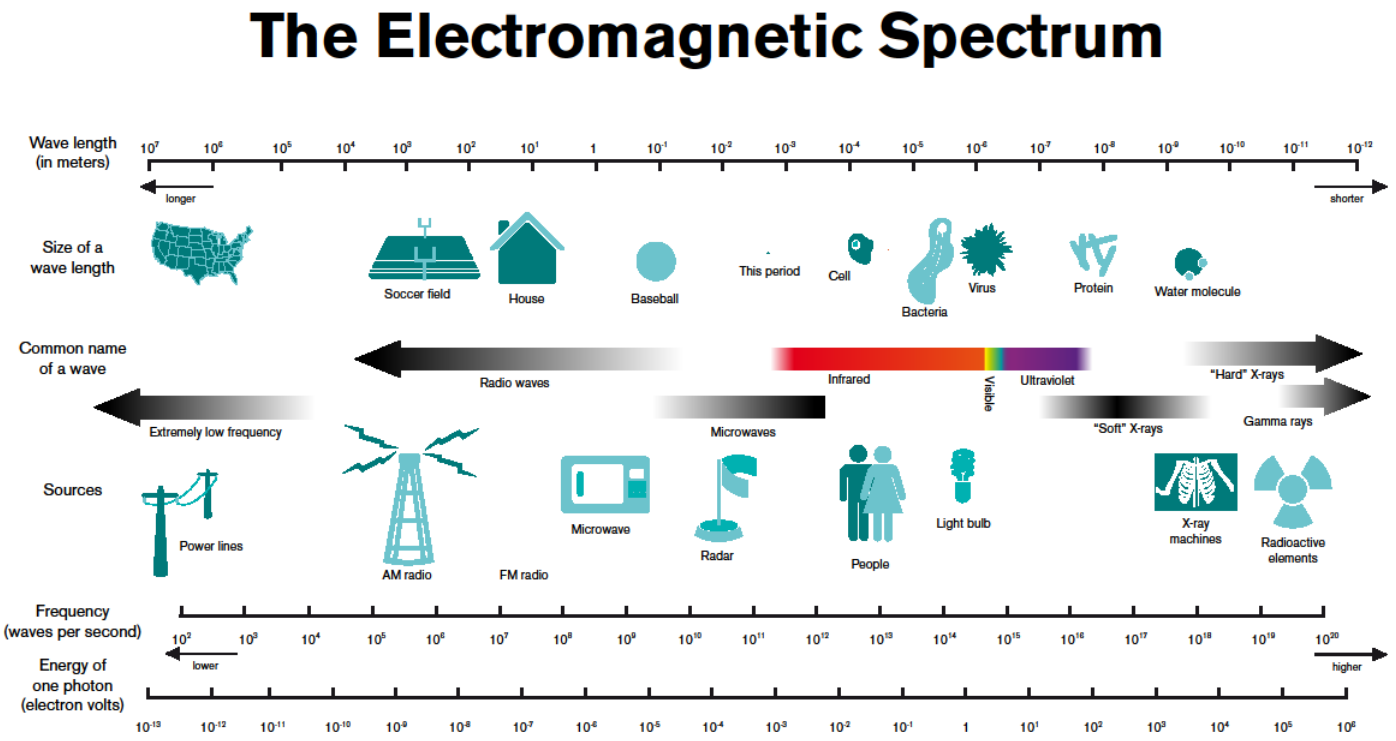
Overview

Establish a basis for understanding of the frequency and the fields

Review the science and studies related to ELF 60 Hz magnetic field exposures and health

Conclusions

What is EMF?


The Electromagnetic Spectrum
Wave length (in meters)
longer
shorter
Size of a wave length
Soccer field
House
Baseball
This period
Cell
Bacteria
Virus
Protein
Water molecule
Common name of a wave
Radio waves
Infrared
Visible
Ultraviolet
"Hard" X-rays
Extremely low frequency
Microwaves
"Soft" X-rays
Gamma rays
Sources
Power lines
AM radio
FM radio
Microwave
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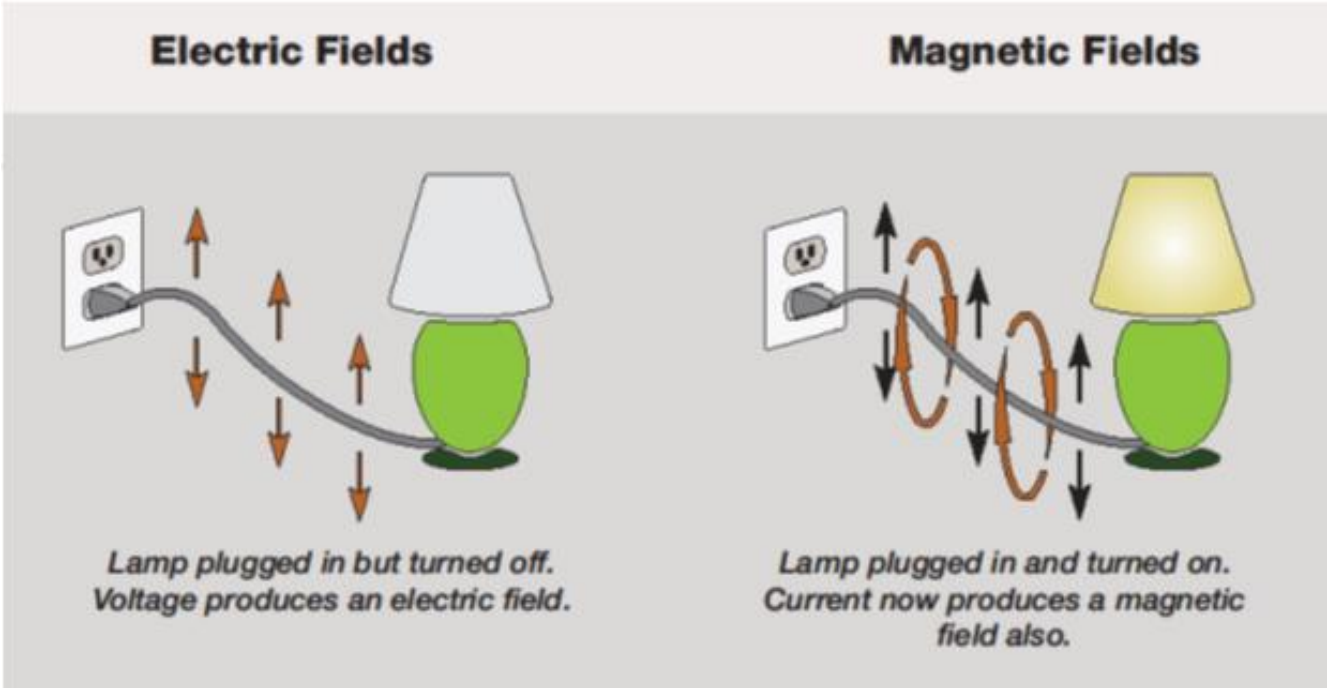
People
Light bulb
X-ray machines
Radioactive elements
Frequency (waves per second)
lower
higher
Energy of one photon (electron volts)

What is EMF?

- EMF refers to two types of fields:
  - Electric fields
  - Magnetic fields

A Comparison of Electric and Magnetic Fields



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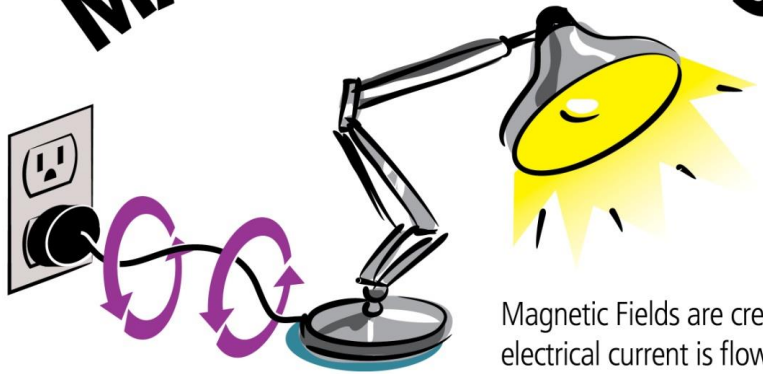

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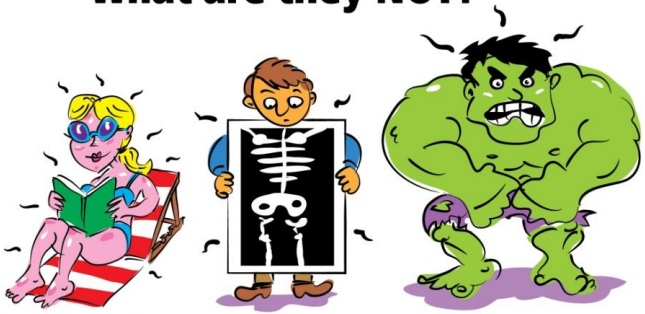
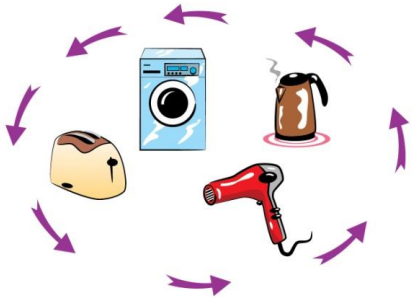


Ultraviolet

X-Rays

Gamma Rays

WHERE are they?



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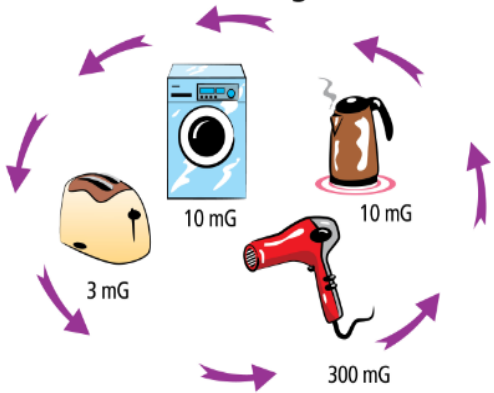
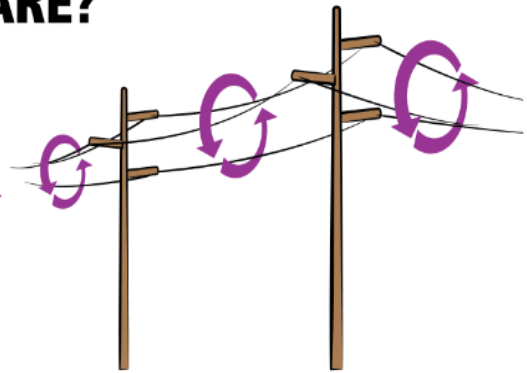


Exposure at 1 ft distance



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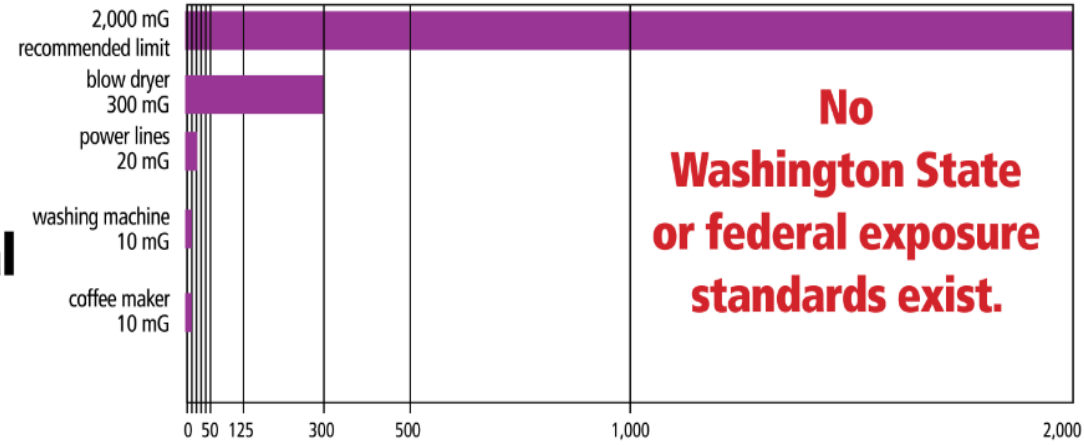

No Washington State or federal exposure standards exist.

Background on EMF Studies

Epidemiology – the study of exposures to humans

Animal and laboratory studies

Is there a plausible biological explanation

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- In total, over 35 epidemiological studies have been performed over the years.

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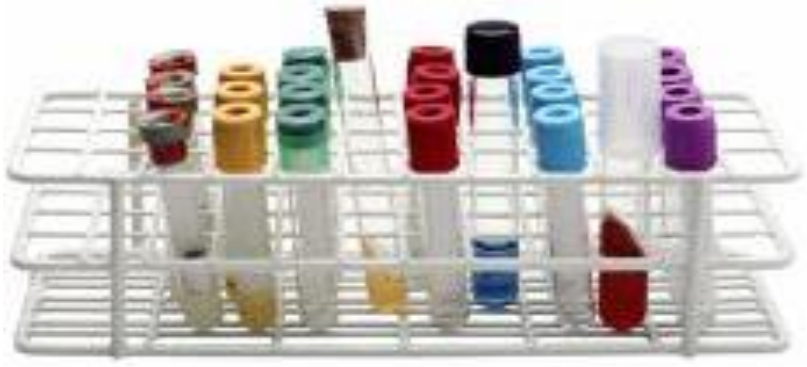
Laboratory Test



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Lab Data and Biological Basis for Effects

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Most studies have used exposures greater than 1,000 mG.

Both cellular and animals have consistently shown a lack of replicated health effects.

Magnetic fields can affect the body through interactions at the cellular level

Minimum magnetic field densities for effects are on the order of the earth's background magnetic field.

How the Evidence Stacks Up for Adverse Health Effects

Weak but somewhat consistent epidemiological data regarding childhood leukemia and magnetic field exposures.

No supporting evidence from animal or cellular studies.

No dose response relationship

No plausible biological mechanism

Arguments Against Carcinogenicity

There has never been a carcinogen known to humans that does not also leave other tell tales signs of an impact.

For example: causes skin cancers but also causes sunburn in short term acute exposures, loss of elasticity, freckles, nevi, fibrous tissue, etc

Electromagnetic Hypersensitivity

What is it, what are the symptoms?

Does exposure to magnetic or electric fields cause this?

- Not according to the WHO – double blind studies showed that symptoms were not correlated with EMF exposures

This does not mean that EHS is not real, it is, but electric or magnetic field exposures are not the cause

What is considered a safe exposure level?

From ICNIRP for the general public, a whole body magnetic field of 2,000 mG to limit an induced current in the body of ~2 mA/m^2

Since magnetic fields penetrate the body without attenuation we would expect similar findings of effects throughout the body and in different species, which we are not.

Conclusions

Over 40 years of research on EMF

$500 million spent on research in the United States alone

About 2,900 studies conducted to date related to cancer

- Very large amount of scientific knowledge

World Health Organization concluded that:

- “The current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields”

The international public exposure limits:

- 2,000 mG - International Commission on Non-Ionizing Radiation Protection
- 9,040 mG - Institute of Electrical and Electronic Engineers

http://www.who.int/peh-emf/about/WhatisEMF/en/index.html

Public Health Summary

EMF is a consequence of using power in our lives

WHO concludes that magnetic fields and health risks are not established nor are they supported by laboratory studies

The public exposure limit is 2,000 mG and exposures are more than 100 times less than the recommended exposure limits

Questions?

PUGET SOUND ENERGY

Overview of Underground Transmission Line Construction

Presented to PSE Community Sounding Board Information Session #2

Lowell Rogers, P.E.

September 17, 2020

OAK STRATEGIC, INC

Transmission

Transmission lines form the backbone of the electrical system. The vast majority of this transmission system is made up of lines that are overhead. With proper vegetation clearances and maintenance, these lines are very reliable.

In some areas where overhead lines are not feasible due to insufficient right of way space, height limitations, or visual concerns, it may be preferred to construct the transmission lines underground rather than routing the line around the area of concern.

OAK STRATEGIC, INC

Differences Between Transmission and Distribution

In PSE's service area, distribution circuits are 34.5kV and lower whereas transmission circuits are 115kV and above.

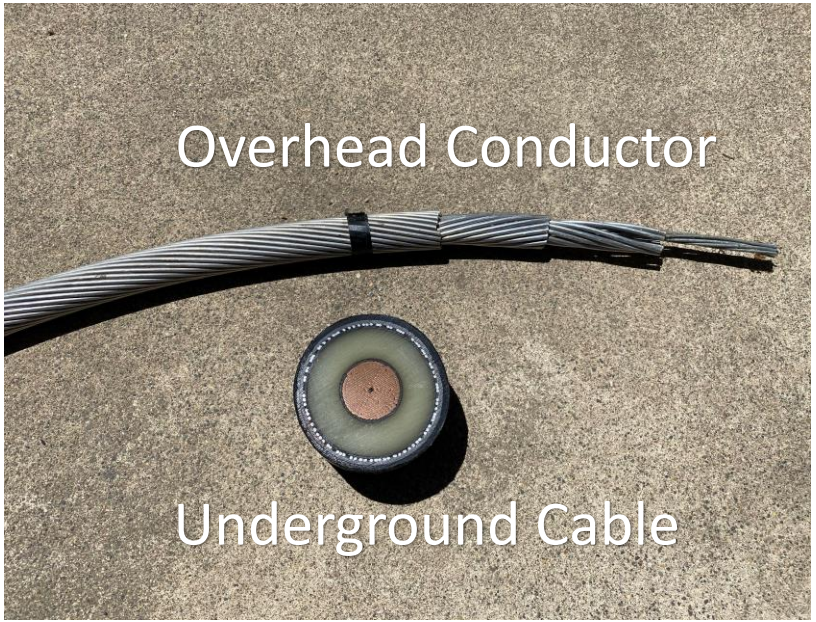
12kV Distribution Line

115kV Transmission Line

Materials

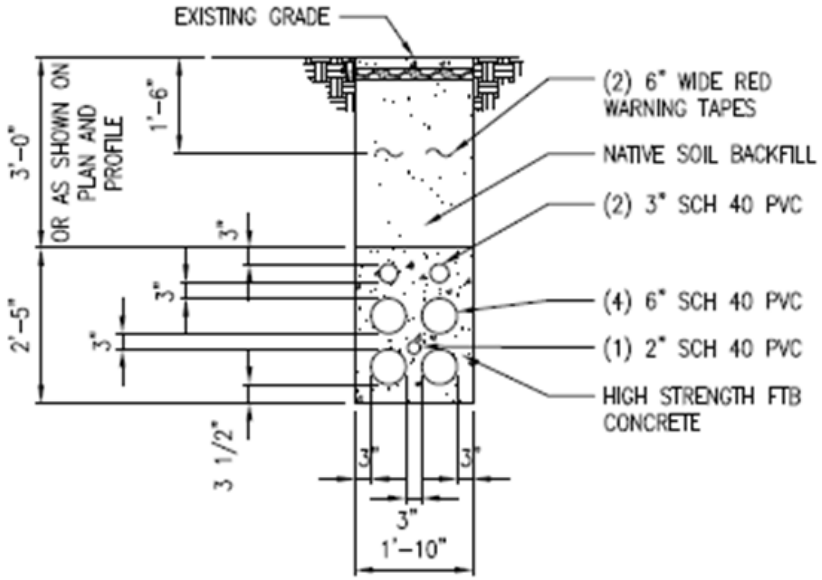
Overhead conductor relies on the surrounding air to provide electrical insulation and cooling.

Underground cable is insulated internally and the heat that is generated is dissipated by the surrounding earth.



OAK STRATEGIC, INC

Duct Bank Configuration



Typical 115kV duct bank cross section.

Underground Transmission Construction Techniques

Cable Duct Bank Excavation

Cable Duct Bank

Underground Transmission Construction Techniques

Cable splice vault

About 8 ft wide by 20 ft long by 9 ft tall

Spaced every 1,500-2,000 ft along the route.

Underground Transmission Construction Techniques

Cable Installation Approximately 2,000 ft cable lengths)

Cable Splicing within vault

Underground Transmission Construction Techniques

Underground to overhead transition structures.

Technical Feasibility

There are situations where an underground transmission line isn't feasible.

- The required capacity of the line cannot be provided by underground cables.
- The length of the line is too great for conventional underground equipment.

Project Specific Feasibility

Where the length and capacity requirements are feasible using underground configurations, there are additional factors to consider:

- Do construction impacts cause unmitigable impacts?
- Are there local regulations the prevent overhead construction?
- Is the cost of underground prohibitive?
- Does the location of the line allow access for repair when damaged?
- Can the service area tolerate a lengthy outage if the line is damaged?

Routing

The route of an underground transmission line can be limited by the following:

- Steep slopes
- Ravines
- Geology (e.g. rock)
- Wetlands, bodies of water
- Environmentally sensitive or protected habitat
- Available space for the duct bank and splice vaults, particularly in areas with other underground utilities.

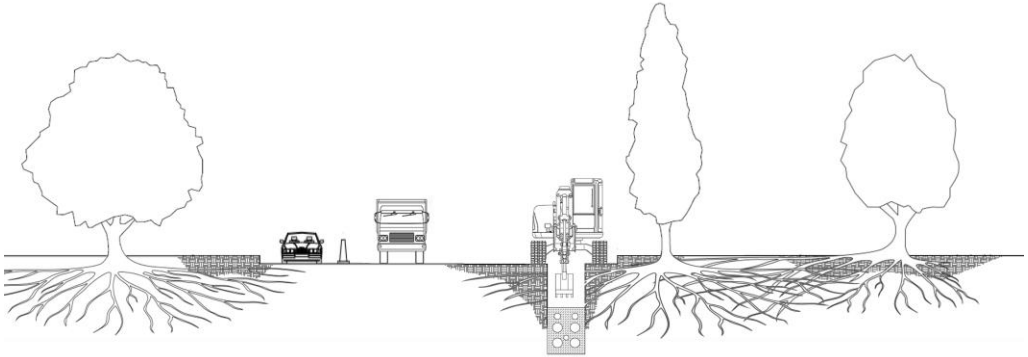
These factors will significantly increase the cost of underground transmission lines if they cannot be avoided.

Environmental Impacts

Underground lines require a cleared right-of-way for the entire length in order to trench excavation and line installation.

As compared to overhead lines, which have the ability to span areas of concern, underground transmission line construction has more direct impact to the environment.

Environmental Impacts



Underground lines require a cleared right-of-way for the entire length in order to trench excavation and line installation. This can significantly impact environmentally sensitive areas such as wetlands and sensitive habitats.

This clearing will require vegetation removal, grading, and contouring of the ground.

Ongoing Right-of-Way Maintenance

Once constructed, the right of way will need to remain clear of vegetation (e.g., trees and shrubs) that have root systems that could damage the duct bank.

Cost Range of Underground Transmission

Underground construction is much more expensive than overhead construction; generally 2.5-7 times for a 115kV single circuit transmission line.

- Example: For a similar overhead line that is estimated to be $2.5million per mile for construction, that line may cost $5-$17million per mile in an underground configuration.

Cost Range of Underground Transmission (continued)

The range reflects the large number of variables that an underground project faces; such as:

- Type of soils to be excavated
- Number of existing underground facilities that need to be protected/avoided.
- Access constraints
- Road closure requirements
- Stream, freeway, or other crossings
- Permitting cost
- Right of way costs

Together these variable can significantly influence costs. In order to determine specific costs for an underground project; the route needs to be identified and a preliminary design completed.

Questions

Any questions?

Thank you for your interest.

Observer Comment

Next steps

- CSB Meeting #4: Route Segments, October 12, 5-7:30 p.m.

  Remember: Resource materials for the CSB and overall project are available on PSE's website

Adjourn

PUGET SOUND ENERGY

Thank you!

Electromagnetic frequencies

Andrew H. Thatcher
Certified Health Physicist

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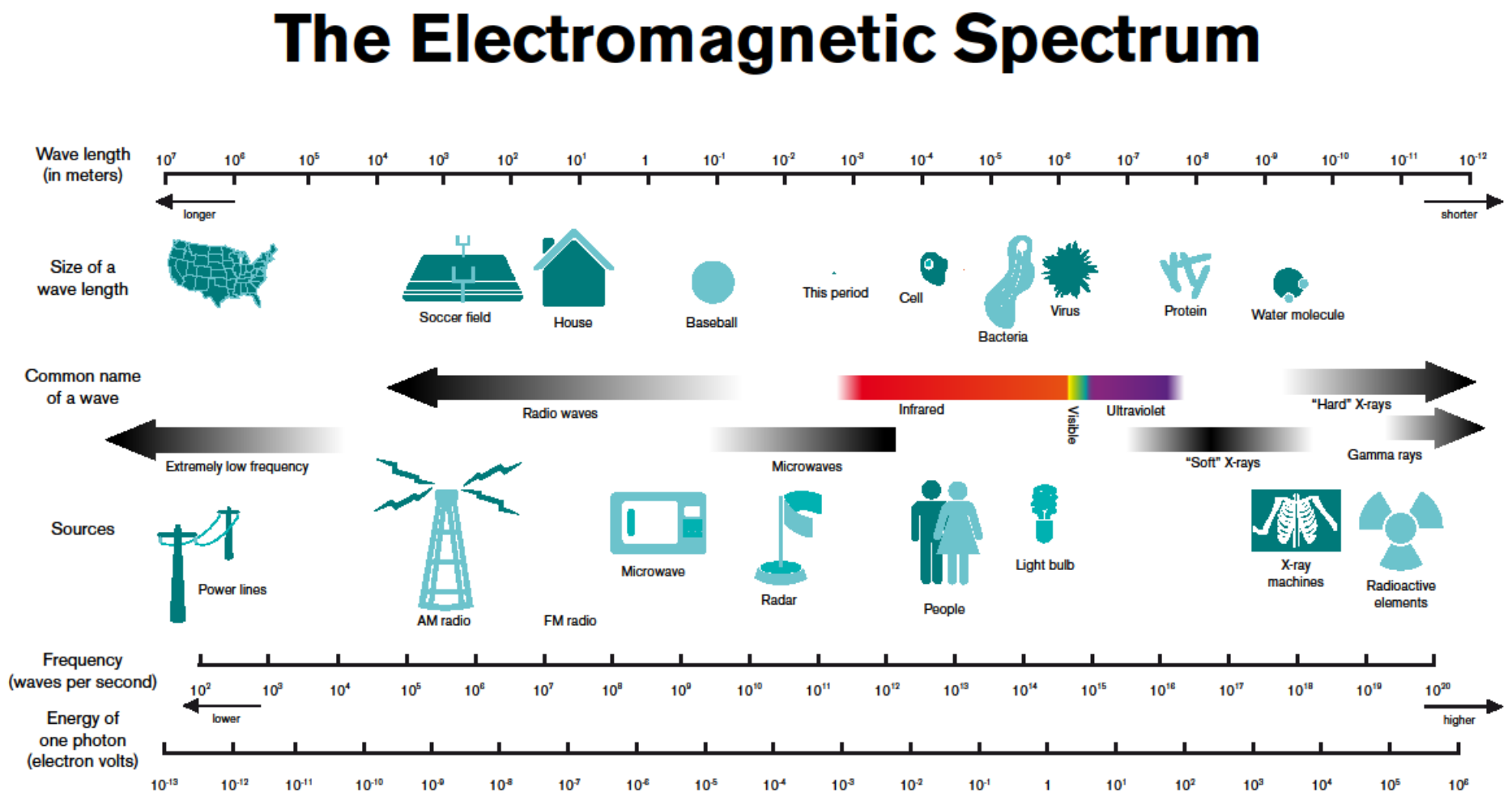
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Water molecule
Common name of a wave
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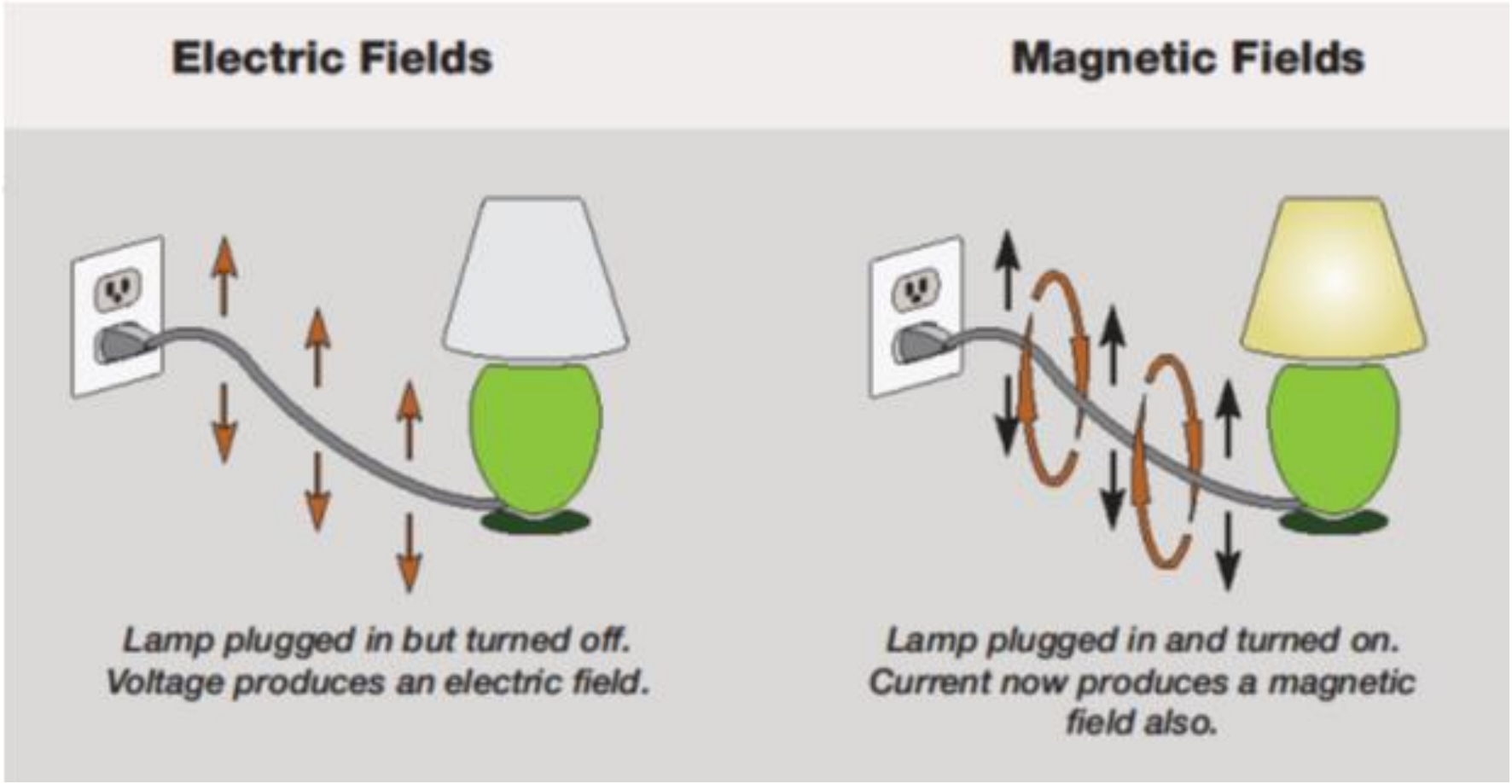
  - Magnetic fields

A Comparison of Electric and Magnetic Fields



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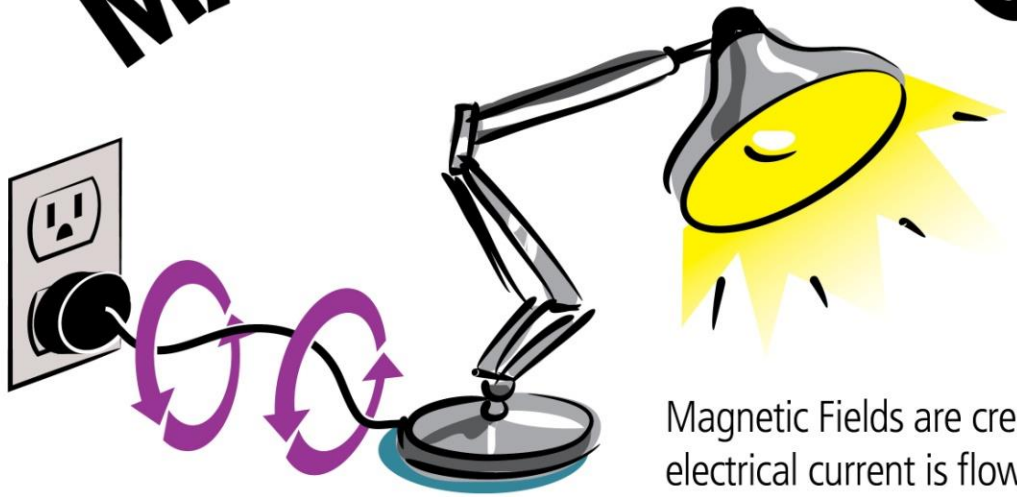

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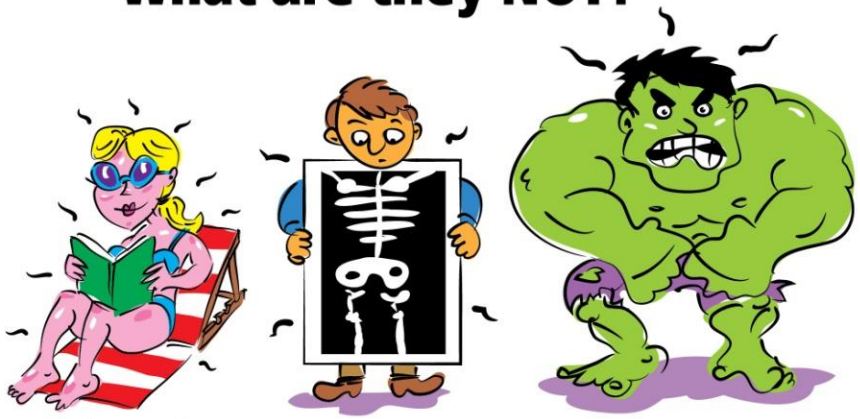
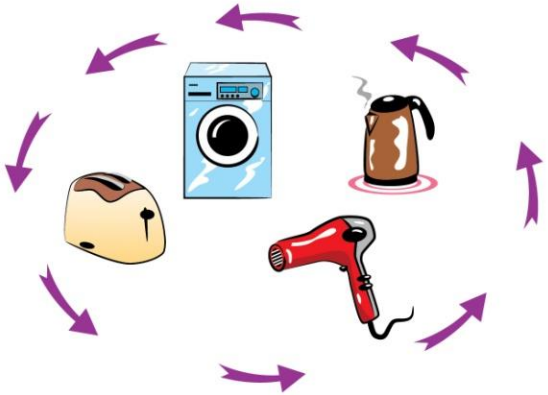


Ultraviolet X-Rays Gamma Rays

WHERE are they?



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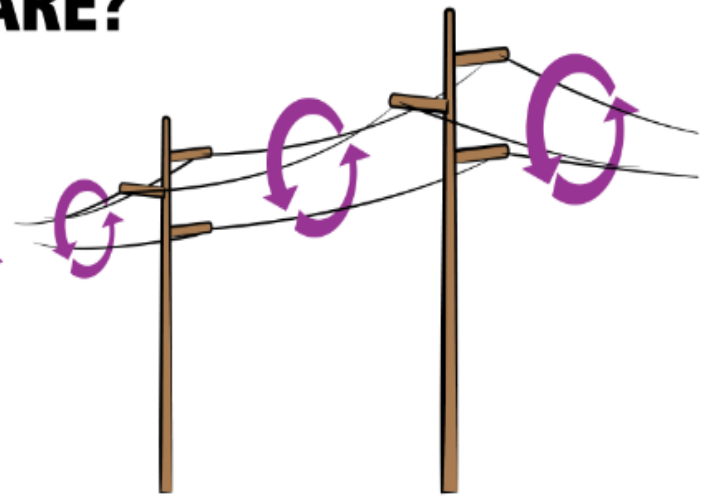
mG = milliGauss

Exposure at 1 ft distance



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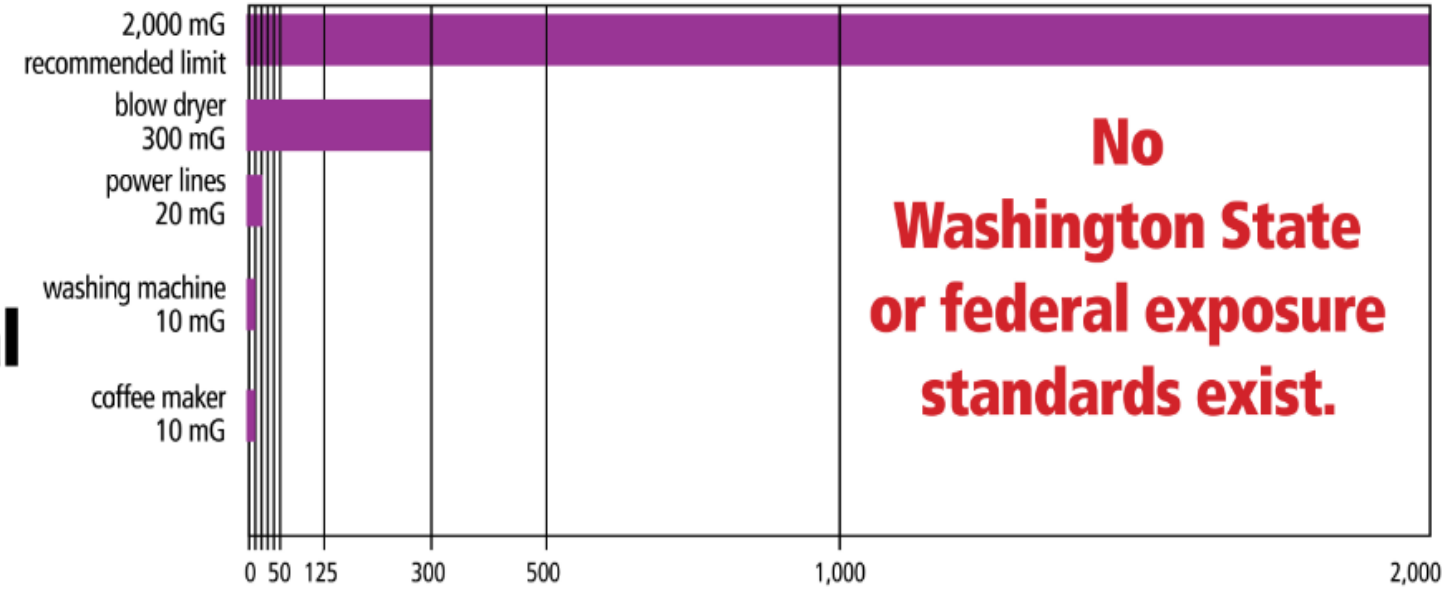

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From ICNIRP for the general public, a whole body magnetic field of 2,000 mG to limit an induced current in the body of ~2 mA/m^2

Since magnetic fields penetrate the body without attenuation we would expect similar findings of effects throughout the body and in different species, which we are not.

Conclusions

Over 40 years of research on EMF

$500 million spent on research in the United States alone

About 2,900 studies conducted to date related to cancer

- Very large amount of scientific knowledge

World Health Organization concluded that:

- “The current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields”

The international public exposure limits:

- 2,000 mG - International Commission on Non-Ionizing Radiation Protection
- 9,040 mG - Institute of Electrical and Electronic Engineers

http://www.who.int/peh-emf/about/WhatisEMF/en/index.html

Public Health Summary

EMF is a consequence of using power in our lives

WHO concludes that magnetic fields and health risks are not established nor are they supported by laboratory studies

The public exposure limit is 2,000 mG and exposures are more than 100 times less than the recommended exposure limits

Overview of Underground Transmission Line Construction

Presented to PSE Community Sounding Board Information Session #2

Lowell Rogers, P.E.

September 17, 2020

OAK STRATEGIC, INC

Transmission

Transmission lines form the backbone of the electrical system. The vast majority of this transmission system is made up of lines that are overhead. With proper vegetation clearances and maintenance, these lines are very reliable.

In some areas where overhead lines are not feasible due to insufficient right of way space, height limitations, or visual concerns, it may be preferred to construct the transmission lines underground rather than routing the line around the area of concern.

OAK STRATEGIC, INC

Differences Between Transmission and Distribution

In PSE's service area, distribution circuits are 34.5kV and lower whereas transmission circuits are 115kV and above.

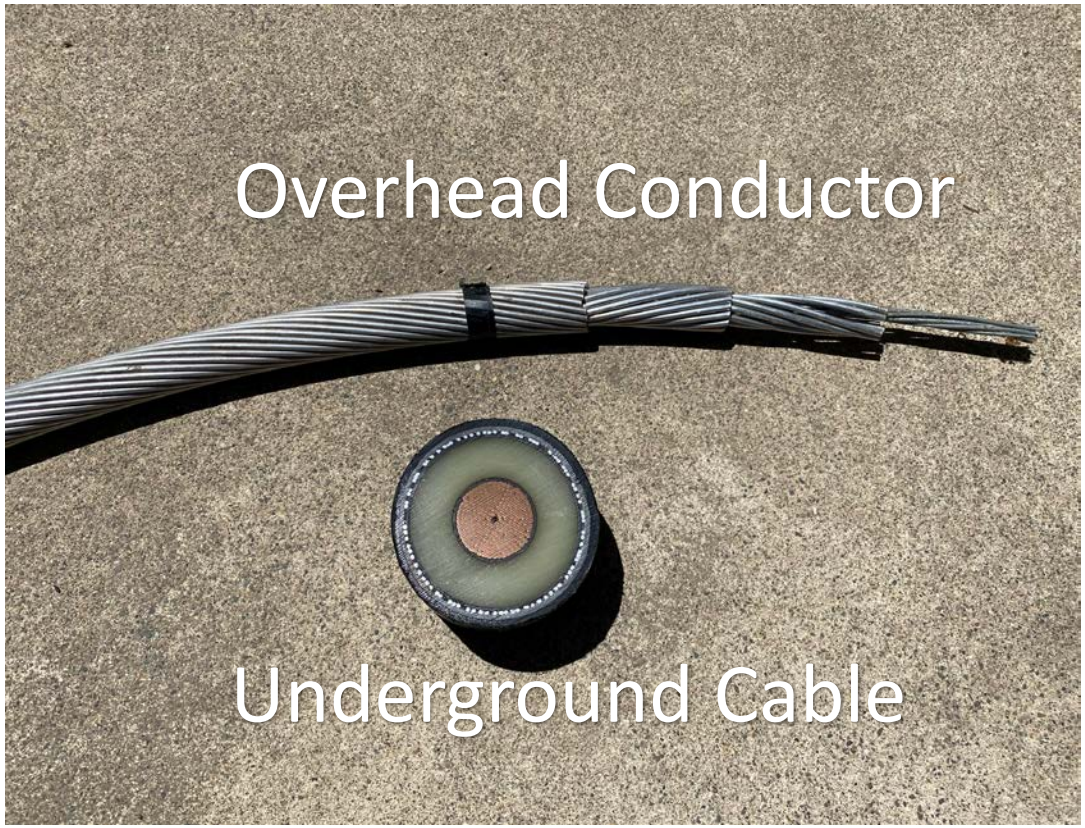
12kV Distribution Line

115kV Transmission Line

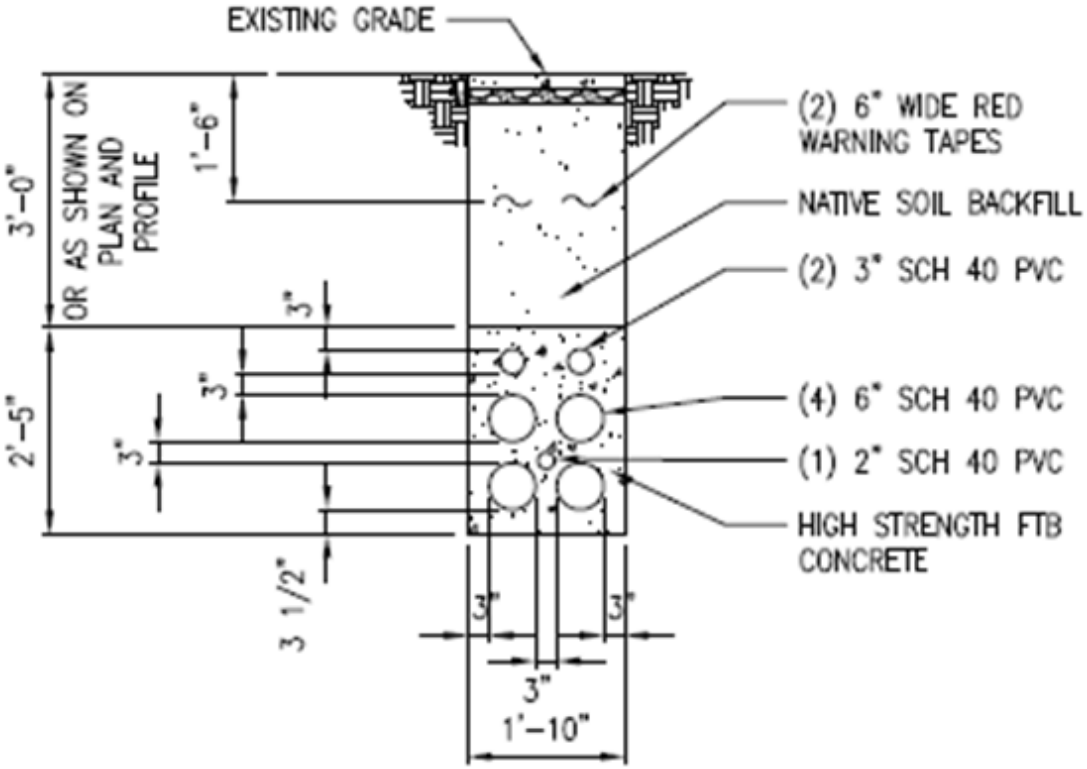
Materials

Overhead conductor relies on the surrounding air to provide electrical insulation and cooling.

Underground cable is insulated internally and the heat that is generated is dissipated by the surrounding earth.



Duct Bank Configuration



Typical 115kV duct bank cross section.

Underground Transmission Construction Techniques

Cable Duct Bank Excavation

Cable Duct Bank

Underground Transmission Construction Techniques

Cable splice vault

About 8 ft wide by 20 ft long by 9 ft tall

Spaced every 1,500-2,000 ft along the route.

Underground Transmission Construction Techniques

Cable Installation
Approximately 2,000 ft cable lengths)

Cable Splicing within vault

OAK STRATEGIC, INC

Underground Transmission Construction Techniques

Underground to overhead transition structures.

Technical Feasibility

There are situations where an underground transmission line isn't feasible.

- The required capacity of the line cannot be provided by underground cables.
- The length of the line is too great for conventional underground equipment.

Project Specific Feasibility

Where the length and capacity requirements are feasible using underground configurations, there are additional factors to consider:

- Do construction impacts cause unmitigable impacts?
- Are there local regulations the prevent overhead construction?
- Is the cost of underground prohibitive?
- Does the location of the line allow access for repair when damaged?
- Can the service area tolerate a lengthy outage if the line is damaged?

Routing

The route of an underground transmission line can be limited by the following:

- Steep slopes
- Ravines
- Geology (e.g. rock)
- Wetlands, bodies of water
- Environmentally sensitive or protected habitat
- Available space for the duct bank and splice vaults, particularly in areas with other underground utilities.

These factors will significantly increase the cost of underground transmission lines if they cannot be avoided.

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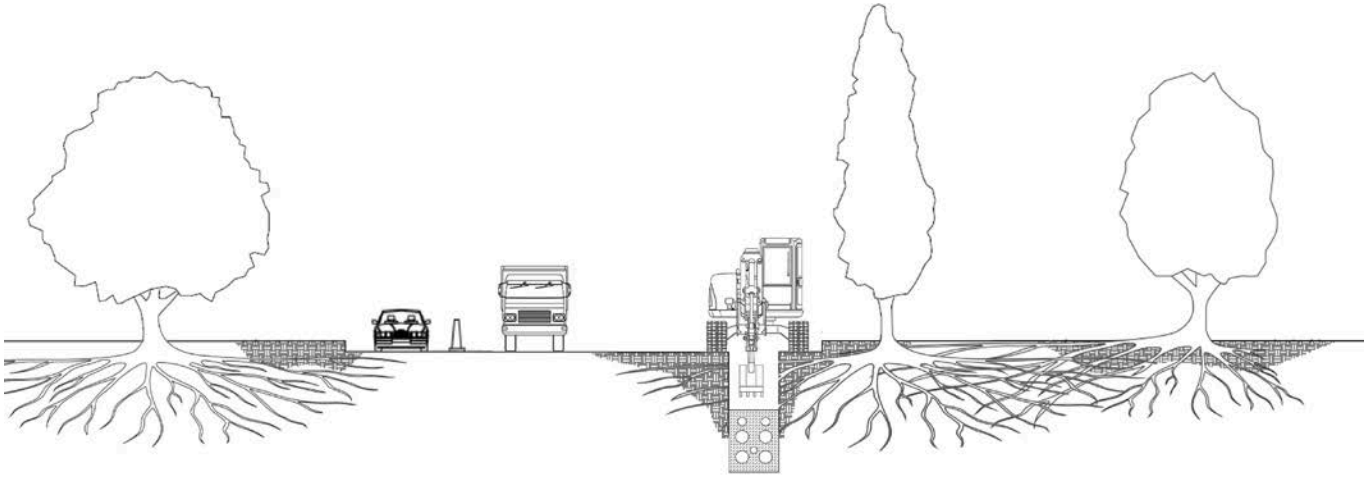
Environmental Impacts

Underground lines require a cleared right-of-way for the entire length in order to trench excavation and line installation.

As compared to overhead lines, which have the ability to span areas of concern, underground transmission line construction has more direct impact to the environment.

Environmental Impacts



Underground lines require a cleared right-of-way for the entire length in order to trench excavation and line installation. This can significantly impact environmentally sensitive areas such as wetlands and sensitive habitats.

This clearing will require vegetation removal, grading, and contouring of the ground.

OAK STRATEGIC, INC

Ongoing Right-of-Way Maintenance

Once constructed, the right of way will need to remain clear of vegetation (e.g., trees and shrubs) that have root systems that could damage the duct bank.

Cost Range of Underground Transmission

Underground construction is much more expensive than overhead construction; generally 2.5-7 times for a 115kV single circuit transmission line.

- Example: For a similar overhead line that is estimated to be $2.5million per mile for construction, that line may cost $5-$17million per mile in an underground configuration.

Cost Range of Underground Transmission (continued)

The range reflects the large number of variables that an underground project faces; such as:

- Type of soils to be excavated
- Number of existing underground facilities that need to be protected/avoided.
- Access constraints
- Road closure requirements
- Stream, freeway, or other crossings
- Permitting cost
- Right of way costs

Together these variable can significantly influence costs. In order to determine specific costs for an underground project; the route needs to be identified and a preliminary design completed.

Questions

Any questions?

Thank you for your interest.

Transmission Line Routing Community Sounding Board

Information Session 2 Summary

September 17, 2020

Overview

Puget Sound Energy (PSE) hosted an online information session for Community Sounding Board (CSB) members on September 17, 2020. The meeting's purpose was for CSB members to gain additional information about electromagnetic fields and undergrounding transmission lines.

The meeting was held online via Webex due to PSE and public health requirements restricting in-person gatherings at this time. Attachment 1 contains the list of meeting participants.

Opening remarks

Kierra Phifer (PSE) welcomed the group, shared a safety moment, and provided a brief recap of past CSB meetings and information session 1. The group welcomed Tom Curly who will be Mark Fisher's replacement as the Suquamish Tribe representative. Kierra also gave a notice to the CSB about planned Winslow Tap pole replacements starting as early as September 22.

Electromagnetic fields overview

Drew Thatcher (Consulting Health Physicist) gave an overview on electromagnetic fields or EMF. EMF is a combination of electric and magnetic fields generated by electrical currents. Numerous case studies conducted by scientists have determined that EMF is not likely to cause childhood leukemia or cancer. Based on a large body of scientific research, the World Health Organization (WHO) concluded that "the current evidence does not confirm existence of any health consequences from exposure to low level electromagnetic fields".

Drew answered questions from CSB members throughout the presentation. Drew's responses and key discussion points are noted below:

- **Have you found studies comparing EMF related to cell phone usage with EMF related to transmission lines?**
  Drew shared that while the magnetic and electric fields that arise from transmission lines and the radiofrequency energy from cell phones are both non- ionizing, they are fundamentally different frequencies and are not related to each other.

- **Is it possible we don't yet have the science to understand why people self-identify as sensitive to EMF and experience effects?**
  Drew explained that there is always a possibility that science or methodologies have not yet developed metrics to understand this data. However, numerous double blind studies have been conducted and conferences have been dedicated to resolving this issue. The bottom line is that the symptoms that people who self- identify as sensitive to EMF experience are not correlated with EMF exposure.

- **Do you have any idea what the EMF level/output might be that could create a sensation for some people, include seeing bright lights?**
  Drew said there is currently no scientific evidence that correlates EMF to these kinds of effects when near transmission lines.

- **As a city representative, how do I respond to a citizen who has concerns about EMF?** Drew offered that referring citizens to the expert reviews produced by the WHO and other international organizations would help them feel safer about EMF; PSE can provide these references. Most people have not heard about the multiple studies that provide evidence of EMF not causing adverse effects on people. The best way to respond is to pass along the expert reviews that have scientific backing.

A question was asked about any literature on power lines and property values. The question was not related to EMF and was tabled.

Undergrounding transmission lines

Lowell Rogers (Oak Strategic, Inc.) gave an overview on underground transmission lines. The presentation gave a synopsis of comparing overhead transmission lines and underground transmission lines, including materials, cost, structures, needed right-of-way for installation and maintenance, and limitations (i.e. environmental impacts, routing criteria, etc.). While underground lines can provide higher reliability (fewer service outages) compared to overhead transmission lines, the significant difference in cost and the limitations related to routing and right-of-way maintenance result in utility companies and jurisdictions needing to carefully consider these implications before determining that undergrounding transmission lines is feasible.

Lowell and PSE answered questions from CSB members throughout the presentation. Responses and key discussion points are noted below:

- **Is wildfire risk a consideration for underground routes?**
  Lowell explained that underground transmission lines are very unlikely to cause wildfires. Many wildfires caused by transmission lines can be traced back to dry vegetation touching the power line or the overhead components of the line failing. To mitigate the risk of wildfires caused by transmission lines, it is important to implement vegetation management practices to create adequate space between transmission lines and vegetation.

- **If an underground cable is damaged for whatever reason, what is the repair time?**
  Lowell shared that the repair time for underground cable(s) will vary depending on the location and damage to the cable(s). Because the underground cable is not visible, finding the damage to the line can be much more difficult and require much more time compared to identifying damage to an overhead transmission line.

- **Would we prevent most of our transmission line outages by building underground lines?**
  Lowell noted that while it's true that outages due to trees are reduced when lines are underground, underground transmission lines can experience damage and outages from dig-ins, geological conditions, or material failure. He explained that overhead lines are very reliable when properly maintained--residents and businesses need to understand that many tree-related outages result from an inability to maintain adequate vegetation management. There's always going to be tension around trimming trees when residents are thinking of the beneficial uses provided by trees, like shade and aesthetic characteristics, while utility companies approach tree trimming from safety and reliability standpoints. PSE, the City, and community liaisons could help get this message out on vegetation management and how this management improves transmission reliability and safety.

- **Do you have cost estimates for the maintenance of an underground line versus an overhead line? Does the initial higher cost of installing a line underground pay off financially over time?**
  Lowell anticipated PSE may be able to provide general estimates comparing the overhead routes and underground routes over the life span of the "missing link" transmission line. PSE will follow up with CSB members.

- **The underground splice vaults look enormous. Are there smaller options?**
  Lowell noted the splice vaults are approximately 8 feet wide by 20 feet long by 9 feet high. They are sited at certain points along the underground route segment as determined by the length of cable section that can be installed, space available and compliance with safety requirements.

- **Is PSE looking at or investing in newer fusion splicing technologies to increase efficiencies, or to increase the length of the line so there are fewer vaults?**
  Lowell explained that the splice vaults presented utilize a proven cable splice technology that has proven to be reliable over a long service life. Lowell also shared that for any project, PSE prefers to use equipment and technologies that have gone through rigorous testing prior to installation and implementation. The distance between splice vaults may vary due to the weight and length of the underground cable spool during construction and specific engineering requirements.

- **Will you replace existing substation equipment as part of this project?**
  PSE explained when the "missing link" transmission line is built, PSE will replace substation-transmission line connection equipment as needed. New equipment will be installed that will handle the energy load distribution if power needs to be rerouted through a substation.

- **Is PSE willing to work with the community to install an underground route segment if it's something the community wants?**
  PSE is willing to work with the community to consider use of underground construction in the project if the community expresses interest in doing so consistent with rules (tariff) on file with its state regulator. PSE would look to the community, specifically the City of Bainbridge Island, to pay the additional costs driven by underground design and construction above those for design and construction of PSE's proposed overhead transmission solution.

Public Comment

While there was one member of the public in attendance for most of the meeting, none were in attendance during the public comment portion of the meeting.

Next steps: upcoming meetings

CSB Meeting 4: October 12, 2020, 5-7:30 p.m.

Closing remarks

Susan and Kierra thanked CSB members for participating. The meeting concluded just after 7:30 p.m.

Attachment 1: Meeting Participants

Community Sounding Board

Individual Interests

Bill Lemon
Carl Siegrist
Elizabeth Doll
Erik Fong
Keith Bass
Ted Jones
Winifred Perkins

Organizational Interests

Glen Tyrrell, Bainbridge Island School District
Hank Teran, Bainbridge Island Fire Department
Jerri Lane, Bainbridge Island Downtown Association
Maradel Gale, Sustainable Bainbridge
Maria Metzler, Helpline House
Mark Epstein, City of Bainbridge Island
Perry Barrett, Bainbridge Island Metro Parks & Recreation District
Stephen Hellriegel, Net253 LLC
Tom Curly, Suquamish Tribe
Walt Hannon, Walt's Market

Subject matter experts

Drew Thatcher
Lowell Rogers

PSE Staff

Andy Swayne, PSE CSB Technical Liaison
Barry Lombard, PSE Project Manager
Kierra Phifer, PSE Local Government Affairs and Community Outreach

EnviroIssues Staff

Darcy Edmunds, EnviroIssues, Webex host and technical support
Nyles Green, EnviroIssues, Notetaker
Susan Hayman, EnviroIssues, Facilitator

Observers

David Cohen (public)
Diann Strom, PSE
Gretchen Aliabadi, PSE
Kerry Kriner, PSE
Kirk Moughamer, HDR
Renee Zimmerman, PSE
Richard Perlot, PSE
Shelby Naten, PSE