

Electric & Magnetic Fields

EMF Exposure Guidelines

- Potential EMF effects on health studied for decades
- Substantial agreement among scientific experts there are no confirmed adverse health effects from power system EMF exposure
- Some studies indicate possible health risk and targeted research is continuing to address uncertainty
- EMF can interfere with some implanted medical devices
- Guideline limits on exposure have been developed based on biological effects from very high fields, such as occur in some occupations
- All guideline limits are much greater than EMF surrounding the proposed substation and transmission

Table 0-1 Summary of the International Commission on Non-Ionizing Radiation Protection Exposure Guidelines

Exposure (60 Hz)	Magnetic Field Maximums
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 0-2 Summary of American Council of Governmental Industrial Hygienists Exposure Guidelines

Exposure (60 Hz)	Magnetic Field Threshold Limit Values
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 0-3 Institute of Electrical and Electronics Engineers Exposure Levels for 60 Hz Magnetic Fields

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

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

Table 0-4 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)

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)



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WHAT WAS MEASURED AND WHERE



Legend

- Long-Term Stationary Locations
- Sidewalk Measurement Locations
- Substation Site
- Potential Vacation
- Study Area

Long-Term Stationary Locations

1. Mirabella Retirement Community
2. The Brewster Apartments
3. Seattle Cancer Care Alliance (SCCA) House
4. Alley 24 Office (233 Yale Building)
5. David Colwell Building

An **Electric Power Research Institute** study of 992 homes in the U.S. found that the average residential magnetic field value was 0.9 mG. City Light was one of 25 electric utilities that participated in this nationwide residential measurement program.

Table 1 Summary of Measured Magnetic Field Levels at Neighborhood Sidewalk Locations and Stationary Neighborhood Locations

Facility Description	Sidewalk Measurements		Stationary Measurements	
	Location	Range of Measured Magnetic Field (mG) ¹	Location	Range of Measured Magnetic Field (mG)
Mirabella Seattle Retirement Community	John Street	0.8 – 14.6	#1	0.5 – 3.0
	Minor Avenue North	0.1 – 1.4		
	Denny Way	0.2 – 1.2		
The Brewster apartments	Pontius Avenue North	1.3 – 4.1	#2	1.5 – 5.6
	John Street	0.5 – 4.0		
	Minor Avenue North	0.3 – 1.4		
Seattle Cancer Care Alliance (SCCA) House	John Street	0.2 – 5.7	#3	1.6 – 5.5
Alley 24 Office (233 Yale Building)	John Street	0.3 – 3.8	#4	1.6 – 3.9
David Colwell building	Alley	0.2 – 11.3	#5	3.1 – 11.3
	Denny Way	0.2 – 2.6		
	Stewart Street	0.2 – 0.6		
	Yale Avenue	0.1 – 3.5		
Parking lots	John Street	0.5 – 7.1	N/A	
Parking lots/retail	Denny Way	0.2 – 2.6		

¹ Includes both morning and evening measurements.

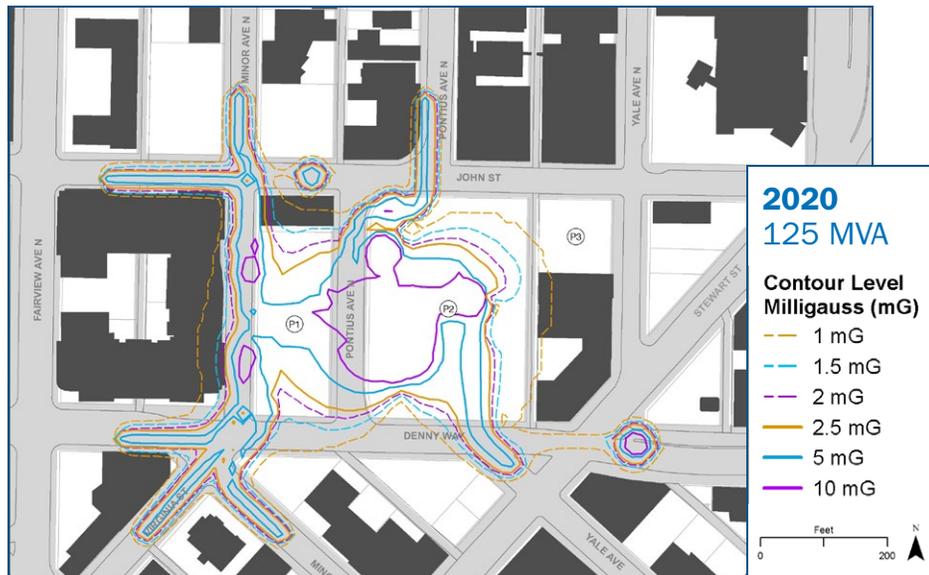


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CALCULATED MAGNETIC FIELDS FOR SUBSTATION SITE

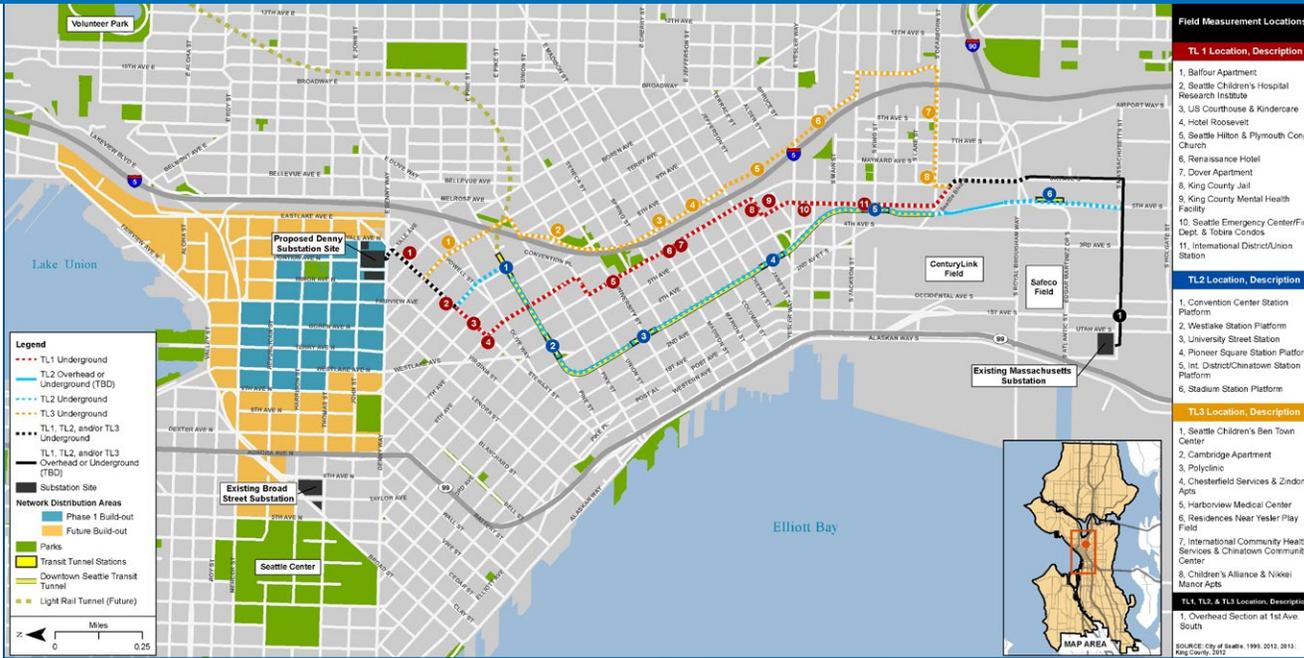


- EMF calculations represent **maximum system operating conditions** which is an infrequent/temporary condition. Typical levels would be lower.
- Typical background in an American home: **0.5 mG – 4 mG** (US EPA)
- National survey of background in 992 residences: **<1mG – 12+ mG** (EPRI/Enertech)
- National survey of 24-hour average personal exposure for 1,012 people: **<1mG – 25+ mG** (NIEHS/Enertech)
- About 25% of the U.S. population spend more than one hour daily in magnetic fields **> 4 mG** (NIEHS)
- All calculated values significantly less than exposure standards and guidelines



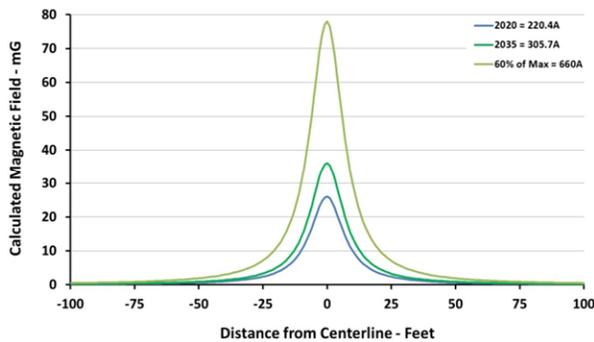
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TRANSMISSION LINE MODELING RESULTS

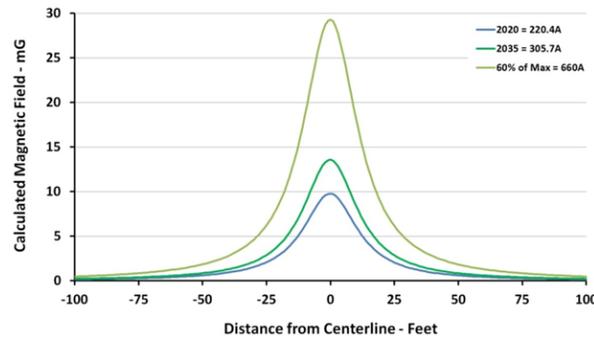


UNDERGROUND

Calculated Magnetic Field Profile for Transmission Line at Depth of 3 feet

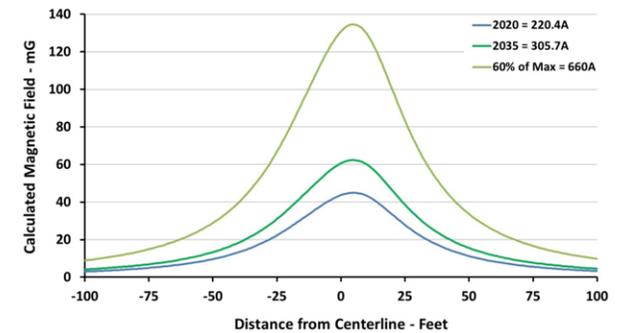


Calculated Magnetic Field Profile for Transmission Line at Depth of 8 feet



OVERHEAD

Calculated Magnetic Field Profile for Overhead Transmission Line Design



NOTE: GRAPHS ABOVE ARE AT DIFFERENT SCALES



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KEY FINDINGS



- The potential for electric and magnetic field (EMF) health effects has been studied extensively for decades. There is substantial agreement among experts that there are no confirmed adverse health impacts from 60 hertz (Hz) EMF exposure.
- Scientific evidence remains inconclusive on risk of childhood leukemia in homes with stronger magnetic fields and research on this topic continues.
- 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 Denny Substation Project will increase EMF within localized areas surrounding the project electrical facilities. These fields will fall significantly below limits in EMF exposure guidelines and standards.
- No adverse health impacts are known from power-frequency EMF. It follows that none will result from the project. This includes no significant impacts under SEPA.

