

## Static Electric and Magnetic Fields: HVDC Transmission Lines

Electric and magnetic fields (EMF) are part of both our natural (e.g., the Earth) and electrified (e.g., a microwave) environments, and are present wherever electricity flows. High-voltage direct current (HVDC) and high-voltage alternating current (HVAC) transmission lines produce different types of EMF, though both are also produced by common household appliances and are non-ionizing (i.e., considered harmless due to their lack of potency). The EMF produced by a transmission line are highest directly under the conductors and dissipate dramatically with distance from the line.<sup>123</sup>

HVDC lines produce what is known as static EMF, which cannot induce currents and voltages (e.g., electric charge or shock) in nearby conductive objects. The static EMF from an HVDC line are most comparable to Earth's magnetic field. The static fields of HVDC lines are too weak to affect the operation of implanted medical devices such as pacemakers, and the possibility of interference to cell phones, GPS receivers, etc., is unlikely. Below are common examples of EMF from common sources as well as the expected static EMF produced by an HVDC transmission line.

Median Static Magnetic Field Levels from Common Sources	
MRI machines	50,000,000 mG
Household magnets	100,000 mG
Electrified railways	10,000 mG
Earth's natural magnetic field	300-700 mG
525kV DC transmission line (standing below conductors)	300-600 mG
Recommended Limits for Exposure to a Static Magnetic Field	
ICNIRP limit for general public	4,000,000 mG
ICES limit for general public	1,180,000 mG

Static Electric Field Levels from Common Sources	
Friction from walking across a carpet	up to 500 kV/m
1 foot from a computer screen	10-20 kV/m
525kV DC transmission line (standing below conductors)	30 kV/m
Recommended Limits for Exposure to a Static Electric Field	
ICNIRP limit for general public	no limit
ICES limit for general public	no limit

The health effects of static EMF and ELF EMF have been studied closely for decades, though there is less interest in the weak static field levels associated with HVDC lines because similar levels occur naturally. The full body of research has been reviewed and summarized the World Health Organization, the International Agency

for Research on Cancer, the International Commission on Electromagnetic Safety (ICES), and the International Commission on Non-ionizing Radiation Protection (ICNIRP). All these scientific panels concluded the current body of research does not indicate that static magnetic fields cause long-term health effects.

The static magnetic field from a 525kV HVDC line will be far below the recommended limits for exposure from the International Commission on Non-ionizing Radiation Protection (ICNIRP) and the International Commission on Electromagnetic Safety (ICES).

More information about static EMF can be found at the following websites:

- ICNIRP: <https://www.icnirp.org/>
- Environmental Protection Agency: <https://www.epa.ie/environment-and-you/radiation/emf/>

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<sup>1</sup> Environmental Protection Agency. (n.d.). Static Electric and magnetic fields. Environmental Protection Agency. Retrieved from <https://www.epa.ie/environment-and-you/radiation/emf/what-is-emf/static-electric-and-magnetic-fields-/#d.en.84428>

<sup>2</sup> "IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz," in IEEE Std C95.1-2019 (Revision of IEEE Std C95.1-2005/ Incorporates IEEE Std C95.1-2019/Cor 1-2019), vol., no., pp.1-312, 4 Oct. 2019, doi: 10.1109/IEEESTD.2019.8859679.

<sup>3</sup> International Commission on Non-Ionizing Radiation Protection (2009) ICNIRP Guidelines on Limits of Exposure to Static Magnetic Fields. *Health Physics*, 96(4), 504-514