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Effect of High Voltage Transmission Lines on Human Health, Plant Life, and Animal life.

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Abstract:

As transmission energy costs rise and new energy sources emerge, high-voltage transmission becomes the most cost-effective option. Large amounts of electrical power are transferred since the higher the gearbox voltage, the more efficient and less expensive the gearbox. Towns are increasing due to population growth, which inevitably leads to the construction of structures near high-voltage power lines. Concurrently, the linked public health and other negative repercussions on human, plant, and animal health emerge. Based on epidemiology studies, this study describes the health impacts of high-voltage AC transmission and high-voltage DC transmission on humans, plants, and animals. Because of the increase in electricity demand caused by population growth, the need for transporting massive amounts of power over long distances has arisen.

This paper provides the reader with an in-depth analysis of all the impacts of high-voltage transmission on any living thing. There are long-term consequences.

All living beings are affected by both long-term and short-term consequences. Large transmission lines with high voltage and current levels generate an electric and magnetic field in the surrounding area. This paper also goes into length about the impacts of magnetic, electric, and electromagnetic fields on human, animal, and plant life. This paper also discusses techniques for mitigating the negative impacts of these fields. There are numerous supporting documentation and research articles both in favour of and against the negative impacts of these high-voltage transmission lines. As a result, there is a heated debate about these implications, which involve government regulating policy and power.

Keywords: high voltage, AC Transmission, health effects of high voltage, line shielding, grounding, compaction, human health, plant health, animal health.

1. INTRODUCTION

A transmission line is related with two fields. They are the electric and magnetic fields. They are referred to collectively as the electromagnetic field, or EMF. They arise naturally as a result of power generation, transmission, distribution, and consumption of electric power. Each has its unique consequences on the health of various living species, which are explored in depth in the following paragraphs.

1.1. ELECTRIC FIELD

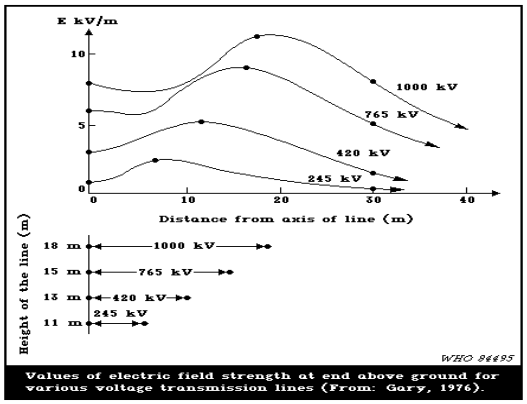
An electric field exists anytime there is a positive and negative electrical charge. They apply forces to other charges in the field. The electric field strength is measured in volts per metre (V/m) or kV/m. The strength of the electric field is determined by the following variables:

Transmission voltage in use, The distance between conductors in the ground, The phase separation if two circuits are next to each other, and the geometric arrangement of the conductors.

The transmission centre line tangential distance is determined by the surrounding environment, such as towering structures such as trees, buildings, fences, and so on.

Tangential distance from the centre line.

The elevation of the measuring location.



Values of electric field strength at end above ground for various voltage transmission lines (From: Gary, 1976).

The chart shows the effect of voltage at various distances from the line's axis.

Because the voltage remains virtually constant, the electric field in a power line fluctuates relatively little.

Each electricity line travels along a property corridor known as an easement. The breadth of the easement is dictated by the system's electrical load. Although public access to an easement is authorised, construction and long-term habitation are not permitted. The EMFs are noticeably lower towards the easement's perimeter than in the centre. The WHO limitations are never exceeded within the easement. As a result, the EMFs outside the easement are substantially below these limitations. For example, the easement width for a standard 330kV transmission tower is 60m.

It should be noted that the electric field remains even when there is no current flowing.

1.2 MAGNETIC FIELD

Because the current in the wires is proportional to the quantity of power consumed, the magnetic field produced by a power line can fluctuate greatly. There are two types of magnetic fields at 50Hz: passive magnetic fields and active magnetic fields. The magnetic field is affected by the following factors:

1. The current passing ratings in conductors. For example, a regular line has an average current of 700A, whereas the biggest line has an average current of 4000A.
2. The queue has been cleared. We see that the highest field occurs beneath the conductor and rapidly decreases with distance on either side.
3. The magnetic field is affected by conductor phasing such as conductor spacing, phase placement, and phase balancing. There are two forms of phase positioning: untransposed phasing and transposed phasing. The phases on both sides of the line are in the same sequence from top to bottom in untransposed phasing, and the magnetic field decreases with the inverse square of the distance. Transposed phasing occurs when the phases on one side are in the opposite sequence as the phases on the other side. The magnetic field diminishes inversely proportional to the distance cube.

When an electrical current flows over a power line, a magnetic field is created as a result of the mobility of an electric charge or current. The magnetic field lines form a ring around the conductor. Magnetic fields are often measured in Tesla.

2. THE EFFECT OF THE ELECTROMAGNETIC FIELD ON HUMAN BEINGS

The human body is made up of biological components such as blood, bones, the brain, the lungs, and so on. The permeability of the human body is equivalent to the permeability of air, but at different frequencies, it has distinct electromagnetic values.

The human body also includes free electric charges in the form of ion-rich fluids such as blood and limb that move in reaction to forces produced by charges on and currents flowing through surrounding power lines.

Electric and magnetic induction are the processes that generate these body currents.

Charges on a power line attract or repel free charges within the body (our bodies contain both positive and negative charges). Because bodily fluids are strong conductors of electricity, charges in the body migrate to the surface when subjected to electric force. A positively charged overhead gearbox line, for example, causes negative charges to flow through the surfaces on the top section of the body. Similarly, negative charges cause positive charges to form. As a result, the charge on the power lines varies between positive and negative several times per second, as do the charges generated on the body surface, with negative charges produced in the top half of the body.

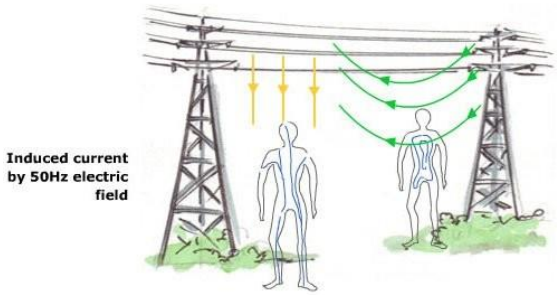


Diagram 2: Field lines traversing the human body

Magnetic induction: The current generated in the body by a magnetic field is highest towards the body's perimeter and smallest at the body's centre.

1. A magnetic field creates a voltage in human tissue, causing a current to flow through it due to its conductivity.
2. The magnetic field has an effect on human tissues, which can be useful or detrimental depending on their type.
3. The quantity of the surface charge and internal body currents produced by any particular power frequency is determined by a variety of parameters. This includes, for example, the amplitude of the currents and charges in the source, the body's distance from the source, the existence of other objects that may shield or concentrate the field, and the body's posture, form, and orientation. As a result, the surface charges and currents induced by a given field vary greatly for various fields.
4. when a person comes in who is isolated from the ground by some insulating material close proximity to an overhead transmission line, and an electrostatic field is established in the human body has an average resistance of around 2000 Ω. When the same individual contacts a grounded item, it discharges through his body, causing a huge current to flow. Natural currents are weaker than discharge currents from a 50Hz electromagnetic field.
5. The undisturbed field limit for humans is 15kV/m RMS to suffer potential shock.

2.1 SHORT-TERM HEALTH PROBLEM

High-voltage power lines release a lot of electromagnetic radiation. These dangerous man-made EMFs interact negatively with the natural electromagnetic fields that exist within humans. They disrupt cell activity, damage DNA strands, and weaken the immune system.
Initial signs of these biological anomalies include dizziness, exhaustion, headaches, nausea, and digestive issues. They frequently lead to more serious disorders in children, pregnant women, and the elderly.

2.2 LONG-TERM HEALTH PROBLEMS

Overhead high voltage power lines ionise the air by emitting trillions of corona ions per second, which are attracted to the aerosol particles of many types of carcinogenic air pollution, such as diesel exhaust, flame retardants in furniture, unintentional byproducts of industries, and so on. The charged pollution particles are subsequently carried by the wind up to 7 km downwind of the power line, where they deposit in the lungs at a far higher rate than uncharged pollutant particles. According to the corona effect risk estimate, up to 400 extra cases of lung cancer death and 3000 extra cases of cardiovascular and respiratory sickness, as well as worsened asthma, may occur annually among the 2.7 million individuals who live near overhead high voltage lines. The following is a comprehensive list of harmful health consequences associated with long-term exposure to overhead high voltage power lines.

1. A wide range of children and adult cancers
2. Leukaemia in children and adults
3. Alzheimer's disease (neurological disorder.)
4. Depression
5. Different types of heart disease
6. Stress
7. Tumour development
8. Cellular activity that is abnormal
9. Perception and memory impairment
10. Genetic abnormalities
11. Gland production insufficiency
12. Mental and behavioural issues
13. Immune system dysfunction
14. Nervous system disorder
15. Birth defects
16. Miscarriages
17. Growth Stagnation
18. Fatigue
19. Headache
20. Nausea
21. Decreased visual and motor reaction time
22. Male sexual dysfunction
23. Asthma aggravation
24. Sleep loss
25. Electromagnetic hypersensitivity

Many scientific and medical research have indicated that children who live near overhead power lines have an increased chance of developing childhood leukaemia.
People who live, work, or go to school nearby are at a higher risk of developing several types of cancer.
The exposure of high voltage overhead lines has been directly connected to Alzheimer's disease and dementia.
Alzheimer's risk increases to 4.9 times and dementia risk increases to 2.5 times the typical predicted rate.

3. ANIMAL EFFECTS OF ELECTROMAGNETIC FIELD

Exposure to high voltage power lines, or EMF, reduces milk yield by 5%, fat-corrected milk yield by 13.8%, and milk fat by 16.4% in cows.
Cows and pigs suffer from breathing problems and weaker systems as a result of high-voltage power

lines. significant voltage power lines result in abnormally low pig birth rates, significant piglet mortality, undersized heifers, and occasional haemorrhages or miscarriages. Dogs and cats exposed to high EMF levels continue to be born with malformed puppies and kittens, have anomalous unbreedable seasons, and have lymph cancer risks that are 6.8 times higher than expected. Animals housed in a high electrostatic field become charged, and when they try to drink water, a spark frequently jumps from their snout to the water.

4. ELECTROMAGNETIC FIELD EFFECT ON PLANTS

The electromagnetic field emitted by high power transmission lines has an impact on plant growth in agricultural and forest environments near high power transmission lines. The current in electricity transmission cables fluctuates with the load. As a result, the influence of EMF caused by current flowing on the growth of plants near high voltage transmission lines remains constant throughout the year. Growth characteristics of crop plants such as shoot length, root length, leaf area, leaf fresh weight, specific leaf weight, shoot/root ratio, total biomass content, and total water content were drastically lowered as a result of numerous practical investigations. Similar trends were detected in biological properties such as chlorophyl.

The effect of cell division and cell expansion was principally responsible for the reduced growth and physiological parameters. In addition, the growth was slowed due to poor action of hormones responsible for cell division and cell expansion.

Finally, the biochemical changes caused by EMF in the plant impact production, resulting in economic loss.

5. EFFECT OF EMF REDUCTION

5.1. LINE SHIELDING:

There are two fundamental approaches for reducing magnetic fields at 50Hz: passive and active. Passive magnetic field mitigation involves rigid magnetic shielding with ferromagnetic and strongly conducting materials, as well as the installation of passive shield wires near transmission lines that generate an opposite cancellation field due to electromagnetic induction. Electronic feedback is used in active magnetic field reduction to sense a fluctuating 50Hz magnetic field and generate a proportionately opposing cancellation field inside a predetermined area enclosed by cancellation coils. This approach is effective in both residential and business settings for reducing magnetic fields from overhead transmission and distribution lines.

5.2LINE CONFIGURATION AND COMPACTION:

Line compaction puts conductors closer together while maintaining a constant minimum safe phase to phase distance. The magnetic field varies with phase to phase gap. By increasing the distance between phases, or by raising the central phase of the conductor above the level of the other phase conductors, the peak value of the magnetic field is reduced (as indicated in the picture below).

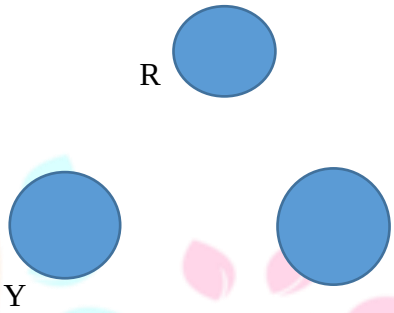


Chart 3: Line configuration and compaction

The magnetic field is reduced when the phase to phase distance is reduced. The electrical insulation level between phases limits this reduction between phases.

Compaction reduces the maximum magnetic field value significantly for single and double circuit lines.

5.3. GROUNDING:

Grounding metal objects on the right-of-way (ROW), such as fences, eliminates these objects as sources of induced current and voltage shocks. To provide alternative channels for induced current flow and prevent nuisance shocks, several grounding points are used.

5.4. PROVIDING RIGHT-OF-WAY (ROW):

Overhead gearbox systems necessitate the use of land strips known as right-of-ways. These strips of land are typically reviewed in order to mitigate the effects of an energised line.

5.5. MAINTAINING PROPER CLEARANCE:

Unlike fences or buildings, movable objects like automobiles and farm machinery cannot be permanently grounded. Maintaining correct clearances for above ground conductors helps to limit the potential of induced current from such objects to people.

6. CONCLUSION

The research on electromagnetic fields and various mitigation techniques examines the various equations that allow us to compute magnetic fields as well as the health impacts of EMF in general.

Magnetic field values are calculated utilising field work for single conductor, three conductor, and double conventional circuits.

Further research on this topic will enable us to entirely eliminate the detrimental effects of high voltage transmission lines on human health, animal life, and plant growth, which will be a difficult feature for young technocrats in the future.

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