

Impact Analysis Of Electrical Transmission Lines

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Editor's Note: This is the conclusion of Impact Analysis Of Electric Transmission Lines by W.R. Kellough. This portion deals with the psychological impact of electric transmission lines on those living near them. The first part appeared in the October 1980 *Right of Way*.

The Psychological Impact

The psychological impact on the well being and peace of mind of people living and working near, or under high voltage transmission lines, has long been a subject of much controversy. Scientific studies have been carried out, both by independent bodies and Ontario Hydro, concerning the effects of electrical high voltage lines on people, on animals and on the environment in general. As with all controversial subjects, results are somewhat inconclusive, and their interpretations tend to support the position of the group which is interpreting them.

The *Study* carried out by the team from the University of Guelph, devotes a complete section to impacts related to electrical fields and ozone production, and excerpts from this section follow, together with comments pertaining to impact severity and possible problem solutions. The phrase, *Impact severity and possible problem solutions*, seems to at least imply, that problems do exist.

Following is the excerpt from this *Study*:

The possibility of ill effect on humans and on farm animals caused by the electrical field found under high voltage transmission or due to ozone production has been expressed by the agricultural community. The specific impacts identified are listed below along with comments pertaining to impact severity and possible problem solutions.

- **Induced charges on wire fences:** It is possible under certain conditions for wire fences to carry an electrical current which is induced by the electromagnetic field present under high voltage transmission lines. This charge, although annoying, is harmless and can be eliminated by suitable grounding.

- **Shocks from farm machinery:** A build-up of static electricity associated with farm machinery operating under the conductors is possible, yet once again is considered as harmless.

- **Ill effects on behaviour, growth and reproduction of cattle in proximity to 500KV transmission:** The mechanism for such interference with livestock is not evident and scientific evidence to support this theory is lacking at this time. Further investigation of such claims may be required to properly evaluate this impact.

- **Interference with radio and television reception:** This depends on line location and is also possible in cases where a transmission line is not functioning properly. The latter problems are usually overcome upon correction of the line defect causing the malfunction or adjustment or receiving antenna.

- **Interference with the operation of electronic farm equipment and machinery:** This may be possible but is not a problem with most existing machinery.

- **Storm damage:** There is no documented evidence to indicate a problem related to an increased occurrence of lightning-kill of livestock in the vicinity of towers. An investigation of insurance claims for such losses might indicate if there is any increased hazard related to lightning on farms having transmission lines.

- **Toxic effects of ozone production:** It is generally concluded that the production of ozone by a transmission line is so small that concentrations reaching the ground are negligible.

The facts and figures regarding the occurrence and severity of these various impacts should be made available to all who are concerned.

Such information should express the probability of occurrence of the impacts and by indicating the nature and degree of the danger involved, would alleviate some of the *fear of the unknown* which is associated with the transmission lines.

The foregoing section dismisses most of the possible problems with phrases such as *Considered harmless* or *Scientific evidence is lacking at this time* or *Further investigation may be required to properly evaluate the impact*. Other studies have however, concluded that there may indeed be ill effects to humans or to farm animals caused by the electrical field found under high voltage transmission cables.

The report prepared by Dr. E. Koczur, P. Eng., of James McLaren Ltd., is titled *The Electrical Effects of High Voltage Transmission Lines* and the introduction to this report is quoted below:

The operation of power transmission lines produces electric and magnetic fields in space around the lines. These fields affect the environment in that they may cause phenomenon which could be annoying or hazardous to humans, animals and vegetables. Among these phenomenon are the following: Corona discharge; production of ozone; radio interference; television interference; audible noise; electromagnetic induction; electrostatic induction; biological effects of electric and magnetic fields.

Some of these effects must be controlled to ensure safe and reliable operation of these lines. Others must be regulated to produce acceptable levels of effect. The magnitude of these effects depends upon the line voltage and current, and the line design.

Section 44 of the National Energy Board Act requires that the Board consider all matters relevant to international power lines before issuing a certificate.

Therefore each applicant for a

certificate is required to provide an environmental impact assessment. Included in this assessment are questions regarding the electrical effects of transmission lines.

This report will discuss these effects, the current state-of-the-art regarding these effects, and answer the questions posed in the *National Energy Board Guidelines on the Environmental Information Required with Application for Certificates for International Power Lines*. As well, data on electrical effects presented at recent hearings will be given.

The report which follows this introduction includes some very involved scientific descriptions and explanations which are actually not germane to this article.

My purpose in quoting from this report is primarily to illustrate the wide range of opinions expressed by various studies and by the persons interpreting these studies.

A portion of the report on page A.9.8 discussing the effect of electrical fields reads as follows:

1.2 -Effects of Electric Fields

An energized power transmission line produces electrostatic and electromagnetic fields. The electrostatic field gradient is a function of the line voltage, the capacitance between conductors and the conductors to ground, the distance from the line to an object and the shape of an object such as vehicle, house, human, animal or vegetation. The field is expressed in kilovolts per metre (kv/m). The magnetic field strength is a function of current flowing in the line. The field is inversely proportional to the distances from the conductors to the object. Magnetic induction produced by the magnetic field may be measured in units of gauss.

1.2.1 -Shock Caused by Electrostatic Fields

Electric shocks may be classed into two categories.

1. Shocks caused by direct contact with the transmission line. The likelihood of this happening is minimal.

2. Shocks caused by electrostatic induction—objects such as vehicles, buildings and fences, which are insulated from the ground may

acquire an electric charge induced by the electric field of the transmission line. The amount of charge depends upon the line voltage, the size of the object and how well it is insulated from the ground. The shock results when the person or animal touches the object and provides a path for the electricity to flow to ground.

The flow of current through the body causes muscle contraction of varying magnitude, depending upon the magnitude of the current. Currents may cause inability to let go of the object or large currents may cause ventricular fibrillation.

A table in the report gives average values of currents associated with various effects. The values are 50 percentage points and the lower values of currents would affect fewer people in each of the categories. These values cause shock effects which might be termed—primary effects. Secondary effects, caused by current values less than those which cause primary shock, may be annoying or painful and can cause involuntary reactions such as falling.

1.2.2 -Fuel Ignition Caused by Electrostatic Discharge

The possibility of accidental ignition of fuel by electric discharge is complex and there are many opinions on the subject. Measurements indicate that high voltages may be induced in vehicles underneath transmission lines. If a vehicle is being refuelled beneath the line it is considered possible that a spark might ignite the vapours. For this reason, parking lots and service stations probably should not be located beneath the line.

1.2.3 -Biological Effects of Electrostatic Fields

Headaches, nervous upset, heart and blood system changes and reduced sexual potential have been reported by Russian researchers as direct effects of electric fields. However, their procedures and conclusions have been criticized by others unable to reproduce their results.

The report goes on to discuss the bio-

logical effects of high voltage transmission lines, and the comments of Ontario Hydro on this discussion:

2.2.3 -Biological Effects of High Voltage Transmission Lines—Discussion

Recent concern has been expressed about the effects of extra high voltage transmission lines particularly in excess of 1000KV. A most important issue is whether or not long-term exposure to electric and magnetic fields can have adverse effects on human, plant, and animal life.

Research in the Soviet Union has indicated that workers exposed to EHV fields are affected. Reports of headaches, tiredness, lassitude, sweating, and loss of sexual ability have been received from the Soviet studies. Changes in blood chemistry were also reported. Workers who have studied these reports however, feel that these symptoms could be attributed to general working conditions and noise levels in the switchyards where the Soviet studies were carried out.

The following comments concerning the Russian work have been reported:

Ontario Hydro—Transmission Environmental—Royal Commission on Electric Power Planning, March 1976—*It is difficult to interpret the significance of the Soviet findings. Most physicians who have studied their research carefully, agree that the psychological symptoms are probably related to unhappiness with the job, the location of the station or the high noise in the switchyards. Most of the physical findings would be common to any similar group of workers unexposed to electric fields.*

A report from the Electric Research Institute titled *Biological Effects of High Voltage Electric Fields* is included in the aforementioned report:

Electric Power Research Institute—Biological Effects of High Voltage Electric Fields—(EPRI—November 1975)

Persons occupationally exposed to high voltage electric fields in the complex environment found in switchyards have complained of a number of disorders,