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.
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> • *Induced charges on wire fences:* It is possible under certain conditions for wire fences to carry an electrical current which is induced by the electromagnet field present under high voltage transmission lines. This charge, although annoying, is harmless and can be eliminated by suitable grounding.
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> • *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.
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> • *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.
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> • *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.
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> • *Interference with the operation of electronic farm equipment and machinery:* This may be possible but is not a problem with most existing machinery.
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> • *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.
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> • *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.
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> 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. Koczkur, 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.
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> 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 failling.

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 biological 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,

such as headaches, fatigue, and nausea, as reported by Soviet research workers. A major problem exists in interpreting these findings because of the difficulty in determining which factors in this unique environment were responsible for the observed symptoms. An additional factor reported by the Soviets is the small-arc self-discharge. Another plausible factor, unique to the switchyard environment, is the very high level of 100 Hz acoustical noise arising from magnetrostriction in the transformer. Such high level 100 Hz acoustical noise can cause similar symptoms.

Some research carried out in Spain was reported by T. Leardini in a paper *UNIPEDE Report on Effect of AC Electric Fields on Human Beings and Animals, March 1976*. As regards the research carried out in Spain this refers to the result of examinations carried out on three workmen operating in installations at 400KV. The persons concerned were all working in the same substation with more then 10 years of service in H.V. substations. They were known to have no clinical history of any significance.

Before taking up their activity in 400KV plants, they had been working in plants with a nominal voltage of 200KV. Since they had begun working in 400KV plants, complaints such as vertigo, visual disturbance, nausea, and loss of strength were observed.

Comments on the Russian and Spanish work by the *Electric Power Research Institute (EPRI) in Biological Effects of High Voltage Electric Fields, 1975:*

In summary, all of the American and West European test results on humans (except for Spain) at present field levels (less than about 20KV/m) gave no indication of hazardous effects. Many of the European laboratory tests were conducted under very carefully controlled conditions which eliminated the possibility of unrecognized and over-shadowing environmental factors such as low-frequency and acoustical noise, and the fact that both the Soviet and West European research scientists have not been able to observe the reported switchyard worker symptoms in a significant way in tests conducted under carefully controlled laboratory conditions, support the view that factors other than the electric field as normally encountered were responsible for the observed symptoms.

Dr. Andrew A. Marino, Veterans Administration Hospital, Syracuse, New York, testified before the State of New York Public Service Commission for a 765KV transmission line: I would recommend against construction as proposed. The level of the electric field which would be produced at points beyond the right-of-way would exceed what I believe is a reasonably safety level. Also, the level of the magnetic field on the right-of-way may cause biological effects in people exposed to these fields. In my opinion, common wisdom dictates that these effects should be studied further.

Ontario Hydro comments of Dr. Marino's work and testimony: *Review of Literature and Research by Dr. Andrew A. Marino*. Dr. Marino is a biophysicist whose primary interest has been the effect of electric current on bone. Most of his experimentation has been done on rats. He has also reviewed extensively the literature regarding the biological effects of electric fields on laboratory animals.

His main conclusion is that electrical fields have a biological effect on living organisms. From his own experiments on rats he concludes that electric fields produce a specific stress reaction. He has done no studies on humans who have been exposed to the electric field of switchyards or transmission lines. In spite of this, he has recommended that 765KV lines should not be built.

Dr. Robert O. Becker, Veterans Administration Hospital, Irving Avenue, Syracuse, New York, also testified at the New York hearings.

Question to Dr. Becker: Would you recommend construction of the 765KV line as proposed by the applicants?

Dr. Becker: No, for the reasons that the strength of both the electric field and magnetic field produced by the line will be in the range possibly productive of biological effects. I believe that chronic exposure of humans to such fields should be viewed as human experimentation, and subjected to the rules previously mentioned. I believe that the most prudent course to follow would be to determine the complete spectrum of biological effects produced by exposure to 60 Hz fields. It should then be possible to establish firm levels of permitted exposure both as to field strength and to exposure times.

Question: Do the conclusions you have proffered apply to transmission lines whose voltage is less than 765KV?

Dr. Becker: Yes, proportionately so.

The report goes on to discuss audible noises created by transmission lines when the conductors are wet and concludes that there are audible noises but indicates that studies are still being carried out to determine specific guidelines and regulations for noise control.

A Study prepared by the University of Minnesota in 1978 also deals with these elements and some of their observations are worth quoting. One of the recommendations was:

> More information needs to be conveyed to farmers, agricultural equipment manufacturers and sales personnel, and organizations concerned with agricultural safety. For example, machinery companies should be made aware of clearance requirements and encouraged to give appropriate warnings on equipment and in their operator's manuals. Sales personnel particularly of irrigation equipment, should be alerted to what are unsafe situations.

The text of the report deals with the matters in some detail.

AGRICULTURAL OPERATIONS NEAR HIGH VOLTAGE TRANS-

MISSION LINES—SAFETY Identifying limitations or constraints on operations which may interfere with or require safety precautions during agricultural operations is necessary if full consideration of electrical transmission-agricultural interaction is to be achieved. This section attempts to identify potential physical hazards resulting from operating farm implements or location buildings, fences, or other stationary objects on or near a high voltage transmission right-of-way. Potential hazards considered are categorized as accidental contact, flashover, and induced effects. A brief discussion of the nature of each hazard and any necessary action to avoid the hazards will be given. Unless otherwise noted, discussion pertains to AC lines.

ACCIDENTAL CONTACT

Accidental contact of a grounded conducting object with a conductor presents an obvious safety hazard regardless of whether the line is AC or DC. Contact can result in a current passing from the conductor through a person to ground. This problem is not unique to high voltage lines. Local distribution lines and service drops present more potential problems for contact because they are located much closer to the ground. Movement of tall objects, such as elevators or grain augers which may be near any electrical lines, require caution. Handling of irrigation pipe is another instance where caution to avoid contact is necessary.

FLASHOVER

Flashover is a result of the breakdown of air as an insulating medium between the line and a conducting object. *Flashovers have the potential for lethal levels of current flow.* This current flow can occur across a distance of up to several feet. Some of the factors which control the breakdown strength of air are: Air pressure, electrode material, presence of water vapor, incident photo ionization and type of voltage. Flashover potential is basically the same for both AC and DC lines.

Insulation design for high-voltage transmission lines is largely determined by switching surges and in some cases by lightning requirements. Under normal conditions insulators are not over stressed by power frequency over-voltages. However, there does exist the possibility of flashovers even without switching or lightning surges under certain conditions. Flashovers can occur in wet weather conditions such as dew, fog, or drizzle when the insulator surfaces have become contaminated with dust. This contamination does not decrease the insulating qualities when dry, however the mixing of contaminants with moisture reduces the insulating value. The flashover would normally occur to the tower. A potential hazard only occurs if a person is touching or very close to the tower when the flashover occurred. In general, under normal weather conditions the possibility of flashover occurring to the ground or to other parts of the transmission system are remote.

Maintaining sufficient clearance between the transmission line and equipment or vehicles will prevent flashovers. The National Electrical Code has recommended clearances required over various ground surfaces.

The report provides a table of recommended clearances for various voltage lines based upon the U.S. National Electrical Safety Code.

Phase-to-phase KV	Clearance Ft
100	22.26
115	22.55
161	23.43
230	24.76
345	26.97
500	29.96

The recommended clearance for equipment by Ontario Hydro is:

Phase to Phase KV	Clearance (From line to top of equipment) FT
115	8
230	10
500	15

Thus the difference between these ground clearances and equipment clearances will dictate the height of machinery that can be operated under the lines, assuming Ontario Hydro has adhered to the U.S. Clearance Standards. However, it is noted that these clearances must be adjusted for any increase in elevation above sea level.

INDUCED EFFECTS

It is common knowledge that metal objects can acquire an electrical charge when placed in the vicinity of an electrical transmission line. This has become more noticeable in recent years with the advent of extra high voltage (EHV) and the ultra-high voltage (UHV) transmission lines.

An electrostatically induced shock resulting from a DC line under normal loading conditions yields only an initial shock whereas from an AC line there is the initial shock plus a continued current flow as a result of the charging current induced by the changing current in the AC line. Electromagnetically-induced shocks are not possible from DC units under normal operating conditions because the current does not change with time.

Although sufficient clearance is maintained between the transmission line and a vehicle or implement to prevent direct contact or flashover, the possibility of safety problems resulting from induced effects must still be considered. The primary concern relates to releasing of charges which may build-up on an ungrounded body due to electrostatic effects. Two aspects of the problem are electric shock for a person touching the object and spark for potential ignition of fuel vapors.

Analysis by an IEEE working group confirmed the severity of these problems varies with the size of the vehicle and its proximity to the line; that is, the larger and closer the vehicle to the line the greater the induction effect. Computer simulation results indicated that vehicles in the vicinity of EHV lines below 500 KV do not create primary shock currents. Above 500 KV, it was determined that primary shock currents could exist if maximum voltages and low tire conductivities are assumed.

Field measurements of induced currents and voltages for a tractor and hay stacker under a 345 KV line have been made by Nebraska Public Power. The maximum field intensity at the measurement site was 2.9 KV/m. The maximum vehicle-to-ground current measured was 1.47 milliamperes which is slightly above the threshold of perception. The most intense shock sensation was produced by the stackwagon alone, insulated from the ground when touched by a grounded person. Under these conditions the induced voltage was 600 volts.

Minimum conductor-to-ground clearances as a function of line voltage and vehicle size have been developed by the Rural Electrificaton Administration assuming a 5 milliamperes maximum current. Their results are displayed in the following figure.

Electrostatically induced charges on an ungrounded vehicle can cause a spark when discharging to a grounded object. Since most vehicles are powered by hydrocarbon fuels, it is important to know if such sparks contain sufficient energy to ignite fuel vapor. In general, it appears it is difficult to cause ignition of hydrocarbon fuel vapors under field conditions. However, if an arc were struck while a vehicle is being refueled under a line, the fumes could be ignited. Precaution when refueling under a line is recommended.

Grounding of stationary structures can prevent the built-up of electrostatic and electromagnetic charges. Stationary objects such as buildings with metal siding, roof, or gutters, and metal storage tanks or bins need some circumstances to have their metal parts bonded together and grounded. Normally, buildings are not located within the right-of-way, but if a building is located adjacent to a EHV transmission right-of-way, all metal parts such as roofs, drain spouts, etc. should be bonded together and grounded.

A number of experimental field tests and theoretical studies concerning the electrostatic effects experienced when a person touches an insulated non-electric fence under a high voltage transmission line have been reported.

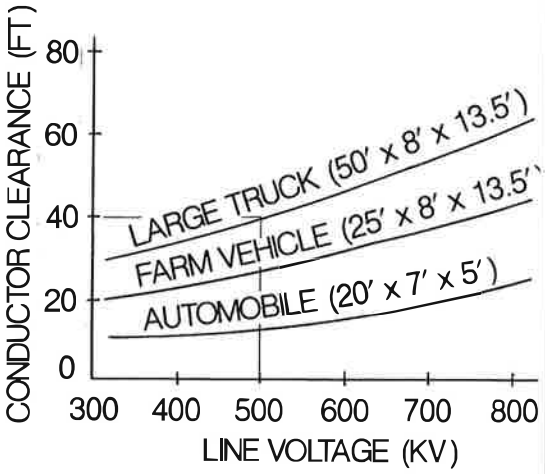
The report goes on to advise that all fences in the vicinity of a high voltage transmission line should be grounded, including electric fences which require special filters. A table of grounding intervals is provided.

The conclusion which is evident from all of the foregoing data is that there is no absolute agreement as to the effects of high voltage transmission lines on humans or animals. Unfavourable reports from one group are quickly refuted by favourable reports from another group.

Power generating corporations provide a continuous source of funds for new studies which invariably turn out to be favourable, while other groups seeking to protect the environment and the people living in it, turn out reports which are generally unfavourable.

It is not the purpose of this report to determine which of the scientific conclusions are valid, but rather to determine how the intrusion of modern technology in the form of transmission and towers on a rural landscape psychologically affects human beings living and working within sight of or adjacent to high voltage transmission cables.

During the course of our research we have had occasion to interview many farmers and their families who live close by or in sight of Ontario Hydro installations. Almost all have confirmed that they experience feelings of anxiety and uneasiness when in an area close to or under hydro cables. A large number of farmers



Minimum Conductor-to-Ground Clearanc vs. Line Voltage for Insulated Vehicles

Non-Electric Fence Grounding Intervals for Line Voltages 345 KV and Above

Line Voltage (KV)	Fence Lateral Distance From Centre or Row (Feet)	Fence Grounding Interval For I_{shock} = 1mA* (Feet)	Fence Grounding Interval For I_{shock} = 5mA** (Feet)
345	Within 75	200	1,000
500	Within 125	150	750
500	Between 125 and 250 (min.)	200	1,000
765	Within 175	125	625
765	Between 175 and 375 (min.)	200	1,000

* —Perception threshold current level flowing through a person.

** —Let-go threshold current level flowing through a person.

were empathic in their refusal to work under cables or to pasture cattle under cables because of some nebulous fear of what could happen. This fear, whether justified or not, does exist in the mind even when only one tower or a single row of cables is the object of distrust.

The conclusions arrived at in the various studies previously quoted may or may not be scientifically supportable. The fears and the anxieties of people living and working under or adjacent to high voltage hydro lines are real and do affect their day-to-day physical activities and peace of mind.

This principle is recognized by the Ontario Land Compensation Board and is reported in 13 LCR, Part IV, July 1978, in the case of *Simpson et al v. Ontario Hydro*. This was a hearing for compensation on September 21, 1977 before the Land Compensation Board.

This case concerned a single 140-foot high tower erected by Ontario Hydro on an expropriated portion of the claimant's property. This tower was located approximately 150 feet from the claimant's residence and could be readily seen from the bedroom and living room window. Portions of the decision are quoted below:

> The claimants testify that the tower is unsightly and can be readily seen from the bedroom and living room windows. They also claim that the sounds emanating from the towers are a nuisance because of the sparking and sizzling of the wires and illuminating of the insulators particularly in cold damp weather. They state that there has been greater interference with television and radio reception which continued even after the purchase of a new television set. They have complained to the Department of Transport about the crackling of the radio and television interference in foggy and misty weather.
>
> They also expressed the concern and fear that the tower might fall on their house. In relation to this latter claim they filed a newspaper clipping showing that there have been occasions when towers have fallen. There was also filed as Exhibit 15, a response from the Ontario Hydro Director of Systems Maintenance, in answer to a query about available statistical data of toppled hydro towers over the years. The Director states in his letter that, *failures were due to tornadoes, high winds, or severe ice and sleet conditions exceeding the loading criteria for which the towers were designed. Usually, under these conditions, there is extensive damage to the surrounding countryside including any farm buildings in the path of the storm.* This statistical data indicates, although the toppling over of hydro towers is not a yearly event, it is certainly not unusual and could be a cause for some concern.
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> On the basis of the foregoing grounds the claimants are of the opinion that they no longer enjoy the amenities that they previously had and that there has been adverse impact upon the wife's health requiring additional medical attention.
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> It is a contention of the claimants that the only alternatives to put them back in the same position would be to move the tower or the house. As the Board has no jurisdiction to impose tower location, even if this was feasible, it therefore must consider the second alternative. The basis of this aspect of the claim is for the cost of moving the house further away from the tower to the east on the other side of the barn. The claimants have expressed their intention to do this.
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> The Board is impressed by the testimony of the claimants indicating quite clearly that the residential amenities have not been placed in a secondary position to that of the development of the property as a productive farm unit. Obviously, the claimants have some strong regard for the peaceful rural or pastoral setting which is confirmed by their attitude to this idyllic wood lot retreat. It is not unusual for a different criteria to be applied by a mythical purchaser and that of an owner knowing what he had that he can no longer enjoy. The tower is located in such a manner to be a constant reminder of the situation before the construction.
>
> The testimony regarding the television and radio interference is uncontradicted. It certainly would have been better if more objective evidence had been available to support the claim. By the same token the respondent, which was aware of this claim, should have been in the position to rebut such evidence, if such evidence was available.
>
> The submission of respondent's counsel that there has not been established a causal connection between the tower proximity and the female claimant's ill health is valid. If one were to accept this subjective evidence without medical testimony in support would be indeed a questionable practice. *But at the same time the evidence has established that a reasonable person might create and maintain a level of anxiety from such an obvious intrusion not previously experienced to constitute personal damage within the* meaning of s.1(1)(e) (i)b of the Expropriations Act.[1]
>
> The Board agrees with the submission of the claimants that there is a nuisance, and are of the opinion that it is reasonable to compensate them so that they would be in the position to relocate the house to remove the nuisance, and thus place themselves in the position previously enjoyed. In the Board's opinion the nuisance as sustained by the claimants is different in kind from that suffered by citizens generally, and that the personal damage would be actionable at common law. The totality of the nuisance; sight, sound, television and radio interference, and anxiety can form the basis of a claim for personal damages that can reasonably be measured by the cost of relocating the residence. The claim and quantum have been sufficiently proven. The Board therefore allows the claim of $15,477.50 for the relocation costs as presented.

[1]Section 1(1)(e)(i)b of this act is: Such personal and business damages, resulting from the construction or use, or both, of the works as the statutory authority would be liable for if the construction or use were not under the authority of a statute.

An appeal by Ontario Hydro to the Supreme Court of Ontario was dismissed with costs in April 1979.

American courts have been cognizant of these elements of damages for some time. In *United States vs. H.G. Hicks,* the United States Court of Appeal stated in 1959:

> **The apprehension of injuries to person or property by the presence of power lines on the property is founded on practical experience and may be taken into consideration in so far as the lines and towers affect the market value of the land. *Kentucky Hydro-Electric Company v. Woodward,* 216 Ky. 618, 287 S.W. 985: *Oklahoma Gas & Electric Company v. Kelly,* 177 Okl. 206, 58 P.2d 328. This is also the law in Tennessee. See *Alloway v. City of Nashville,* 88 Tenn. 510, 526, 13 S.W. 123, 8 L.R.A. 123, which holds that it is a question for the jury whether a reasonable apprehension of danger from inherent defects and unavoidable accidents may exist, and, if so, such an apprehension so far as it depreciates the present market value of the land not taken is an element of incidental damages. From this record with its details as to the structure of the power lines and towers we find that the apprehension is reasonable.**

And in *Ohio Public Service Co. vs. Derhring* an appeal by Ohio Public Service Co. to the State of Ohio Court of Appeals the Court said in 1929:

> ***Request No. 5 was as follows:* Danger from lightning, danger that a cable might break and fall, danger that a cable might fall on a wire fence, danger to crops by towers being blown over and danger to persons or livestock are too remote, speculative and uncertain to afford a basis for allowance of damages.**
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> ***Request No. 6 was as follows:* The court charges you as a matter of law that you should not award defendant any damages on account of any fears of danger to himself, his family or livestock which they or any future purchaser might entertain on account of the construction or maintenance of this transmission line.**
>
> **We think the danger and fear referred to in these requests were elements which, in so far as they affected the market value, might be considered in determining damages to the residue.**

There is compelling evidence that the general public has an apprehension of high voltage transmission lines and that the courts are prepared to consider such matters in awarding compensation.

It is not difficult to comprehend apprehension of lay persons when even the experts cannot agree upon the risk and hazard of working around and under high voltage electrical transmission lines. The apprehension obviously, is based upon an interaction between what is known and that which is unknown. Man has always been apprehensive of the unknown particularly when what is known is not very reassuring.

Hydro lines can be seen, can be heard and often smelled and it is known that they carry a lethal flow of high voltage electricity. Few lay persons have any understanding of what an electrical current is and even less of its side effects.

While they will often cheerfully put themselves in a position of risk, crossing roads, driving cars and flying in airplanes, the Hydro line is intruded upon them and this coupled with controversy among the experts as to safety and danger is certainly enough to cause anxiety or apprehension in the mind of the average person. Whether justified or not its existence must affect the marketability of property that is impacted by electrical transmission lines.