Electric Field Effects on Biological Issues- A Case Study

R. Sudha, Femina Sarbudeen, Sharmila Hussain

Abstract- ***Due to the population explosion of the world, towns are expanding, many building construct high voltage overhead power transmission lines. Because of power demand we need huge amount of power for over long distances. Large transmission lines configurations with high voltage and current level generates large value of electric and magnetic fields stresses which affect the human being and the nearby objects located at ground surfaces. But medical studies have shown that a low frequency EM field accelerates the healing of bone fractures. The non ionizing radiation causes the health effects in human which is low frequency electromagnetic fields which is produced by the electricity systems. This is not affect only the human ,it will affect the animals, plants, vehicles, fences, pipelines etc.***

Index Terms - Extra High Voltage Line (EHV), Electro Magnetic Field (EMF), Ultra High Voltage Line (UHV).

I. INTRODUCTION

During decades of health related EMF research a large body of knowledge in this area has been accumulated. The electrostatic effects from overhead EHV lines are caused by the extremely high voltage. While electromagnetic effects are due to line loading current and short circuit currents. For eg, potential drop in the earth's surface due to high faults currents direct flash over from line conductors to human beings or animals. Electrostatic field cause damage to human life, plants, animals, metallic objects such as fences and buried pipelines. Although it is not a biological effect, electromagnetic interference of power frequency as low as 2 kVm-1 with certain cardiac pacemakers could have medical significance.

There are two types of currents:

a) Primary shock current:

To produce the primary shock current 25 volts is necessary. Because the normal resistance of the human body is about 2-3 k-ohm. If the current exceeds 6-10 mA it will cause direct physiological harm. The danger here arises due to ventricular fibrillation which affects the main pumping chambers of heart so it will stop the blood circulation, so the death will occur. The primary shock current required varies directly as the body weight for I=10mA the current must flow for a time interval of 272 sec before death occurs in a 50 kg human.

Manuscript received on April, 2013.

R.Sudha, School of Electrical Engineering, VIT University, Vellore, India.

Femina Sarbudeen, School of Electrical Engineering, VIT University, Vellore, India.

Sharmila Hussain, School of Electrical Engineering, VIT University, Vellore, India.

b) Secondary shock current:

These cannot cause direct physiological harm but may produce adverse reactions. Currents from 1-6 mA are classed as 'let go' currents. At this level a human being control of muscles to let the conductor go as a soon as the tingling sensation occurs. A 50% probability that the let-to-current may increase to primary shock current the limit for men is 16mA, for women 10 mA. At 0.5% probability the currents are 9 mA for women, 4.5 mA for children. A human body has an average capacitance of 250PF, when standing on an insulated platform of 0.3m above ground. In order to reach the let go current value this will required 1000-2000V.

II. PHYSICAL INTERACTION OF ELECTRIC FIELD WITH BIOLOGICAL OBJECTS

a) The fields:

Untroubled power frequency electric field accessible to the public rarely exceed 10kvm-1.localized fields near appliances may exceed 1kvm-1.but common electric field in home and work places rarely exceed 100vm-1.these fields are altered by the presence of conducting biological objects. The approximate values for internal fields can be obtained that are enough for our purposes by considering 3 physical phenomena,

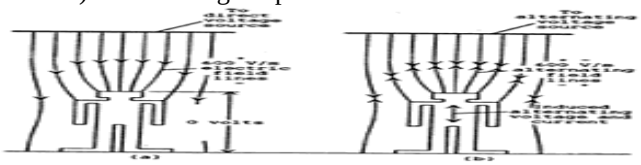
1) The field enhancement in the air electric field caused by the presence of the conducting object,

2) The continuity of the current density at the boundary between materials,

3) The distributions of field and current densities that take place within the object.

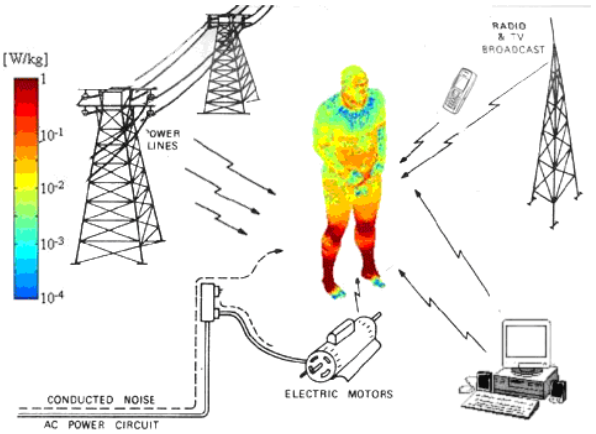
III. PHYSICAL CHARACTERISTICS OF ENVIRONMENT EM FIELDS

Electromagnetic waves are ac electric and magnetic fields that propagate at different frequencies and the "biological effects vary with frequency". The most energetic 'ionizing radiation', such as cosmic and x-rays(10^18-10^22HZ),damage cells and even ultraviolet(10^16HZ)waves in sunlight can damage skin. Lower frequency waves are 'non ionizing', but microwaves (10^9-10^11HZ) that cook foods obviously damage cells which transmute at about 10^9HZ, could be involved in brain cancer but we do not know how those frequency (or) the communication bands of radio and television (10^4-10^8HZ) affect biological processes.



IV. BIOLOGICAL EFFECTS AND HEALTH RISKS:

A number of epidemiological studies have suggested that there is an increased risk associated with exposure to low frequency EM fields. Feychsing & Ahlborn(1993) took the advantage of detailed records of power usage in Sweden to demonstrate that the effects are depends upon the dose. At 2 mG (milli guass) magnetic field which is slightly above the normal background of 1 mG, the relative risk of occurring pediatric leukemia was 2.7 at the higher field level of 3 mG the relative risk increased to 3.8 they have also been reports of increased disease for adults in electrical occupations, such as high incidence of "breast cancer" in male telephone workers which is raring men. Researchers found that increase leukaemia in children living near electric power distribution lines. Several studies have shown that occupational exposure to extremely low frequency EMF as a potential risk factor for "Neuro Degenerative Disease".



V. EMF EFFECTS ON PREGNANCY OUTCOME:

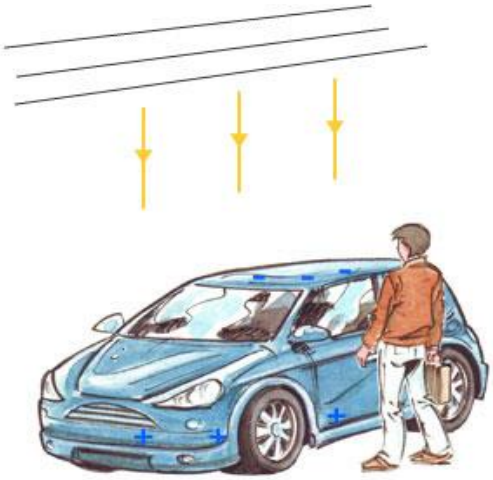
Many different sources and experiences to emf in the living and working environment, including computer screens, water beds and electric blankets, radio frequency welding machine, diathermy equipment and radar have been valued by the WHO(World Health Organization) & other organizations. Overall weight of evidence shows that experience to fields at typical environmental levels does not increase the risk of any opposing adverse outcome such as natural abortion, mal formation, low birth weight and congenital diseases. Such as reports of prematurity low birth weight in children of workers in electronic industry but these have not been recorded by the scientific community has being necessarily caused by the field exposures.

VI. EMF EFFECTS ON CATARACTS

When the workers are exposure to high levels of radio frequency & microwave radiation they will get the eye irritation. The experimental of this idea do not support the animals that forms of eye damage can be produced at levels that they are not thermally hazardous.

VII. EMF EFFECTS ON HUMANS BEINGS DUE TO VEHICLES PARKING

The vehicle also charged when it is stopped under a transmission line traversing his field when he gets off the vehicle and touches a grounded object, he will discharge himself through his body which is a pure resistance about 2000 ohm. The discharge current when more than the let go current can shock and damage to brain. Limit for the undisturbed field is 15kv/m so the EHV (or) UHV must be designed such that this limit is not exceeded. eg, USA has selected maximum electrostatic filed gradient to be 9 kv/m at 1200kv for their 1150kv line and in order to do so used a minimum clearance at mid span of 23.2 where areas they have selected 17.2m based on clearance required for switching surge insulation recommended by the national electrical safety council.



The car below the high voltage power line is subjected to an electric field: it does induce a displacement of charges. The car acquires a certain potential, different than that of the approaching person.

When he touches the metallic surface, the two potentials will even out (*). The electric shock may be unpleasant, but it is not dangerous.

It is this type of phenomenon to which animals drinking at a trough under a high voltage line are subjected. The solution consists of correctly grounding the trough.

If the vehicles are parked under a line or driving through acquire electrostatic charge if their tyres are made of insulating material. If parking lots are located under a line the minimum recommended safe clearance is 17m for 345 kv and 20 m for 400 kv lines, Trucks and lorries will require on extra 3m clearance. The danger lies in a human being attempting to open the door and getting a chock there itself.

VIII. ELECTROMAGNETIC HYPER SENSITIVITY AND DEPRESSION

There is little scientific evidence to support the idea of electromagnetic hyper sensitivity. Recent studies found that the individuals do not show consistent reaction under properly controlled condition of emf exposure they ask whether aches and pains, headaches, lethargy, depression, sleeping disorders, an even convulsions and epileptic seizures could be associated with emf exposure. More studies are continuing on the subjects.

IX. EMF EFFECTS ON ANIMALS

The cages under EHV lines have shown birds are affected by high electrostatic field at about 30KV/m. Other animals gat a charge on their bodies and when they proceed to a water through to drink water,

a spark usually jumps from their nose to the grounded pipe (or) trough. Like hens are unable to pickup grain chattering of their beaks which also affect their growth.

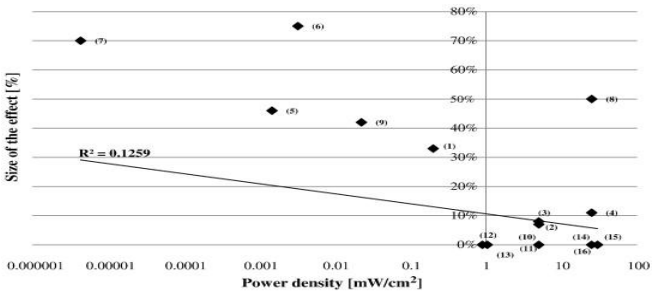
X. EMF EFFECT ON PLANT LIFE

The voltage level of high power transmission lines are 400kv, 230kv, 110kv, 66kv etc. The electromagnetic field from high power transmission line affects the growth of plants. At field strength of 20KV/m their sharp edges of the stalk give corona discharges so that damage occurs to the upper portion of the grain bearing parts. However, the entire plant does not suffer damage. At 30KV/m by products of corona, namely ozone & N2O becomes intense. The resistance heating due to increased current prevents full growth of plant and grain. Thus, 20KV/m can be considered as the limit and again the safe value for a human being governs line design.

XI. EMF EFFECTS ON PIPELINE/FENCES/CABLES

Fences, buried cables and pipelines are important pieces of equipment to require careful layout. Metallic fences parallel to line must grounded every 75m.Pipelines longer than 3m &larger than 15cm in diameter are recommended to be buried at least 30m laterally from the line centre to avoid dangerous eddy currents that could cause corrosion. Sail boat rain gutters and insulated walls of nearby houses are also subject of potential danger.

SURFACECURRENT DENSITY(mA/m2)	HEALTH EFFECT
<1	Absence of any established effects.
1 to 10	Minor biological effects.
10 to 100	Well established effects a)visual effect b)possible nervous system effect
100 to 1000	Changes in central nervous system.
>1000	Ventricular fibrillation (Heart condition) health hazards.



XII. CONCLUSION

Based on the analysis and other research projects there is no conclusive and convincing evidence that the low frequency EMF originated from the high voltage transmission line is a cause for cancer or others health effects in humans. According to the epidemiological studies assumed that there is a increased risk of cancers due to the EM field. But the risk is appeared to be small in magnitude and weak. Although the possibility is still remain about the ELECTROMAGNETIC FIELD.

ACKNOWLEDGEMENT

We are very thankful to the contribution of VIT university and sudha mam for providing us with all necessary requirements for this paper and each and everybody who directly or indirectly helped us in this paper.

REFERENCE

1. Extra high voltage ac transmission engineering-Rakosh Das begamudre,
2. Matthias Otto*,Karl Ernst von Muhlendahl-"EMF-Do they play a role in children's environmental health (CEH)?"-Kinderunwelt gGmbH of the german academy of paediatrics Adolescent Medicine, Westerbreite 7,49084 Osanbruck, Germany-Int J.Hyg.Environ.Health 210(2001)635-644,
3. Edwin L.Carstensen-Department of Electrical Engineering, The University of Rochester. Rochester, NY 14627,USA-Journal of electrostatics 39 (1997) 157-174,
4. Martin Blank-Department of Physiology and Cellular Biophysics,Colombia University,Newyork,NY 10032,USA-Biosystems 35 (1995) 175-178,
5. Madurai kamaraj University-S.Somasekaran,
6. SSGBCOE&T,Electronics and Communication Engineering-Girish Kulkarni 1,Dr.W.Z.Gandhare.

AUTHORS PROFILE

R.Sudha: Assistant professor(Senior) (SELECT) at VIT university,Vellore.

Femina sarbudeen: Pursuing B.Tech (EEE) at VIT university,Vellore,

Sharmila Hussain: Pursuing B.Tech (EEE) at VIT university,Vellore,