Eskom

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Dear Ms Yako

THRESHOLDS FOR RADIATION FROM POWER LINES / SUBSTATIONS

Your response letter to Eskom dated 22 June 2006 (ref. 12/12/16/2) has reference. The issue of electric and magnetic fields is a complex one which has been actively managed by Eskom for several decades now, and I welcome this opportunity to share our current position with you. From the outset it must be emphasized that our position is informed by an enormous body of research undertaken internationally. We continuously access this work and review and revise our positions accordingly.

Despite the results of this considerable body of research, which focuses on the possible health effects from power frequency electric and magnetic fields (EMF), the topic still concerns people. Rigorous research over the past thirty years has shown, although no ill-health effects have conclusively been demonstrated from EMF exposure, the concern raised by some epidemiological studies that a low risk may be associated with long-term exposure and some types of cancer [1,4], has spurred a precautionary approach in some countries. The extent of this precautionary approach does however vary widely, with most countries applying the limits of the ICNIRP referred to below.

It should be noted that measurements conducted throughout the world of typical magnetic field levels in power line environments, where the public may be exposed, have demonstrated these levels to be well within international exposure limits. These limits are established by the International Commission on Non Ionizing Radiation Protection (ICNIRP) [3]. Although these limits are not regulated in South Africa, they are endorsed by the Department of Health and the South African Forum for Radiation Protection which is actively supported by Eskom.

Although the National Institute of Environmental Health Sciences (NIEHS) and the International Agency for Research on Cancer (IARC) has classified power frequency magnetic fields as a possible carcinogen, it should be noted that other known agents in the same category include coffee and saccharin, two agents which are use daily. The general consensus it that this risk is very low where the limits mentioned above are experienced.

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ESKOM'S APPROACH

Eskom's approach has been informed by the available research which concludes that exposure to power frequency magnetic fields does not present a significant health risk to the general population at large. It is however, Eskom's policy to continue monitoring developments in international research on the topic and to adopt a precautionary approach informed by these developments and the guidelines established by the ICNIRP.

As opposed to nuclear radiation, X-rays, etc, power line EMF's are classified as non-ionising radiation, that is, they have insufficient energy to change the genetic material of cells. Biological effects from EMF are caused by the current induced inside the body by these fields.

Basic restrictions are set on the current density in the body, to prevent negative effects on normal nervous system functioning. The biological effects arising from current densities induced in the body can be summarized as follows:

Current Density (milliamps per square metre – mA/m^2)	**Effects**
> 1000	Extra systoles (interference to the cardio-vascular system), ventricular fibrillation possible, definite health hazards
100 – 1000	Changes in central nervous system excitability established, stimulation thresholds, possible health hazards.
10 – 100	Well established effects, visual effects (phosphenes), possible nervous system effects, facilitation of bone fracture reunion reported.
1 – 10	Minor biological effects reported.

There is broad consensus that a basic restriction on induced current density of $10mA/m^2$ provides considerable safety margin (a factor of 10) below the level at which stimulation of nerves and muscle tissue occurs. Thus this level is set for occupational exposure. In the case of public exposure, an additional safety factor of 5 is introduced to arrive at a basic restriction of $2\ mA/m^2$.

Knowing the current density restriction, it is possible to calculate the electric and magnetic field levels that will induce such a current density. From an exposure evaluation point of view, it is also easier and more practical to measure electric and magnetic fields than to measure a current density inside the human body.

Based on this rationale, the electric and magnetic field exposure limits set by the International Commission on Non-Ionising Radiation Protection (ICNIRP) are presented in the Table below [3].

Reference Levels: 50Hz Electric and Magnetic Continuous Field Exposure Limits set by ICNIRP

Exposure	Electric field (kV/m)	Magnetic Field (μT)
Occupational	10	500
Public	5	100

Basic Restriction: 10mA/m^2 (occupational), 2mA/m^2 (public) not to be exceeded.
Should the Reference Level, spatially averaged over the whole body, be exceeded, it must be ensured that the Basic Restriction is met and that this value (10mA/m^2 for occupational and 2 mA/m^2 for the general public) is not exceeded [3].

Both Italy and Switzerland have introduced regulatory measures to ensure that magnetic fields to which the public is exposed do not exceed levels of the order of 0,4 microTesla (μT). The financial implications of this action will run into billions [2] in the redesign and rebuilding of major infrastructure – especially transmission infrastructure.

In summary Eskom has been managing the issue by means of:

- Monitoring developments in national and international research;
- Participating in and supporting local EMF research;
- Establishing a national EMF Forum in the Department of Health to report back on research findings and to make recommendations on how to manage the issue in South Africa;
- Sharing information on the topic, in a reactive manner;
- Measuring field levels on request;
- Monitored electric and magnetic field exposure and health of live line workers.
- Applying the guidelines developed by ICNIRP

I hope you find this information useful. Please do not hesitate to contact me should you need any more detail or a presentation on this topic.

W Poulton
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[1] Assessment of Health Effects from Exposure to Power Line Frequency Electric and Magnetic Fields, Working Group Report of the National Institute of Environmental Health Sciences, US Department of Health and Human Services, Aug 1998.

[2] R Conti, Possible Impacts of Limits for Human Exposure to Magnetic Fields, Keynote Presentation SC 36, CIGRE Session, Paris, 2002

[3] Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields (up to 300GHz), Health Physics, Vol 74, No 4: 494-522, April 1998.

[4] US National Institute of Environmental Health Sciences (NIEHS), Report on Health Effects from Exposure to Power Line Frequency Electric and Magnetic Fields, NIH Publication No 99-4493, 4 May 1999.