



Proposed Thyspunt Transmission Lines Integration Project (TTLIP)

MINUTES OF FOCUS GROUP MEETING

**Held on
Thursday, 26 January 2012**

**at
Lucky Look Creche, Tiryville, Uitenhage**

SiVEST Environmental (Pty) Ltd

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Draft Minutes prepared by:

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Please address any comments to Nicolene Venter at the above address.

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YOUR COMMENTS ON THE DRAFT MINUTES

Your comments on these draft Minutes will be appreciated. In particular, we request you to verify that your comments, concerns and/or issues raised during the meeting have been minuted correctly. It is important to note that the draft Minutes are not verbatim.

FOCUS GROUP MEETING

TIRYVILLE COMMUNITY, LUCKY LOOK CRECHE, TIRYVILLE, UITENHAGE

Venue: Lucky Look Creche, Tiryville, Uitenhage
Date: Thursday, 26 January 2012
Time: 16h00

1 WELCOME AND INTRODUCTIONS

Nicolene Venter, SiVEST, as facilitator, thanked the attendees for attending the Focus Group Meeting.

The attendees were requested to identify themselves when raising questions, comments and/or concerns for minute taking purposes.

2 MEETING ATTENDEES

A copy of the Attendance Record is attached as Annexure A.

3 PURPOSE OF THE MEETING

Nicolene Venter informed the attendees that the project team responded to the community's request that a presentation be done and information be provided regarding Nuclear and the association of the proposed Nuclear Power Station with the proposed Transmission power lines.

At the public meeting held in July 2011, the project team was made aware that the residents of Tiryville associate the electricity that will be transported by the proposed Transmission power lines would be radioactive. It was important for the team to inform and present the association of generating electricity by making use of nuclear and the evacuation of the electricity generated through power lines

4 NUCLEAR PRESENTATION

Loyiso Tyabashe, Eskom, presented and explained by making use of visual materials:

- the workings of a nuclear power plant that generates electricity;
- how electricity is generated by making use of nuclear;
- the international safety requirements for a nuclear plant to which Eskom is committed to adhere to and comply with; and
- how electricity is evacuated from a nuclear plant into Eskom's electricity network

The project team made use of the opportunity to physically present a piece of conductor to the attendees which enabled them feel the conductors used by Eskom to 'transport' power from power stations to substations, and substations to end users.

Below is a picture of the example of a conductor that was presented and passed around to the attendees.



The presentation was translated by Nicolene Venter into Afrikaans to ensure that attendees are fully informed and understood the technical reference made by Loyiso Tyabashe.

A copy of the presentation is attached as Annexure B.

A copy of the EMF Report is attached as Annexure C.

A copy of Eskom's Information Brochure (Part 1) is attached as Annexure D.

A copy of the World Health Organisation (WHO) – EMF and Public Health document is attached as Annexure E.

5 DISCUSSION SESSION AND QUESTIONS

Please refer to Annexure F.

6 CLOSURE AND WAY FORWARD

Nicolene Venter informed attendees that the draft FGM minutes will be distributed to all attendees.

All present were thanked for their attendance and the valuable inputs received at the meeting. All were informed that the meeting would not be the only opportunity to submit comments on the proposed project. At any time throughout the EIA process they can submit comments and/or concerns.

The meeting was closed at 17h30.

ATTENDANCE RECORD

ATTENDANCE REGISTER: Tiryville - EMF Feedback Meeting

Lucky Look Creche, Tiryville, Uitenhage

Date: Thursday 26th January 2012 Time: 16h00


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COPY OF PRESENTATION




OVERVIEW OF ELECTRICITY GENERATION FROM A NUCLEAR POWER STATION

L TYABASHE
CHIEF ENGINEER
BSc. Eng. MSc. Eng (UCT); Safety Engineer
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Purpose



- To describe the electricity generation process using nuclear power as a heat source,
- To outline how nuclear radioactive elements from a nuclear plant cannot be transmitted through the transmission power lines.


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Basic Overview of Electricity Production in Coal and Nuclear Power Stations




Power Generation Process:

- Heat source – provides the primary energy source
- Boiler or Steam Generator – converts water to steam
- Turbine – turbine blades convert thermal steam energy to mechanical (rotational) energy of the turbine shaft which is also bolted to the generator shaft
- Generator – converts rotational mechanical energy of the shaft to electrical energy
- Transformer – steps voltage up or down for efficient transmission
- Transmission lines transmit electricity to end-users




Today, most power plants are designed to generate electricity by heating water in a pressure vessel. The steam drives a turbine that runs a generator, producing electricity.

Differences and Similarities between Coal and Nuclear Plant Design and Operation

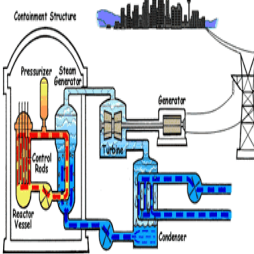


Coal Plant schematic




- Similarity – Steam, turbine and generator operation
- Difference – Heat source

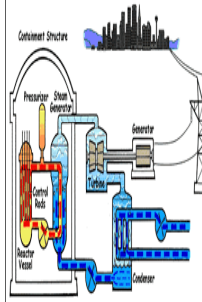
Nuclear Plant schematic




The Primary Circuit




- **Reactor Vessel**
 - Contains fuel assemblies that house the heat source
 - Control rods are used to control the fission reaction inside the reactor thus controlling power of the reactor. Boron, dissolved in water, is also used for this purpose.
- **Pressuriser** keeps the main/primary circuit under high pressure to ensure that no boiling occurs. This is applicable for Pressurised Water Reactors (PWRs).
- **Steam Generator** allows heat transfer to occur between the primary circuit to the secondary circuit (without mixing)
- **Containment structure** houses the primary circuit components and acts as a final barrier for radioactive products.

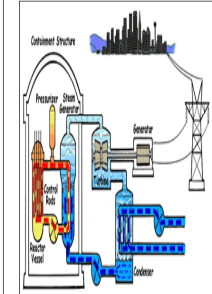


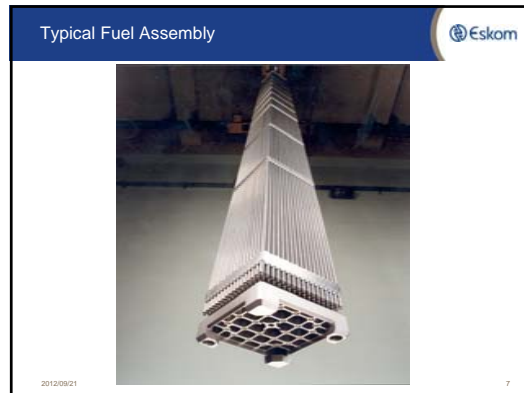
Heat Energy from Fission



- **Fission** – the splitting of a heavy unstable nucleus into two parts accompanied by the emission of neutrons, radiation and the release of heat energy.







Plant Physical Barriers

- A Nuclear Power Plant is designed to protect man and environment, in the process of electricity generation, from potential radiation effects.
- This objective is accomplished through , among other mechanisms, 3 physical barriers:
 - Fuel assembly cladding material
 - Reactor Coolant system
 - Containment Structure

The Secondary Circuit

- Turbine** uses steam from the Steam Generator to turn its shaft which is connected to the generator shaft (rotor).
- An **electrical generator** converts mechanical energy produced by a turbine into electrical energy.
- The three main components for producing power are the **stator, rotor and exciter**.
- As the **rotor** rotates through a **stator** magnetic field, electricity is induced in the coil.
- The **exciter** controls the voltage to be within a specific design envelope.

Conclusion

- A nuclear power plant operates very similar to other thermal power plants such as coal plants. The fundamental difference is the heat source which is the nuclear fuel housed in the nuclear reactor.
- The design of nuclear power plants is aimed at protecting man and environment in the electricity generation process.
- It is **not** feasible for nuclear radioactive products, emanating from a nuclear power plant, to be found in transmission lines.

2012/09/21

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THANK YOU

COPY OF EMF REPORT

HEALTH EFFECTS FROM POWER FREQUENCY ELECTRIC AND MAGNETIC FIELDS: RECENT FINDINGS

P H Pretorius & K R Hubbard

Abstract: *This paper summarises the findings of a recent review conducted by the National Institute of Environmental Health Sciences on the possible health effects of power frequency electric and magnetic fields (EMF). The review group suggested that EMF should be regarded as a 'possible carcinogen'. The paper further places this finding in perspective with similar and other classifications of carcinogens and stresses the importance of communicating these perspectives to the lay person.*

Keywords: Electric, Magnetic, Field, EMF, and Health, Review

1. BACKGROUND

Much debate was centred around possible health effects of power frequency electric and magnetic fields (EMF) over the past three decades. The National Institute of Environmental Health Sciences (NIEHS) was charged in 1992 by the US Congress to prepare and submit *an evaluation of the potential human health effects from exposure to extremely low frequency (ELF) EMF*. This work was carried out under the (US\$60 million, 5 year) EMF Risk Assessment and Public Information Dissemination (RAPID) Programme funded by the US Department of Energy that came to an end in 1997/8¹.

2. EVALUATION PROCESS¹

To evaluate the quality of the science and the strength of the evidence on EMF, NIEHS organised three symposia (covering epidemiology, *in vivo* studies and *in vitro* studies) with special breakaway sessions to discuss the EMF research findings. In addition, a Working Group (WG) Meeting was held with the Group members comprising scientists both within and outside EMF research and representing a wide range of disciplines, including: engineering, epidemiology, cellular and molecular biology, medicine, mathematics, neurobiology, pathology, physics, statistics and toxicology. The objective of the WG was to perform a critical review and evaluation of the research data on ELF EMF exposure and potential biological and / or health effects.

The WG issued a report in August 1998. Comments on the report, both public and scientific were invited for submission by October 1998. A condensed Working

Group report was submitted to the US Congress in June 1999².

Only peer-reviewed literature, published in acknowledged scientific journals was used in the evaluation.

The process of evaluating the carcinogenic risk of EMF was based on a programme, accepted and used by the International Agency for Research on Cancer (IARC) to evaluate the carcinogenic risk of chemicals to humans since 1971. The objective with this programme is to prepare, with the help of International Working Groups of Experts, and to publish in the form of monographs, critical reviews and evaluation of evidence on the carcinogenicity of a wide range of human exposures.

The IARC monographs are recognised as an authoritative source of information on the carcinogenicity of a wide range of human exposures. These monographs may assist national and international authorities in making risk assessments and in formulating decisions concerning any necessary preventative measures. They also provide evaluations based on scientific qualitative judgements about evidence for or against carcinogenicity from the available data. These evaluations represent only one part of the body of information on which regulatory measures may be based. Other components of regulatory decisions may vary from one situation to another and from country to country responding to different socio-economic and national priorities. Therefore, no recommendation is given with regard to regulation or legislation, which is the responsibility of individual governments and/or other international organisations.

Evaluations of the strength of the evidence for carcinogenicity were made based on the following:

2.1 Degrees of evidence for carcinogenicity in humans and in experimental animals and supporting evidence

(These categories refer only to the strength of evidence that an exposure is carcinogenic and not to the extent of its carcinogenic potency nor to the mechanisms involved).

Chief Consultant: Electric and Magnetic Fields (EMF), Eskom Technology Group.

i) *Carcinogenicity in humans, classified according to the following categories¹:*

- a) *Sufficient evidence of carcinogenicity* – the WG considers that a causal relationship has been established between exposure and agent, ie, a positive relationship has been observed between exposure and cancer in studies in which chance, bias and confounding could be ruled out with reasonable confidence.
 - b) *Limited evidence of carcinogenicity* – a positive association has been observed between exposure and agent and cancer for which a causal interpretation is considered by the WG to be credible, but chance, bias or confounding could not be ruled out with reasonable confidence.
 - c) *Inadequate evidence of carcinogenicity* – Available studies are of insufficient quality, consistency or statistical power to permit a conclusion regarding the presence or absence of a causal association or no data on cancer in humans are available.
 - d) *Evidence suggests lack of carcinogenicity* – there are several adequate studies covering the full range of levels of exposure that human beings are known to encounter, which are mutually consistent in not showing a positive association between exposure to the agent and any studied cancer at any observed level of exposure.
- ii) *Carcinogenicity in animals, classified according to the following categories*¹:
- a) *Sufficient evidence of carcinogenicity* – the WG considers that a causal relationship has been established between agent and an increased incidence of malignant neoplasms or of an appropriate combination of benign and malignant neoplasms in (a) two or more species of animals or (b) in two or more independent studies in one species carried out at different times or in different laboratories or under different protocols.
 - b) *Limited evidence of carcinogenicity* – the data suggest a carcinogenic effect but are limited for making a definitive evaluation because (a) evidence of carcinogenicity is limited to a single experiment, (b) there are unresolved questions regarding the adequacy of the design, conduct or interpretation of the study.
 - c) *Inadequate evidence of carcinogenicity* – Studies cannot be interpreted as showing either the presence or absence of a carcinogenic effect because of major qualitative or quantitative limitations.
 - d) *Evidence suggest lack of carcinogenicity* – Adequate studies involving at least two species are available which show that, within the limits of the tests used, the agent is not carcinogenic. A conclusion of evidence suggesting lack of

carcinogenicity is inevitably limited to species, tumour sites and levels of exposure studied.

2.2 Other data relevant to the evaluation of carcinogenicity and its mechanisms¹

The strength of the evidence that any carcinogenic effect observed is due to a particular mechanism is assessed using terms such as weak, moderate or strong.

2.3 Overall evaluation¹

The body of evidence is considered as a whole in order to reach an overall evaluation. The agent or exposure circumstance is described according to the working of one of the following categories:

Group 1: *The agent is carcinogenic to humans:* sufficient evidence of carcinogenicity in humans or evidence in humans is less than sufficient but there is sufficient evidence of carcinogenicity in experimental animals and strong evidence in exposed humans that the agent acts through a relevant mechanism of carcinogenicity.

Group 2A: *The agent is probably carcinogenic:* limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals or inadequate evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals and strong evidence that carcinogenesis is mediated by a mechanism that also operates in humans.

Group 2B: *The agent is possibly carcinogenic:* limited evidence of carcinogenicity in humans and less than sufficient evidence of carcinogenicity in experimental animals; inadequate evidence of carcinogenesis in humans but sufficient evidence of carcinogenicity in experimental animals; inadequate evidence of carcinogenicity in humans but limited evidence of carcinogenicity in experimental animals.

Group 3: *The agent is not classifiable as to its carcinogenicity to humans:* evidence of carcinogenicity is inadequate in humans and inadequate in experimental animals.

Group 4: *The agent is probably not carcinogenic:* evidence suggesting lack of carcinogenicity in humans and in experimental animals.

3 SUMMARY OF EVALUATION¹

3.1 Carcinogenicity in humans:

Of the 29 WG members, 19 voted that EMF are possibly carcinogenic to humans (Group2B). One member abstained and the remaining members voted EMF to be either a Group 3 or Group 4 carcinogen.

- The above decision was driven by the results of childhood leukemia in residential environments and

of chronic lymphocytic leukemia (CLL) in adults in occupational settings.

- *In vitro* and mechanistic data provide, at best, marginal support for the conclusion that ELF EMF are possibly carcinogenic to humans.
- While ELF magnetic field fields at intensities greater than 100µT provide moderate support for effects *in vitro*, there was little evidence of effects at intensities below this limit.

3.2 Non-Cancer Health Effects:

The WG draw the following conclusions related to non-cancer health effects:

- Adverse birth outcomes from maternal occupational exposure – inadequate evidence.
- Reproductive effects from paternal exposure – inadequate evidence.
- Alzheimer’s disease – inadequate evidence.
- Amyotrophic lateral sclerosis – inadequate evidence.
- Suicide and depression – inadequate evidence.
- Adverse effects on pregnancy outcome or depression – inadequate evidence.
- Effects on immune system in experimental animals – no evidence.
- Cardiovascular disease – inadequate evidence.
- Effects on hematological parameters in rodents – no evidence.
- Neurobehavioral, neuropharmacological, neurophysiological and neurochemical effects in experimental animals – weak evidence.
- Reproductive or developmental effects from exposure to sinusoidal magnetic fields in experimental animals – no evidence.
- Affects bone repair and adaptation – strong evidence (for complex clinical exposures to pulsed electromagnetic fields).
- Affect nervous system and non-bone connective tissue repair and adaptation in vertebrates – no conclusion reached.
- Short term exposure and heart rate variability – weak evidence.
- Short term exposure and changes in sleep disturbance – weak evidence.
- Short term exposure and suppression of melatonin – weak evidence.
- Alters the levels of melatonin in rodents – weak evidence.
- Alters the levels of melatonin in sheep and baboons – no evidence.
- Effects on hematological system in experimental animals – no evidence.
- Electric fields can be perceived – strong evidence.

4 OVERALL EVALUATION¹

- The WG concluded that classification of ELF EMF as possibly carcinogenic (Group 2B) is a conservative, public health decision based on limited evidence of an increased risk for childhood leukemia with residential exposure and an increased occurrence of CLL associated with occupational exposure.
- For these cancers, the results of *in vivo*, *in vitro* and mechanistic studies do not confirm or refute the findings of epidemiological studies.
- Overall body of evidence has laid a foundation for furthering the understanding of the biological effects, mechanisms and exposure circumstances that may be related to the possible carcinogenicity and other adverse human health effects of exposure to ELF EMF.

5 IN PERSPECTIVE

This paper reflects the findings presented in the NIEHS WG Report. Further, the following comments are those of the author and not of Eskom in particular: The table below indicates examples of several well known carcinogenic agents, the categories they fall in and the number of carcinogens per category.

Category	Examples	No in Category
Group 1	Asbestos, benzene, tobacco smoking	75
Group 2A	Formaldehyde, ultraviolet radiation	59
Group 2B	Chloroform, saccharin, coffee, gasoline, welding fumes, (EMF)	225
Group 3	Coal dust, selenium, toluene	474
Group 4	Caprolactam	1

Suggestions to treat EMF as a Group 2B carcinogen may be alarmist and of concern to the lay person. However, being informed that coffee and saccharin (well known consumables by choice) fit the same carcinogenic profile as EMF, may largely alleviate such alarm or concern. It is therefore imperative that EMF information of this nature, be accurately communicated and conveyed in perspective to the person, less versed on the topic.

6 REFERENCES

- 6.1 Assessment of Health Effects from Exposure to Power Line Frequency Electric and Magnetic Fields, NIEHS Working Group Report, Aug 1998 (<http://www.niehs.nih.gov>).
- 6.2 NIEHS Report on Health Effects from Exposure to Power Line Frequency Electric and Magnetic Fields, NIH Publication No 99-4493, 4 May 1999.

ESKOM INFORMATION BROCHURE (Part 1)



Eskom Information Brochure: Electric and Magnetic Fields (EMF's)

1. SUMMARY

There is an ever increasing misconception, by the general public, with regard to health risks associated with Electric and Magnetic Fields (EMF's) and Electric Transmission power lines.

Research into the biological effects of EMF has been accompanied by considerate public concern over the last decade or more. Lay understanding of the topic has, unfortunately, also been clouded by media coverage with a sensational tone to it.

Electric and Magnetic Fields are associated with all electrical equipment and not just power lines.

The EMF's to which people are exposed in the home and office environments are well within the International Radiation Association (IRPA) recommended guidelines.

FACT SHEET: ELECTRIC AND MAGNETIC FIELDS – CAN THEY AFFECT YOU?

Electricity is essential in our modern society; we use it in our homes, at leisure and in our work places. Without it we would be unable to function as we do and it would be difficult to envisage industrial development. Therefore any suspicion that fields associated with electric power may be harmful to humans must be addressed in a responsible manner.

There have been several debates about human exposure to these fields and their possible biological effects. In many instances this has become an emotional issue widely discussed by the media. Because of the lack of sufficient knowledge on the subject, such reports have had the effect of blowing the subject out of proportion.

QUESTION:

What is an Electric Field?

ANSWER:

The electric field is the invisible “force” generated by the voltage on a conductor. Close to the conductor this field is at its maximum and decreases the further one moves away from the conductor.

The electric field rises and falls, fifty times per second, as the voltage rises and falls on the conductor. The frequency with which the voltage rises and falls is measured in hertz. In this case 50 hertz, the frequency at which Eskom generates electricity. The unit used to indicate the value of the field is kilovolt per metre (kV/m).

QUESTION:

What is the value of the electric field near Eskom’s power lines?

ANSWER:

A typical maximum value of the electric field at the servitude boundary of the highest voltage transmission line in South Africa, namely 765 000 volt, is about 3kV/m. This level is lower than the maximum limit of 5kV/m suggested for continuous general public exposure by the International Radiation Protection Association (IRPA), which forms part of the World Health Organisation.

It is interesting to note also that the intensity of the electric field is reduced markedly by objects such as vegetation and buildings.

Extensive research has found no detrimental effects on health from electric fields.

QUESTION:

What is a Magnetic Field?

ANSWER:

The Magnetic Field is also an invisible force, generated by the current flowing in the conductors. The intensity of the magnetic field also drops rapidly the further one moves away from the conductor..

QUESTION:

What is the unit of measurement for the magnetic field?

ANSWER:

The unit of measurement for the magnetic field generated by power lines is the microtesla (μT). A typical maximum value for the magnetic field intensity, at man's height underneath a 765 000 volt transmission line carrying 1 000 ampere, is about $3\mu\text{T}$ as measured at the end of a servitude. The suggested IRPA limit for continuous general public exposure is $100\mu\text{T}$.

QUESTION:

Can the magnetic field around conductors have a negative effect on people and animals?

ANSWER:

After nearly two decades of scientific research on power frequency fields and their possible biological effects, scientists have not been able to decide whether or not exposure to magnetic fields is harmful to human or animal health.

QUESTION:

Has research on the subject been shelved?

ANSWER:

No. Research is increasing in many laboratories around the world in an attempt to finally answer all the questions.

Reviews of past research have been carried out by various health and regulatory bodies, including the World Health Organisation (WHO), Cigre (International Conference on High Voltage Systems) and the Electric Power Research Institute (EPRI) in the United States.

Various national bodies such as the National Grid Company in England, and various universities and research groups world-wide are also involved in ongoing research.

They have all been trying to reach a conclusion on whether adverse health effects exist or not.

QUESTION:

Has Eskom carried out any research on the subject?

ANSWER:

Eskom, as South Africa's national electricity supply utility and as a responsible organization is involved in local research on the issue. The main drive is to measure the electromagnetic environment around our lines and substations to determine the levels of public and employee exposure.

Eskom supports university research in South Africa, and continuously encourages the creation of a countrywide electric and magnetic field forum.

Eskom is continuously monitoring research and literature on the subject to stay abreast of developments.

For more information: dial 011 629 5212/6295107 during office hours.

**WORLD HEALTH ORGANISATION (WHO) – EMF and Public
Health Document**



Fact sheet N°322
June 2007

Electromagnetic fields and public health

Exposure to extremely low frequency fields

The use of electricity has become an integral part of everyday life. Whenever electricity flows, both electric and magnetic fields exist close to the lines that carry electricity, and close to appliances. Since the late 1970s, questions have been raised whether exposure to these extremely low frequency (ELF) electric and magnetic fields (EMF) produces adverse health consequences. Since then, much research has been done, successfully resolving important issues and narrowing the focus of future research.

In 1996, the World Health Organization (WHO) established the International Electromagnetic Fields Project to investigate potential health risks associated with technologies emitting EMF. A WHO Task Group recently concluded a review of the health implications of ELF fields (WHO, 2007).

This Fact Sheet is based on the findings of that Task Group and updates recent reviews on the health effects of ELF EMF published in 2002 by the International Agency for Research on Cancer (IARC), established under the auspices of WHO, and by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) in 2003.

ELF field sources and residential exposures

Electric and magnetic fields exist wherever electric current flows - in power lines and cables, residential wiring and electrical appliances. **Electric** fields arise from electric charges, are measured in volts per metre (V/m) and are shielded by common materials, such as wood and metal. **Magnetic** fields arise from the motion of electric charges (i.e. a current), are expressed in tesla (T), or more commonly in millitesla (mT) or microtesla (μ T). In some countries another unit called the gauss, (G), is commonly used ($10,000\text{ G} = 1\text{ T}$). These fields are not shielded by most common materials, and pass easily through them. Both types of fields are strongest close to the source and diminish with distance.

Most electric power operates at a frequency of 50 or 60 cycles per second, or hertz (Hz). Close to certain appliances, the magnetic field values can be of the order of a few hundred microtesla. Underneath power lines, magnetic fields can be about $20\text{ }\mu\text{T}$ and electric fields can be several thousand volts per metre. However, average residential power-frequency magnetic fields in homes are much lower - about $0.07\text{ }\mu\text{T}$ in Europe and $0.11\text{ }\mu\text{T}$ in North America. Mean values of the electric field in the home are up to several tens of volts per metre.

Task group evaluation

In October 2005, WHO convened a Task Group of scientific experts to assess any risks to health that might exist from exposure to ELF electric and magnetic fields in the frequency range >0 to $100,000\text{ Hz}$ (100 kHz). While IARC examined the evidence regarding cancer in 2002, this Task Group reviewed evidence for a number of health effects, and updated the evidence regarding cancer. The conclusions and recommendations of the Task Group are presented in a WHO Environmental Health Criteria (EHC) monograph (WHO, 2007).

Following a standard health risk assessment process, the Task Group concluded that there are no substantive health issues related to ELF electric fields at levels generally encountered by members of the public. Thus the remainder of this fact sheet addresses predominantly the effects of exposure to ELF magnetic fields.

Short-term effects

There are established biological effects from acute exposure at high levels (well above 100 μT) that are explained by recognized biophysical mechanisms. External ELF magnetic fields induce electric fields and currents in the body which, at very high field strengths, cause nerve and muscle stimulation and changes in nerve cell excitability in the central nervous system.

Potential long-term effects

Much of the scientific research examining long-term risks from ELF magnetic field exposure has focused on childhood leukaemia. In 2002, IARC published a monograph classifying ELF magnetic fields as "possibly carcinogenic to humans". This classification is used to denote an agent for which there is limited evidence of carcinogenicity in humans and less than sufficient evidence for carcinogenicity in experimental animals (other examples include coffee and welding fumes). This classification was based on pooled analyses of epidemiological studies demonstrating a consistent pattern of a two-fold increase in childhood leukaemia associated with average exposure to residential power-frequency magnetic field above 0.3 to 0.4 μT . The Task Group concluded that additional studies since then do not alter the status of this classification.

However, the epidemiological evidence is weakened by methodological problems, such as potential selection bias. In addition, there are no accepted biophysical mechanisms that would suggest that low-level exposures are involved in cancer development. Thus, if there were any effects from exposures to these low-level fields, it would have to be through a biological mechanism that is as yet unknown. Additionally, animal studies have been largely negative. Thus, on balance, the evidence related to childhood leukaemia is not strong enough to be considered causal.

Childhood leukaemia is a comparatively rare disease with a total annual number of new cases estimated to be 49,000 worldwide in 2000. Average magnetic field exposures above 0.3 μT in homes are rare: it is estimated that only between 1% and 4% of children live in such conditions. If the association between magnetic fields and childhood leukaemia is causal, the number of cases worldwide that might be attributable to magnetic field exposure is estimated to range from 100 to 2400 cases per year, based on values for the year 2000, representing 0.2 to 4.95% of the total incidence for that year. Thus, if ELF magnetic fields actually do increase the risk of the disease, when considered in a global context, the impact on public health of ELF EMF exposure would be limited.

A number of other adverse health effects have been studied for possible association with ELF magnetic field exposure. These include other childhood cancers, cancers in adults, depression, suicide, cardiovascular disorders, reproductive dysfunction, developmental disorders, immunological modifications, neurobehavioural effects and neurodegenerative disease. The WHO Task Group concluded that scientific evidence supporting an association between ELF magnetic field exposure and all of these health effects is much weaker than for childhood leukaemia. In some instances (i.e. for cardiovascular disease or breast cancer) the evidence suggests that these fields do not cause them.

International exposure guidelines

Health effects related to short-term, high-level exposure have been established and form the basis of two international exposure limit guidelines (ICNIRP, 1998; IEEE, 2002). At present, these bodies consider the scientific evidence related to possible health effects from long-term, low-level exposure to ELF fields insufficient to justify lowering these quantitative exposure limits.

WHO's guidance

For high-level short-term exposures to EMF, adverse health effects have been scientifically established (ICNIRP, 2003). International exposure guidelines designed to protect workers and the public from these effects should be adopted by policy makers. EMF protection programs should include exposure measurements from sources where exposures might be expected to exceed limit values.

Regarding long-term effects, given the weakness of the evidence for a link between exposure to ELF magnetic fields and childhood leukaemia, the benefits of exposure reduction on health are unclear. In view of this situation, the following recommendations are given:

- Government and industry should monitor science and promote research programmes to further reduce the

uncertainty of the scientific evidence on the health effects of ELF field exposure. Through the ELF risk assessment process, gaps in knowledge have been identified and these form the basis of a new research agenda.

- Member States are encouraged to establish effective and open communication programmes with all stakeholders to enable informed decision-making. These may include improving coordination and consultation among industry, local government, and citizens in the planning process for ELF EMF-emitting facilities.
- When constructing new facilities and designing new equipment, including appliances, low-cost ways of reducing exposures may be explored. Appropriate exposure reduction measures will vary from one country to another. However, policies based on the adoption of arbitrary low exposure limits are not warranted.

Further reading

WHO - World Health Organization. Extremely low frequency fields. Environmental Health Criteria, Vol. 238. Geneva, World Health Organization, 2007.

IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Non-ionizing radiation, Part 1: Static and extremely low-frequency (ELF) electric and magnetic fields. Lyon, IARC, 2002 (Monographs on the Evaluation of Carcinogenic Risks to Humans, 80).

ICNIRP - International Commission on Non-Ionizing Radiation Protection. Exposure to static and low frequency electromagnetic fields, biological effects and health consequences (0-100 kHz). Bernhardt JH et al., eds. Oberschleissheim, International Commission on Non-ionizing Radiation Protection, 2003 (ICNIRP 13/2003).

ICNIRP – International Commission on Non-Ionizing Radiation Protection (1998). Guidelines for limiting exposure to time varying electric, magnetic and electromagnetic fields (up to 300 GHz). Health Physics 74(4), 494-522.

IEEE Standards Coordinating Committee 28. IEEE standard for safety levels with respect to human exposure to electromagnetic fields, 0-3 kHz. New York, NY, IEEE - The Institute of Electrical and Electronics Engineers, 2002 (IEEE Std C95.6-2002).

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DISCUSSION SESSION AND QUESTIONS

BESPREKINGSDOKUMENT / DISCUSSION DOCUMENT

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Issue/Comment	Raised By	Response
1. Sosiaal en Socio-Ekonomiese Aanverwante Kommentaar / Social and Socio-Economic Related Comments		
<p>Spreek haar kommer uit oor die impak wat die kraglyne op hulle as inwoners kan hê, veral omdat dit van die kernkragstasie af kom.</p> <p>Translation: Express his concern that the power line will have on them as residents especially since the lines are coming from the nuclear power station.</p>	Swartz, Rowanda Swartz, Natasha Resident: Tiryville	<p>Soos per die aanbieding van Eskom se Kernkrag Fisikus is die voorgestelde kraglyne nie radio-aktief nie aangesien dit gewone elektrisiteit is wat die lyne voorsien, ongeag of dit van 'n kern kragstasie of steenkool kragstasie af kom.</p> <p>Nicolene Venter, SiVEST</p> <p>Translation: As per Eskom's Nuclear Physicist's presentation the proposed power lines are not radio-active as it is normal electricity that is provided through the lines whether the power is generated by a nuclear power station or a coal fired power station.</p>
2. EMF en Gesondheid Aanverwante Kommentaar / EMF and Health Related Comments		
<p>Die kwessie rondom gesondheid was geopper veral as daar 'n fout op die kraglyn ontstaan en naby gelee inwoners kan gesondheid gewys nadelig geraak word.</p> <p>Translation: The issue was raised regarding health, especially if there is a fault on the power line and could adversely affect the health of those residents in close proximity.</p>	Maart, Jennifer Resident, Tiryville	<p>There will be no negative health impacts associated with a faulty power line as there are no nuclear associated with the power lines and the distance from the power line to the nearest house is over a km away.</p> <p>Loyiso Tyabashe, Eskom</p>
<p>Dit word verneem hoe ver mag 'n huis van die kraglyn af wees om 'n veilige afstand te wees.</p> <p>Translation: It was enquired as to what is a safe distance between the power line and a house.</p>		<p>Each 400kv power line will have a registered servitude of 55m which means a house can be build (or if an existing house) from the 55m servitude outwards.</p> <p>Translation: Elke 400kV kraglyn sal 'n geregistreerde serwituut van 55m hê wat beteken dat 'n huis vanaf die 55m buitekant toe gebou kan word (of indien 'n bestaande huis).</p> <p>Paul da Cruz, SiVEST</p>
3. Kommunikasie/Konsultasie Aanverwante Kommentaar / Communication/Consultation Related Comments		
<p>Die versoek was gerig dat 'n afskrif van die Kernkrag aanbieding en die EMF verslag waarna Mnr Hubbard verwys het, by die konsepsnotule aangeheg moet word.</p> <p>Translation: The request was made that a copy of the Nuclear presentation and the EMF report referred to Mr. Hubbard, to be attached to the draft Minutes.</p>	All Attendees Resident, Tiryville	<p>Request noted.</p> <p>Nicolene Venter, SiVEST</p>
4. Kernkrag Aanverwante Kommentaar / Nuclear Related Comments		
<p>'n Kernkragstasie is 'n gevaalike plek om by te werk en dit word verneem wat word van die klere van die mense wat daar werk.</p>	Swartz, Rowanda Resident: Tiryville	<p>People working in the plant wear protective clothes as prescribed and regulated by Law and these protective clothes stay on the premises.</p>

Issue/Comment	Raised By	Response
<u>Translation:</u> A Nuclear Power Station is a dangerous place to work and it was asked as to what happens to the clothes of the people who work there.		<u>Translation:</u> Mense wat in die aanleg werk dra beskermende kleren wat voorgeskryf en gereguleer word deur die Wet en hierdie beskermende kleren bly op die perseel. <i>Loyiso Tyabashe, Eskom</i>