

Eskom, South Africa

Review of Empetus
Report on Electric and
Magnetic Fields (EMF)
from Overhead
Power Lines

Project Ref: 518214/001-2

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1. Executive Summary

- 1.1 Eskom as a leading energy provider in South Africa is keen to ensure that it is aware of and up-to-date with international knowledge, guidance and good practice on the impacts of exposure to electric and magnetic fields from overhead power lines.
- 1.2 In early 2006, Eskom commissioned Empetus CC to produce a report on the human health impacts of electric and magnetic fields due to exposure from overhead power lines. Eskom has now commissioned Peter Brett Associates to peer review the Empetus CC *Final Report on Electric and Magnetic Fields from Overhead Power Lines* to comment on its relevance, accuracy, adequacy and appropriateness.
- 1.3 The aim of the Empetus report was to provide an easy to understand, non-technical, report on the health impacts of exposure to the electric and magnetic fields of power lines. It is only partially successful in achieving this. Though the majority of the content of the report is sound, the way it is structured, the lack of transparency in how the evidence was gathered and interpreted as well as some of the phraseology used within it makes the document flawed from a public health perspective.
- 1.4 The strongest aspect of the Empetus report are the technical elements: the analysis of the physical measurements and the analysis of approaches to shielding. The overall range of evidence presented the health effects of electric and magnetic fields encompassing research on humans, animals and plants is also very good. The weakest parts are the development of the scope of the report, what review methodology was used, the way some of the evidence review extracts are presented and the presentation of risk perception and communication research and evidence to help Eskom resolve community concerns about the potential health impacts of power lines.
- 1.5 In conclusion, while this report is a good starting point it does not provide the easy to understand overview that was aimed for and overall we judge the report is more likely to heighten community and other stakeholders concerns rather than resolve them.

This executive summary contains an overview of the key findings and conclusions. However no reliance should be placed on any part of the executive summary until the whole of the report has been read.

2. Introduction

- 2.1 Eskom as a leading energy provider in South Africa is keen to ensure that it is aware of and up-to-date with international knowledge, guidance and good practice on the impacts of exposure to electric and magnetic fields from overhead power lines.
- 2.2 In early 2006, Eskom commissioned Empetus CC to produce a report on the impacts of electric and magnetic fields due to exposure from overhead power lines.
- 2.3 Eskom has now commissioned Peter Brett Associates to peer review the Empetus CC *Final Report on Electric and Magnetic Fields from Overhead Power Lines* to comment on its relevance, accuracy, adequacy and appropriateness.
- 2.4 The four objectives of this peer review¹ were to:
- Review the adequacy and appropriateness of the scope of the report.
 - Review the adequacy and appropriateness of the evidence and technical aspects within the report.
 - Review the appropriateness of the conclusions drawn.
 - Provide constructive suggestions for enhancing the scope, evidence and conclusions of the report
- 2.5 Thirty years of research with over 25,000 articles and 129 reviews have not resolved public concern and scientific uncertainty about the health impacts of being exposed to electric and magnetic fields of power lines^{2 3}. This is because the health effects of exposure to electric and magnetic fields (EMF) at a population level are both very

¹ Peer review is the evaluation by experts of the quality and relevance of work carried out by other experts. Gitanjali B. Peer review -- process, perspectives and the path ahead. J Postgrad Med 2001;47:210-4; <http://www.jpgmonline.com/article.asp?issn=0022-3859;year=2001;volume=47;issue=3;spage=210;epage=4;aulast=Gitanjali>; last accessed 30th June 2006

² Summary of health effects, Electromagnetic fields website, World Health Organization; <http://www.who.int/peh-emf/about/WhatisEMF/en/index1.html>; last accessed 30th June 2006

³ Electric and magnetic fields information website; National Grid http://www.emfs.info/expert_ScienceReviews.asp; last accessed on 3rd July 2006

weak and very small. This exacerbates the inherent weaknesses and limitations in the scientific methodologies used to investigate EMF exposure and health impacts.

- 2.6 Alongside this research, a wider social and scientific shift has also occurred where the absence of evidence on health effects is not seen to mean evidence of the absence of impacts. This is embodied in the Precautionary Principle which states that uncertainty should not preclude us from safeguarding the environment and human health. The Principle argues that organisations dealing with environmental and health risks should proceed with caution and wherever possible pursue a strategy that makes allowances for the uncertainty of potential impacts⁴.
- 2.7 There is considerable public sensitivity around the issue of residential exposure to EMFs from power lines. This means that review evidence needs to be conveyed accurately, adequately and appropriately to ensure that trust and confidence are enhanced and misunderstandings and suspicions reduced between local communities and electricity transmission companies. Selective presentation of evidence or the use of sources that are perceived to be biased can hinder the communication process, hurt reputation and make the siting and planning of power lines more difficult.
- 2.8 This report is made up of seven chapters:
- Chapter 1 is an introduction to this peer review report and its context.
 - Chapter 2 describes the peer review methodology.
 - Chapter 3 reviews the scope of the Empetus report.
 - Chapter 4 reviews the evidence and technical aspects of the Empetus report.
 - Chapter 5 reviews the conclusions of the Empetus report.
 - Chapter 6 provides recommendations for enhancing the Empetus report.

⁴ The Precautionary Principle: public health, protection of children and sustainability; World Health Organization Background Document; Fourth Ministerial Conference on Environment and Health Budapest, Hungary, 23–25 June 2004; http://www.euro.who.int/healthimpact/MainActs/20040129_1 last accessed 30th June 2006

- Chapter 7 summarises the overall findings and implications of this peer review.

3. Review Methodology

- 3.1 The methodology used in this peer review has not been based on any established criteria for the review of health impact evidence.
- 3.2 This is because firstly, while there is work in progress, through the UK Department of Health, on a set of review criteria for assessing health impact evidence reviews this is not currently in the public domain⁵.
- 3.3 Secondly, the only internationally recognised health evidence review criteria are those of the Cochrane collaboration⁶. However, these are for carrying out systematic reviews and as the Empetus report is not a systematic review they are not appropriate.
- 3.4 Thirdly, as the Empetus report provided no explicit description of the methodology used to collect and interpret the evidence it has been difficult to fully verify the adequacy and appropriateness of their approach.
- 3.5 The peer review methodology involved a close reading of the report with verification of the evidence, the sources of evidence and the technical issues described in the report.
- 3.6 The internet was the major information gateway used for this peer review given the time constraints and the structure of the Empetus report. Google was used as the search engine of choice.

⁵ A guide for reviewing evidence for health impact assessment; J Mindell et al, London Health Observatory (in development)

⁶ Cochrane Handbook for Systematic Reviews of Interventions (formerly the Reviewers' Handbook); Version 4.2.5; The Cochrane Collaboration; <http://www.cochrane.org/resources/handbook/>; last accessed 30th June 2006

- 3.7 Where no sources were listed attempts were made to identify the source through keyword searches.
- 3.8 Where sources were not available in the public domain these were accessed through subscription-based information services or verified through citations within secondary sources.

4. Review of the Empetus Methodology

4.1 The scope of the Empetus report was to:

“...support answers, in a not-too-technical manner and in a way that is easy to understand, to some of the questions that may be raised.”

4.2 Six areas are covered:

- Specific concepts that need to be addressed in forming an understanding of the topic.
- Examples of typical field levels in various environments, including power line environments.
- An overview of reviews on research findings.
- Findings of studies conducted on farm animals and plants near power lines.
- Exposure limits
- Opinions and conclusions drawn by international and credible organisations, such as, the World Health Organization.

4.3 The main sentence concerning the scope of the report states that it will provide information to support answers to ‘some of the questions’ that might be raised but does not make explicit what these questions are likely to be and why only some and not all likely questions are going to be addressed in the report.

4.4 There is no explanation of how these objectives were arrived at and what approach would be used to address them.

4.5 There is no proper consideration of risk perception or risk communication and how the six themes lead to the development of the five risk management principles put forward in the report’s conclusion.

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- 4.6 Finally, and most importantly, the sketchy nature of the scope and its context raise more questions about the report which reduces the credibility of the information and evidence presented.
- 4.7 Overall, though the scope of the Empetus report is adequate, the six areas or themes in particular, the overall aim itself is not appropriate given the existing communication material available in the public domain. It would have been better if the report had:
- a) to have highlighted existing materials available from authoritative sources (see conclusion) that could be used by Eskom to help answer the questions and concerns of affected communities;
 - b) provided the technical context for the power transmission within South Africa (as the Empetus report has done); and
 - c) focused on the risk perception, communication and management issues as they relate to the health impacts of EMF exposure from power lines.

5. Review of the Evidence and Technical Aspects of the Empetus Report

What are electric and magnetic fields?

- 5.1 Section 2.1 of the Discussion provides a good overview of what electric and magnetic fields are and how they relate to the power line infrastructure used by Eskom.

Modern power line structures and associated fields

- 5.2 Section 2.2 of the Discussion provides a good overview of the modern power line structures and their associated fields as they relate to the power line infrastructure used by Eskom.

Overview of research findings

- 5.3 Section 2.3 Overview of research findings would have been better termed 'What are the effects on humans?' to keep it consistent with Sections 2.4 and 2.5 on 'What are the effects on animals?' and 'What are the effects on plants?'.
- 5.4 The research literature on the human health impacts of EMF is very large and difficult to place in context. A rapid overview of key reviews is therefore a valid and sound approach. However, there is no attempt in this section to describe how the reviews presented were chosen and what reviews, if any, had been excluded and why. There was also no information on what bibliographic and internet sources had been used.
- 5.5 The most accessible list of reviews on EMF exposure and human health effects is found on the National Grid site which lists the major international reviews undertaken between 1977 and 2004⁷. There have been 129 reviews in that period.

⁷ Reviews of EMF Science conducted by Scientific Panels, Public Health Organizations, or Governmental Bodies; http://www.emfs.info/expert_ScienceReviews.asp; last accessed 30th June 2006

- 5.6 It is not useful to undertake an overview of all these reviews as there have been significant advances in study methodology, statistical methods and computing resources over the last ten. Therefore, it would have been reasonable to focus only on the reviews carried out within the last ten years - 1996 to 2006 – as they provide the best and most accurate assessment of the health impacts of EMF exposure.
- 5.7 The Empetus report provides a very brief historical background to EMF health research and then provides a conclusion statement on what the reviews state on one key health impact – the weak association between EMF exposure and childhood leukaemia.
- 5.8 The report's definition of epidemiology is poor and its explanation of the limitations of epidemiology and studies on EMF and human health is partial. A better approach would have been to place epidemiology with the context of the other clinical and laboratory studies on the impacts of EMF exposure.
- 5.9 A better description of the range of study types and the place of epidemiology is provided by the World Health Organization on its EMF website⁸:

“A mix of studies in different research areas is essential for the evaluation of a potential adverse health effect of electromagnetic fields. Different types of studies investigate distinct aspects of the problem. Laboratory studies on cells aim to elucidate the fundamental underlying mechanisms that link electromagnetic field exposure to biological effects. They try to identify mechanisms based on molecular or cellular changes that are brought about by the electromagnetic field - such a change would provide clues to how a physical force is converted into a biological action within the body. In these studies, single cells or tissues are removed from their normal living environment which may inactivate possible compensation mechanisms.

Another type of study, involving animals, is more closely related to real life situations. These studies provide evidence that is more directly relevant to establishing safe

⁸ Different types of studies are needed; Comprehensive information is provided hereafter on what electromagnetic fields are, their impact on health, as well as the current exposure standards and recommended precautions; World Health Organization; <http://www.who.int/peh-emf/about/WhatisEMF/en/index2.html>; last accessed 30th June 2006

exposure levels in humans and often employ several different field levels to investigate dose-response relationships.

Epidemiological studies or human health studies are another direct source of information on long-term effects of exposure. These studies investigate the cause and distribution of diseases in real life situations, in communities and occupational groups. Researchers try to establish if there is a statistical association between exposure to electromagnetic fields and the incidence of a specific disease or adverse health effect. However, epidemiological studies are costly. More importantly, they involve measurements on very complex human populations and are difficult to control sufficiently well to detect small effects. For these reasons, scientists evaluate all relevant evidence when deciding about potential health hazards, including epidemiology, animal, and cellular studies.”

- 5.10 The report then goes on to state that many studies have been undertaken over the last twenty whilst only providing two references. It would have been useful to cite the some of the reviews listed on the National Grid EMF website.
- 5.11 Six reviews are explored in detail but how and why these particular reviews were chosen is not clear. One review is from an international agency, the International Agency for Research on Cancer (IARC), two from the UK National Radiological Protection Board (NRPB now part of the UK Health Protection Agency) and three from US agencies; the US Environmental Protection Agency (EPA), the US National Academy of Sciences (NAS) and the US National Institute of Environmental Health Sciences (NIEHS).
- 5.12 The US EPA review cited at 2.3.2 in the Empetus report is superseded by the more recent work of the NIEHS. Furthermore, a search on the EPA website identified a page on EMF exposure from power lines and human health impacts of buying a house near them. The page states that the EPA have not issued an official statement on the issue of EMF exposure and human health risks and then goes on to highlight key conclusions from the review by IARC and NIEHS⁹.

⁹ EMF, US Environmental protection Agency; <http://www.epa.gov/radiation/sources/emf.htm>; last accessed 30th June 2006

- 5.13 It is unclear why two reviews by the NRPB are presented given that the 2001 report is an updating of the 1992 report taking into account experimental and epidemiological research completed and published since the 1992 report.
- 5.14 In detailing the conclusions of the NIEHS the extracts cited at 2.3.4 in the Empetus report are selective and come from different sources including in one case a NIEHS press release which cannot be classed as the same quality of evidence as the actual review report. The extract quoted at the bottom of page 12 is a partial with the first two paragraphs of the conclusion of the review report not stated. Including them changes the whole tenor of the argument made by the NIEHS. The first two paragraphs of the conclusion are (highlighting of phrases in bold added)¹⁰:

*“As part of the EMF-RAPID Program’s assessment of ELF-EMF-related health effects, an international panel of 30 scientists met in June 1998 to review and evaluate the weight of the ELF-EMF scientific evidence (12). Using criteria developed by the International Agency for Research on Cancer, **none of the Working Group considered the evidence strong enough to label ELF-EMF exposure as a “known human carcinogen” or “probable human carcinogen.” However, a majority of the members of this Working Group (19/28 voting members) concluded that exposure to power-line frequency ELF-EMF is a “possible” human carcinogen.** This decision was based largely on “limited evidence of an increased risk for childhood leukemias with residential exposure and an increased occurrence of CLL (chronic lymphocytic leukemia) associated with occupational exposure.” For other cancers and for non-cancer health endpoints, the Working Group categorized the experimental data as providing much weaker evidence or no support for effects from exposure to ELF-EMF.*

The NIEHS agrees that the associations reported for childhood leukemia and adult chronic lymphocytic leukemia cannot be dismissed easily as random or negative findings. The lack of positive findings in animals or in mechanistic studies weakens the belief that this association is actually due to ELF-EMF, but cannot completely discount the finding. The NIEHS also agrees with the

¹⁰ 1999 NIEHS Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields; Conclusions and Recommendations; National Institute of Environmental and Health Sciences; http://www.niehs.nih.gov/emfrapid/html/EMF_DIR_RPT/Corec18fT.HTM ; last accessed 30th June 2006

conclusion that no other cancers or non-cancer health outcomes provide sufficient evidence of a risk to warrant concern.”

- 5.15 The table of findings presented at 2.3.5 is accurate and appropriate¹¹.
- 5.16 The second quote of the NIEHS (top of page 13) is taken from their press release for the report and even this quote is taken out of context as the NIEHS Director Kenneth Olden, Ph.D., says, *“The lack of consistent, positive findings in animal or mechanistic studies weakens the belief that this association is actually due to EMF, but it cannot completely discount the epidemiological findings. For that reason, and because virtually everyone in the United States uses electricity and therefore is routinely exposed to EMF, efforts to encourage reductions in exposure should continue. For example, industry should continue efforts to alter large transmission lines to reduce their fields and localities should enforce electrical codes to avoid wiring errors that can produce higher fields.”*¹²
- 5.17 The section *Further discussion on the NIEHS report* (not numbered) of the Empetus report describes the classification of EMFs as possible carcinogens as “alarmist and of concern to lay people” it then goes on to provide a table of examples of other familiar everyday food substances that also fall into the category of possible carcinogens and recommends that comparing EMFs to everyday food substances that are also classed as possible carcinogen to reduce alarm and concern. This statement shows a lack of understanding of the risk perception and risk communication literature. Risk comparisons can be useful but need to be used carefully and do not work well in situations where a voluntary risk (ingestion of coffee and saccharine) is compared to an involuntary risk, namely, exposure to EMFs from power lines. In most instances this is likely to exacerbate community concerns and generate community anger.

¹¹ Assessment of Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields; Working Group Report; National Institute of Environmental Health Sciences; 1998; http://www.niehs.nih.gov/emfrapid/html/WGReport/PDF_Page.html; last accessed 30th June 2006

¹² Environmental Health Institute Report Concludes Evidence is 'Weak' that EMFs Cause Cancer; National Institute of Environmental Health Sciences, Press Release #9-99; 15 June 1999 June 15, 1999; <http://www.niehs.nih.gov/oc/news/emffin.htm>; last accessed 30th June 2006

- 5.18 The NRPB 2001 extract cited at 2.3.7 in the Empetus report is an extensive and accurate one that provides considerable detail on the evidence on the health impacts of EMF exposure¹³.
- 5.19 The IARC 2001 press release cited at 2.3.7 in the Empetus report is an accurate and appropriate one¹⁴. It would have been better and more authoritative to quote the original monograph or its summary¹⁵.
- 5.20 The source of the *Review of epidemiology and Childhood Leukaemia* cited at 2.3.8 in the Empetus report is a paper titled *Childhood leukemia and residential magnetic fields: are pooled analyses more valid than the original studies?*¹⁶. This study is not a review of all the epidemiology but a critical assessment highlighting the potential limitations and weaknesses of the two pooled analyses which have been influential in determining international EMF exposure standards, as they demonstrated a weak association between EMF exposure and childhood leukaemia, compared to three robust studies conducted more recently which show no association.
- 5.21 The source for the Review of Studies on Breast Cancer cited at 2.3.9 in the Empetus report is not the report which is referenced in the bibliography but the press release of the report¹⁷. The report does not actually say this. The full summary statement within the report states (bold and underline highlighting has been added):

¹³ ELF Electromagnetic Fields and the Risk of Cancer: Report of an Advisory Group on Non-Ionising Radiation; National Radiological protection Board now part of the Health protection Agency; Volume 12, No 1; http://www.hpa.org.uk/radiation/publications/documents_of_nrp/abstracts/absd12-1.htm; last accessed 30th June 2006

¹⁴ IARC finds limited evidence that residential magnetic fields increase risk of childhood leukaemia; Press Release No 136; International Agency for Research on Cancer; 27 June 2001; http://www.iarc.fr/ENG/Press_Releases/archives/pr136a.html ; last accessed 30th June 2006

¹⁵ Non-Ionizing Radiation, Part 1: Static and Extremely Low-Frequency (ELF) Electric and Magnetic Fields; Summary - Monograph No 80; International Agency for Research on Cancer; 2002; <http://monographs.iarc.fr/ENG/Monographs/vol80/volume80.pdf>; and <http://monographs.iarc.fr/ENG/Monographs/allmonos90.php> last accessed 30th June 2006

¹⁶ Childhood leukemia and residential magnetic fields: are pooled analyses more valid than the original studies?; Elwood J; Bioelectromagnetics; 2006 Feb;27(2):112-8.

¹⁷ Power Frequency Electromagnetic Fields, Melatonin and the Risk of Breast Cancer; Press Release; Health Protection Agency, UK; 9 February 2006 http://www.hpa.org.uk/hpa/news/articles/press_releases/2006/060209_emf_cancer.htm; last accessed 30th June 2006

“Exposure to power frequency electromagnetic fields (EMFs) is ubiquitous in modern life. The hypothesis that chronic exposure to EMFs may increase the risk of breast cancer, via a reduction in secretion of the hormone melatonin from the pineal gland, was first made almost 20 years ago, and has led to a great deal of research. To review this hypothesis, this report addresses the evidence on three issues, namely, whether:

(a) EMFS affect the production or action of melatonin,

(b) melatonin affects the risk of breast cancer,

(c) EMFs affect the risk of breast cancer.

Investigations using cells, animals and humans have not given consistent or convincing evidence that EMF exposure affects melatonin production or action. However, there are deficiencies in the existing research, which leaves open the possibility of an affect.

There is stronger evidence that melatonin can inhibit the growth of cancer cells in laboratory culture and in animals. Data on the possible relation of melatonin levels to risk of subsequent breast cancer in humans are limited and inconclusive. Studies investigating the effect of light exposure (which affects melatonin) n breast cancer risk in humans have given some evidence for an association, but left it unclear whether, if there is an association, it is causal in nature.

There is no consistent evidence, from research using cells, animals and humans, that EMF exposure is a cause of breast cancer, nor has any mechanism for such an association been demonstrated.

The report concludes with recommendations for further research.

Overall, the evidence that melatonin, and the timing and extent of light exposure, may affect breast cancer risk is intriguing but not conclusive. In aggregate, the evidence to date does not support the hypothesis that exposure to power frequency EMFs affects melatonin levels of the risk of breast cancer.”

- 5.22 The source for the Review of Electromagnetic Hypersensitivity cited at 2.3.10 in the Empetus report is accurate and appropriate however the World Health Organization

factsheet does not use the pejorative term 'claim' but 'characterise' for describing electromagnetic hypersensitivity and its symptoms. Furthermore in the first paragraph of the Conclusion on diagnosis of hypersensitivity the complete paragraph states¹⁸:

“EHS is characterized by a variety of non-specific symptoms that differ from individual to individual. The symptoms are certainly real and can vary widely in their severity. Whatever its cause, EHS can be a disabling problem for the affected individual. EHS has no clear diagnostic criteria and there is no scientific basis to link EHS symptoms to EMF exposure. Further, EHS is not a medical diagnosis, nor is it clear that it represents a single medical problem.”

- 5.23 The source for the potential effects on pacemakers cited at 2.3.11 in the Empetus report is accurate and appropriate¹⁹.
- 5.24 An overall summary paragraph on the evidence of human health impacts would have been useful at the end of this section

What are the effects on animals?

- 5.25 It has not been possible in the time available for this peer review to follow up all the sources of evidence on animal health impacts. The information and analysis provided seems appropriate.
- 5.26 An overall summary paragraph on the evidence of animal health impacts would have been useful at the end of this section

What are the effects on plants?

- 5.27 It has not been possible in the time available for this peer review to follow up all the sources of evidence on plant health impacts. The information and analysis provided seems appropriate.

¹⁸ Electromagnetic fields and public health: electromagnetic hypersensitivity; Factsheet no 296, World Health Organization; 2005; <http://www.who.int/mediacentre/factsheets/fs296/en/index.html>; last accessed 30th June 2006

¹⁹ National Grid EMF website; http://www.emfs.info/sci_implant.asp; last accessed 30th June 2006

- 5.28 An overall summary paragraph on the evidence of animal health impacts would have been useful at the end of this section.

Exposure Limits

- 5.29 The sources and statements made in this section are accurate and appropriate.
- 5.30 It is worth noting that at least six states – Florida, Minnesota, Montana, New Jersey, New York and Oregon - have set standards for transmission line electric fields; with Florida and New York also having standards for magnetic fields. In the majority of cases, the maximum fields permitted by each state are the maximum fields that existing lines produce at maximum load-carrying conditions. Some states further limit electric field strength at road crossings to ensure that electric current induced into large metal objects such as trucks and buses does not represent an electric shock hazard²⁰.

Can Fields be reduced

- 5.31 Section 2.7 is very good. It would have been helpful if the differences between small, low, medium, high and very high costs were explained. It would have been useful to go from approaches that have marginal effects on field reduction to those that have good and then on to those that have exceptional field reducing effects.

International Opinion and Consensus

- 5.32 The opinions of four agencies are presented in Section 2.8. These are the International Council on Large Electric Systems (CIGRE); the World Health organisation (WHO), the US National Institute of Environmental Health Sciences (NIEHS) and the UK National Radiological Protection Board. However, there is no explanation of why these were chosen, and why CIGRE should be quoted first ahead of the opinion of WHO especially as the judgements and statements of WHO, NIEHS and NRPB have been used earlier on in the report.

²⁰ Chapter 5: EMF exposure standards, Questions & Answers EMF electric and magnetic fields associated with the use of electric power; National Institute of Environmental Health Sciences and National Institutes of Health Sciences; 2002; <http://www.niehs.nih.gov/emfrapid/booklet/standard.htm> ; last accessed 30th June 2006

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- 5.33 Quoting industry bodies first is also problematic as they can be seen by the general public as biased sources. Statements from organisations that are widely seen as authoritative and independent should be placed ahead of quotes from industry bodies.
- 5.34 There is also a difference in opinion between the view of CIGRE and that of the other agencies who agree that while overall there is no evidence of negative human health impacts with the exception of childhood leukaemia, they recommend a precautionary approach of reducing, intense and prolonged, residential and occupational exposure to EMFs whenever and wherever possible.
- 5.35 It would have been useful to quote extracts from statements made by health agencies of other countries e.g. Australia and Canada^{21 22}.
- 5.36 Overall, the sources and quotes used in Section 2.8 are accurate and appropriate.

²¹ Electricity and health, Factsheet No 19; Australian Radiation Protection and Nuclear Safety Agency; http://www.arpansa.gov.au/is_electricity.htm

²² Health Effects and Exposure Guidelines Related to Extremely Low Frequency Electric and Magnetic Fields - An Overview; Prepared by the ELF Working Group of the Federal-Provincial-Territorial Radiation Protection Committee – Canada; 2005; <http://www.bccdc.org/content.php?item=196>; last accessed 30th June 2006

6. Review of the Conclusions of the Empetus Report

- 6.1 The conclusion is very short and does not adequately or appropriately summarise the state and quality of the evidence on human, animal and plant health impacts from exposure to EMFs from power lines.
- 6.2 There is no synthesis and analysis of areas of consensus and disagreement in the opinions and judgements of different health protection agencies around the world.
- 6.3 The conclusions reached by the Empetus report with regard to what the current general consensus on the health effects of EMFs is only partially sound i.e. only partially adequate and appropriate. The conclusion is not adequate or appropriate because it focuses solely on the question of biological and clinical responses. While developing a biological understanding of how EMF exposure could produce health effects is important it is not sufficient as in vitro responses can and do differ from in vivo and whole organism responses. How a single cell, or sheet of cells responds can be very different from how a whole organism responds as there are interactions and synergistic effects within the whole organism which cannot be replicated in cell studies.
- 6.4 More importantly, there is reasonably broad, though not complete, consensus that EMF exposure may play some role in inducing leukaemia in children and therefore exposure to EMFs should be reduced wherever and whenever possible. This is not adequately highlighted in the conclusion.
- 6.5 Finally, the report is weakest in its development of the risk perception and risk communications issues as they apply to the health impacts of EMF exposure from power lines. It simply states five principles. These principles are very good but there is no development of them and no statement about how, and from what sources, these principles are derived. More significantly where the report does provide risk communication advice, in the section on *Further discussion on the NIEHS report* on page 13, the advice is flawed and likely to raise concerns as well as potentially

generating anger among affected communities given that the report advises on the use of risk comparisons between a voluntary risk e.g. ingestion of coffee by an individual with the involuntary risk of having a new power line being sited near homes.

7. Recommendations

- 7.1 First, nowhere does the report explicitly state, including in the title of the report, that it is examining the current evidence of and guidance on the human health impacts of exposure to electric and magnetic fields from overhead power lines. The effects on animals and plants is presented but the main focus of the report is clearly on human health impacts. If animal and plant health impacts are part of the scope, something which is not made explicit, then the title should read the human, animal and plant health impacts of exposure to electric and magnetic fields from overhead power lines.
- 7.2 Second, a clearer statement concerning the scope of the report and an explanation of the methodology used to generate the evidence base are crucial.
- 7.3 Third, a fuller conclusion based on the material already collected and analysed, particularly a deeper analysis and appreciation of the statements quoted in the report, as well as a more sophisticated examination of the risk perception and risk communication issues would be worthwhile.
- 7.4 Fourth, a glossary of the key concepts and terms used within the report would aid understanding.
- 7.5 In terms of useful material and resources there are two outstanding public domain publications available, published by two authoritative sources, which better achieve the stated aim of the Empetus report. These two documents are *Establishing a Dialogue on Risks from Electromagnetic Fields* produced by the World Health Organization and the *Questions & Answers on Electric and Magnetic Fields Associated with the Use of Electric Power* (which is mentioned in the Empetus report) by the US National Institute of Environmental Health Sciences and National Institutes of Health^{23 24}. These documents should be required reading for staff of electricity

²³ Establishing a Dialogue on Risks from Electromagnetic Fields; Radiation and Environmental Health; Department of Protection of the Human Environment; World Health Organization; 2002; http://www.who.int/peh-emf/publications/risk_hand/en/index.html ; last accessed 30th June 2006

²⁴ Questions & Answers EMF electric and magnetic fields associated with the use of electric power; National Institute of Environmental Health Sciences and National Institutes of Health Sciences; 2002; <http://www.niehs.nih.gov/emfrapid/booklet/standard.htm> ; last accessed 30th June 2006

utilities engaged in the siting and planning of power lines and are important documents to provide to affected communities.

- 7.6 In terms of internet resources two websites provide a comprehensive and easy to understand overview of the health impacts of exposure to EMF. These are the World Health Organization EMF website at <http://www.who.int/peh-emf/en>, which provides a public health perspective, and the National Grid EMF website <http://www.emfs.info>, which provides an electricity industry perspective.

8. Summary Conclusions

- 8.1 The aim of the Empetus report is to provide an easy to understand, non-technical, report on the health impacts of exposure to the electric and magnetic fields of power lines. It is only partially successful in achieving this.
- 8.2 Though the majority of the content of the report is sound, the way it is structured, the lack of transparency in how the evidence was gathered and interpreted as well as some of the phraseology used within it makes the document flawed from a public health perspective.
- 8.3 The strongest aspect of the Empetus report are the technical elements: the analysis of the physical measurements and the analysis of approaches to shielding. The overall range of evidence presented the health effects of electric and magnetic fields encompassing research on humans, animals and plants is also very good. The weakest parts are the development of the scope of the report, what review methodology was used, the way some of the evidence review extracts are presented and the presentation of risk perception and communication research and evidence to help Eskom resolve community concerns about the potential health impacts of power lines.
- 8.4 Our focus has been on reviewing the human health aspects of the Empetus report and therefore it has not been possible, in the time available, to follow up all the sources of evidence on animal and plant health impacts though the information and analysis provided seem appropriate. It would worthwhile at some later date to have these areas reviewed in more depth.
- 8.5 In conclusion, while this report is a good starting point it does not provide the easy to understand overview that was aimed for and overall we judge the report is more likely to heighten community and other stakeholders concerns rather than resolve them.
- 8.6 As stated earlier, in terms of useful material and resources there are two outstanding public domain publications available, published by two authoritative sources, which better achieve the stated aim of the Empetus report These two documents are

Establishing a Dialogue on Risks from Electromagnetic Fields produced by the World Health Organization and the *Questions & Answer on Electric and Magnetic Fields Associated with the Use of Electric Power* (which is mentioned in the Empetus report) by the US National Institute of Environmental Health Sciences and National Institutes of Health. These documents should be required reading for staff involved in the siting and planning of power lines and are important documents to provide to affected communities.

- 8.7 In terms of internet resources two websites provide a comprehensive and easy to understand overview of the health impacts of exposure to EMF. These are the World Health Organization EMF website at <http://www.who.int/peh-emf/en> and the National Grid EMF website <http://www.emfs.info>. From these two websites the vast majority of the information, evidence and literature on EMF exposure and health impacts can be accessed.