Summary: Childhood Leukaemia and 50Hz Magnetic Fields

Introduction

Acute Lymphoblastic Leukaemia (ALL) is the most common form of childhood cancer and accounts for more than one third of the cancers in the 0-14 year age bracket. It most commonly occurs in children aged 2 to 8 with a peak incidence at age 4. However it can affect all age groups. The survival rate with modern treatment now exceeds 70%.

In 1979, Wertheimer and Leeper reported that magnetic fields from high current installations such as power lines and substations in the proximity to residences were associated with increased risks of childhood cancer. Since that time, at least twenty epidemiological studies have been conducted in this area worldwide. Taking this evidence into account, in 2002 the International Agency for Research on Cancer (IARC) classified 50 Hz magnetic fields as a possible carcinogen.

Childhood Leukaemia Rates in Australia (2001)

Leukaemia rates vary according to gender and age. The highest rates occur in 0-4 year olds with annual rates of 9.6 (male) and 7.5 (female) per 100,000. The rates decrease to 3.8 (male) and 3.9 (female) for 10-14 year olds. The total childhood (0-14 years) risk is about 91 (male) and 80 (female) per 100,000. The most recent data from the Australian Institute of Health and Welfare indicated that in 2001 there were 228 new cases of ALL in Australia

Epidemiological Studies of Exposure to Magnetic Fields and Human Health

The Wertheimer and Leeper study initiated a large number of epidemiological studies worldwide. However, one of the major problems with electric and magnetic fields (EMF) epidemiology is exposure assessment. Practically everyone is exposed to extremely low frequency (ELF) magnetic fields, there is a wide variety of sources and exposures vary greatly over short distances which makes it difficult for researchers to identify the appropriate exposure parameter. Several different approaches have been used, including a wire code configuration classification scheme, calculated historical magnetic field levels using data from various registries and the distance between power lines or other sources of high magnetic fields and residences. It would be expected that measurement would prove to be the ideal exposure assessment method, however, difficulties arise because there is no agreement on what physical measurement should be made. In addition, retrospective measurements are inexact and the relevant exposure period is not known.

There is a large body of research seeking to establish whether there is a connection between ELF exposure and adverse health effects including leukaemia and brain tumours in childhood and later in life. Other diseases and effects have been studied including breast cancer, cardiovascular disease and suicide. Overall the most consistent result indicating a positive association is for childhood leukaemia. For this reason attention has been focussed on childhood leukaemia and studies have used the exposure metrics described above with the following outcomes:

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- **wire codes:** elevated risks found in two studies were not found in two others;
- **distance:** elevated risks for children residing within 100 m of a power line have been reported but no increase in risk was found in other studies. Most of the reported studies were based on only a small number of cases. However, in a recent study elevated risks for childhood cancer up to a distance of 600 m from high voltage power lines were reported (at this distance the magnetic field from the line will be negligible compared with other sources);
- **calculation:** this approach was used in Scandinavian countries and for a small number of cases increased risk was found in three studies but not in a fourth; and
- **measurement:** elevated risk, although, in most cases, not statistically significant was found in about 10 studies with exposure generally ≥0.2μT.

Pooled studies

In an attempt to reduce the statistical uncertainty of the studies Ahlbom et al (2000) have pooled data from what they considered to be the better of the published studies. They found no elevated risk among the 3,203 children with leukaemia with residential magnetic field exposure < 0.4 μT. However, for exposures ≥ 0.4 μT a relative risk of 2.0 was found. For these exposures there were 44 leukaemia cases and the expected number of cases was 24.

Greenland et al.(2000) also undertook a pooled analysis and found a relative risk of 1.7 in association with residential magnetic fields, usually assessed as 24-hour time weighted average, of ≥ 0.3 μT.

International Agency for Research on Cancer (IARC)

IARC is part of the World Health Organization and is responsible for coordinating and conducting research on the causes of human cancer and the mechanisms of carcinogenesis. It publishes expert assessments on the carcinogenic potential of chemical and physical agents. In 2002 it classified magnetic fields as a possible carcinogen (Group 2B). The classification applied to childhood leukaemia but to no other cancers in humans

Implication of Childhood Leukaemia Results

As discussed above there is some epidemiological evidence that prolonged exposure to power frequency magnetic fields at levels higher than what is normally encountered is associated with a small risk of leukaemia in children. There is no evidence from either cellular or animal studies that would suggest a causal link.

If the relationship was found to be causal it would be possible to estimate how many of the annual cases of childhood leukaemia are due to exposure to residential magnetic fields. A survey of 300 randomly selected houses currently underway in Melbourne would suggest that in 3-4% of houses the magnetic field in a child's bedroom exceeds 0.4 μT. If this percentage applied to all Australian houses and the pooled results were valid in Australia then it could be estimated that up to about 7 cases out of 225 annual cases of childhood leukaemia could be due to exposure to residential magnetic fields

Precautionary Approach

On the basis of the above information the standard recommends a precautionary approach (see Section 5 Protection - occupational and general public exposure). Precautionary policies and approaches are discussed in Annex 6 of the Standard.

A separate document on the ARPANSA internet discusses possible mitigation strategies that could be applied to reduce exposure to 50 Hz magnetic fields.