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Caroline Flint MP  
Minister for Public Health

8<sup>th</sup> May 2007

Dear Minister

**First Interim Report of the Stakeholder Advisory Group for ELF EMF (SAGE)**

I am writing this open letter to you as a member of the Stakeholder Advisory Group on ELF EMFs (SAGE) whose First Interim Report was published on the 27<sup>th</sup> April.

I am grateful to the National Grid for initiating the Stakeholder process and to the Government, under the Department of Health, for taking the lead aimed at bringing together all relevant stakeholders to examine precaution against public exposure to power frequency electric and magnetic fields in view of concerns over health effects, in particular an association with childhood leukaemia.

The Government has already accepted that there is a doubling of the risk of childhood leukaemia associated with average magnetic field exposure from the electricity supply above 0.4 microtesla, well below typical levels found close to high voltage powerlines. Childhood leukaemia is mercifully rare, the risk is about 1 in 1400 in childhood but a doubling of risk would increase this to 1 in 700.

As the SAGE process developed, it became clear that two rather different perspectives were emerging on the need to take precaution against public exposure to power frequency electric and magnetic fields. One view, which I and many others do not subscribe to, is to accept previous conclusions of bodies such as the UK Health Protection Agency (HPA), the International Agency for research on Cancer (IARC) and the World Health Organisation (WHO), that the evidence of adverse health effects are strong enough for magnetic fields to be classified as a possible carcinogen only in the case of childhood leukaemia and therefore only precautionary action involving very low costs are justified. In disagreeing with this view, some of us feel it would be highly unusual to discover an

environmental agent which caused increased risk of childhood leukaemia without affecting the risk of any other illness.

In contrast, I along with many others subscribe to the view that the health effects of exposure to electric and magnetic fields from the electricity supply are much more widespread and both on public health and cost-benefit grounds strong precaution against exposure is justified.

In reaching this conclusion we first noted the overall findings of the California Department of Health Services EMF Report of 2002 (see Table 1 appended below). In total, the Report considered 212 epidemiological studies. Taking one representative risk ratio per study (as defined by the California assessors), 158 of the 212 risk ratios were positive (i.e. greater than 1.00, indicating increased risk) and 50 were both positive and statistically significant in their own right. The statistical probability that this combination of studies within the 212 total occurs simply by chance is so small that we can firmly rule out chance as an explanation for the total body of findings. We must therefore seek other possible explanations. Importantly, we need to take seriously the possibility of a causal association between EMF exposure and these adverse health effects.

We next looked at a breakdown of the findings of epidemiological studies for the individual health endpoints considered (see Table 2 appended below). In many cases we found that we could again rule out chance to explain the positive links with EMF exposures. You may be aware that the California Report classified five health endpoints as possibly causal (Class 2B on the IARC classification): childhood leukaemia, adult leukaemia, adult brain cancer, amyotrophic lateral sclerosis (ALS) and miscarriage.

In the light of the findings of the California Report, we then looked at one of the other major EMF reports, namely the 2002 report of the International Agency for Research on Cancer (IARC). We were somewhat surprised to find that whereas the report's authors classify only childhood leukaemia as a possible carcinogen, in the case of cancer health outcomes, the IARC report considers essentially the same set of studies as in the California Report. These are laid out in tables 26, 29 and 30 of the IARC Report. An analysis of these aggregate findings for adult leukaemia and adult brain cancer produces essentially the same results as for the California Report. It would appear that while the IARC authors considered the various studies individually, there is no evidence of considering the aggregation of results other than subjectively, thereby missing the important statistical information it contained.

In the specific case of childhood leukaemia, it has been claimed that the association with magnetic fields, if causal would account for only 2 cases of childhood leukaemia annually in the UK. We would challenge this assumption as merely representing a tip of an iceberg. In public health risk estimation for cancer, it would be more usual to use a linear no-threshold model, in which the risk only becomes zero at zero exposure to magnetic fields. If we apply this more usual model, then around 60 cases of childhood leukaemia annually might be associated with magnetic fields from the electricity supply, or around 11% of the total annual incidence in the UK. While this figure is not brought out in the SAGE Report, it is in line with published estimates for the United States, which also suggests an approximate 11% attributable case figure.

The SAGE report also considers the findings of the 2005 study by Draper *et al.* which is the largest ever study of childhood leukaemia in relation to proximity to high voltage powerlines. The authors report increased incidence of childhood leukaemia up to 600 metres from National Grid 275 and 400 kV powerlines in England and Wales. While this is beyond the range of the direct electric and magnetic fields, it is within range of corona ion emission from powerlines, which may act to increase exposure to air pollution particulates.

If the Draper *et al.* findings were replicated for the more numerous 132 kV powerlines, which more often pass over populated areas, then in addition to the 60 cases from magnetic fields in general, up to a further 25 cases of childhood leukaemia annually, specifically due to overhead high voltage powerlines, might occur in the UK.

Taking account of all of the estimates of adverse health effects, it is very clear that the public health impact could be at least 100 times greater than for the minimalist estimate for childhood leukaemia alone. Under these circumstances, a cost-benefit analysis strongly supports a ban on future building of homes near high voltage powerlines.

This analysis also suggests that where high voltage powerlines pass over or very close to houses, a programme of burial of these powerlines could be introduced in a way that is cost-beneficial.

Finally, I wish to mention briefly the significant advances in scientific understanding of how exposure to EMFs, principally the magnetic field component, might lead to increased risk of adverse health effects.

There is compelling evidence from laboratory studies that low level magnetic fields enhance the effects of known cancer causing agents on cells. The evidence supports the established mechanism by which magnetic fields can increase the lifetime of free radicals in the body and hence their ability to damage DNA.

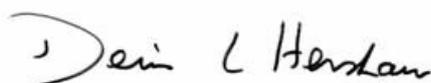
People exposed to EMFs in and around their homes have been found to experience nocturnal disruption of the production of the important hormone and natural anti-cancer agent melatonin. This may provide a common link with reported adverse health effects.

There is now a body of evidence that small fluctuations in the Earth's magnetic field, are themselves related to a number of adverse health effects. This provides an important analogy with the observations for power frequency fields.

Animals across a wide range of species detect tiny changes in the Earth's magnetic field for purposes of navigation. Such bio-detection illustrates that biological systems can detect and respond to small variations in magnetic fields at similar levels to those associated with ill health with power frequency fields. Interestingly, the detailed bio-detection mechanism involves free radicals and possible links to the pineal gland, the site of melatonin synthesis.

In summary therefore, the weight of evidence of adverse health effects associated with EMFs from the electricity supply justifies precautionary measures which go well beyond the options discussed in today's First Interim Report.

Yours sincerely

A handwritten signature in black ink that reads "Denis L Henshaw". The signature is written in a cursive style with a large initial 'D'.

Denis L Henshaw  
Professor of Human Radiation Effects

**Table 1. Summary of the findings of epidemiological studies considered by the California Department of Health Services EMF Report 2002**

Disease	Studies	Positives	Significant positives	Significant negatives
Childhood leukaemia	19	16	3	0
Adult leukaemia	43	32	11	0
9 other diseases	150	110	36	1
Total	212	158	50	1
p-value for total		$2.5 \times 10^{-13}$	$4.4 \times 10^{-15}$	

**Notes:**

1. The column headed 'Studies' refers to the number of epidemiological studies considered in each category.
2. The column headed 'Positives' represents the number of positive odds ratios found in each category, taking one representative odds ratio per study as assessed by the California panel.
3. The column headed 'Significant positives' represents the number of positive odds ratios which were statistically significant in their own right at the 95% confidence level.
4. The 'p-values for total' represent the probability that the total number of Positives and the total number of Significant positives was a chance finding.

**Table 2. Epidemiological studies reviewed by CHD (2002) and the corresponding number of odds ratios > 1.0, number which were statistically significant and p value for each set.**

Disease	Number of studies	Positive studies: number, p value*	Significant positives: number, p value*
1. Childhood leukaemia	19	16 0.0014	3 0.01
2. Adult leukaemia	43	32 0.0007	11.5 <<0.00001
3. Adult brain cancer	32	25 0.0007	6 0.0001
4. Miscarriage	37	27.5 0.0015	9 <<0.00001
5. ALS	7	6 0.06	3 0.0004
6. Childhood brain cancer	12	6 >0.5	2 0.04
7. Female breast cancer	24	17.5 0.012	5.5 0.0001
8. Male breast cancer	16	11.5 0.04	-
9. Alzheimer's disease	6	4 0.34	2.5 0.001
10. Suicide	8	6.5 0.02	3 0.0007
11. Heart disease	8	6.5 0.02	5.5 <<0.00001

\*Null hypothesis, result occurs by chance