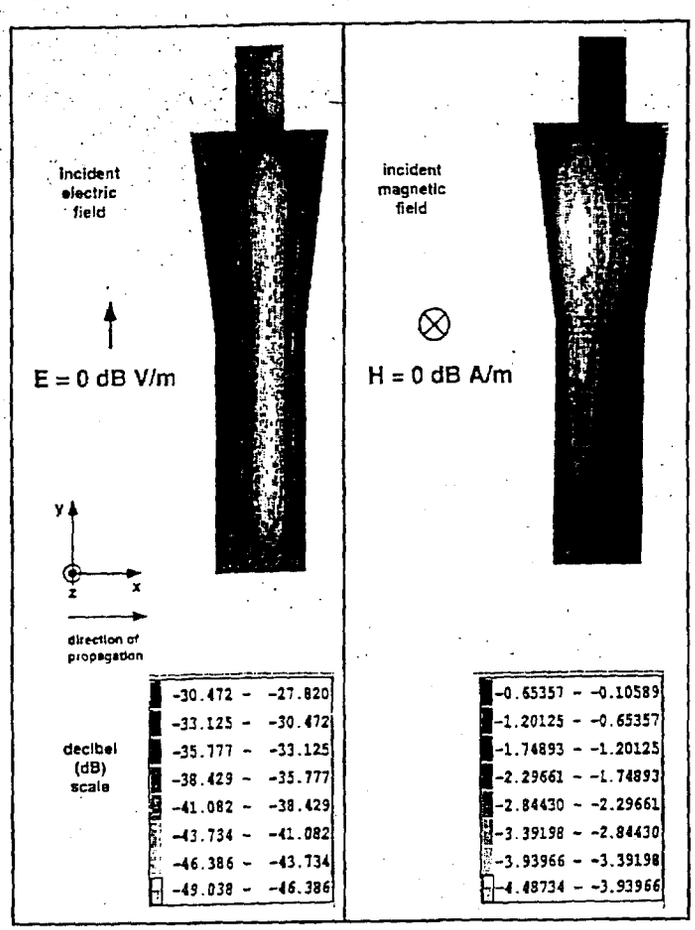
Computer Simulation of Field Distribution inside a Human Body



Relative electric (E) and magnetic (H) field variation (magnitude in dB) at 15 MHz in a 2-dimensional model of man.

Source: EMC Baden Ltd c/o ABB Research Center, 5405 Dattwil

Figure C.2: *Attenuation of electric and magnetic fields within a human body (finite element calculation)*

Appendix D

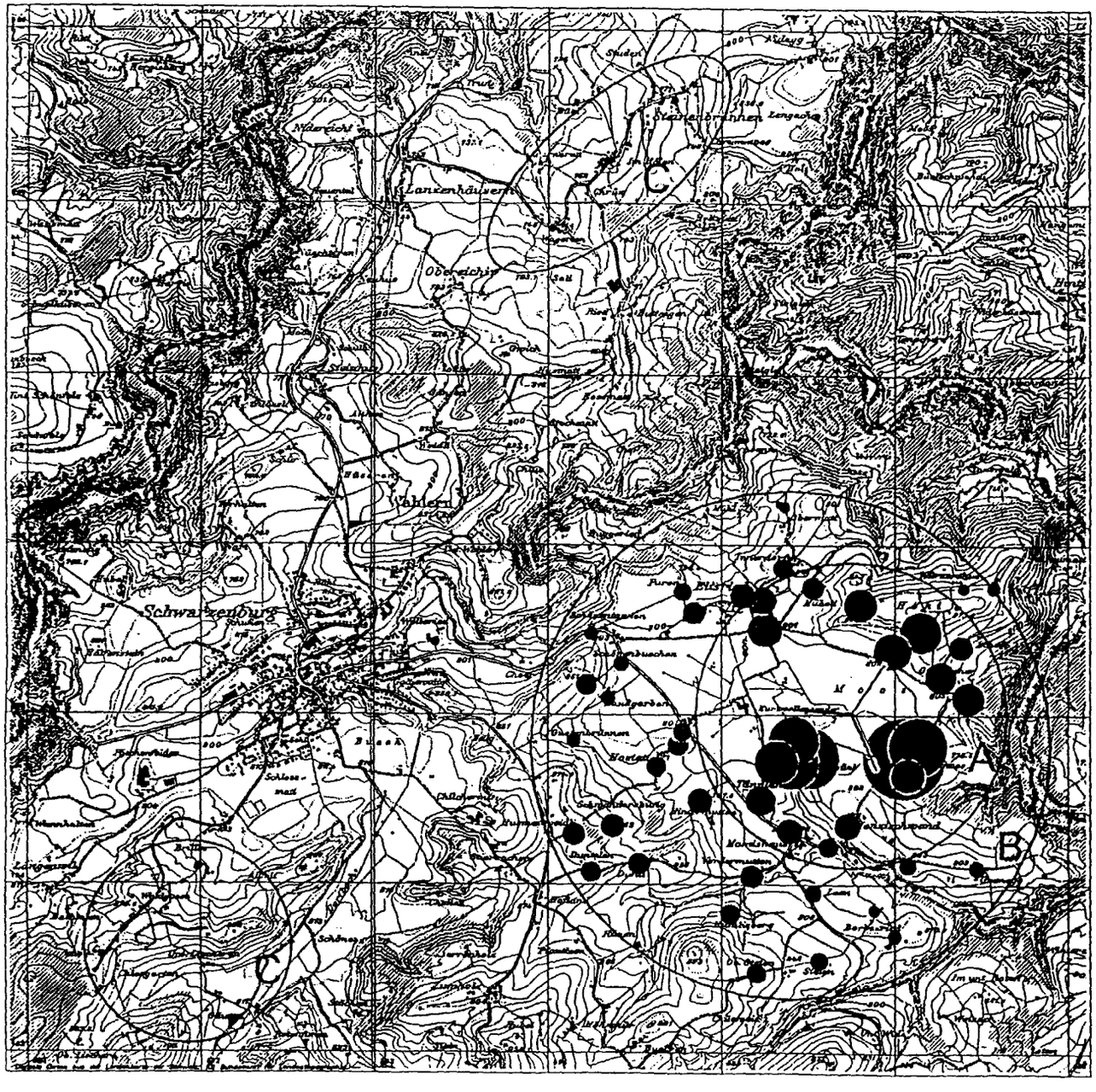
Maps

The maps were prepared by Meteotest and their production financed by the Swiss Federal Office of Environment Forest and Landscape.

The maps depict the outdoor magnetic field strength measured in the course of Study I. The area of the circles is proportional to the magnetic field strength. The semi-shaded squares indicate sites at which background exposure exceeds the fields of the Transmitter.

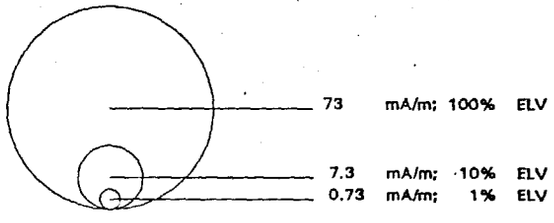
The grid width corresponds to 1x1 km.

Shortwave Transmitter Schwarzenburg: Outdoor Magnetic Field Strength



24 hour average
Operational condition: Normal

Magnetic Field Strength



ELV: Exposure Limit Value (IRPA 1988)

Background exposure

A: Investigation zone; high exposure
B: Investigation zone; medium exposure
C: Control zones

Measurement period: August 1992 to August 199

1 km

Original Scale 1:25000.
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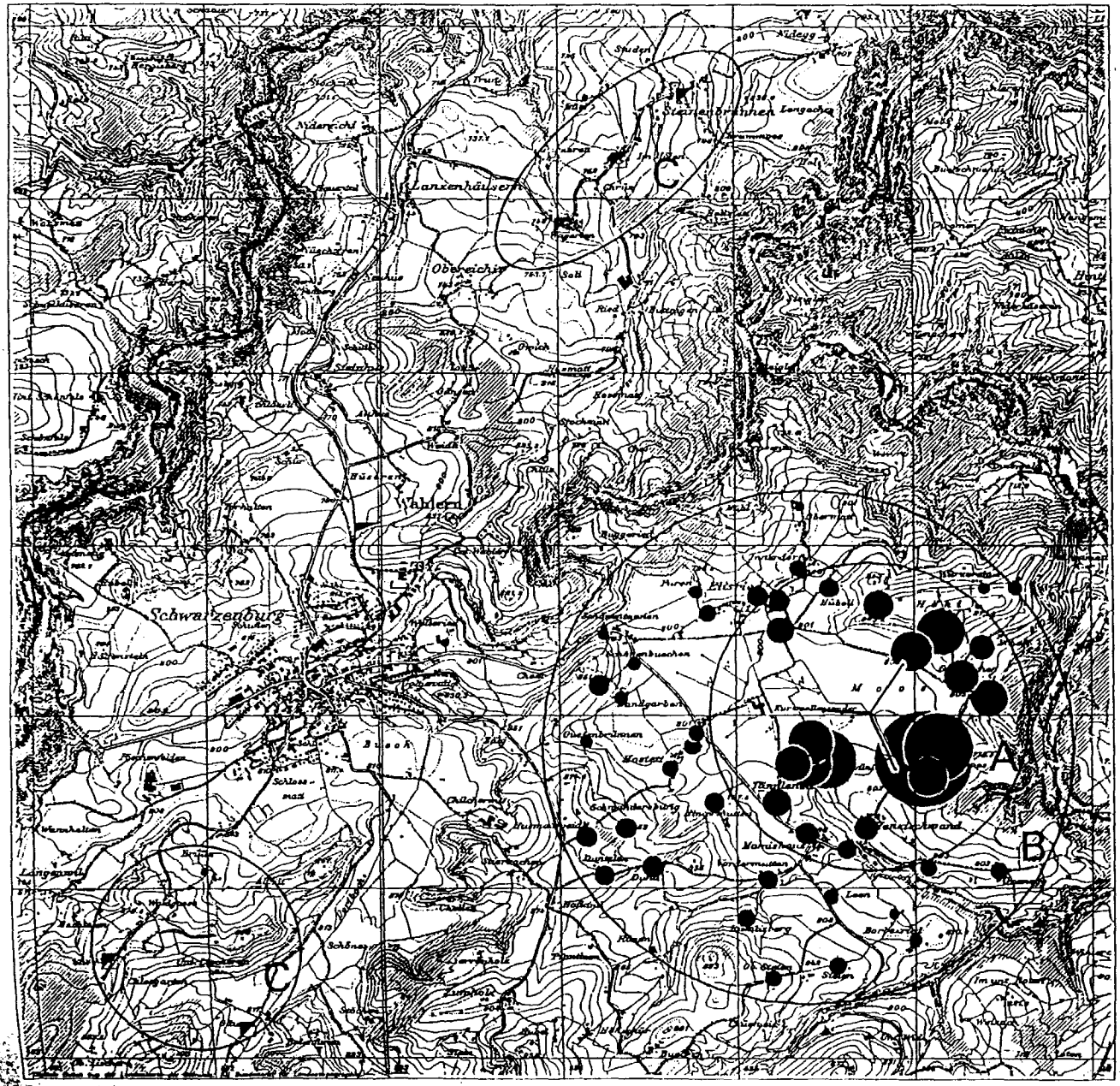
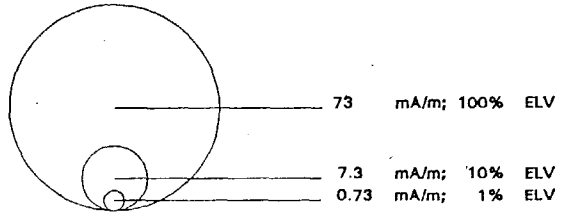
METEOTEST

Shortwave Transmitter Schwarzenburg: Outdoor Magnetic Field Strength



Daytime average: 06.00-22.00 local summer time
Operational condition: Normal

Magnetic Field Strength



ELV: Exposure Limit Value (IRPA 1988)

Background exposure

A: Investigation zone; high exposure
B: Investigation zone; medium exposure
C: Control zones

Measurement period: August 1992 to August 19

1 km

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METEOTEST

Shortwave Transmitter Schwarzenburg: Outdoor Magnetic Field Strength

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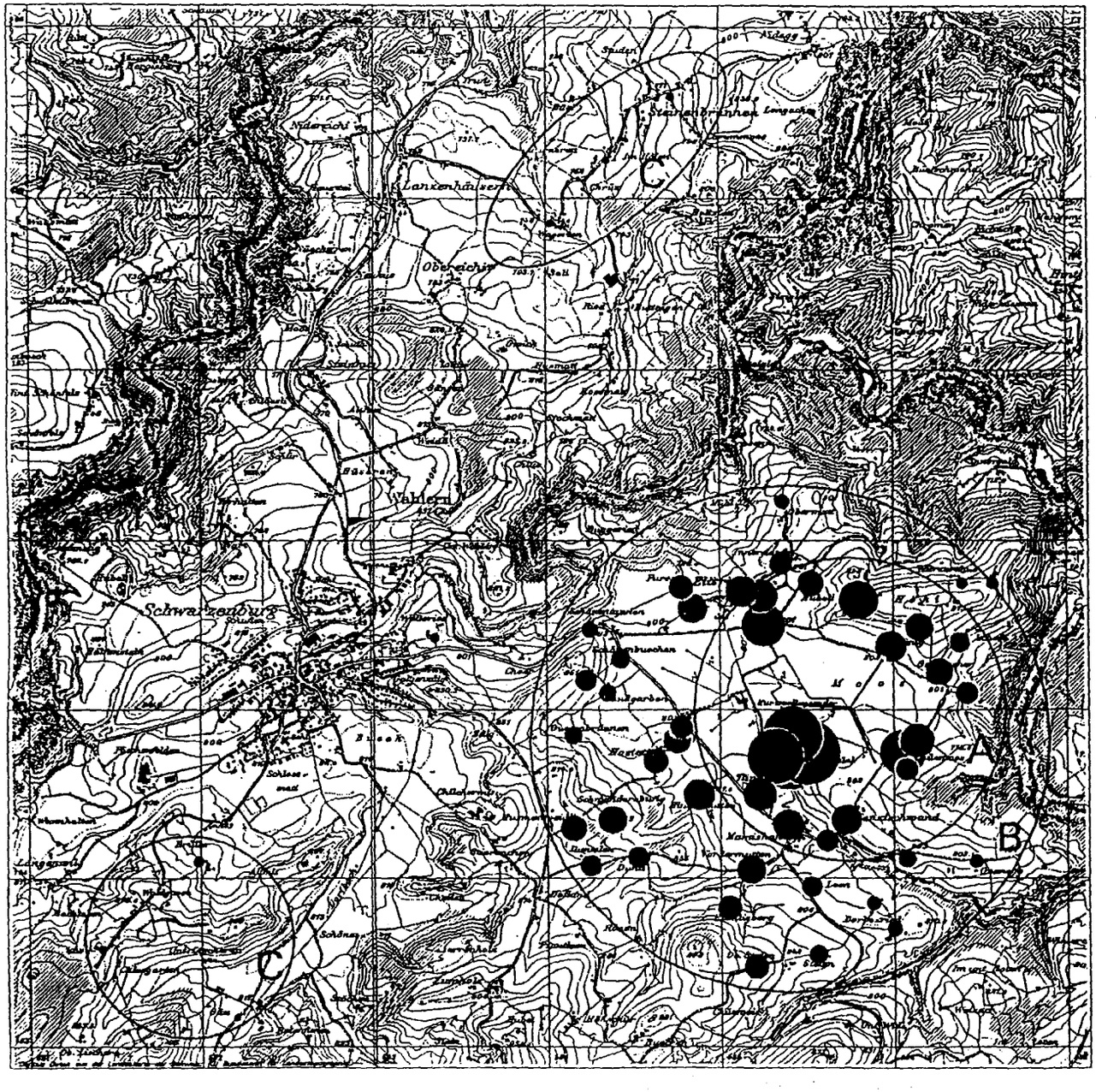
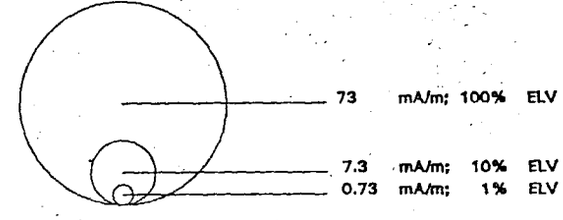
METOTEST

Shortwave Transmitter Schwarzenburg: Outdoor Magnetic Field Strength



Nighttime average: 22.00-06.00 local summer time
Operational condition: Normal

Magnetic Field Strength



ELV: Exposure Limit Value (IRPA 1988)

Background exposure

A: Investigation zone; high exposure
B: Investigation zone; medium exposure
C: Control zones

Measurement period: August 1992 to August 1993

1 km

Original Scale 1:25000.
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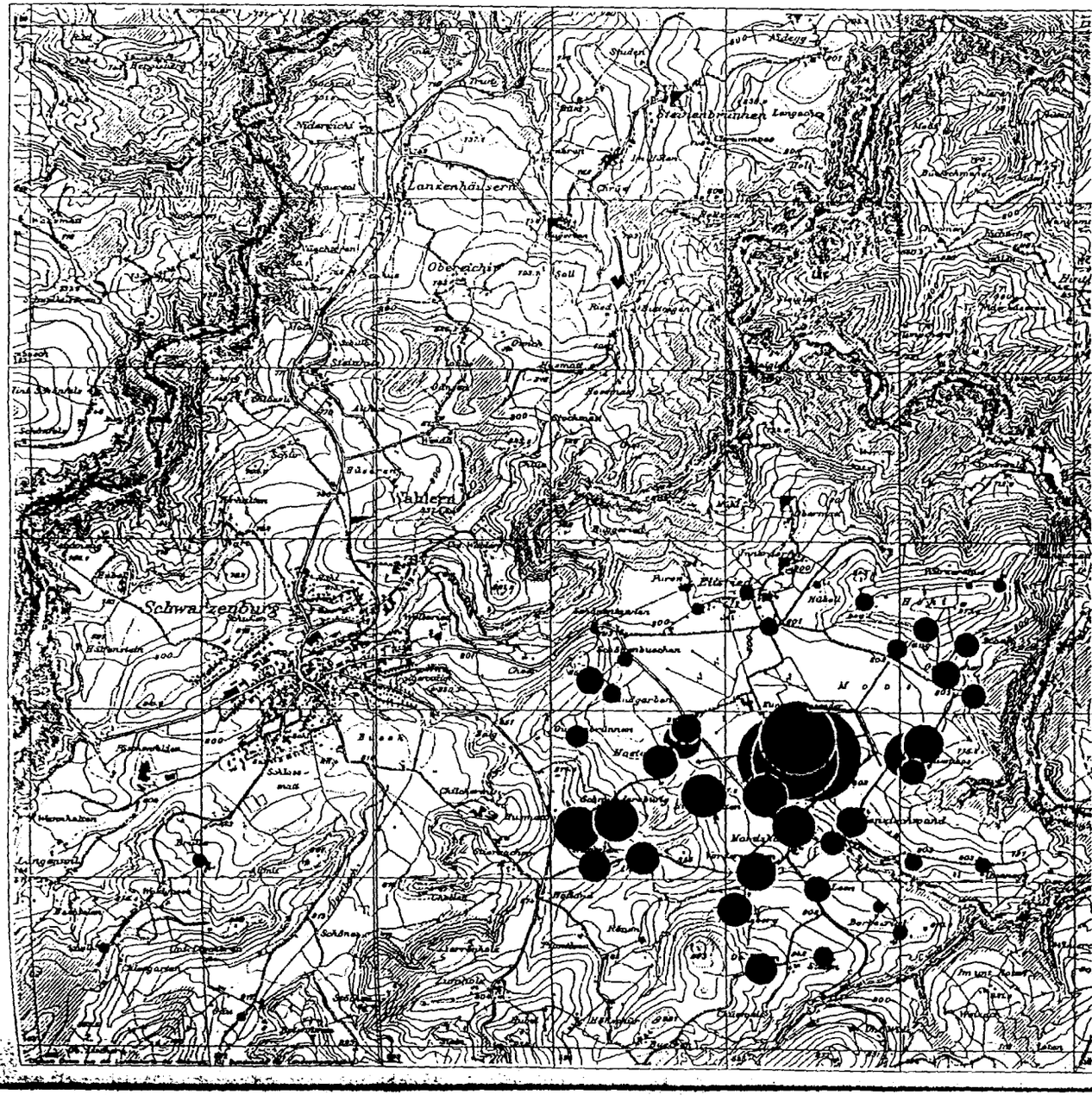
METOTEST

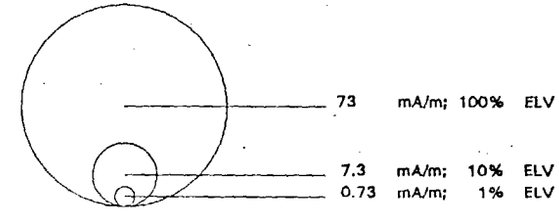
Shortwave Transmitter Schwarzenburg: Outdoor Magnetic Field Strength



Time of emission: 00.00-01.45 local summer time
Operational condition: Normal
Target area: South America

Frequency	Direction
9810 kHz	260°
15570 kHz	230°

Magnetic Field Strength



ELV: Exposure Limit Value (IRPA 1988)

Background exposure

Measurement period: August 1992 to August 1993

1 km

Original Scale 1:25000.
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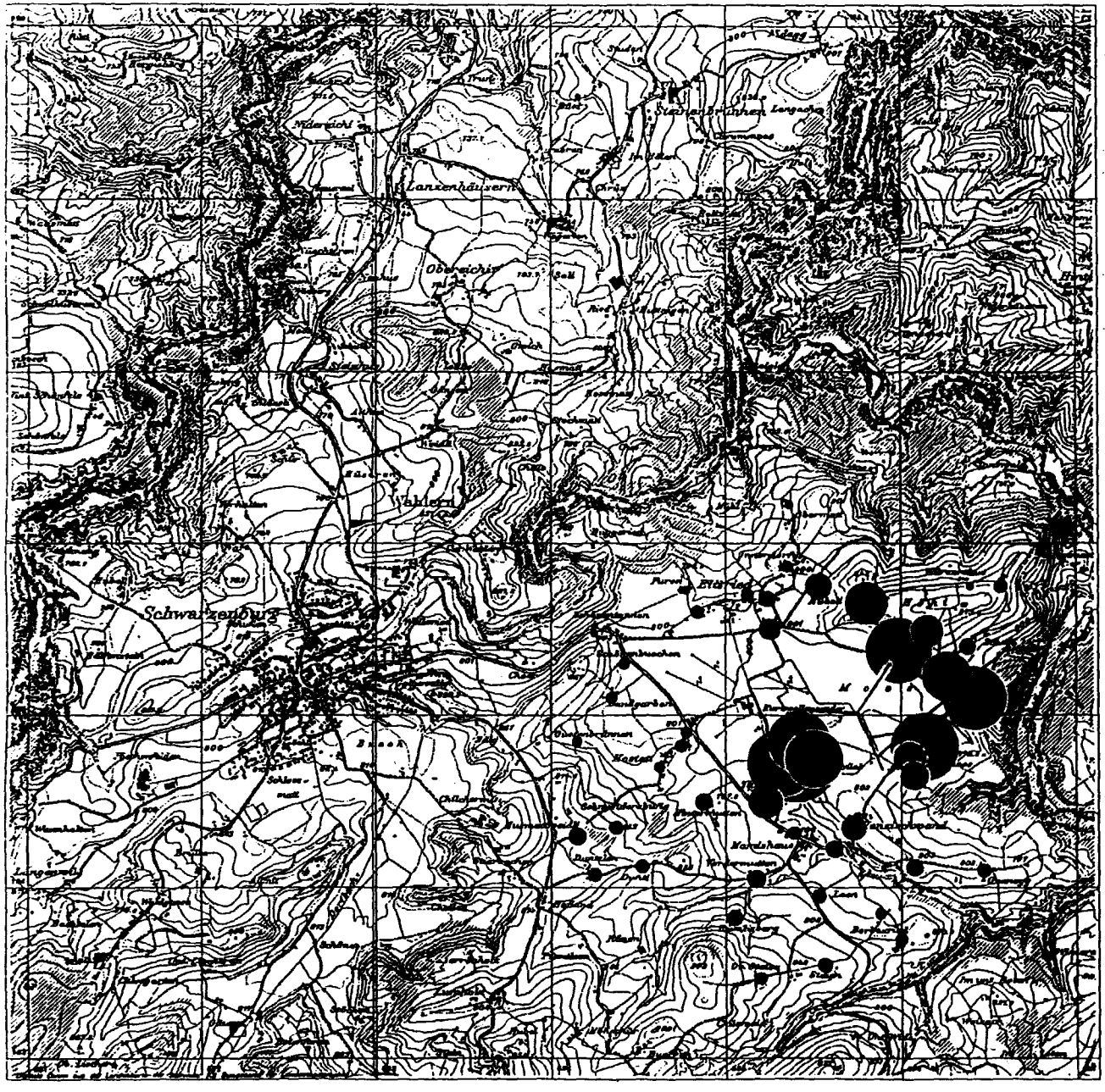
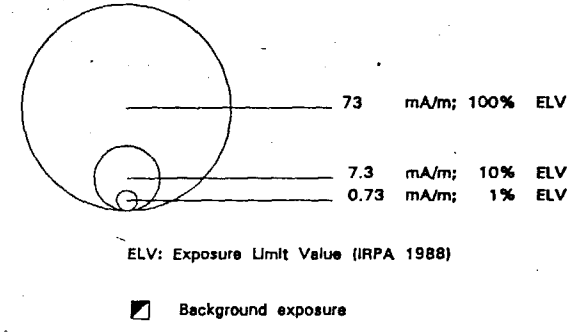
Shortwave Transmitter Schwarzenburg: Outdoor Magnetic Field Strength



Time of emission: 00.00-01.45 local summer time
Operational condition: Experimental
Target area: South America

Frequency	Direction
9810 kHz	80°
15570 kHz	50°

Magnetic Field Strength



Measurement period: August 1992 to August 1993

1 km

Original Scale 1:25000.
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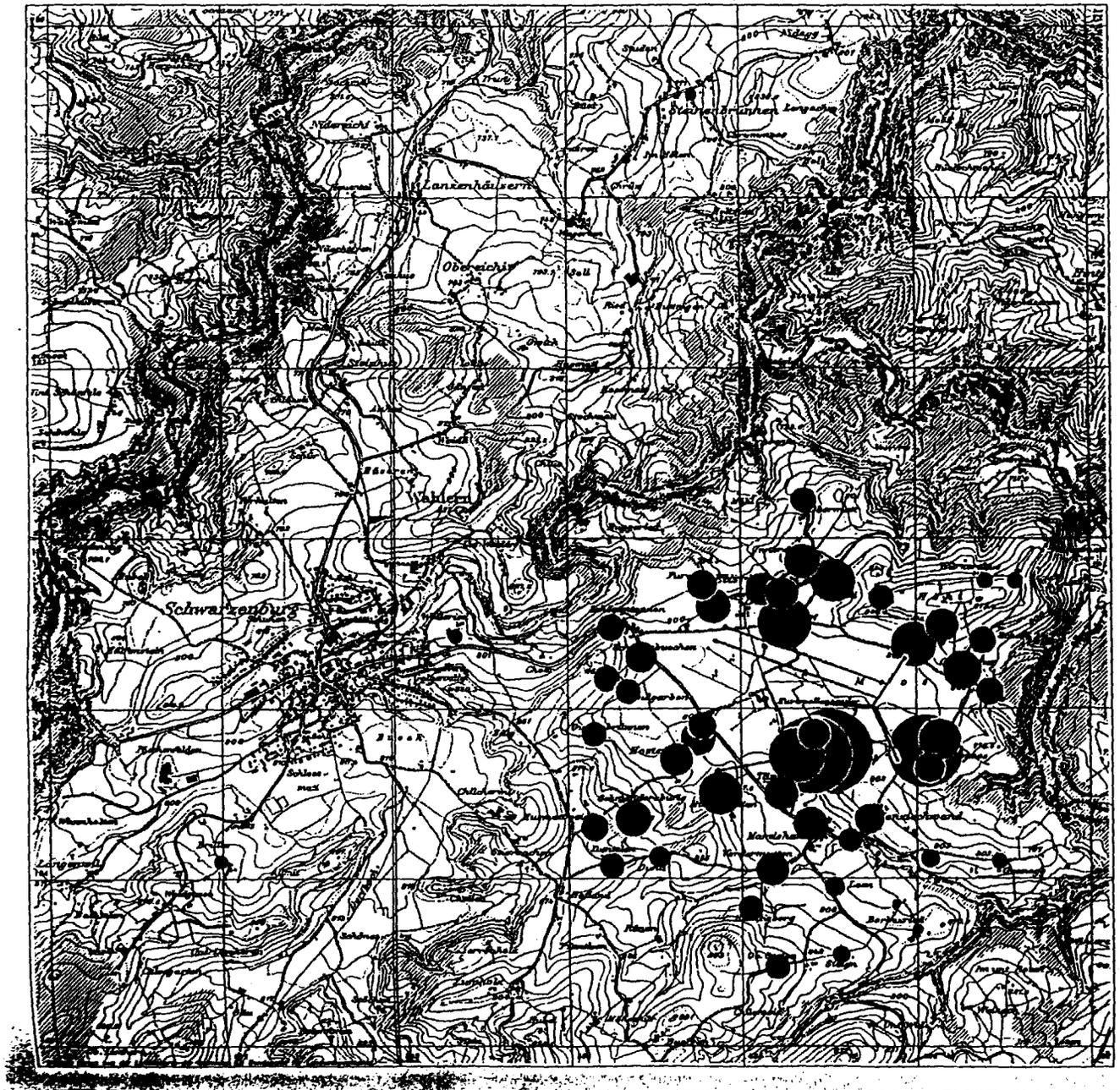
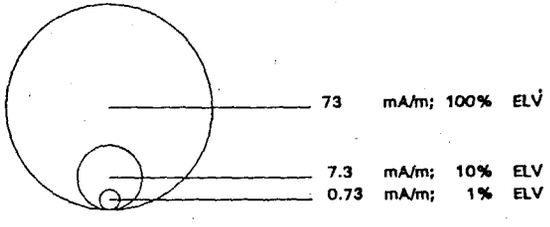
Shortwave Transmitter Schwarzenburg: Outdoor Magnetic Field Strength



Time of emission: 02.00-03.45 local summer time
Operational condition: Normal
Target area: Central America

Frequency	Direction
6135 kHz	290°
9885 kHz	290°
12035 kHz	260°

Magnetic Field Strength



ELV: Exposure Limit Value (IRPA 1988)

Background exposure

Measurement period: August 1992 to August 1993

1 km

Original Scale 1:25000.
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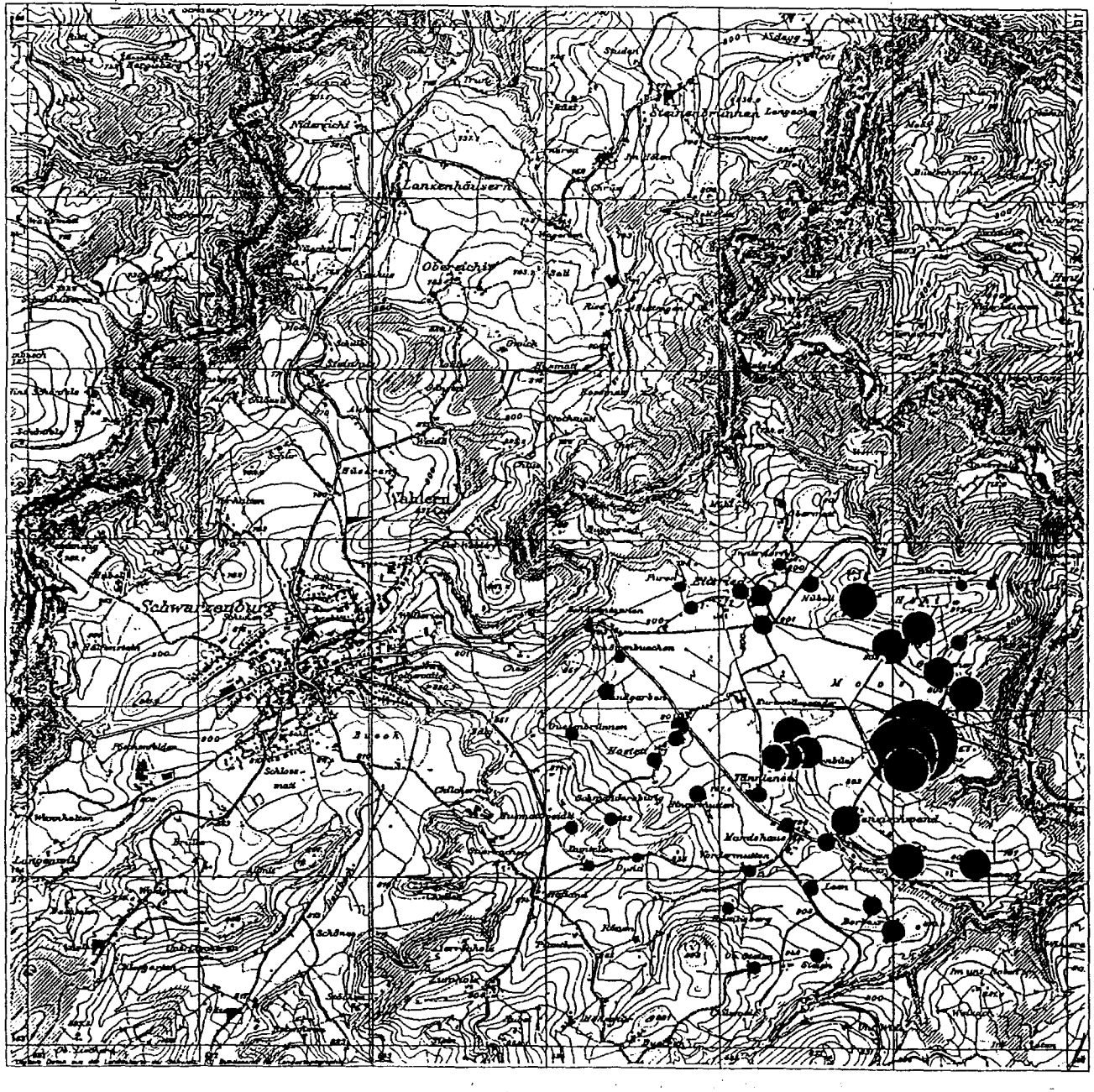
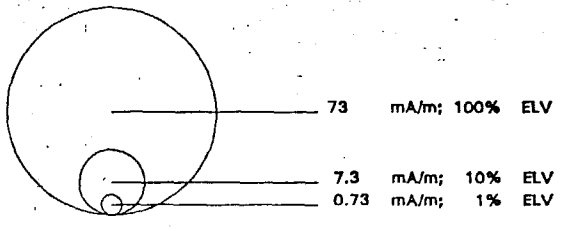
Shortwave Transmitter Schwarzenburg: Outdoor Magnetic Field Strength



Time of emission: 02.00-03.45 local summer time
Operational condition: Experimental
Target area: Central America

Frequency	Direction
6135 kHz	110°
9885 kHz	110°
12035 kHz	80°

Magnetic Field Strength



ELV: Exposure Limit Value (IRPA 1988)

Background exposure

Measurement period: August 1992 to August 1993

1 km

Original Scale 1:25000.
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Journal of Pineal Research
ISSN 0742-3098

JUL 29 1997

Exhibit 1b
Cellular Phone Taskforce
12-21-97

Absence of chronic effect of exposure to short-wave radio broadcast signal on salivary melatonin concentrations in dairy cattle

Stärk KDC, Krebs T, Altpeter E, Manz B, Griot C, Abelin T. Absence of chronic effect of exposure to short-wave radio broadcast signal on salivary melatonin concentrations in dairy cattle. J. Pineal Res. 1997; 22:171–176.
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Abstract: A pilot study was conducted to investigate the influence of electromagnetic fields in the short-wave range (3–30 MHz) radio transmitter signals on salivary melatonin concentration in dairy cattle. The hypothesis to be tested was whether EMF exposure would lower salivary melatonin concentrations, and whether removal of the EMF source would be followed by higher concentration levels. For this pilot study, a controlled intervention trial was designed. Two commercial dairy herds at two farms were compared, one located at a distance of 500 m (exposed), the other at a distance of 4,000 m (unexposed) from the transmitter. At each farm, five cows were monitored with respect to their salivary melatonin concentrations over a period of ten consecutive days. Saliva samples were collected at two–hour intervals during the dark phase of the night. As an additional intervention, the short-wave transmitter was switched off during three of the ten days (off phase). The samples were analyzed using a radioimmunoassay. The average nightly field strength readings were 21-fold greater on the exposed farm (1.59 mA/m) than on the control farm (0.076 mA/m). The mean values of the two initial nights did not show a statistically significant difference between exposed and unexposed cows. Therefore, a chronic melatonin reduction effect seemed unlikely. However, on the first night of re-exposure after the transmitter had been off for three days, the difference in salivary melatonin concentration between the two farms (3.89 pg/ml, CI: 2.04, 7.41) was statistically significant, indicating a two- to seven-fold increase of melatonin concentration. Thus, a delayed acute effect of EMF on melatonin concentration cannot completely be excluded. However, results should be interpreted with caution and further trials are required in order to confirm the results.

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Key words: electromagnetic fields – saliva sampling – melatonin – dairy cow

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Received July 26, 1996; accepted December 11, 1996.

Introduction

An increasing concern about potential adverse health effects of electromagnetic fields (EMF) exists among the public, which is partially increased by the fact that the causal relationships are still unclear [Hileman, 1993]. In order to investigate the effect of a single-source EMF generated by a short-wave radio transmitter on the well being of the local population, a number of studies were conducted in the area of a station in Schwarzenburg, Switzerland [Altpeter et al., 1995].

Possible negative health effects of EMF exposure on animal health have also been discussed [Mercer, 1985]. Consequently, an additional study was planned with the objective of quantifying the influence of EMF caused by a short-wave radio transmitter on the health of dairy cows in the region. In order to be able to measure a possible biological effect of EMF exposure, an EMF-sensitive physiological process, with—if disturbed—a potential negative health impact, needed to be monitored.

In the literature, serum melatonin concentrations

have been described as being sensitive to EMF exposure in mammals [Reiter, 1992, 1993a,b; Grota et al., 1994; Yellon, 1994]. In livestock, as in other species, melatonin acts as a mediator of photoperiodic information to the endocrine system. It governs seasonal hormonal cycles in all seasonally reproductive species, such as sheep [Williams and Helliwell, 1993], goats [Chemineau et al., 1992], farmed deer [Asher et al., 1993], and horses [Guerin et al., 1995]. Additional effects on other endocrine processes, as well as gastrointestinal physiology, have also been described [Paterson and Foldes, 1994; Reiter, 1991]. Furthermore, melatonin seems to have oncostatic and immunoenhancing effects [Maestroni et al., 1989; Liburdy et al., 1993; Maestroni, 1993]. Due to the complex effects of melatonin, any factors influencing its production might disturb body functions at various sites [Reiter, 1991].

Because of its quick release and nightly production, distinct diurnal cycles of melatonin serum concentrations have been observed in many species, including the cow [Berthelot et al., 1990; Paterson and Foldes, 1994], peak production always occurring during the dark period. Similar concentrations can also be measured in other peripheral compartments, such as urine [Perissin et al., 1993], milk [Illnerová et al., 1993], and saliva [Vakkuri, 1985; Demel, 1992]. In this study, the more readily accessible peripheral melatonin concentration in saliva was used as a marker for biological response to EMF in the study area.

The objective of the study presented here was to measure 1) the acute, and 2) the chronic effect of EMF generated by a short-wave radio transmitter on melatonin concentrations in the saliva of dairy cows.

Animals and methods

Study design

Melatonin levels in the saliva of EMF-exposed and unexposed dairy cows were measured during a 10-day period. The exposed site was selected because it had the highest field strength in the vicinity of the source (transmitter), whereas the site considered unexposed was situated at a distance, at an EMF strength which corresponded to the average observed throughout Switzerland.

A chronic effect of exposure was measured through a comparison of exposed and unexposed animals. The short-wave transmitter generating the exposure had a maximal power of 3 × 150 kW, generating an electric field frequency of 3–30 MHz, i.e., in the short-wave range. Exposure is defined by two components: the electric field (E-field) and the magnetic field (H-field). The H-field was measured for 24 hours (mA/m) within the barn using an isotropic probe (special version of EH 30 KW, EMC-Baden Ltd., Dättwil, Switzerland; for detailed specification see Altpeter et al. [1995]). The baseline exposure was measured during the off phase of the transmitter for 3×24 hours at the site of the antenna.

During days 3–5 the transmitter was turned off. This intervention was known neither to the farmers, the veterinarians collecting the samples, nor to the technicians analyzing them. The acute effect of the exposure was calculated through melatonin concentration comparison before, during, and after the intervention in both the exposed and the unexposed group.

Farms and animals

Melatonin measurements were performed on two farms, one EMF-exposed (A), the other non-exposed (B). These farms were chosen from a list provided by local veterinarians. Farm A was the closest to the EMF source (500 m), while Farm B was 4 km from the source. Both farms specialized in dairy production at the average Swiss production level. The herd size of farms A and B was 19 and 14 cows, respectively. All animals grazed for about 7 hours every day of the study period but were housed in barns at night.

From each farm, five animals were selected for the study. All subjects were lactating Red Holsteins, 3–4 years old and 118–242 days pregnant on the first day of the study.

Sampling protocol

Saliva samples were collected using cotton wool swabs designed for saliva sampling in humans (SALIVETTEN, Sarstedt, Germany). Samples were taken every two hours (i.e., seven times) during the night with the help of dim red light. The swabs were introduced deeply into the cow's mouth, left there for about 1 min until they were soaked with saliva, then extracted using a thread attached to the swab. The animals were not restrained. Samples were taken at 1930, 2130, 2330, 0130, 0330, 0530, and 0730h for 10 consecutive days from September 5 until September 15, 1993. Sunrise on the first day was 0649h and sunset 1959h (Schweizerische Meteorologische Anstalt). Saliva samples were immediately stored in sealed tubes on dry ice until they were thawed at room temperature and centrifuged at 3,500 rpm for 5 min on the following day, then stored at –20°C.

Sample analysis

A commercial radioimmunoassay (RIA) was used (^{125}I-Melatonin, Immuno Biological Laboratories, Hamburg, Germany; Manz et al. [1989]). The analyses were performed by REPROMED, Hamburg.

Briefly, melatonin was extracted using diethylether. The extract was dried and the pellets resuspended in buffer. Radiolabeled melatonin and antibodies against melatonin were added. After centrifugation, the antigen-antibody complex was dissolved in scintillation fluid and the radioactivity measured in a 12-channel gamma scintillation camera (Berthold, Germany).

As this assay had not previously been used with cow saliva, the following evaluation tests were performed. Melatonin was added to two saliva samples with low melatonin concentrations, according to the standard used in the RIA. The samples were analyzed and results compared with the standard curve established with buffer. The curve calculated from the results was parallel to the standard curve. The recovery calculated from three standard points was 82 ± 5%. A possible negative influence of organic material (hay, grass) in saliva samples was excluded by comparing results from untreated and centrifuged, ether-extracted samples. No difference was detected.

Statistical methods

Melatonin concentrations of the exposed and nonexposed cows were compared after $\log_{10}$-transformation. As this study was of an explorative nature, containing a substantial number of missing values (Table 1) and outliers (Fig. 1), it was decided to use a local regression model, including 95% confidence limits for fitting the mean profile of each group [Chambers and Hastie, 1992]. ANOVA would have been inappropriate because the missing and extreme data points lead to an unbalanced design with highly influential data points.

Local regression models provide means for fitting regression functions or regression surfaces to data. Consider any point x in the space of the predictors: One basic specification in a local regression model is that there is a neighborhood of size α containing x, within which the regression surface is well approximated by a function from a specific parametric class. This regression surface is fitted in the neighborhood of all x_i. The characteristics of local regression models allow the smoothing of the response as a function of the predictors. Thus, the fitting methods are non-parametric regression procedures.

In the present study, a linear regression model (first-degree polynomial) was fitted to the data in the neighborhood of size $\alpha = 0.1$, which contains 10% of all data points. Based on a Gaussian distribution, 95% confidence limits for the mean profiles were calculated. The 95% confidence limits of the difference between the mean profiles was then estimated by pointwise summing of the mean profiles' variances and then Bonferroni-adjusted for multiple testing. If the 95% confidence interval of the difference of the two profiles does not encompass zero, this indicates a statistically significant result. This is an application of a method introduced by Azzalini and Chiogna [1992] and made available by the public statistical library Statlib (statlib@lib.stat.cmu.edu). The results are presented graphically.

Table 1. Analyzable samples per night (35 samples collected each night on each farm)

	Farm A (%)	Farm B (%)	Total (%)
Night 1	16 (45.7)	10 (28.6)	26 (37.1)
Night 2	27 (77.1)	28 (80.0)	55 (78.6)
Night 3	30 (85.7)	27 (77.1)	56 (80.0)
Night 4	30 (85.7)	25 (71.4)	55 (78.6)
Night 5	22 (62.9)	20 (57.1)	42 (60.0)
Night 6	28 (80.0)	29 (82.9)	57 (81.4)
Night 7	28 (80.0)	27 (77.1)	55 (78.6)
Night 8	34 (97.1)	29 (82.9)	63 (90.0)
Night 9	26 (74.3)	33 (94.3)	59 (84.3)
Night 10	28 (80.0)	28 (80.0)	56 (80.0)
Total	269 (76.9)	256 (73.1)	525 (75.0)

Results

The mean nightly EMF exposure measured on the exposed farm was 1.59 mA/m with a maximum of 4.9 mA/m. On the nonexposed farm the mean nightly EMF exposure was below the measurement threshold of the probe (0.3 mA/m). From earlier measurements it was known that the exposure in the area of the nonexposed farm was approximately 0.076 mA/m [Altpeter et al., 1995]. This value corresponds to an average value in nonexposed rural areas in Switzerland.

The melatonin concentrations measured in the individual samples ranged from 1.0 pg/ml to 750 pg/ml in the exposed and 1.0 pg/ml to 316 pg/ml in the nonexposed animals during the ten days.

Acute effect

During the first five nights no statistical difference of the average salivary melatonin levels were observed between the two groups. During the sixth night, the first night after the off phase, a statistically significant difference between the two profiles of +3.89 pg/ml (95% CI 2.04; 7.41 pg/ml) was observed, indicating an acute recovery from suppression of melatonin due to the removal of the EMF of the transmitter (Figs. 1, 2).

Chronic effect

Because the two mean profiles during the first two nights were virtually identical (Figs. 1, 2), there was

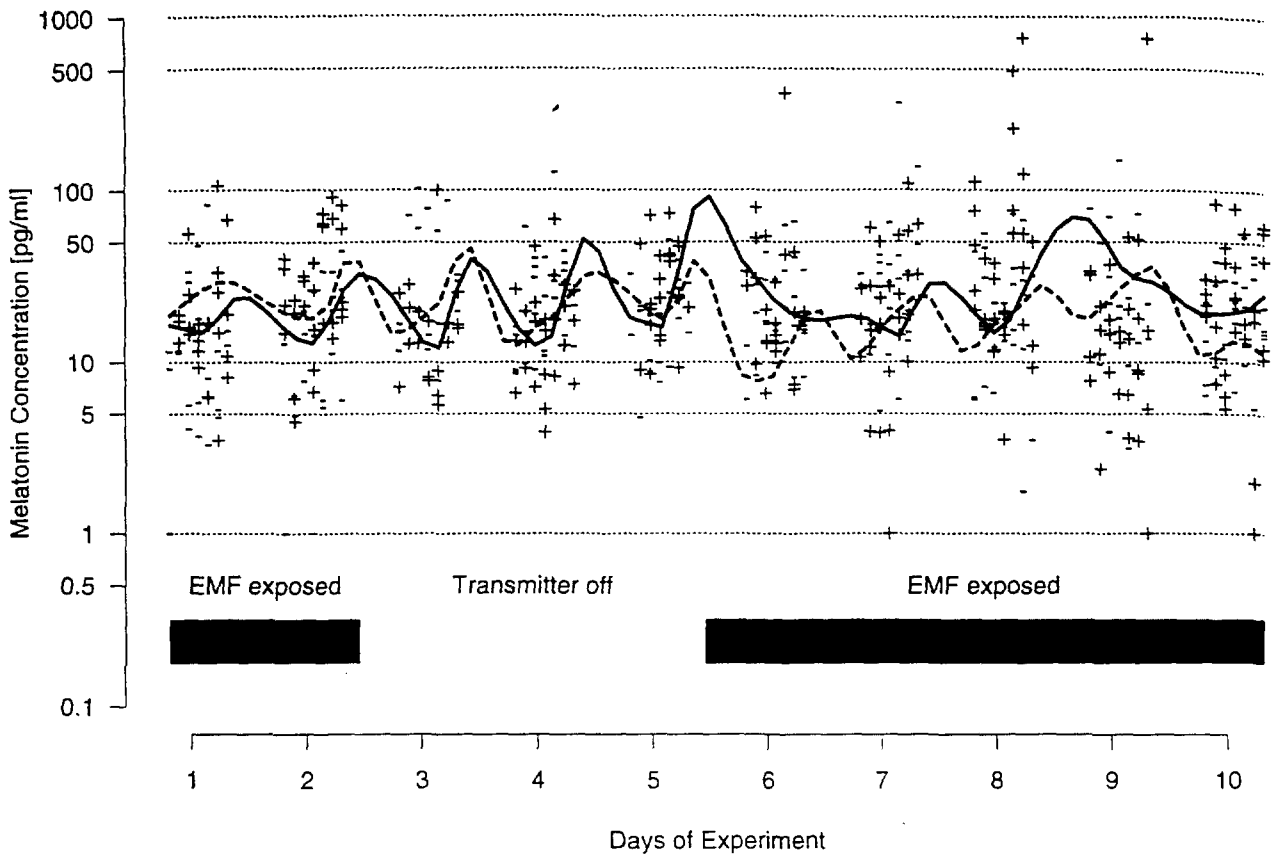

Fig. 1. Salivary melatonin levels measured in exposed ("+" symbols) and unexposed ("–" symbols) cows (n = 5 in each group). The smoothed mean profiles are plotted as lines (continuous line = exposed group, dashed line = control group).

no indication of a chronic effect, although there seemed to be a slight phase shift (Fig. 1). This shift disappeared by the end of the off phase.

Discussion

The results of this study provide some evidence of a statistically significant recovery effect four days after removal of an exposure with a maximal field strength of 4.9 mA/m in the frequency range of short waves (3–30 Hz). Interestingly, no chronic effect had been observed before the intervention. However, as this was a pilot study the sample size was restricted to only five animals per group and consequently the power of the study was insufficient to exclude a limited EMF effect. With a sample size of five in this study, the minimal detectable standardized difference between the means of the groups was 3.06 standard deviations ($\alpha = 0.05$, $\beta = 0.20$; Riedwyl [1978]). In order to detect a standardized difference between the means of the groups of one standard deviation, at least 16 animals per group would have been necessary, which is more than the current average herd size of Swiss dairy farms (13 cows). Also, because no samples were collected during the day the estimation of the melatonin cycles are rather imprecise. Still, the findings suggest a slight effect of EMF on melatonin levels, in contrast to the results of the project part done on humans, where no effect on 6-hydroxy-melatonin-sulfate in urine was detected [Altpeter et al., 1995]. A similar recovery effect in serum melatonin levels in rats was observed by Kato et al. [1994]. They exposed animals to a circular polarized 50 Hz magnetic field for six weeks. The exposure significantly reduced nocturnal melatonin concentration, but at one week following cessation of exposure melatonin concentration had returned to normal levels.

The influence of EMF exposure on melatonin levels in cow saliva has been studied for the first time and a technique for saliva sample collection was established. This technique was practical under limited light conditions and well accepted by the animals. They were only marginally disturbed and, when lying, they usually did not get up for sampling, although it could not be avoided in some cases. This seems important, as melatonin concentrations are basically higher in a standing position than when an individual is lying down [Deacon and Arendt, 1994].

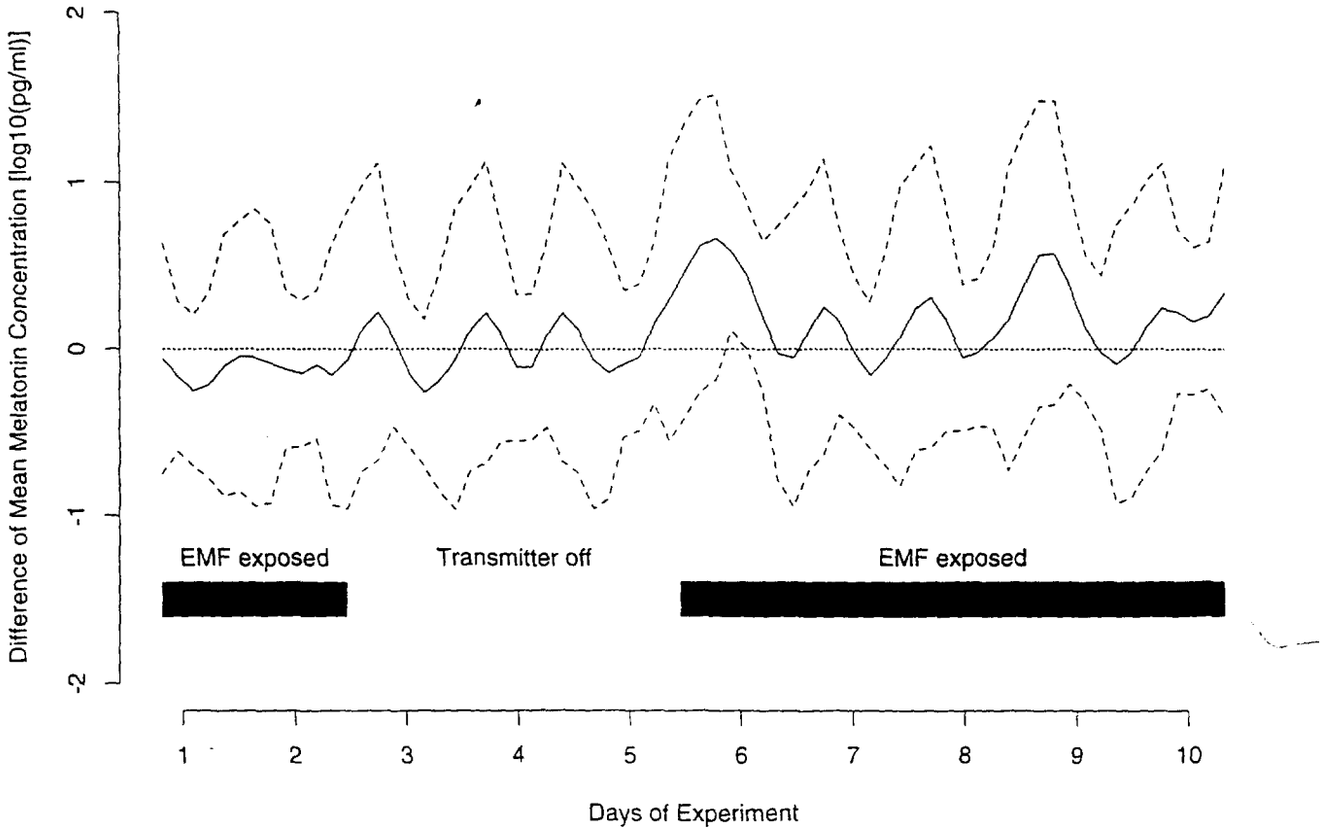

Fig. 2. Profile of the difference of the average salivary melatonin concentration series in the two study groups, including 95% confidence limits.

As it was not technically possible to centrifuge the swabs immediately in the barns, the amount of saliva collected was not known until the next day, when, in some cases, it was discovered that not enough liquid could be extracted from the swab for the RIA. This caused a certain loss of data points, which could be avoided in the future by collecting more than one sample per animal. Thus, saliva sampling for melatonin measurements in cows seems to be a promising technique because it is non-invasive and can easily be performed under dim light conditions.

Salivary melatonin levels have been described as closely linked to serum melatonin concentrations in humans [Vakkuri, 1985; Demel, 1992]. However, the comparative levels in the two compartments have not yet been reported in cattle. The salivary melatonin concentrations reported here were higher than maximal serum levels of 90 pg/ml measured by other researchers [Berthelot et al., 1990] but similar to nightly serum concentrations of 44.13 to 327.51 pg/ml reported by Martin et al. [1983]. The fact that the results described here were obtained with a commercial RIA developed for humans and not specifically adapted to saliva analysis may explain these differences.

In conclusion, this study detected a small effect of EMF in the short-wave range on salivary melatonin concentrations in dairy cows. However, more research is needed to conclusively establish an effect of EMF on melatonin levels. Saliva sampling has a potential as an easy and non-invasive technique and needs to be further developed as an aid to veterinary diagnosticians.

Acknowledgments

We thank the farmers for their cooperation and Ms. Anke Wunderlich, Repromed Hamburg, for her lab work. We are also grateful to the members of the scientific project panel acting on behalf of the Swiss Federal Office of Energy (Dr. J. Cattin, Chairman) for their support and critical appraisal of the project. The project was funded by the Swiss Federal Office of Energy, Bern.

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Exhibit 1C
Cellular Phone Taskforce 12-21-97

Do radiofrequency electromagnetic fields cause sleep disorders ?

E.S. Altpeter, K. Sprenger, K. Madarasz, Th. Abelin
Department of Social- and Preventive Medicine, University of Berne, Switzerland
email: altpeter@ispm.unibe.ch

Starting point to the research program reported here were health complaints of various types in the neighbourhood of a shortwave radio station. At the beginning of this study, the discussion on radiofrequency electromagnetic fields (RFEMF) and sleep disorders had hardly started, but has received considerable attention since. For example Mann and Röschke (1996) showed a reduction of REM-sleep in 14 healthy volunteers blindly exposed to 900 MHz (digital mobile radio telephone) during a randomized controlled experiment with subjects serving as their own controls. This supports the findings reported here.

Objectives

- **Are health disturbances reported *more* frequently in the neighbourhood of the short wave radio transmitter than in more distant areas ? Is there a relationship to measured EMF exposure ?**
- **What disturbances remain associated with EMF in multivariate analysis ?**
- **Can the findings be replicated and extended in the same population 4 years later ?**
- **Is there evidence for a biophysical mechanism ? Or for a psychological *mechanism* ?**

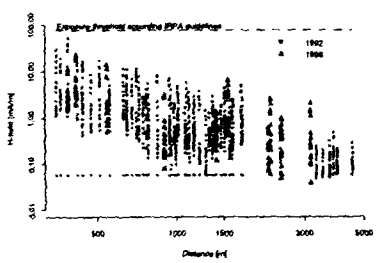
Methods

The principal study design was a cross-sectional study of more or less exposed individuals. In addition, an experimental situation was created by turning off the transmitter for 3 days during 10-day observation period.

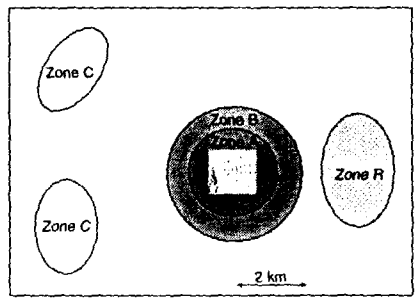
- Exposure assessment
  - by defining 4 zones according to distance (first interview study 3 zones, see figure 1)
  - by 24-hour measurement of magnetic field strength (H-field [mA/m]) at 56 (1992) and 10 sites (1996)
- Health effects assessment
  - Health interview with check-list on 26 symptoms (a study of chronic diseases was discontinued due to small population size)
  - symptom diaries (confirming interview data)
- Assessment of possible mechanisms
  - by measuring 6-Hydroxy-Melatonin-Sulfate in early-morning urine of 65 humans and Melatonin in 2-hourly saliva samples of 10 dairy cows
  - Personality assessment by Freiburger Personality Inventory
  - Interview question on opinion concerning transmitter's influence on health
  - Assessment of confounding through socio-demographic variables including education, taxable income etc.
- Statistical Methods
  - crosstable calculation (S+ 3.3 for Windows 3.x)
  - linear logistic regression (S+ 3.3 for Windows 3.x)
  - repeated measurement analysis by 'mmodel' supplied by A. Azzalini and 'generalized estimating equations' supplied by V. Carey (Statlib, S+ 3.3)
  - graphical modelling by mgraph of MIM 2.3

Results

Exposure measurements: The association of distance and H-field strength was confirmed. The range of measurements per site reflects the changing directional transmissions.

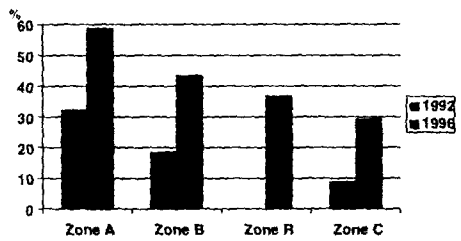


Definition of Zones:



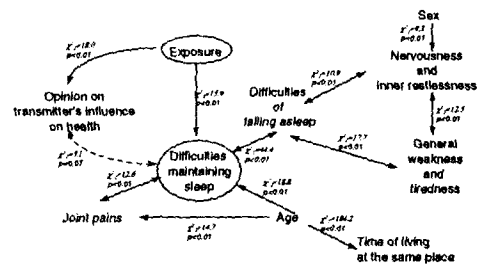
Difficulties maintaing sleep (interview):

($p<0.01$)



In 1992 and 1996 frequent episodes of awakening at night were most strongly associated with distance *and exposure*. The reason for the general prevalence increase is unknown.

Graphical Model:

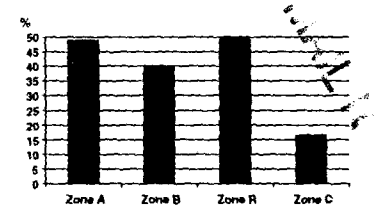


Other health complaints showed only indirect association with exposure. Lack of *arrows* means lack of significant association.

Logistic regression: 10-fold exposure increase is associated with a 2.4 fold OR-increase (95% C.I.: 1.29 to 4.55)

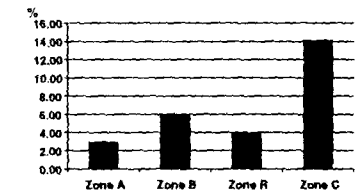
Specific questions *provide further* evidence for a causal relation between sleep disorders and operation of the radio station:

Do you sleep better away from home (only *persons with sleep disorders included*)



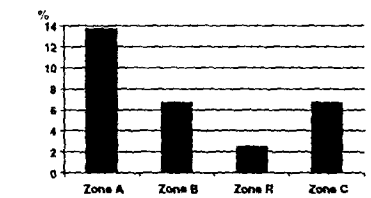
Drinking coffee at night?

($p<0.01$)



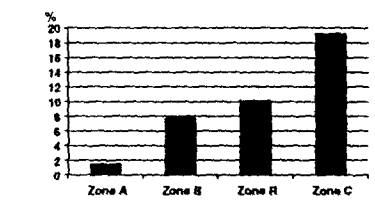
Taking medication against sleep disorders

($p<0.01$)



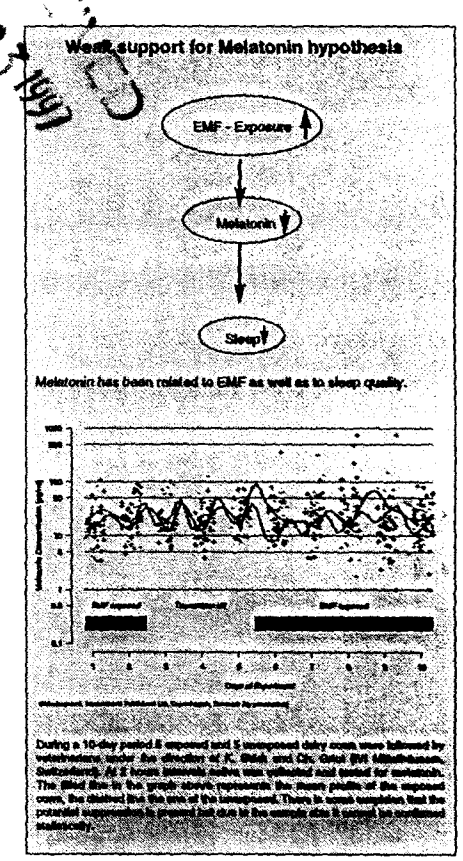
Having a heavy meat at night...?

($p<0.01$)



Mechanism:

No evidence for a psychological mechanism was found. Personality structure does not vary between Zones.



Conclusions

Our observations point at a risk of sleep disorder caused by operation of the radio station. The mechanism - *psychological or biophysical* - remains uncertain and requires *further research*. For a psychological association the consistancy of results *would be* astonishing.

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BUWAL, Bundesamt für Umwelt, Wald und Landschaft
OFEFP, Office fédéral de l'environnement, des forêts et du paysage
UFAFP, Ufficio federale dell'ambiente, delle foreste e del paesaggio
FOEFL, Federal Office of Environment, Forests and Landscape

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3152 Mamishaus

Exhibit 1d
Cellular Phone
Taskforce
12-21-97

Gesundheitliche Auswirkungen des Kurzwellensenders Schwarzenburg

Sehr geehrte Damen und Herren

Wir nehmen Bezug auf unser Schreiben vom 15.12.1995, in welchem wir Ihnen eine Stellungnahme der Arbeitsgruppe "Nichtionisierende Strahlung" zur Frage der Immissionsgrenzwerte im Kurzwellenbereich in Aussicht gestellt haben. Die Arbeitsgruppe hat diese Stellungnahme in der Zwischenzeit verabschiedet (siehe Beilage) und kommt zu folgendem Schluss:

Die Arbeitsgruppe hält einen Zusammenhang zwischen den festgestellten Schlafstörungen und dem Sendebetrieb für erwiesen, obwohl die in der Umgebung des Senders Schwarzenburg gemessenen Feldstärken überall unterhalb der 1990 empfohlenen Immissionsgrenzwerte (vgl. Biologische Auswirkungen nichtionisierender elektromagnetischer Strahlung auf den Menschen und seine Umwelt; 1. Teil, Frequenzbereich 100 kHz bis 300 GHz; Schriftenreihe Umweltschutz Nr. 121, BUWAL, Juni 1990) liegen. Sie weist darauf hin, dass es fraglich sei, ob diese empfohlenen Immissionsgrenzwerte den Schutz des Menschen auch bei langfristiger Exposition gewährleisten, sieht sich aber derzeit noch nicht in der Lage, mit wissenschaftlichen Methoden niedrigere Immissionsgrenzwerte abzuleiten, welche die beobachteten Schlafstörungen mit Sicherheit verhindern könnten. Wenn beim Kurzwellensender Schwarzenburg Massnahmen getroffen werden sollen, dann erachtet die Arbeitsgruppe eine Sendepause während der Nacht als eine sinnvolle Massnahme.

Das BUWAL und das BAG (Bundesamt für Gesundheitswesen) schliessen sich dieser Beurteilung an. Beide Aemter haben die für den Kurzwellensender Schwarzenburg zuständigen Behörden (Eidg. Verkehrs- und Energiewirtschaftsdepartement sowie die Volkswirtschaftsdirektion des Kantons Bern) in diesem Sinne orientiert.

Wir hoffen, Ihnen mit diesen Angaben zu dienen, und verbleiben

mit freundlichen Grüssen

Bundesamt für Umwelt, Wald
und Landschaft
Der Direktor

Ph. Roch

Beilage: Stellungnahme der Arbeitsgruppe "Nichtionisierende Strahlung"

Arbeitsgruppe
"Nichtionisierende Strahlung"

Zürich, im März 1996

Stellungnahme der Arbeitsgruppe "Nichtionisierende Strahlung"

zur Untersuchung

"Gesundheitliche Auswirkungen des Kurzwellensenders Schwarzenburg"

Die Arbeitsgruppe wurde vom BUWAL angefragt, eine Stellungnahme zu den Ergebnissen der Untersuchung beim Kurzwellensender Schwarzenburg abzugeben.

Sie hat die Berichte "Gesundheitliche Auswirkungen des Kurzwellensenders Schwarzenburg" (BEW-Schriftenreihe Nr. 56, August 1995) und "Study on Health Effects of the Shortwave Transmitter Station of Schwarzenburg, Bern, Switzerland" (BEW-Schriftenreihe Nr. 55, August 1995) an zwei Sitzungen eingehend besprochen. An der ersten Sitzung war Prof. Abelin, der Leiter der Studie, als Gast anwesend.

Die Arbeitsgruppe beurteilt die vorliegende Untersuchung und deren Ergebnisse aus wissenschaftlicher Sicht wie folgt:

1. Die Untersuchungs- und Auswertemethodik ist sinnvoll gewählt.

2. Die von der Arbeitsgruppe in Uebereinstimmung mit der Internationalen Kommission zum Schutz vor nichtionisierender Strahlung (ICNIRP) empfohlenen Immissionsgrenzwerte (siehe: "Biologische Auswirkungen nichtionisierender elektromagnetischer Strahlung auf den Menschen und seine Umwelt", Schriftenreihe Umweltschutz Nr. 121, BUWAL 1990) waren an keinem Messstandort und bei keinem Sendezustand überschritten.

3. Es wurde keine Häufung von körperlichen Krankheiten, z.B. Krebs oder Diabetes gefunden. Die Arbeitsgruppe gibt allerdings zu bedenken, dass die untersuchte Bevölkerungsgruppe klein ist. Eine allfällige Erhöhung des Krankheitsrisikos hätte massiv sein müssen, damit sie überhaupt hätte nachgewiesen werden können.

4. Aus der Personen-Befragung ergab sich eine Häufung von Schlafstörungen und weiteren psychovegetativen Störungen in der Nähe des Senders. Mehr als 50 % der über 45-Jährigen in der am stärksten exponierten Zone A machten starke und häufige Schlafstörungen geltend. Nach dem Abstellen des Senders verbesserte sich die Schlafqualität. Diese Befunde waren statistisch signifikant.

   Die Arbeitsgruppe erachtet einen Zusammenhang zwischen dem Sendebetrieb und subjektiv wahrgenommenen Schlafstörungen als erwiesen. Es handelt sich um einen bemerkenswerten Befund, der jedoch durch weitere Studien an anderen Standorten erhärtet werden sollte. Wie weit die Schlafstörungen durch die elektromagnetischen Felder direkt verursacht und wie weit sie durch andere Faktoren, die auch mit dem Sendebetrieb in Zusammenhang stehen, indirekt ausgelöst oder verstärkt werden, lässt sich aufgrund des Datenmaterials nicht entscheiden. Eine direkte Wirkung der elektromagnetischen Felder kann jedenfalls nicht ausgeschlossen werden.

5. Falls die elektromagnetischen Felder des Kurzwellensenders für die psychovegetativen Störungen kausal verantwortlich sind, ist derzeit keir biologisches Wirkungsmodell so weit erhärtet, dass es die Wirkungen in diesem nicht-thermischen Bereich plausibel wiederzugeben vermöchte. Damit ist auch nicht bekannt, welche physikalischen Parameter der Immissionen (elektrisches, magnetisches Feld; Modulation; Polarisation; Frequenz oder Kombination von Frequenzen) und welche zeitlichen Aspekte der Exposition (Spitzenwerte; durchschnittliche Belastung z.B. während der Nacht oder während des Tages) von Bedeutung sind.

6. Die Arbeitsgruppe hat sich intensiv mit der Frage beschäftigt, ob die derzeit angewendeten Immissionsgrenzwerte niedriger festgelegt werden müssten oder ob allenfalls zwischen kurzfristiger und langfristiger Exposition unterschieden werden sollte.

   Sie ist der Ansicht, dass die aktuell gültigen Immissionsgrenzwerte den Schutz des Menschen bei kurzfristiger Exposition von einigen Minuten nach wie vor gewährleisten. Als sie im Jahr 1990 diese Grenzwerte für die Schweiz zur Anwendung empfohlen hat, ist sie davon ausgegangen, dass bei deren Einhaltung schädigende und belästigende Wirkungen auch bei länger dauernder Exposition unwahrscheinlich sind. Die Resultate der vorliegenden Untersuchung haben nun gezeigt, dass dies zumindest in der Umgebung des Kurzwellensenders Schwarzenburg fraglich ist. Andererseits reicht das Ergebnis einer einzelnen Studie nicht aus, um niedrigere Immissionsgrenzwerte für längere Expositionszeiten, beispielsweise für die mittlere Belastung während der Nacht, während 24 Stunden oder während eines Jahres, abzuleiten. Die Arbeitsgruppe erinnert in diesem Zusammenhang an die Kriterien, welche sie bei ihren früheren Beratungen an wissenschaftliche Berichte gestellt hat, damit diese als Basis für Immissionsgrenzwerte zugelassen wurden. Sie hält diese nach wie vor für gültig:

   - Ein Befund soll unabhängig reproduziert sein.
   - Es soll ein Wirkungsmodell vorhanden sein, das die Beobachtungen zu erklären vermag.
   - Die Kausalität zu den elektromagnetischen Feldern soll erwiesen sein.

   Keine der drei Bedingungen ist im vorliegenden Fall erfüllt.

7. Die Arbeitsgruppe wiederholt ihre frühere Empfehlung, angesichts der Hinweise und Unsicherheiten über chronische Wirkungen die Immissionen auch im Bereich unterhalb der Immissionsgrenzwerte so weit zu reduzieren, wie dies technisch und betrieblich möglich und wirtschaftlich tragbar ist. Dieser Grundsatz eines zukunftsgerichteten Umweltschutzes erhält durch die Ergebnisse der vorliegenden Untersuchung zusätzliches Gewicht.

   Wenn die zuständigen Behörden im vorliegenden Fall vorsorgliche Massnahmen verlangen wollen, dann erachtet die Arbeitsgruppe eine Sendepause während der Nacht als sinnvoll, sofern parallel zum reduzierten Sendebetrieb eine erneute Evaluation der Schlafqualität vorgenommen wird.

Der Vorsitzende

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U S A

Bern, December 8, 1997

THIS LETTER REPLACES THE LETTER OF DECEMBER 5, 1997, WHICH CONTAINED AN ERROR

Results of our Studies on Radio-Frequency EMF (RF-EMF) and Sleep Disorder

Dear Mr. Firstenberg:

As my secretary told me, you asked for a copy of our English-language report on the above-mentioned work. I enclose a copy of our report (sent by FEDEX on December 5, 1997), which was published in a Swiss government publication series in 1995. Its principal result is that a statistical association was found between the RF-EMF field strengh and the occurrence of difficulties in maintaining sleep. This association is maintained in multivariate analysis, even in a type of path analysis, where all other factors and distorders are controlled for.

Another result was that in a pilot study of more and less exposed cows, stopping the transmitter was as a visual impression associated with a slow rise of the peak melatonin concentration in saliva, and a shift in the daily melatonin cycle. Turning the transmitter on again was associated with a lowering of the peak. Results on melatonin were negative for humans, but as we think from knowledge gained since that time, we may not have chosen the most appropriate study design. The results of that study were published by Stärk et al. in J Pineal Research 1997; 22:171-176.

In the Summer of 1996, we repeated our initial interview survey, in order to ask more detailed questions related to sleep disorder and to include an additional exposed population living in a neigboring political commune. The results confirmed our earlier conclusions, but this additional study was not of a type to test the question of whether the association between RF-EMF and sleep disorder was based on a biological or a psychological mechanism. These results have not yet been published. A publication for a peer-reviewed scientific journal is in preparation, but it will take several months, if not longer, until they will be duly published. Nevertheless, I also enclose a letter-size copy of a poster, which we presented at the European Regional Meeting of the International Epidemiological Association in Münster, Germany, in September of this year (sent by FEDEX on December 5, 1997).

I hope that this information and these materials will be of use to you.

Sincerely yours,

Theodor Abelin

Theodor Abelin, M.D., M.P.H.
Professor and Department Head

Enclosures (sent by FEDEX on Dec.5, 1997)

Exhibit 2
Cellular Phone Taskforce
Dec. 21, 1997

1997:19

Possible health implications of subjective symptoms and electromagnetic fields

A report prepared by a European group of experts for the European Commission, DG V

Ulf Bergqvist and Evi Vogel (eds)
Leif Aringer
Joe Cunningham
Fabriziomaria Gobba
Norbert Leitgeb
Luis Miro
Georg Neubauer
Ingeburg Ruppe
Paolo Vecchia
Cecilia Wadman

EUROPEAN COMMISSION
DIRECTORATE-GENERAL V
EMPLOYMENT, INDUSTRIAL RELATIONS AND SOCIAL AFFAIRS
Public health and safety at work
Public health analysis, policy and programme coordination and development

This work was made possible by financial support from the DG V of the European Commission (SOC 96 200576 05FO1).

Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use which might be made of the following information.

A great deal of additional information on the European Union is available on the internet. It can be accessed through the European server (http://www.europa.eu.int).

ARBETE OCH HÄLSA VETENSKAPLIG SKRIFTSERIE
ISBN 91-7045-438-8 ISSN 0346-7821

Arbetslivsinstitutet
National Institute for Working Life

National Institute for Working Life

The National Institute for Working Life is Sweden's center for research and development on labour market, working life and work environment. Diffusion of information, training and teaching, local development and international collaboration are other important issues for the Institute.

The R&D competence will be found in the following areas: Labour market and labour legislation, work organization and production technology, psychosocial working conditions, occupational medicine, allergy, effects on the nervous system, ergonomics, work environment technology and musculoskeletal disorders, chemical hazards and toxicology.

A total of about 470 people work at the Institute, around 370 with research and development. The Institute's staff includes 32 professors and in total 122 persons with a postdoctoral degree.

The National Institute for Working Life has a large international collaboration in R&D, including a number of projects within the EC Framework Programme for Research and Technology Development.

ARBETE OCH HÄLSA
Redaktör: Anders Kjellberg
Redaktionskommitté: Anders Colmsjö
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Arbetslivsinstitutet,
171 84 Solna, Sverige

ISBN 91-7045-438-8
ISSN 0346-7821
Printed at CM Gruppen

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