Effects of pulsed high frequency EMF (900 MHz, 217 Hz pulse) exposure during pregnancy on offspring of rats

12N98501

FINAL REPORT

Number 1 of 3 Originals

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Date:
December 1998

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Statement of Study Director:

Study No.: 12N98501

Exposure: pulsed high frequency EMF

Title: Effects of pulsed high frequency EMF exposure during pregnancy on offspring of rats

The study described in this report was conducted following the OECD Principles of Good Laboratory Practice (GLP) (Bundesanzeiger No. 42a of March 2, 1983 [German version]) and following the Principles of Good Laboratory Practice according to Annex 1 ChemG (Bundesgesetzblatt, Part I of July 29, 1994), also following Guideline 67/548/EWG in connection with Guideline 88/302/EWG "Teratogenicity Study" (Amtsblatt der EG, L133, S. 24, v. 30.5.88) and OECD-Guideline 414 "Teratogenicity".

This report provides a correct and faithful record of the results obtained.

I accept the responsibility for the validity of the study.

Dr. rer. nat. J. Buschmann
Study Director

Statement of Principal Scientists:

Study No.: 12N98501

Exposure: pulsed high frequency EMF

Title: Effects of pulsed high frequency EMF exposure during pregnancy on offspring of rats

We, the undersigned, hereby declare that the work was performed by us or under our supervision according to the procedures herein described and that this report provides a correct and faithful record of the results obtained.

Date Signature

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1. Introduction

1.1 Objective of the Study

The objective of the study was to investigate the effects of pulsed high frequency EMF exposure during pregnancy on offspring of rats.

1.2 Guidelines for the Study

The study described in this report was conducted following the Principles of Good Laboratory Practice according to Annex 1 ChemG (Bundesgesetzblatt, Part I of July 29, 1994), also following Guideline 67/548/EWG in connection with Guideline 88/302/EWG "Teratogenicity Study" (Amtsblatt der EG, L133, S. 24, v. 30.5.88) and OECD-Guideline 414 "Teratogenicity".

1.3 Selection of Animal Species

Rats are often used for reproductive and other toxicity studies, because of the economy in their use, the information available on physiology, reproductive data, and the susceptibility to different chemicals.
Therefore, the rat was the species of choice and there are historical control data of the chosen strain available at Fraunhofer ITA.

1.4 Study Duration

The study was started February 16, 1998 (first day of mating) and finished March 18, 1998 (last day of sacrifice).

1.5 Field Strength Selection

An average electric power density of 4.6 W/m^2 was selected in the cage area in the absence of animals. This value represents the human safety limit value according to relevant regulations (DIN VDE 0848 Teil 2/Oktober 91, 26. Verordnung zur Durchführung des Bundes-Immissions-schutzgesetzes 26. BImSchV/Dezember 96).

2. Exposure Conditions

A far field of an antenna transmitting at 900 MHz with a 217 Hz pulse was investigated. Field type, pulse, modulation frequency, and antenna type were selected to model the situation in the far field around a mobile phone station (D net).

3. Test System

3.1 Animal Model

Wistar rats, Crl:(WI)BR, Charles River Deutschland, Sulzfeld, were used in this study. Virgin females (7 weeks old on delivery) and males (at least 10 weeks old on delivery) were obtained from the breeder.
The study was performed with 70 female and 20 male animals.

3.2 Acclimatization Period

Prior to the start of the mating period, the rats were acclimated for approx. 2 weeks in polycarbonate (Makrolon®) cages in animal room T1.036 of the Fraunhofer ITA. The daily observations showed that the rats were in a good healthy condition and they were therefore accepted for this study.

3.3 Identification

Each animal in the study was assigned a unique individual identification number on a numbered metal plate on the cage. The ears of the animals were also tattooed corresponding to the identification numbers.
After successful mating and randomization of the females they were assigned a study specific animal number. All data collected from an animal was filed under this individual number. Identification labels and individual data sheets were kept in the animal room and showed the following information: Study number, group number, animal number, mating date, body weight, food consumption, and days of exposure.
When an animal died or was sacrificed, the date of death was entered on the individual animal data sheet which contains sacrifice data on the reverse side. All cage information was checked against the individual animal sheet prior to sending the animal for autopsy.
Identification labels were prepared in duplicate and attached to the bottles with the different

fixatives for the fetuses. Within the bottles, all fetuses were tagged individually.

3.4 Housing and Maintenance

Until mating, dams were housed in groups of two in polycarbonate (Makrolon ®) cages type III (21 x 42 x 18 cm). After mating they were kept individually in cages of the same type. Before day 6 post conceptionem (p.c.), animals were housed in room no. T1.036, thereafter in room no. T1.045.
On the days of exposure, dams were housed individually in special metal free polycarbonate (Makrolon ®) cages type III with plastic lid and glass drinking tubes in special plastic (PVC) racks in room no. T1.045 . Before exposure, cages were changed twice every week, during exposure every second day or more often if necessary.
Absorbent softwood (altromin 3/4, Altromin International, Lage, Germany), was used as bedding in the cages.
A closed formula commercial chow in pellet form identified as "1314 N specially prepared", purchased from Altromin International, Lage, Germany, was offered ad libitum as the diet for this study. Filtered tap water was offered fresh weekly in polycarbonate (Makrolon®) bottles, ad libitum. Temperature and relative humidity were recorded continuously. The temperature in the animal room was set on 20 - 24 °C and the rel. humidity 40 - 70 %.
The animal room lighting was an artificial light/dark cycle, lights on at 6.00 a.m., lights off at 6.00 p.m.

4. Conduct of the Study

4.1 Mating

Animals were mated 2 females :1 male overnight in the Makrolon® cages of the females. Next morning vaginal smears were taken from the females. A female was considered positive if sperm was found in the vaginal smear and/or if a vaginal plug was detected. This day of detection was considered day 0 p.c.

4.2 Randomization

After successful mating, the dams were randomized according to a randomization list prepared in advance and assigned a study specific number.

4.3 Groups

The following groups were formed:

Group	Power density* W/m²	Daily exposure time	No. of mated females	Animal No.
A	0 (Sham exposure)	20 h	24	001-024
B	4.6**	20 h	24	101-124

* target value in the cage area

** human safety limit value

Due to the double blind study design (see 4.4), animal numbers were assigned without knowledge of exposure, so that animals from the front part of the room were considered "Group 0", those of the rear part "Group 1".

After completion of the study, the following assignment could be made:

Group 0: Exposure to 4.6 W/m² (target value in the cage area)

Group 1: Control (Sham exposure)

4.4 Exposure

Dams were exposed from day 6 p.c. (11.00 a.m.) through day 19 p.c. (7.00 a.m.), 20 h per day (approx. 11.00 a.m. - 7.00 a.m.). On the days of exposure, dams were housed individually in special metal free cages with plastic lid and glass drinking tubes in special plastic racks. Cage positions were changed daily according to a plan prepared in advance, in order to achieve similar exposure conditions for all animals.

For exposure, animal room No. T1.045 was separated into two laboratory parts, forming two completely separate rooms for the control and exposed group, resp. Both parts of the room were identical in terms of size, climatization, cage positions, antenna and cable position. Consequently, the investigations were performed as a double blind study.

4.4.1 Field Characteristics

The rats were exposed to a far field of an antenna transmitting at 900 MHz with a 217 Hz pulse. Field type, pulse, modulation frequency, and antenna type were selected to model the situation in the far field around a mobile phone station (D net). For more details, see separate

report by IMST, entitled "Conception and construction of an exposure setup for the investigation of the influence of pulsed electromagnetic RF fields on defined physiological parameters of rats".

4.4.2 Shielding

Both parts of the room for the exposed and the control group, resp., were completely electromagnetically shielded. Consequently, all external electromagnetic influences could be excluded as well as the influence from the exposed room on the adjacent control room.
Copper polyester nonwoven (Flectron®, EMC-Technik & Consulting GmbH, Stuttgart) was used as shielding material. Concerning exposure, an electromagnetic uncoupling of control and treated group of at least 60 dB (Shielding factor 1:1 Million in relation to power density) was achieved in the cage area. For more details, see separate report by IMST.

4.4.3 Control of the Exposure Data

The presence/absence of the HF field was controlled by a computer and values were recorded every 5 minutes. Additionally, the rooms were controlled for low frequency magnetic fields. For more details, see separate report by IMST.

4.5 Clinical Observations

All animals were observed in their cages at least once daily.

4.5.1 Body Weight

Individual body weights of the dams were determined to the nearest 0.1 g on days 0, 6, 10, 15, and 20 p.c.

4.6 Postmortal Findings at Sacrifice

At the end of the study, all dams were sacrificed by $C0_2$ overdose and subsequent exsanguination.

4.6.1 Macropathology of the Dams

Necropsy was performed in all dams, and all macroscopic changes were recorded.

4.6.2 Reproductive Parameters

At terminal sacrifice, the following reproductive parameters were determined: Uterine weight, number of Corpora lutea, implantation sites (after ammonium sulfide staining in uteri without visible implantations), number and position of early and late resorptions, number and position of live and dead fetuses, sex, position and individual weight of live fetuses as well as individual placental weight.
Fetuses weighing less than 2 g were classified as "runts".
An animal was considered "non pregnant" only if no implantations sites could be determined even after ammonium sulfide staining.

4.7 Fetal Investigations

During preparation of the fetuses, each individual fetus was tagged with an individual number. All fetuses were carefully inspected for external anomalies (incl. hematomas and position anomalies of the limbs).
For further investigations, the fetuses of each litter were divided alternatingly.

4.7.1 Skeletal Investigations

One half of the fetuses were fixed in 70 % Ethanol and subsequently eviscerated. After that bone staining with alizarin red was performed and fetuses were examined for skeletal anomalies and ossification defects as indicators of a possible developmental retardation.
The findings were recorded on special data sheets according to a given terminology.

4.7.2 Visceral Investigations

The remaining half of the fetuses were fixated in BOUIN'S fixative and examined for visceral anomalies using WILSON's slicing technique. At least 1 day before examination, the fetuses were placed in 99 % ethanol to remove BOUIN's fixative. Immediately before preparation of slices, fetuses were placed on dry ice in order to improve the quality of the slices.
The findings were recorded on special data sheets according to a given terminology.

4.8 Statistical Evaluation

All data were recorded using special data sheets. Mean value and standard deviation or incidences were calculated.

Differences between groups were considered casewise as statistically significant for $p < 0.05$ and marked in the tables by "*" ($p < 0.05$) or "**" ($p < 0.01$). Body weight, fetal and placental weight were analyzed using analysis of variance. If the group means differed significantly with this method, the mean of the treatment group was compared with the mean of the control group using DUNNETT's test. Incidence data were analyzed using the two-tailed FISHER's exact test.

In all instances, the dam or litter was used as the basic unit. For assessment of incidence data, additional comparisons were performed based on fetuses. All statistics were run on the SAS system 6.2 on a VAX microcomputer.

Maternal weight gain during exposure was calculated as:

$$\text{Body weight}_{\text{day 20 p.c.}} - \text{Body weight}_{\text{day 6 p.c.}}$$

Total maternal body weight gain was determined as:

$$\text{Body weight}_{\text{day 20 p.c.}} - \text{Body weight}_{\text{day 0 p.c.}}$$

To determine the maternal body weight gain except uterus, uterine weight was subtracted from this value.

Data from non pregnant animals (see 4.6.2) were excluded from all calculations.

Preimplantation loss was determined following the formula:

$$\text{Preimplantation loss} = \frac{\text{No. Corpora lutea} - \text{No. Implantation sites}}{\text{No. Corpora lutea}} * 100$$

Postimplantation loss was determined following the formula:

$$\text{Postimplantation loss} = \frac{\text{No. Implantation sites} - \text{No. Live fetuses}}{\text{No. Implantation sites}} * 100$$

If in exceptional cases the number of Corpora lutea was lower than the number of implantation sites, then the actual value was included for calculations, but postimplantation loss was taken as 0.

All incidence data on visceral or skeletal anomalies and ossification defects are presented as:

Number of fetuses with the given anomaly / Number of litters with such fetuses.

5. Results and Discussion

5.1 Mating

Seven matings were necessary to yield 48 sperm positive females. All of them were pregnant at final sacrifice.

5.2 Control of the Exposure Data

The exposure data in both rooms are described in details in a separate report by IMST entitled "Conception and construction of an exposure setup for the investigation of the influence of pulsed electromagnetic RF fields on defined physiological parameters of rats". In summary, the HF signal was stable during the whole exposure period. For more details, see the above-mentioned report.

5.3 Clinical Observations

The animals showed no abnormal clinical symptoms during the study (see Appendix 1). No mortality occurred and there were no signs of abortion or premature delivery in exposed and sham-exposed dams.

5.3.1 Body Weight of the Dams

Mean values of body weight gains are summarized in Table 1, the individual data are shown in Appendix 1.
No influence was found on body weight gain, which is evidenced by similar body weights at all weighings. The total body weight gain, the weight gain during exposure as well as the maternal weight gain except uterus were also not influenced by exposure (Table 1).

5.4 Postmortal Findings at Sacrifice

5.4.1 Macropathology of the Dams

Macroscopic adspection of maternal organs did not indicate any pathological changes in

control and treated dams (Appendix 1).

5.4.2 Reproductive Parameters

Mean values and incidences of relevant reproductive parameters are summarized in Table 2, litter data are reported in Appendix 2.
Mean number of Corpora lutea per dam is similar in both groups. There was no influence of exposure on pre- and postimplantation loss, number of implantation sites and live fetuses (Table 2).

5.5 Fetal Investigations

The number of live fetuses and the relation between male and female fetuses was not influenced by exposure (Table 2, Appendix 2).

5.5.1 Fetal and Placental Weights

Mean values of fetal and placental weights are shown in Table 3, individual litter data are reported in Appendix 2.
Fetal and placental weights were not influenced by exposure.

5.5.2 External Anomalies

External anomalies are summarized Table 4, individual litter data are shown in Appendix 2.
The observed anomalies (subcutaneous hematomas) are not considered to be malformations, and they were observed in both the control and the treated group in similar incidence. Subcutaneous hematomas can also occur during preparation of the fetuses.
Consequently, no influence of the exposure could be detected on the incidence of single external anomalies, the number of fetuses with external anomalies, and the number of litters with affected fetuses.

5.5.3 Skeletal Anomalies

The incidence of skeletal anomalies is reported in Table 6, the individual litter data are given in Appendix 4.
The observed anomalies are not considered to be malformations, but sporadically occurring

variations like rudimentary accessory lumbar ribs, cervical ribs, wavy ribs, short 13th ribs, curly cartilaginous part of the ribs, dumbbell shaped vertebral centrae, bipartite vertebral centrae, asymmetric sternebrae, and bipartite sternebrae.
All anomalies were found in both groups, including the control group, and/or in an incidence which is characteristic for the used strain of Wistar rats.
No statistically significant differences were found between the groups for any single anomaly, nor for the total number of fetuses with skeletal anomalies and total number of litters with fetuses showing skeletal anomalies.
Consequently, no influence of exposure on skeletal anomalies was found.

5.5.4 Ossification Data

The incidence of incomplete ossification is summarized in Table 7, individual litter data are reported in Appendix 6. The mean number of ossified centres is shown in Table 8, with individual litter data listed in Appendix 5.
The observed findings are not considered to be malformations, but sporadically occurring incomplete ossification in supraoccipital, exoccipital, interparietal, parietal, frontal, squamosal, nasal, zygomatic, premaxillary, hyoid, pterygoid bones, mandible, cervical vertebral arches, thoracic vertebral centres and arches, sacral vertebral arches, ribs, ileum, ischium, pubis, and humerus. All observed defects were found in both groups, including the control group, and/or in an incidence which is characteristic for 20 day old fetuses of the used strain of Wistar rats.
No relevant differences were found between the groups for any incompletely ossified bone, nor for the total number of fetuses with incomplete ossification and the total number of litters with fetuses showing incomplete ossification. This is evidenced by the finding that litter-based evaluation did not reveal any statistically significant differences in any of the investigated parameters.
Based on fetuses, statistically significant differences were found between the groups for two parameters (number of fetuses with incompletely ossified cervical vertebral arches and number of fetuses with incompletely ossified humerus, Table 7). These differences are considered to be without biological relevance by the following reasons:

1. No differences were found in a comparison based on litters, which is the relevant unit of this type of study.
2. The incidences found in both groups is within the normal range.
3. The incidence of defects in the treated group is lower than that in the control group.

The number of calcified cervical vertebral centres, caudal vertebral arches and centres,

sternebrae, metacarpals, metatarsals, proximal phalangae of the forelimbs, distal phalangae of the forelimbs and hindlimbs, and the total number of ossified centres was not different between the control and the treated group (Table 8).

Consequently, no influence of exposure on the incidence of findings of incomplete ossification and on the number of ossified centres was found.

5.5.5 Visceral Anomalies

The incidence of visceral anomalies is summarized in Table 5, the individual litter data are reported in Appendix 3.
The observed anomalies are not considered to be malformations, but sporadically occurring variations like dilated renal pelvis, dilated ureter, blood in respiratory tract (obviously by swallowing blood), blood in thoracic cavity, blood in peritoneum, blood in brain, subcutaneous hematoma (the latter four findings possibly induced artificially during preparation), and subcutaneous edema.
All anomalies were found in both groups, including the control group, and/or in an incidence which is characteristic for the used strain of Wistar rats.
No statistically significant differences were found between the groups for any single anomaly, nor for the total number of fetuses with anomalies and total number of litters with fetuses showing visceral anomalies.
Consequently, no influence of exposure on visceral anomalies was found.

6. Summary and Conclusions

The objective of the study was to investigate the effects of pulsed high frequency EMF exposure during pregnancy on offspring of rats. A far field of an antenna transmitting at 900 MHz with a 217 Hz puls (D net) at 4.6 W/m^2 (human safety limit value) in the cage area was investigated. Pregnant Wistar rats, Crl:(WI)BR, were exposed from day 6 p.c. (11.00 a.m.) through day 19 p.c. (7.00 a.m.), 20 h per day (approx. 11.00 a.m. - 7.00 a.m.). On the days of exposure, dams were housed individually in special metal free cages with plastic lid and glass drinking tubes in special plastic shelves. Cage positions were changed daily in order to achieve similar exposure conditions for all animals. A sham exposed control group was run concurrently. The investigations were performed as a double blind study.
Both parts of the room for the exposed and the control group, resp., were completely electromagnetically shielded. Copper polyester nonwoven was used as shielding material.

Concerning exposure, an electromagnetic uncoupling of control and treated group of at least 60 dB was achieved in the cage area. The presence/absence of the HF field was controlled by a computer and values were recorded every 5 minutes. Additionally, the rooms were controlled for low frequency magnetic fields.

The study was conducted following OECD-Guideline 414 "Teratogenicity". At day 20 p.c., dams were sacrificed to determine potential prenatal toxic effects of the exposure. The following reproductive parameters were determined: Uterine weight, number of Corpora lutea, implantation sites (after ammonium sulfide staining in uteri without visible implantations), number position of early and late resorptions, number and position of live and dead fetuses, sex, position and individual weight of live fetuses as well as individual placental weight. Fetuses were examined for external anomalies. One half of the fetuses were examined for skeletal anomalies. The remaining half of the fetuses were examined for visceral anomalies using WILSON's slicing technique.

The animals showed no abnormal clinical symptoms during the study. No mortality occurred and there were no signs of abortion or premature delivery in exposed and sham-exposed dams. No influence was found on total body weight gain, the weight gain during exposure as well as the maternal weight gain except uterus. Macroscopic adspection of maternal organs did not indicate any pathological changes.

There was no influence of exposure on pre- and postimplantation loss, number of implantation sites and live fetuses. Fetal and placental weights were not influenced by exposure.

No influence of the exposure could be detected on the incidence of single external, visceral and/or skeletal anomalies, the number of fetuses with these anomalies, and the number of litters with affected fetuses.

The observed anomalies are not considered to be malformations, but sporadically occurring variations. All anomalies were found in both groups, including the control group, and/or in an incidence which is characteristic for the used strain of Wistar rats.

There was also no effect on the incidence of incomplete ossification, which sporadically occurred in both groups in an incidence which is characteristic for 20 day old fetuses of the used strain of Wistar rats. The number of calcified ossification centres was also not influenced.

In conclusion, an exposure of gravid Wistar rats [Crl:(WI)BR] from day 6 - 19 p.c. to a far field of an antenna transmitting at 900 MHz with a 217 Hz pulse (D net) with 4.6 W/m^2 did not affect any of the investigated maternal and fetal parameters.

Consequently, no teratogenic, embryolethal or retarding effects of the exposure were found in the present study.

7. Tables and Figures

In the tables, the following group assignment is used:

Group 0: Exposure to 4.6 W/m² (target value in the cage area)
Group 1: Control (Sham exposure)

Table 1: Maternal Body Weight Gain

	Group	
Parameter	0	1
Total body weight gain, g		
Mean	**151.4**	**153.6**
SD	16.5	28.3
Min	121.6	73.3
Max	181.5	203.6
Body weight gain during exposure, g		
Mean	**120.2**	**122.0**
SD	16.5	27.7
Min	86.8	49.4
Max	155.9	169.0
Body weight gain except uterus, g		
Mean	**67.0**	**69.5**
SD	13.5	13.2
Min	41.8	43.1
Max	91.2	98.4

No significant differences ($p < 0.05$, ANOVA + DUNNETT's test)

Table 2: Litter Data

Parameter	Group 0	Group 1
Corpora lutea		
Mean	**17.42**	**17.13**
SD	1.72	3.04
Min	14	10
Max	22	22
Implantations		
Mean	**16.38**	**15.63**
SD	1.93	4.34
Min	10	3
Max	19	21
Live Fetuses		
Mean	**15.17**	**14.92**
SD	2.50	4.37
Min	9	2
Max	18	21
Postimplantation loss		
Mean	**1.20**	**0.70**
SD	1.74	0.80
Min	0	0
Max	7	3
%	7.3	4.5
Litters with resorptions/total litters	15/24	13/24
%	62.5	54.2
Sex ratio M/F	0.92	1.08

No significant differences ($p < 0.05$, ANOVA + DUNNETT's test)

Table 3: Fetal and Placental Weight

Parameter	Group 0	Group 1
Fetal weight, ♂, g		
Mean	**3.61**	**3.71**
SD	0.22	0.27
Min	3.23	3.15
Max	4.02	4.20
Fetal weight, ♀, g		
Mean	**3.45**	**3.48**
SD	0.20	0.28
Min	3.00	2.98
Max	3.78	3.88
Placental weight, g		
Mean	**0.58**	**0.60**
SD	0.05	0.09
Min	0.47	0.44
Max	0.65	0.88

No significant differences ($p < 0.05$, ANOVA + DUNNETT's test)

Table 4: External Anomalies

(All data presented as: Number of fetuses with the given anomaly / Number of litters with such fetuses)

Parameter		Group 0	Group 1
Total investigated	N / N	364 / 24	358 / 24
Subcutaneous hemorrhage	N / N	8/6	10/8
Total external anomalies	N / N	8/6	10/8
Fetuses with external anomalies	%	2.2	2.8
Litters with fetuses with external anomalies	%	25.0	33.3

No significant differences ($p < 0.05$, FISHER's exact test)

Table 5: Visceral Anomalies

(All data presented as: Number of fetuses with the given anomaly / Number of litters with such fetuses)

		Group	
Parameter		0	1
Total investigated	N / N	176/24	173/24
Dilated renal pelvis			
slight	N / N	24/12	16/10
medium	N / N	7/4	1/1
high	N / N	1/1	0/0
Dilated ureter			
slight	N / N	45/18	37/15
medium	N / N	14/7	10/8
Blood in respiratory tract	N / N	2/2	0/0
Blood in thoracic cavity	N / N	13/11	13/6
Blood in peritoneum	N / N	38/16	43/17
Blood in brain	N / N	0/0	1/1
Subcutaneous hematoma	N / N	20/10	17/10
Subcutaneous edema	N / N	0/0	3/2
Total visceral anomalies	N / N	104/24	94/20
Fetuses with visceral anomalies	%	59.1	54.3
Litters with fetuses with visceral anomalies	%	100.0	83.3

No significant differences ($p < 0.05$, FISHER's exact test)

Table 6: Skeletal Anomalies

(All data presented as: Number of fetuses with the given anomaly / Number of litters with such fetuses)

		Group	
Parameter		0	1
Total investigated	N / N	188 /24	185/24
Rudimentary accessory lumbar rib/s	N / N	12/6	11/8
Cervical rib/s	N / N	0/0	2/2
Wavy rib/s	N / N	24/11	21/12
Short 13th rib/s	N / N	3/1	4/3
Curly rib/s (cartilage)	N / N	8/6	6/5
Dumbbell shaped vertebral centra/e	N / N	28/17	41/16
Bipartite vertebral centra/e	N / N	4/4	9/8
unilaterally ossified	N / N	2/2	0/0
Asymmetric sternebra/e	N / N	25/17	20/11
Bipartite sternebra/e	N / N	1/1	2/1
Total skeletal anomalies	N / N	80/23	81/22
Fetuses with skeletal anomalies	%	42.5	43.8
Litters with fetuses with skeletal anomalies	%	95.8	91.7

No significant differences ($p < 0.05$, FISHER's exact test)

Table 7: Incomplete or Missing Ossification

(All data presented as: Number of fetuses with the given anomaly / Number of litters with such fetuses)

Parameter (Bone structure)		Group 0	Group 1
Total investigated	N / N	188/24	185/24
Supraoccipital bone	N / N	128/24	132/24
Holes	N / N	30/11	21/7
Exoccipital bone	N / N	0/0	1/1
Interparietal bone	N / N	165/24	163/24
Parietal bone	N / N	102/23	86/19
Frontal bone	N / N	31/13	37/14
Squamosal bone	N / N	100/23	91/22
Holes	N / N	3/2	5/2
Nasal bone	N / N	43/15	44/15
Zygomatic bone	N / N	39/18	36/15
Premaxillary bone	N / N	2/2	3/2
Hyoid bone	N / N	66/20	49/15
Pterygoid bone	N / N	1/1	0/0
Mandible	N / N	1/1	1/1
Cervical vertebral arches	N / N	2*/2	9*/6
Thoracic vertebral centres	N / N	1/1	3/3
Thoracic vertebral arches	N / N	1/1	1/1
Sacral vertebral arches	N / N	20/11	19/9
Rib/s	N / N	2/2	2/2
Ileum	N / N	0/0	1/1
Ischium	N / N	7/4	7/4
Pubis	N / N	11/6	9/4
Humerus	N / N	0*/0	5*/1
Total incomplete ossification	N / N	183/24	178/24
Fetuses with incomplete ossification	%	97.3	96.2
Litters with fetuses with incomplete ossification	%	100	100

* $p < 0.05$ (FISHER's exact test)

Table 8: Number of Ossified Centres

Parameter		Group 0	Group 1
Cervical vertebral centres	Mean	0.31	0.35
	SD	0.33	0.43
Caudal vertebral arches	Mean	1.87	1.74
	SD	0.55	0.71
Caudal vertebral centres	Mean	4.66	4.74
	SD	0.39	0.50
Sternebrae	Mean	5.11	5.13
	SD	0.63	0.59
Metacarpals	Mean	3.30	3.41
	SD	0.33	0.37
Metatarsals	Mean	4.00	4.00
	SD	0.00	0.02
Proximal phalangae (forelimbs)	Mean	0.04	0.06
	SD	0.12	0.15
Distal phalangae (forelimbs)	Mean	5.00	5.00
	SD	0.00	0.00
Distal phalangae (hindlimbs)	Mean	5.00	5.00
	SD	0.00	0.00
Total number ossified centres	Mean	29.30	29.43
	SD	1.73	2.01
	N	24	24

No significant differences ($p < 0.05$, ANOVA + DUNNETT's test)

8. Appendix: Individual Litter Data

In the appendices, the following group assignment is used:

Group 0: Exposure to 4.6 W/m^2 (target value in the cage area)
Group 1: Control (Sham exposure)

Appendix 1: Individual Maternal Data

Dam No.	Power Density W/m²	Gravidity	Body weight (g) on day p.c. 0	6	10	15	20	Body weight gain (g) Total	During Exposure	Except Uterus	Symptoms	Macropath Findings
001	4.6	G	211.1	245.9	250.8	284.2	332.7	121.6	86.8	50.1	N	N
002	4.6	G	224.9	259.4	255.0	293.5	371.3	146.4	111.9	61.3	N	N
003	4.6	G	234.7	246.7	271.8	316.1	376.6	141.9	129.9	63.6	N	N
004	4.6	G	236.5	271.9	285.5	336.6	406.5	170.0	134.6	81.3	N	N
005	4.6	G	223.1	257.2	263.0	298.0	369.2	146.1	112.0	54.9	N	N
006	4.6	G	230.2	267.4	289.9	323.6	372.2	142.0	104.8	91.2	N	N
007	4.6	G	222.5	258.3	261.8	294.9	365.3	142.8	107.0	48.5	N	N
008	4.6	G	220.0	244.5	252.6	282.2	346.8	126.8	102.3	42.0	N	N
009	4.6	G	238.9	272.4	280.7	314.2	398.0	159.1	125.6	60.1	N	N
010	4.6	G	211.7	252.7	256.1	293.2	362.1	150.4	109.4	60.6	N	N
011	4.6	G	226.7	246.7	261.1	299.9	368.9	142.2	122.2	41.8	N	N
012	4.6	G	242.3	268.0	292.9	319.0	387.6	145.3	119.6	72.6	N	N
013	4.6	G	219.4	249.4	265.6	287.1	383.6	164.2	134.2	75.6	N	N
014	4.6	G	216.9	238.4	261.7	287.4	344.5	127.6	106.1	64.0	N	N
015	4.6	G	282.3	326.5	318.0	354.0	453.1	170.8	126.6	89.7	N	N
016	4.6	G	231.1	262.4	275.1	310.7	383.1	152.0	120.7	76.0	N	N
017	4.6	G	237.4	263.0	279.6	310.1	386.1	148.7	123.1	61.9	N	N
018	4.6	G	255.4	281.0	306.0	346.4	436.9	181.5	155.9	82.8	N	N
019	4.6	G	242.0	281.8	284.6	314.0	369.8	127.8	88.0	71.7	N	N
020	4.6	G	246.7	289.0	297.3	335.1	418.8	172.1	129.8	74.7	N	N
021	4.6	G	219.8	248.3	270.4	289.3	375.5	155.7	127.2	65.7	N	N
022	4.6	G	263.0	287.1	301.6	347.1	433.3	170.3	146.2	69.3	N	N
023	4.6	G	232.0	260.4	274.9	309.9	385.7	153.7	125.3	68.5	N	N
024	4.6	G	250.6	288.5	310.5	345.6	424.8	174.2	136.3	79.6	N	N
Mean	4.6	G	234.1	265.3	277.8	312.2	385.5	151.4	120.2	67.0	(0)	(0)
SD			16.9	19.8	19.3	22.3	30.2	16.5	16.5	13.5		
N			24	24	24	24	24	24	24	24		
Min.			211.1	238.4	250.8	282.2	332.7	121.6	86.8	41.8		
Max.			282.3	326.5	318.0	354.0	453.1	181.5	155.9	91.2		

Appendix 1(continued): Individual Maternal Data

Dam No.	Power Density W/m²	Gravidity	Body weight (g) on day p.c. 0	6	10	15	20	Body weight gain (g) Total	During Exposure	Except Uterus	Symptoms	Macropath Findings
101	0	G	210.2	240.8	253.8	288.9	367.5	157.3	126.7	71.4	N	N
102	0	G	219.4	249.9	256.2	292.3	367.1	147.7	117.2	66.5	N	N
103	0	G	243.5	280.1	280.5	323.8	401.6	158.1	121.5	66.0	N	N
104	0	G	246.8	298.7	308.9	359.0	434.7	187.9	136.0	98.4	N	N
105	0	G	217.7	255.9	278.1	326.7	421.3	203.6	165.4	87.3	N	N
106	0	G	209.7	255.5	264.8	306.7	389.2	179.5	133.7	83.9	N	N
107	0	G	230.2	260.1	268.4	301.7	346.9	116.7	86.8	63.0	N	N
108	0	G	258.6	286.4	291.1	336.7	397.6	139.0	111.2	74.3	N	N
109	0	G	227.9	261.1	273.5	306.1	381.0	153.1	119.9	67.1	N	N
110	0	G	218.8	250.8	259.3	305.2	372.6	153.8	121.8	71.7	N	N
111	0	G	208.2	232.1	248.6	260.5	281.5	73.3	49.4	60.0	N	N
112	0	G	221.7	256.9	271.1	294.9	361.1	139.4	104.2	56.5	N	N
113	0	G	259.0	293.5	307.1	343.4	442.9	183.9	149.4	81.8	N	N
114	0	G	218.6	258.4	264.5	295.5	347.6	129.0	89.2	86.9	N	N
115	0	G	239.7	257.3	291.1	320.9	416.6	176.9	159.3	65.3	N	N
116	0	G	231.5	262.0	277.3	310.9	385.9	154.4	123.9	84.7	N	N
117	0	G	257.1	287.5	300.1	324.0	376.7	119.6	89.2	63.6	N	N
118	0	G	262.3	296.2	304.7	339.7	394.6	132.3	98.4	43.1	N	N
119	0	G	234.6	262.2	275.6	316.1	381.7	147.1	119.5	55.5	N	N
120	0	G	236.2	273.1	294.5	323.1	410.9	174.7	137.8	61.5	N	N
121	0	G	234.1	244.2	291.7	339.0	413.2	179.1	169.0	82.5	N	N
122	0	G	257.4	287.1	296.5	327.1	397.5	140.1	110.4	58.0	N	N
123	0	G	245.3	265.7	293.5	320.3	404.4	159.1	138.7	53.5	N	N
124	0	G	248.8	279.9	300.9	337.7	429.0	180.2	149.1	65.5	N	N
Mean	0	G	234.9	266.5	281.3	316.7	388.5	153.6	122.0	69.5	(0)	(0)
SD			17.1	18.4	18.0	21.7	34.5	28.3	27.7	13.2		
N			24	24	24	24	24	24	24	24		
Min.			208.2	232.1	248.6	260.5	281.5	73.3	49.4	43.1		
Max.			262.3	298.7	308.9	359.0	442.9	203.6	169.0	98.4		

Appendix 2: Individual Litter Data

Dam. No.	Power density W/m²	Uterine Weight G	Corpor lutea	Impl.	Live Fetuses Total	M	F	Resorptions Early	Late	Dead Fetuses	Fetal weight (g) M	F	Plac. weight g	Preimpl loss	Postim. loss	No. Fetuses w/gross anom.	for investi	w/visc. anom.	for skel. investi-	w/skel. anom.
001	4.6	71.5	18	13	13	6	7	0	0	0	3.79	3.47	0.47	5	0		6	3	7	3
002	4.6	85.1	16	16	15	9	6	1	0	0	3.77	3.48	0.48	0	1	2 Hem.	7	5	8	2
003	4.6	78.3	16	16	15	6	9	1	0	0	3.25	3.14	0.52	0	1		7	1	8	0
004	4.6	88.7	18	18	16	10	6	1	1	0	3.50	3.24	0.58	0	2		8	2	8	5
005	4.6	91.2	16	16	16	5	11	0	0	0	3.69	3.59	0.65	0	0		8	6	8	7
006	4.6	50.8	14	16	9	4	5	7	0	0	3.37	3.38	0.61	0	7	1 Hem.	4	1	5	2
007	4.6	94.3	19	18	17	7	10	1	0	0	3.91	3.62	0.59	1	1		8	6	9	5
008	4.6	84.8	18	16	15	7	8	1	0	0	3.60	3.45	0.63	2	1		7	5	8	2
009	4.6	99.0	19	18	17	10	7	1	0	0	3.90	3.78	0.65	1	1		8	4	9	2
010	4.6	89.8	16	16	16	7	9	0	0	0	3.89	3.60 6	0.62	0	0		8	4	8	6
011	4.6	100.4	18	18	18	10	8	0	0	0	4.02	3.78	0.56	0	0	1 Hem.	9	7	9	4
012	4.6	72.7	18	17	12	5	7	5	0	0	3.89	3.63	0.60	1	5		6	4	6	4
013	4.6	88.6	18	17	16	8	8	1	0	0	3.54	3.54	0.61	1	1	1 Hem.	8	4	8	5
014	4.6	63.6	18	15	11	5	6	3	1	0	3.39	3.46	0.59	3	4		5	1	6	3
015	4.6	81.1	18	16	15	9	6	1	0	0	3.47	3.27	0.47	2	1		7	2	8	2
016	4.6	76.0	15	15	15	9	6	0	0	0	3.23	3.30	0.60	0	0	1 Hem.	7	4	8	4
017	4.6	86.8	18	17	16	8	8	1	0	0	3.55	3.48	0.60	1	1		8	4	8	3
018	4.6	98.7	19	19	18	5	13	1	0	0	3.77	3.49	0.60	0	1		9	6	9	5
019	4.6	56.1	15	10	10	3	7	0	0	0	3.44	3.46	0.59	5	0		5	4	5	1
020	4.6	97.4	22	18	18	10	8	0	0	0	3.34	3.06	0.56	4	0		9	4	9	4
021	4.6	90.0	17	16	16	3	13	0	0	0	3.60	3.49	0.51	1	0		8	8	8	2
022	4.6	101.0	19	19	18	10	8	1	0	0	3.57	3.50	0.63	0	1	2 Hem.	9	9	9	3
023	4.6	85.2	16	16	15	7	8	1	0	0	3.44	3.49	0.59	0	1		7	2	8	3
024	4.6	94.6	17	17	17	11	6	0	0	0	3.69	3.59	0.51	0	0		8	8	9	3
Mean	4.6	84.4	17.42	16.38	15.17	7.25	7.92	1.13	0.08	0.00	3.61	3.45	0.58	1.12	1.20	Hemato				
SD		13.6	1.72	1.93	2.50	2.40	2.10	1.68	0.28	0.00	0.22	0.20	0.05	1.59	1.74					
N		24	24	24	24	24	24	24	24	24	24	24	24	24	24					
Min.		50.8	14	10	9	3	5	0	0	0	3.23	3.00	0.47	0	0					
Max.		101.0	22	19	18	11	13	7	1	0	4.02	3.78	0.65	5	7					
Total					364											8	176	104	188	80

Appendix 2 (continued): Individual Litter Data

Dam No.	Power density W/m²	Uterine weight g	Corpor lutea	Impl.	Live Fetuses Total	M	F	Resorptions Early	Late	Dead Fetuses	Fetal weight (g) M	F	Plac. weight g	Preimpl loss	Postim. loss	No. Fetuses w/gross anom.	for visc. investig.	w/visc. anom.	for skel. investig.	w/skel.m anom.
101	0	85.9	15	15	14	8	6	1	0	0	3.98	3.88	0.57	0	1		7	5	7	4
102	0	81.2	19	16	15	8	7	1	0	0	3.28	3.00	0.64	3	1	1 Hem.	7	4	8	0
103	0	92.1	16	16	16	8	8	0	0	0	3.97	3.85	0.58	0	0	1 Hem.	8	7	8	3
104	0	89.5	15	18	15	6	9	0	3	0	3.80	3.65	0.56	0	3		7	5	8	2
105	0	116.3	21	21	21	16	5	0	0	0	3.83	3.45	0.53	0	0		10	5	11	3
106	0	95.6	16	16	16	9	7	0	0	0	3.86	3.71	0.58	0	0	3 Hem.	8	3	8	5
107	0	53.7	12	10	10	5	5	0	0	0	3.55	3.40	0.55	2	0		5	1	5	1
108	0	64.7	17	14	12	7	5	2	0	0	3.40	3.28	0.71	3	2		6	6	6	5
109	0	86.0	15	15	15	7	8	0	0	0	3.83	3.52	0.62	0	0	1 Hem.	7	4	8	2
110	0	82.1	16	16	15	7	8	1	0	0	3.61	3.39	0.54	0	1		7	3	8	3
111	0	13.3	10	3	2	2	0	1	0	0	4.20		0.73	7	1		1	0	1	1
112	0	82.9	18	18	17	8	9	1	0	0	3.23	2.98	0.44	0	1	1 Hem.	8	0	9	4
113	0	102.1	20	19	18	11	7	1	0	0	3.66	3.54	0.61	1	1	1 Hem.	9	7	9	8
114	0	42.1	12	7	7	4	3	0	0	0	3.97	3.78	0.63	5	0		3	0	4	1
115	0	111.6	19	19	19	8	11	0	0	0	3.98	3.60	0.63	0	0		9	6	10	3
116	0	69.7	17	14	12	6	6	2	0	0	3.45	3.13	0.88	3	2		6	4	6	4
117	0	56.0	16	10	10	7	3	0	0	0	3.45	3.03	0.55	6	0		5	4	5	4
118	0	89.2	21	19	18	8	10	1	0	0	3.15	3.06	0.53	2	1		9	4	9	7
119	0	91.6	17	16	16	10	6	0	0	0	3.78	3.61	0.62	1	0		8	6	8	6
120	0	113.2	20	20	19	10	9	1	0	0	3.96	3.82	0.65	0	1		9	0	10	3
121	0	96.6	19	18	17	8	9	1	0	0	3.88	3.75	0.63	1	1	1 Hem.	8	4	9	0
122	0	82.1	18	16	15	6	9	1	0	0	3.61	3.41	0.56	2	1		7	4	8	4
123	0	105.6	20	19	19	7	12	0	0	0	3.86	3.60	0.63	1	0		9	6	10	3
124	0	114.7	22	20	20	10	10	0	0	0	3.75	3.60	0.53	2	0	1 Hem.	10	6	10	5
Mean	0	84.1	17.13	15.63	14.923	7.7522	7.1677	0.5833	0.1255	0.00	3.71	3.48	0.60	1.6255	0.7088					
SD		24.6	3.0429	4.3422	4.3733	2.6588	2.7777	0.6544	0.6122	0.00	0.27	0.28	0.09	2.0188	0.8066	.				
N		24	24	24	24	24	24	24	24	24	24	23	24	24	24					
Min.		13.3	10	3	2	2	0	0	0	0	3.15	2.98	0.44	0	0					
Max.		116.3	22	21	21	16	12	2	3	0	4.20	3.88	0.88	7	3					
Total					358											10	173	94	185	81

Appendix 3: Individual litter data of visceral anomalies

Dam	Power	No of fetuses ...												
No.	densit	inves-	Dilated renal			Dilated ureter		Blood in ...				Sc.	Sc.	Total
	w/m²	tigate	slight	med.	high	slight	med.	resp.	thorax	perit.	brain	hemat	edem	anom.
001	4.6	6	1	0	0	1	1	1	0	0	0	0	0	3
002	4.6	7	0	0	0	2	0	0	2	0	0	1	0	5
003	4.6	7	0	0	0	1	0	0	0	0	0	0	0	1
004	4.6	8	1	0	0	2	0	0	0	0	0	0	0	2
005	4.6	8	0	0	0	3	0	0	2	2	0	0	0	6
006	4.6	4	0	0	0	0	0	0	0	0	0	1	0	1
007	4.6	8	2	0	0	4	0	0	0	3	0	0	0	6
008	4.6	7	0	0	0	3	0	0	1	2	0	1	0	5
009	4.6	8	2	0	0	3	0	0	1	2	0	0	0	4
010	4.6	8	0	0	0	1	0	0	1	2	0	0	0	4
011	4.6	9	0	1	1	0	2	0	1	4	0	2	0	7
012	4.6	6	2	0	0	3	0	0	0	1	0	0	0	4
013	4.6	8	0	0	0	0	0	0	1	2	0	1	0	4
014	4.6	5	0	0	0	0	0	0	0	0	0	1	0	1
015	4.6	7	2	0	0	2	0	0	0	0	0	0	0	2
016	4.6	7	0	0	0	0	0	1	1	2	0	1	0	4
017	4.6	8	3	0	0	4	0	0	0	0	0	0	0	4
018	4.6	9	0	0	0	0	0	0	1	5	0	2	0	6
019	4.6	5	0	0	0	2	1	0	0	1	0	0	0	4
020	4.6	9	1	0	0	2	1	0	0	3	0	0	0	4
021	4.6	8	4	1	0	4	4	0	1	2	0	3	0	8
022	4.6	9	2	1	0	3	1	0	1	2	0	5	0	9
023	4.6	7	1	0	0	1	0	0	0	1	0	0	0	2
024	4.6	8	3	4	0	4	4	0	0	4	0	2	0	8
Total	4.6	176	24	7	1	45	14	2	13	38	0	20	0	104

Appendix 3 (continued): Individual litter data of visceral anomalies

Dam	Power	No of fetuses ...											
No.	density	inves-	Dilated renal pelvis		Dilated ureter		Blood in ...				Sc.	Sc.	Total
	w/m²	tigated	slight	med.	slight	med.	resp. tr.	thorax	periton	brain	hemat.	edem	anom.
101	0	7	2	0	2	2	0	0	1	0	1	0	5
102	0	7	0	1	1	1	0	0	1	0	1	0	4
103	0	8	1	0	1	1	0	3	3	0	4	0	7
104	0	7	1	0	1	1	0	1	4	1	0	0	5
105	0	10	0	0	0	0	0	3	2	0	0	2	5
106	0	8	0	0	0	0	0	0	3	0	2	0	3
107	0	5	0	0	0	0	0	0	1	0	0	0	1
108	0	6	2	0	4	2	0	1	1	0	0	0	6
109	0	7	0	0	1	0	0	0	4	0	1	1	4
110	0	7	0	0	2	0	0	0	1	0	0	0	3
111	0	1	0	0	0	0	0	0	0	0	0	0	0
112	0	8	0	0	0	0	0	0	0	0	0	0	0
113	0	9	0	0	4	0	0	0	3	0	3	0	7
114	0	3	0	0	0	0	0	0	0	0	0	0	0
115	0	9	1	0	2	0	0	3	3	0	0	0	6
116	0	6	1	0	3	1	0	0	0	0	0	0	4
117	0	5	1	0	3	1	0	0	0	0	0	0	4
118	0	9	4	0	3	1	0	0	0	0	0	0	4
119	0	8	0	0	0	0	0	0	6	0	1	0	6
120	0	9	0	0	0	0	0	0	0	0	0	0	0
121	0	8	2	0	2	0	0	0	2	0	1	0	4
122	0	7	1	0	3	0	0	0	1	0	0	0	4
123	0	9	0	0	0	0	0	2	4	0	1	0	6
124	0	10	0	0	5	0	0	0	3	0	2	0	6
Total	0	173	16	1	37	10	0	13	43	1	17	3	94

Appendix 4: Individual litter data of skeletal anomalies

Dam	Power	No of fetuses ...											
No.	density	inves-	Accessory ribs		Ribs			Vertebral centrae			Sternebrae		Total
	w/m²	tigated	lumbal	Cervic al	wavy	short 13th	curly cartil.	dumb- bell	bipart.	unilat.	asymm .	bipart.	anom.
001	4.6	7	0	0	1	0	0	1	0	0	1	0	3
002	4.6	8	0	0	0	0	0	1	0	0	1	0	2
003	4.6	8	0	0	0	0	0	0	0	0	0	0	0
004	4.6	8	0	0	1	0	0	1	0	0	4	0	5
005	4.6	8	1	0	4	0	0	3	1	1	1	0	7
006	4.6	5	0	0	1	0	0	2	0	0	0	0	2
007	4.6	9	0	0	4	0	0	0	0	0	1	0	5
008	4.6	8	0	0	0	0	0	1	0	0	1	0	2
009	4.6	9	0	0	0	0	1	0	0	0	1	0	2
010	4.6	8	0	0	4	3	0	3	0	0	2	0	6
011	4.6	9	0	0	0	0	0	3	1	0	1	0	4
012	4.6	6	0	0	2	0	0	2	1	1	1	1	4
013	4.6	8	5	0	2	0	2	0	0	0	0	0	5
014	4.6	6	0	0	2	0	1	1	0	0	0	0	3
015	4.6	8	0	0	1	0	1	2	0	0	1	0	2
016	4.6	8	0	0	0	0	2	2	0	0	1	0	4
017	4.6	8	1	0	0	0	0	0	0	0	2	0	3
018	4.6	9	1	0	0	0	1	1	0	0	3	0	5
019	4.6	5	0	0	0	0	0	1	0	0	0	0	1
020	4.6	9	2	0	0	0	0	2	0	0	0	0	4
021	4.6	8	0	0	0	0	0	0	0	0	2	0	2
022	4.6	9	0	0	0	0	0	1	1	0	1	0	3
023	4.6	8	0	0	2	0	0	0	0	0	1	0	3
024	4.6	9	2	0	0	0	0	1	0	0	0	0	3
Total	4.6	188	12	0	24	3	8	28	4	2	25	1	80

Appendix 4 (continued): Individual litter data of skeletal anomalies

Dam	Power	No of fetuses ...											
No.	density	inves-	Accessory ribs		Ribs			Vertebral centrae			Sternebrae		Total
	w/m²	tigated	lumbal	cervica l	wavy	short 13th	curly cartil.	dumb-bell	bipart.	unilat.	asymm.	bipart.	anom.
101	0	7	0	0	0	0	1	1	0	0	3	0	4
102	0	8	0	0	0	0	0	0	0	0	0	0	0
103	0	8	0	0	0	0	0	2	2	0	0	0	3
104	0	8	0	0	0	0	0	0	0	0	2	0	2
105	0	11	0	0	2	0	0	1	0	0	0	0	3
106	0	8	0	0	2	0	0	4	0	0	2	0	5
107	0	5	0	0	1	0	0	0	0	0	0	0	1
108	0	6	2	0	4	2	1	2	1	0	0	0	5
109	0	8	1	0	1	0	0	1	0	0	1	0	2
110	0	8	0	0	2	1	0	1	0	0	2	0	3
111	0	1	0	0	0	0	0	0	0	0	1	0	1
112	0	9	3	0	0	0	0	2	1	0	2	0	4
113	0	9	0	0	1	0	2	4	1	0	3	0	8
114	0	4	0	0	1	0	0	0	0	0	0	0	1
115	0	10	0	0	2	0	0	1	0	0	0	0	3
116	0	6	1	0	1	0	0	0	0	0	0	2	4
117	0	5	0	0	0	1	0	3	0	0	0	0	4
118	0	9	0	0	1	0	0	6	1	0	0	0	7
119	0	8	1	0	3	0	0	5	1	0	0	0	6
120	0	10	0	0	0	0	1	2	1	0	1	0	3
121	0	9	0	0	0	0	0	0	0	0	0	0	0
122	0	8	1	0	0	0	0	2	0	0	2	0	4
123	0	10	1	1	0	0	0	0	0	0	1	0	3
124	0	10	1	1	0	0	1	4	1	0	0	0	5
Total	0	185	11	2	21	4	6	41	9	0	20	2	81

Appendix 5: Individual Ossification Data (Number of ossified centres)

Dam	Power	Number of ossified centres ...									
No.	Density	Cerv.	Caudal vertebral		Sterne-	Meta-	Meta-	Phalangae			Total
	W/m²	verteb.	arches	centre	brae	carpal	tarsals	Forelimb		Hindl.	
		centre						proxi.	distal	distal	
001	4.6	0.71	2.71	5.14	5.43	3.50	4.00	0.57	5.00	5.00	32.06
002	4.6	0.25	2.31	5.00	5.75	3.50	4.00	0.00	5.00	5.00	30.81
003	4.6	0.38	1.06	4.38	3.75	3.00	4.00	0.00	5.00	5.00	26.57
004	4.6	0.13	0.88	4.38	4.75	3.50	4.00	0.00	5.00	5.00	27.64
005	4.6	0.13	1.94	4.75	5.00	3.44	4.00	0.00	5.00	5.00	29.26
006	4.6	0.20	1.20	4.80	5.40	3.00	4.00	0.00	5.00	5.00	28.60
007	4.6	0.44	1.67	4.33	5.67	3.61	4.00	0.00	5.00	5.00	29.72
008	4.6	0.13	2.00	4.75	5.25	3.06	4.00	0.00	5.00	5.00	29.19
009	4.6	0.22	2.22	5.00	5.44	4.00	4.00	0.22	5.00	5.00	31.10
010	4.6	0.38	1.50	4.38	5.38	3.44	4.00	0.00	5.00	5.00	29.08
011	4.6	0.22	2.33	5.33	5.67	3.11	4.00	0.00	5.00	5.00	30.66
012	4.6	0.17	2.17	4.83	5.50	3.25	4.00	0.00	5.00	5.00	29.92
013	4.6	0.00	2.38	5.25	4.75	3.13	4.00	0.00	5.00	5.00	29.51
014	4.6	1.00	2.00	4.50	6.00	3.33	4.00	0.00	5.00	5.00	30.83
015	4.6	0.00	1.50	4.13	4.88	2.75	4.00	0.00	5.00	5.00	27.26
016	4.6	0.00	1.50	4.00	4.63	3.00	4.00	0.00	5.00	5.00	27.13
017	4.6	0.00	2.25	5.13	5.88	3.69	4.00	0.06	5.00	5.00	31.01
018	4.6	0.22	1.83	4.33	4.22	3.17	4.00	0.00	5.00	5.00	27.77
019	4.6	0.40	1.20	4.60	4.20	3.00	4.00	0.00	5.00	5.00	27.40
020	4.6	0.11	1.50	4.22	4.00	3.00	4.00	0.00	5.00	5.00	26.83
021	4.6	0.38	2.88	5.25	5.63	3.88	4.00	0.00	5.00	5.00	32.02
022	4.6	0.00	1.78	4.44	5.00	2.78	4.00	0.00	5.00	5.00	28.00
023	4.6	1.25	1.31	4.25	4.75	3.31	4.00	0.00	5.00	5.00	28.87
024	4.6	0.78	2.78	4.78	5.78	3.72	4.00	0.06	5.00	5.00	31.90
Mean	4.6	0.31	1.87	4.66	5.11	3.30	4.00	0.04	5.00	5.00	29.30
SD		0.33	0.55	0.39	0.63	0.33	0.00	0.12	0.00	0.00	1.73
N		24	24	24	24	24	24	24	24	24	24
Min		0.00	0.88	4.00	3.75	2.75	4.00	0.00	5.00	5.00	26.57
Max		1.25	2.88	5.33	6.00	4.00	4.00	0.57	5.00	5.00	32.06

Appendix 5 (continued): Individual Ossification Data (Number of ossified centres)

Dam	Power	Number of ossified centres ...									
No.	Density	Cerv.	Caudal vertebral		Sterne-	Meta-	Meta-	Phalangae			Total
	W/m²	verteb.	arches	centre	brae	carpal	tarsals	Forelimb		Hindl.	
		centre						proxi.	distal	distal	
101	0	0.43	2.86	5.43	5.14	3.79	4.00	0.00	5.00	5.00	31.65
102	0	0.00	0.25	3.63	4.25	3.00	4.00	0.00	5.00	5.00	25.13
103	0	0.00	1.88	4.38	5.38	3.06	4.00	0.00	5.00	5.00	28.70
104	0	0.38	2.19	4.88	5.13	3.56	4.00	0.00	5.00	5.00	30.14
105	0	1.36	2.68	5.27	5.91	3.86	4.00	0.45	5.00	5.00	33.53
106	0	0.13	1.06	4.75	5.00	3.06	4.00	0.00	5.00	5.00	28.00
107	0	0.00	2.10	4.80	5.40	3.60	4.00	0.00	5.00	5.00	29.90
108	0	0.00	1.67	4.33	5.83	3.50	4.00	0.00	5.00	5.00	29.33
109	0	0.25	2.00	5.63	5.63	4.00	4.00	0.38	5.00	5.00	31.89
110	0	0.25	2.25	4.88	5.50	3.31	4.00	0.00	5.00	5.00	30.19
111	0	0.00	1.00	5.00	6.00	4.00	4.00	0.00	5.00	5.00	30.00
112	0	0.00	2.44	4.78	5.11	3.44	3.94	0.00	5.00	5.00	29.71
113	0	0.67	1.17	4.44	3.89	2.67	3.94	0.00	5.00	5.00	26.78
114	0	1.50	2.00	5.50	5.25	3.25	4.00	0.00	5.00	5.00	31.50
115	0	1.10	0.80	4.60	5.10	3.10	4.00	0.00	5.00	5.00	28.70
116	0	0.50	1.83	3.83	4.83	3.00	4.00	0.00	5.00	5.00	27.99
117	0	0.00	0.60	4.20	4.80	3.00	4.00	0.00	5.00	5.00	26.60
118	0	0.22	1.00	4.33	4.33	3.11	4.00	0.00	5.00	5.00	26.99
119	0	0.25	0.94	4.88	3.88	3.13	4.00	0.00	5.00	5.00	27.08
120	0	0.60	2.45	4.70	5.70	3.70	4.00	0.00	5.00	5.00	31.15
121	0	0.22	2.33	5.33	5.44	3.89	4.00	0.50	5.00	5.00	31.71
122	0	0.00	2.00	5.00	5.13	3.50	4.00	0.00	5.00	5.00	29.63
123	0	0.10	2.25	4.70	5.70	3.70	4.00	0.00	5.00	5.00	30.45
124	0	0.40	2.10	4.50	4.90	3.70	4.00	0.00	5.00	5.00	29.60
Mean	0	0.35	1.74	4.74	5.13	3.41	4.00	0.06	5.00	5.00	29.43
SD		0.43	0.71	0.50	0.59	0.37	0.02	0.15	0.00	0.00	2.01
N		24	24	24	24	24	24	24	24	24	24
Min		0.00	0.25	3.63	3.88	2.67	3.94	0.00	5.00	5.00	25.13
Max		1.50	2.86	5.63	6.00	4.00	4.00	0.50	5.00	5.00	33.53

Appendix 6: Individual Ossification Data (Incomplete ossification of bones)

	Exp.	Number of fetuses with incomplete ossification in ...																						
No	W/m²	total	supra	exoc	interp	pariet	fronta	squa	nasal	zygo	prem	hyoid	ptery	man	ribs	cva	tvc	tva	sva	ileum	ischi	pubis	hume	total
001	4.6	7	3	0	5	3	0	3	2	1	0	2	1	0	0	0	0	0	0	0	0	0	0	6
002	4.6	8	6	0	8	4	1	5	0	1	0	6	0	0	0	0	0	0	0	0	0	0	0	8
003	4.6	8	5	0	8	2	3	4	3	2	1	4	0	0	0	0	0	0	3	0	1	1	0	8
004	4.6	8	5	0	8	4	0	5	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	8
005	4.6	8	3	0	6	2	1	4	2	2	0	3	0	0	0	0	0	0	1	0	0	1	0	8
006	4.6	5	4	0	5	1	0	2	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0	5
007	4.6	9	5	0	9	4	0	7	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	9
008	4.6	8	5	0	8	5	0	3	1	2	0	3	0	0	0	0	0	0	0	0	0	0	0	8
009	4.6	9	1	0	9	4	2	2	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	9
010	4.6	8	8	0	8	8	6	8	5	6	0	6	0	1	0	1	0	0	3	0	3	4	0	8
011	4.6	9	6	0	7	6	0	7	0	2	0	4	0	0	0	0	0	0	0	0	0	0	0	8
012	4.6	6	6	0	6	5	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	6
013	4.6	8	5	0	8	6	1	6	6	5	0	3	0	0	1	0	0	1	1	0	0	0	0	8
014	4.6	6	4	0	5	3	0	2	2	1	0	1	0	0	0	0	0	0	1	0	0	0	0	6
015	4.6	8	5	0	7	4	1	3	2	3	0	4	0	0	0	1	0	0	2	0	1	1	0	7
016	4.6	8	5	0	2	0	1	1	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	8
017	4.6	8	8	0	8	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
018	4.6	9	8	0	9	7	1	3	1	1	0	6	0	0	0	0	0	0	1	0	0	1	0	9
019	4.6	5	4	0	4	5	3	4	4	2	1	2	0	0	0	0	0	0	0	0	0	0	0	5
020	4.6	9	7	0	8	6	6	7	7	3	0	5	0	0	0	0	0	0	2	0	0	0	0	9
021	4.6	8	7	0	8	2	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	8
022	4.6	9	9	0	9	5	4	5	4	2	0	5	0	0	1	0	0	0	4	0	2	3	0	9
023	4.6	8	3	0	4	4	0	5	0	2	0	4	0	0	0	0	0	0	1	0	0	0	0	6
024	4.6	9	6	0	6	5	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
total	4.6	188	128	0	165	102	31	100	43	39	2	66	1	1	2	2	1	1	20	0	7	11	0	183

Abbreviations: cva: cervical vertebral arches; tvc: thoracic vertebral centres; tva: thoracic vertebral arches; sva: sacral vertebral arches

Appendix 6 (continued): Individual Ossification Data (Incomplete ossification of bones)

Dam	Exp.	Number of fetuses with incomplete ossification in ...																						
No	W/m²	total	supra	exoc	interp	pariet	fronta	squa	nasal	zygo	prem	hyoid	ptery	man	ribs	cva	tvc	tva	sva	ileum	ischi	pubis	hume	total
101	0	7	1	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
102	0	8	2	0	8	4	2	2	3	1	0	3	0	1	0	0	0	0	2	0	0	0	0	8
103	0	8	6	0	6	2	1	3	2	2	0	5	0	0	0	1	0	0	1	0	1	1	0	8
104	0	8	1	0	7	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
105	0	11	4	0	9	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	9
106	0	8	7	0	8	8	4	5	6	2	0	6	0	0	0	0	0	0	1	0	0	0	0	8
107	0	5	4	0	3	1	3	2	2	1	0	3	0	0	0	0	1	0	1	0	1	1	0	5
108	0	6	2	0	1	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
109	0	8	3	0	6	1	2	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	8
110	0	8	8	0	8	8	2	5	1	3	1	6	0	0	0	2	0	0	0	0	0	0	0	8
111	0	1	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
112	0	9	6	1	8	7	1	5	2	1	0	1	0	0	0	1	1	0	0	0	0	0	0	8
113	0	9	9	0	9	6	6	7	5	6	0	6	0	0	0	2	0	0	5	0	1	5	0	9
114	0	4	3	0	3	1	0	2	1	3	0	0	0	0	1	0	0	0	1	0	0	0	0	3
115	0	10	9	0	10	9	5	9	7	4	0	1	0	0	0	0	0	0	3	0	0	0	0	10
116	0	6	5	0	5	0	0	3	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	6
117	5	5	3	0	2	0	1	1	1	2	0	0	0	0	0	0	0	0	1	0	0	0	0	5
118	5	9	9	0	9	8	2	7	2	2	0	0	0	0	0	0	1	0	0	0	0	0	0	9
119	5	8	8	0	8	8	5	8	8	5	2	6	0	0	1	2	0	1	4	1	4	2	5	8
120	5	10	6	0	10	3	1	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	10
121	5	9	9	0	9	5	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
122	5	8	7	0	8	2	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	8
123	5	10	10	0	10	6	2	6	1	1	0	3	0	0	0	0	0	0	0	0	0	0	0	10
124	5	10	9	0	10	3	0	6	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	10
total	5	185	132	1	163	86	37	91	44	36	3	49	0	1	2	9	3	1	19	1	7	9	5	178

Abbreviations: cva: cervical vertebral arches; tvc: thoracic vertebral centres; tva: thoracic vertebral arches; sva: sacral vertebral arches

Appendix 7: Summary Table

Parameter	Exposure 4.6 W/cm^3
Maternal weight gain	-
Clinical symptoms	-
Macroscopic pathology	-
Number of live fetuses	-
Pre-/postimplantation loss	-
Fetal/placental weight	-
External anomalies	-
Visceral anomalies	-
Skeletal anomalies	-
State of ossification	-

Abbreviations:

- no effect on the given parameter compared to control group

An exposure of gravid Wistar rats [Crl:(WI)BR] to a far field of an antenna transmitting at 900 MHz with a 217 Hz pulse (D net) with 4.6 W/m^2 did not affect any of the investigated maternal and fetal parameters.

No teratogenic, embryolethal or retarding effects of the exposure were found.