

A Study of Farm Animals Near 765 KV Transmission Lines

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Newspaper reports, claims to electric companies and laboratory studies on birds and rodents have frequently been cited as proof that electric and magnetic fields produced by high voltage transmission lines are harmful to farm animals.

The objective of this study, conducted during 1977-1979, was to determine if electric and magnetic fields produced by a 765KV transmission line (the highest voltage line permitted in the U.S.) had any grossly detectable effect on behavior, growth rate, milk production, reproductive performance and general health of farm animals maintained under practical farm conditions.

American Electric Power contracted with Drs. H. E. Amstutz and David B. Miller to conduct an unbiased evaluation on twelve Indiana livestock farms traversed by the I & M E Co., Dumont-Jefferson 1765KV Aerial Line. This line had been energized in 1969 so several generations of animals had been born and raised under the line prior to initiation of the study. Long term effects of exposure to electric and magnetic fields could therefore be studied through 10 years.

Selection of Farms For Study

Indiana & Michigan Electric Company (I&MECo.), an operating company of American Electric Power, selected 34 farms traversed by the Jefferson-Dumont 765KV line that records indicated had sizeable livestock holdings. Dr. Amstutz and an I&MECo. representative visually inspected these farms to determine suitability for the study. Major criteria were a sizeable livestock enterprise, animals pastured or confined directly under the line, probability of animals being under the line during winter months, appearance of reasonable management, reasonable proximity to other potentially acceptable farms, and a variety of species. During the inspection tour six additional farms were added to the group because they appeared to fulfill the above criteria.

Dr. Amstutz classified the total group of farms into five classes as follows:

Class 1 -- Excellent prospect

Class 2 -- Acceptable prospect

Class 3 -- Poor prospect

Class 4 -- Animals on farm but not under line

Class 5 -- No evidence of animals on farm

Nine farms were placed in Class 1, six in Class 2, eleven in Class 3, five in Class 4, and nine in Class 5.

Dr. Amstutz and I&MECo. representatives then visited the best thirteen prospects and explained the proposed study to them. They were told that a report form would be distributed to each farm operator. The operator would be expected to complete the form bi-monthly and return it to Dr. Amstutz. Farm operators were also informed that Dr. Amstutz would visit the farm at bi-monthly intervals to inspect their livestock and that Dr. Miller, I&MECo., and AEP representatives might occasionally visit the farm to make electrical measurements.

Twelve farm operators agreed to the proposed study. (One declined because his health prevented him from adequately maintaining his farm in the manner where he was willing to let visitors see it.) One farm did not have livestock under the line at the beginning, but the operator planned to secure animals and place them there in the near future. Unfortunately, the plans never materialized. Thus, the beginning group consisted of eleven farms: three dairy, one sheep, four beef, one swine, one swine and beef, and one horse and mixed cattle. Total initial livestock inventory on the eleven farms was 10 horses, 55 sheep, 149 beef cattle, 337 hogs, and 429 dairy cattle.

Participation

The study was officially started in April, 1977, when Dr. Amstutz made his first inspection visits to all eleven farms. The study was concluded in April 1979. Nine farms participated in the study for the two-year duration. The operator of farm number 6 (beef cattle) planned to sell his cattle after approximately one year, and did so. The operator of farm number 4 (another beef cattle farm) was forced by deteriorating health to sell the farm and cattle after 14 months.

Each participating farm was visited bi-monthly, making a total of 13 visits to each of the nine farms that completed the study. Prior to each visit, Dr. Amstutz informed the farm operators that he would be available to discuss the health of their animals if they so desired, but their presence for the study inspection was not necessary. Operators or representatives were present during approximately one-half of the visits. A copy of the form, "Study of Farm Animals Under 765KV Lines" was mailed along with the announcement of Dr. Amstutz's impending visits. Operators were requested to complete and return the form at completion of each two-month report period.

Response was excellent: 102 report forms (86%) were completed and returned. Since 16 report forms were not completed, estimates were required in some instances to calculate time under the line, etc. Only those births actually reported are referred to in this study. Because of the 16 missing reports, the total may not be precisely accurate.

Some health problems were, of course reported, but none of the operators reported any health problems with animals that they thought were caused by the 765KV line.

The accompanying Table 1 gives basic data for each of the cattle herds included in this study.

Table 1

BASIC FARM DATA CHART
AEP/I&M Study of Farm Animals
Under 765KV Transmission Lines

(All farms are transversed by the I&MECo. Dumont-Jefferson 765KV Aerial Line.)

Farm No.	Type Of Stock	Breed	Number Of Head	Maximum E-Field KV/m
1	Beef Cattle	Hereford	40	9.5
2	Beef Cattle	Hereford	40	4.5
4	Beef Cattle	Red Poll	13	9.6
6	Beef Cattle	Charolais	35	8.4
9	Dairy Cattle	Holstein	22	6
10	Dairy Cattle	Holstein	100	9.5
11	Dairy Cattle	Holstein	300	8.0

Editor's Note: Information on farms 3 (sheep), 5 (hogs), 7 (horses) and 8 (hogs) has been omitted.

A Summary Of Findings And Reports From Each Farm

Farm 1

Hereford Cattle

This is a gently rolling hill farm that has a small breeding herd of Hereford cows and several sows. Ten or twelve steers are fed out during the winter. During the summer months, the breeding herd is confined to a pasture field transversed by the 765KV line for its full length. During the winter, the breeding herd is confined to a barn, adjoining barn lot, and corn field. The corn field is located under the 765KV line.

The farm operator reported 24 bovine births and three deaths in the herd from May 1, 1977 to April 30, 1979. He purchased one bull for breeding purposes and sold one bull for slaughter. The operator reported his cattle were under

the line approximately 405 days of the 24-month report period. Growth rate, reproductive performance, behavior, and health of the herd were reported to be normal during the period. He observed no problems with his animals that he attributed to the 765KV line. A closing inventory of 27 head of cattle was reported by the owner on April 30, 1979.

The performance of this herd was compatible with the breeding, feeding, and management practices applied. One of the deaths reported was due to a mechanical injury, one due to a bacterial infection, and one due to exposure during exceedingly cold weather. The growth rate, behavior, reproductive performance, and health of the herd were considered to be normal for the breeding, feeding, and management practices. No health problems were observed in the livestock on this farm that could be attributed to the 765KV line.

Farm 2

Hereford Cattle

This farm reported 40 head of Polled Hereford breeding cattle at the beginning of the study.

It is an extremely well-managed herd and the cattle perform very well. The operator reported 82 births, 4 deaths, 7 purchases, and 63 sales or removals from the herd during the 24-month report period.

The herd was under the line 365 days of each year. Reproductive performance, growth rate, behavior, and health of the herd were reported by the farm operator to be normal throughout the period. The farm operator observed no problems with his animals that he attributed to the 765KV line. Calves on this farm grew very rapidly. Seven steer calves 6 months of age, sold in October 1978, averaged 500 pounds; and, four heifer calves, sold at the same time, averaged 475 pounds. An eight-year old cow sold in December weighed 980 pounds. Nineteen steer calves, 6 months of age, sold in April, 1978, were estimated to weigh 575-600 pounds, which is far above average weight for calves of that age. Twenty-seven steer and heifer calves weaned and moved to another farm in September, 1978, weighed 460 pounds. A closing inventory of 62 cattle was reported by the owner on April 30, 1979.

Bi-monthly inspections indicated that the growth rate, behavior, reproductive performance, and health of the herd were normal for the breeding, feeding, and management practices. No health problems in the livestock on this farm were attributed to the 765KV line.

Farm 4

Red Poll Cattle

This beef cattle farm had 12 Red Poll Cattle at the inception of the study.

He reported eight births, two deaths, and four cattle sold during the 14 months that he participated in the study. Two cows were found dead in the pasture field shortly after calving. They were found in small depressions in a corner far removed from the 765KV line. There was no opportunity to view or necropsy the animals, so the cause of death was not determined, but grass tetany was suspected. The owner reported that two of the sale animals were sold at 6 months of age and weighed 425 and 475 pounds. This is an acceptable weight for Red Poll calves at this age.

The cattle were reported to be under the line 365 days of the year. (This farm was in the study the first year only.) Reproductive health, behavior, growth rate, and health were reported to be normal by the operator throughout the study

period. He reported that he did not observe any animal health problems that he thought were caused by the 765KV line. Due to health problems of the owner, this herd was dispersed in June, 1978.

Bi-monthly inspections indicated that the growth rate, reproductive performance, behavior and general health of the herd were normal for the breeding, feeding, and management practices. No health problems that could be attributed to the 765KV line were observed.

Farm 6

Charolais Cattle

This Charolais beef cattle farm reported 23 cows, one bull, and 11 calves at the beginning of the study. Because of an unfavorable economic situation in the beef cattle business and greater interest in grain farming, the operator informed us that he would disperse the herd early in 1978. The herd was dispersed during the January-February report period. During the eight-month report period, seven births were reported, one death, four breeding sales, and twenty-nine slaughter sales. Animals were under the line 150 days. The farm operator reported health, growth rate, reproductive performance, and behavior of the animals normal throughout the report period. He did not observe any problems with his animals that he thought were caused by the 765KV line.

The bi-monthly inspections indicated that the herd health, reproductive performance, behavior, and growth rate of the animals were normal for the breeding, feeding, and management practices observed. No animal health problems could be attributed to the 765KV line.

Farm 9

Mixed Dairy Cattle & Dalmatian Dog

Twenty-two (22) dairy cattle, including both cows and calves, were listed on the original inventory for this farm. The operator is an exceptionally good manager and caretaker. He reported his animals spent 465 days under the line during the two-year period. During the study, he sold six cows for slaughter, one for breeding purposes, and reported one death. Animals sold for slaughter in 1977-78 averaged 1,363 pounds body weight, and four animals sold in 1978-79 averaged 1,431 pounds, which is satisfactory weight for the Holstein breed. Milk production by this herd has been good, averaging 13,359 pounds per cow per year, based on owner's estimates at two-month intervals. Average production per year for the state of Indiana in 1978 was 10,729 pounds of milk.

The owner reported behavior, milk production, health, and reproductive performance were normal. He stated that his cattle appeared to prefer to stay under the line, and he did not observe any problems with his animals that he attributed to the 765KV line. The farm operator reported a closing inventory of 13 lactating dairy cattle on April 30, 1979.

Bi-monthly inspections of this herd indicated behavior, growth rate, milk production, and reproductive performance normal for the feeding, breeding, and management practices. No health problems in the herd were considered to be caused by the 765KV line.

Farm 10

Holstein Cattle

One hundred (100) Holstein cattle were listed on the initial inventory for this farm. The operator indicated in his report the cattle spent 730 days under the line during the study. There have been 105 births and 7 abortions reported. Six (6) cows have been purchased, 25 sold for beef, and 11 sold for breeding purposes. The cows sold for beef averaged 1,380 pounds, which is acceptable weight for Holstein cows. Milk production has been very good in this herd. Official Dairy Herd Improvements Association records as of April 1, 1978 placed the rolling herd average at 13,076 pounds and April 2, 1979 at 12,921 pounds. When compared to average 1978 production of 10,729 pounds for all Indiana dairy cows, this herd produced in excess of 2,000 more pounds of milk per cow per year. A three-year old cow was sold from this herd in 1978 for \$5,600. Another cow was producing over 100 pounds of milk per day in April, 1979.

The operator reported that milk production, behavior, and health of the herd were normal throughout the study years. Reproductive health was reported as normal, except for the March-April, 1978 report, which stated, "Had trouble getting cows bred and a lot with uterus infection. We also had three cows with displaced abomasums." The operator reported a closing inventory of 61 lactating cows on April 30, 1979.

Bi-monthly inspections of this herd indicated that the milk production and animal behavior were normal. Reproductive health and general health problems were attributed to sanitation and housing deficiencies.

No problems that could be attributed to the 765KV line were observed.

Farm 11

Holstein Cattle

Three hundred (300) head of Holstein cattle were initially inventoried on this farm, but the milking herd was listed at 70 head. Both bull calves and heifer calves are raised on the farm, which inflates cattle numbers. The herd spent 730 days under the line during the two-year study period. Sixty-two births, two abortions, and five deaths were reported during the first 10-month report period. Most of the deaths were calves that died from cold weather exposure. Thirteen sick animals were also reported, which is not exceptional for a confined dairy herd. Mastitis, post calving problems, and neonatal diarrhea were most frequently observed. Nine cows were sold for slaughter. Weight was not reported for all, but those reported averaged 1,400 pounds, which is satisfactory for the breed. This was one of the high-milk producing herds in the state of Indiana during 1978. As of April 1, 1978, the rolling herd average, according to official Dairy Herd Improvement Association records, was 17,276 pounds of milk per cow per year. Comparison with the average milk production for Indiana dairy cows of 10,729 pounds revealed this herd averaged 6,547 pounds more milk per cow per year. Another herd of 39 head was purchased and added to this herd in January, 1979, which prevented meaningful comparison with earlier performance. A closing inventory of 125 lactating cows was reported April 30, 1979.

Bi-monthly inspections of the herd indicated the behavior, general health, reproductive health, and milk production of this herd were satisfactory. No problems that could be attributed to the 765KV line were observed.

Electrical Measurements Made In Conjunction With The Study Of Farm Animals Near 765KV Transmission Lines

The primary purpose for the electrical measurements part of this program is to quantify the electro-magnetic environment in which the subjects of this study live.

To accomplish these surveys, several types of measurements were made in the animal grazing areas of each farm. Comments on procedures and results, for each type of measurement, are described on the following pages.

A - C Electric Field Mappings

The Polytek FMB 109 Field Meter was used for the E-field measurements.

Generally, one or more traverses were made, perpendicular to the line, 1 meter above the ground. Mappings parallel to the line, in some cases, were also made. At one meter, the electric field was, in all cases, perpendicular to the ground and the Field Meter was held in the proper position to record this vertical component. In all cases, the maximum E-field (at one meter height) in each farm's grazing area was recorded. Some representative plots are shown, along with calculated curves taken from the reference cited. The following conclusions can be drawn from these curves:

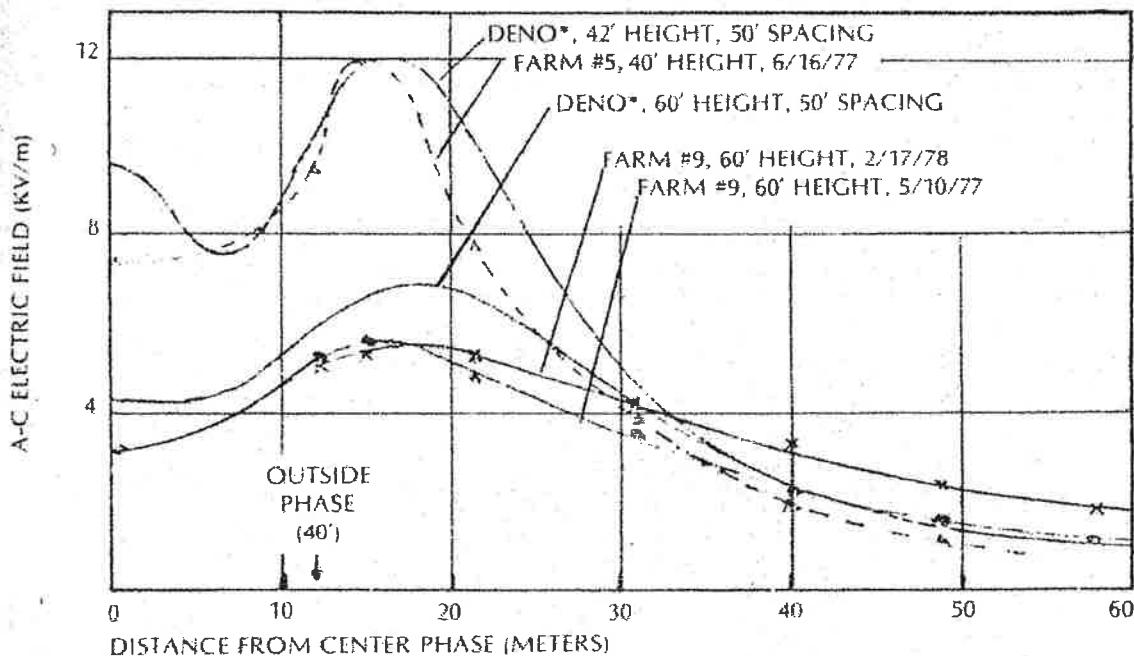
a. The data for a given site are in reasonable agreement with the theoretical calculations, taking into consideration differences in spacing and non-flatness of the actual topography.

b. Comparing the two sets of data taken for the same location of Farm #9, suggests that winter conditions cause the field strength to hold at higher values for further distance away from the line. This could be caused by winter ground level being higher, possibly because of the frozen ground and one-foot layer of snow, and also by the conductor height change due to temperature. This same type of Spring-Winter difference was also found on Farm #10, as can be seen from the data on the tabulation sheets.

Typical Electric Field Data

*REF. D. W. DENO, "Transmission Line Fields,"

IEEE Trans PAS-95, 1600-1611, 1976.



A - C Magnetic Field Mappings:

From previous investigations by others, the A-C magnetic field was expected to be small, maximizing at about .6 gauss (6×10^{-5} Tesla, or 6×10^{-5} weber m^{-2}) from a 50-foot high 765KV line carrying 4000 A.* A second reference indicates the same peak field from a 500KV 1000 A line.** The peak value should occur approximately directly under the center phase, where the B-field will be vertical.

In our magnetic field measurement program, the Polytek FMB 109 Field Meter was used with a magnetic field loop detector. Table 2, Page 56, shows measurements, which are

indicative of the magnetic field values recorded at the two test farms. These values are far below the magnitudes reported in the literature, due to the line currents being considerably lower than 4000 A while these data were being recorded.

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** Electrical and Biological Effects of Transmission Lines: A Review," Bonneville Power Administration, Portland, Oregon 1977.

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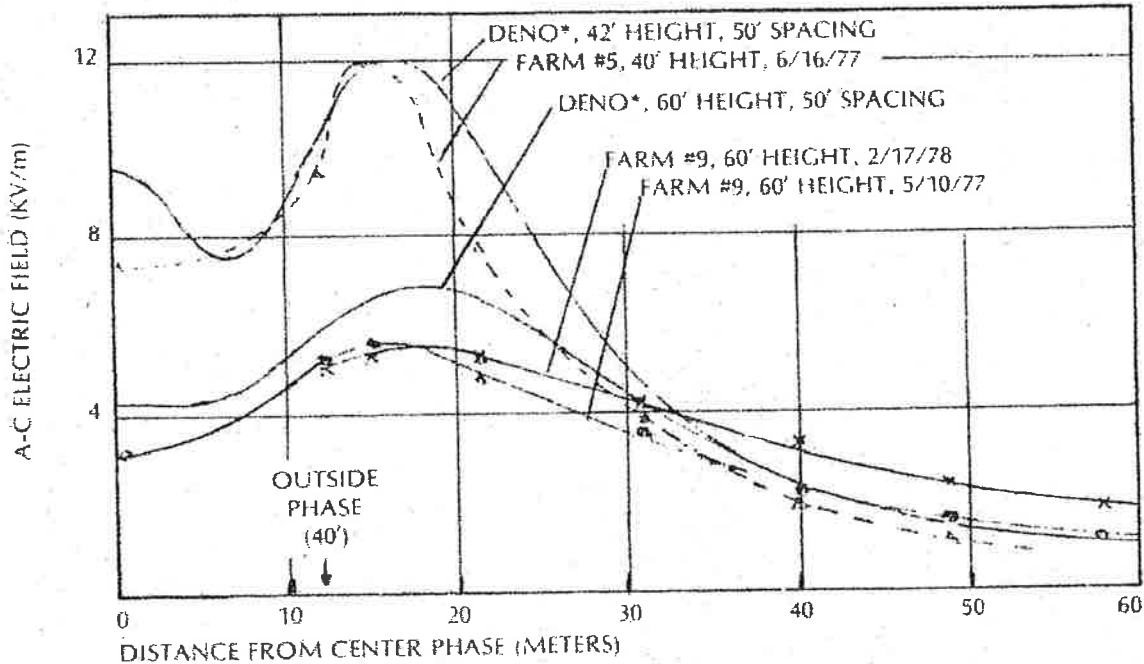
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Table 2

Magnetic field approximately one meter (three feet) above ground surface, in gauss (10^{-3} Wb. m², 10^{-3} Tesla).

Date	Time	Farm	Approx. Current	Line Height	Center Phase	East Phase	30'	60'
5/11/77	1000	#11	181 Amps.	50'	.012	.01	.0035	.004
6/16/77	0900	#4	486 Amps.	50'	—	.056	.0375	.023

Potentials and Induced Currents:

The potentials, which objects assumed when located under the line and the induced currents which flowed through these objects to ground, were recorded at several locations. For the potential measurement, the object would be insulated from ground, for instance by use of a rubber pad, and the potential would be recorded by connecting the potential meter between the object and ground. For the induced current reading, the object was again insulated from ground and the current meter was connected between the

object and ground. Ground was obtained by driving a metal rod 10 to 20 cm into the ground. The following instruments were used, often consecutively, to confirm the reading:

- Ballantine 3-24 digital multimeter
- Triplet 630 PI K multimeter (5000 ohm, volt, a-c)
- Simpson 260 multimeter (5000 ohm, volt, a-c)
- Polytek FMB 109

Table 3, shows a selection of potential and current data taken during the tests.

Table 3

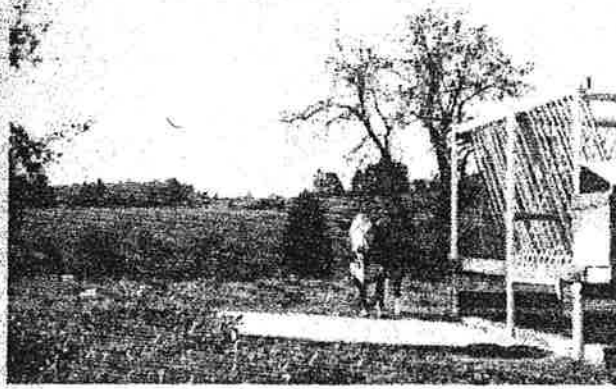
Potentials and Currents to Ground.

Farm #	Field Strength In kV/meter*	Object	Potential In Volts**	Current In ma
1	1	one man	150	.012
		two men	190	.025
5	11	one man	1,500	.11
6	8.2	one man	1,500	.10
7	5	one man	—	.06
8	.3	feeder roof	.3	—
		feed tank	—	.05
9	5.5	one man	280	.06
		three men	—	.15
10	8.5	one man	—	.140
		one cow (cow not insulated from ground)	—	.2-.3
11	8	one man, arms lowered	1,200	.08
		one man, one arm raised	1,300	.12
		automobile (voltage decreased with time)	250	.5

*Not necessarily the maximum field strength on this farm. Values are approximate.

**Voltages are highly dependent on the impedance of the insulation at the time of the measurements.

Special Test On Cattle. Farm #1



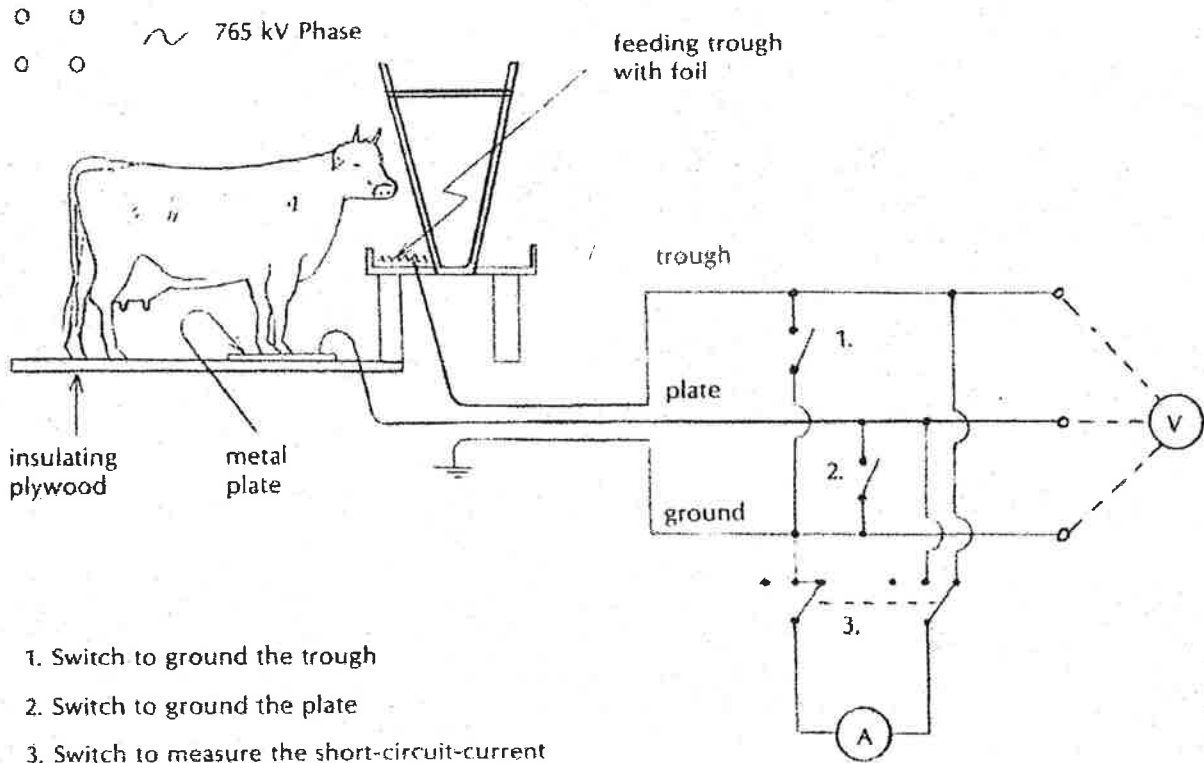
A special feeding structure shown in the above photograph was constructed and located in a high field region of Farm #1. The electric field measures approximately 6 to 8 KV M in the area of the structure. Note that the cattle stand on a metal plate attached to an insulated platform. The feed trough is lined with aluminum foil which is also insulated from ground. A cable attached to this foil liner can then be used either to measure the cow's potential or to control the current which passes through the

cow to ground. The electrical arrangement is shown on the accompanying sketch.

There were some difficulties experienced in satisfactorily insulating the platform and the feed trough. Complications also resulted from a cow, standing on the ground next to the platform, reaching into the feed trough, or a cow, standing on the ground, touching and grounding a cow on the platform. The short circuit current which a single cow normally discharges in this electric field intensity is 100 to 200 microamperes. Electrically connecting an automobile (insulated by its tires) and two insulated men to the feed trough to boost the current to 800 microamperes usually resulted in no observable reaction, either when the cow first touched the feed trough or continued to feed.* These data suggest that the threshold action of a cow to A-C electrical current is in the vicinity of three-quarters of a milliampere, which is well above the current normally intercepted by a cow even in the highest field areas under a 765KV line.

* There was evidence, however, that one cow reacted when she reached over and fed while standing on the ground. In this case, she intercepted only the current delivered by the structure, which was measured to be about 700 microamperes.

Electrical Measurements on Cattle



Electric Field Measurements

Electric Field Scans (kV/m)
(3 feet above ground)

Farm	1	1	2	2
Date	6/16/77	6/15/77	6/16/77	6/16/77
Time	1430	1500	1200	1215
Scan	4 spacers* S. of tower	On high plain 1/4 distance from towers.	1 1/2 spacers* S. of tower.	4 spacers* S. of tower. In midspan lower level of pasture.
Location and Comment	along ridge; tall grass	Tall grass	Upper level of pasture.	lower level of pasture.
210' E of E phase				
180' E of E phase				
150' E of E phase				
120' E of E phase			0.67	0.52 (ditch)
90' E of E phase	Valley 1/3 bottom	1.3 (100')	1.3	1.0
60' E of E phase	2.2	2.2 (70')	2.4	2.1
30' E of E phase	3.7	5.9 (40')	4.0	3.6
10' E of E phase	4.0	6.8	4.5	4.1
Under E phase	3.5	5.2	4.2	3.8
Under Center phase	1.8	1.8	2.3	
Under W phase	3.5	6.2	4.0	
10' W of W phase	3.8	6.75	4.0	
30' W of W phase	3.8	5.2	2.4	
60' W of W phase		2.9	under tree 0.18	
90' W of W phase		1.75		
120' W of W phase				
150' W of W phase				
180' W of W phase				
210' W of W phase				

*A typical 765kV span of 1,000 feet has four spacers.

Electric Field Scans (kV/m)
(3 feet above ground)

Farm	4	6
Date	6/16/77	6/15/77
Time	0900	1830
Scan Location and Comment	3 1/2 spacers* South of tower.	Midspan towers rises toward E; tall grass
210' E of E phase		
180' E of E phase	.043	0.41
150' E of E phase	.07	0.55
120' E of E phase	1.1	0.7
90' E of E phase	2.0	1.4
60' E of E phase	3.8	2.6
30' E of E phase	7.6	6.2
10' E of E phase	9.1	8.4
Under E phase	8.8	8.2
Under Center phase	3.75	5.7
Under W phase	4.1	7.7
10' W of W phase	4.2	7.8
30' W of W phase	4.0	5.9
60' W of W phase	3.0	2.9
90' W of W phase	1.9	1.8
120' W of W phase	1.2	1.0
150' W of W phase	0.66	0.5
180' W of W phase	0.46	
210' W of W phase	0.20	

Upper Level
Steep Hill
Lower Level

*A typical 765kV span of 1,000 feet has four spacers.

Electric Field Measurements

Electric Field Scans (kV/m)
(3 feet above ground)

Farm	9	10	10	9	11
Date	5/10/77	5/10/77	2/17/78	2/17/78	5/11/77
Time	1400	1700	1500	1330	1000
Scan Location and Comment	Along N1250 slopes down to W. N of tower.	At peak of hill in pasture, 3 spacers N of tower.*	At peak of hill in pasture.	Along N1250 10' out from fence; 1M above snow; Snow 1' deep.	Midspan towers. Tall alfalfa.
210' E of E phase	.47			1.0	
180' E of E phase				1.4	
150' E of E phase	1.0	0.8 (160')	1.3	1.9	0.6 (160')
120' E of E phase	1.5	1.2 (130')	1.8	2.3	1.0 (130')
90' E of E phase	2.1	1.8 (100')	2.7	3.3	1.8 (100')
60' E of E phase	3.6	3.2 (70')	4.3	4.2	2.8 (70')
30' E of E phase	4.8	5.7 (40')	6.5	5.1	5.1 (40')
10' E of E phase	5.5	8.5	8.0	5.4	7.2
Under E phase	5.2	8.0	8.0	5.1	6.9
Under Center phase	3.1	5.9	5.8		4.9
Under W phase	3.0	8.7	7.8		7.5
10' W of W phase	4.0	8.5	8.3		8.0
30' W of W phase					
50' W of W phase					
90' W of W phase					
120' W of W phase					
150' W of W phase					
180' W of W phase					
210' W of W phase	line height: 60'				

*A typical 765kV span of 1,000 feet has four spacers.

Farm Animal Electric Perception Thresholds

Stock Type	Approximate Weights Lbs.	Electrical Threshold More Than	Electrical Threshold Less Than
Hogs	250	49uA	300uA
Sheep	125	40uA	200uA
Beef Cattle	1,000	750uA*	—

*This value is believed to be close to threshold.

Summary and Conclusions

This two-year study of eleven (11) livestock farms was initiated to determine the effects, if any, of electric and magnetic fields from 765KV transmission lines on farm animals. Nine (9) farms were studied for the full two-year period. One beef farm discontinued operations after ten months and another beef farm after fourteen months.

The farm operators made continual observations of their animals' health and submitted bi-monthly reports. A veterinary bi-monthly inspection of the animals was made and a report of each inspection prepared. Eighty-six percent (86%) of the farm operator reports were returned and 100% of the veterinary reports were available and provide the basis for this final report. As would be expected, there were a few health problems and some deaths in beef cattle, dairy cattle, swine, and sheep, but these were not considered uncommon.

Animals were maintained under widely variable breeding, feeding, management and housing conditions. All of these factors influenced health, but housing was especially significant in the case of young or debilitated animals during the extremely severe winter weather.

Performance of the animals was commensurate with breeding, feeding, management, and housing practices. Some animals performed poorly and others performed extremely well.

Thirty-six crossbred pigs gained an average of 1.76 pounds a day for a 116-day feeding period, and required only

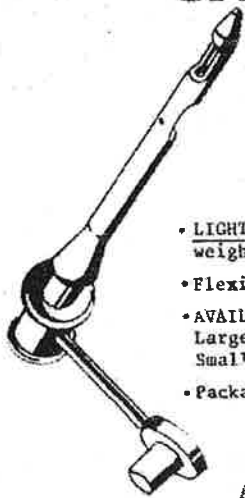
3.33 pounds of feed per pound of gain. A seventy-cow Holstein dairy herd reached a rolling herd average of 17,276 pounds of milk per cow per year, which compares to an Indiana average of 10,729 pounds. Nineteen Polled Hereford steer calves were estimated to weigh 575-600 pounds by the owner when they were sold at six months of age. Average weight of six-month old steer calves in Indiana is estimated to be 385 pounds.

Fourteen Montadale lambs averaged 95 pounds at 4½ months of age. Average weight of all such lambs in Indiana is estimated at 92 pounds. Sheep from the same flock won prizes at county and state fairs. The above evidence indicates that animals can and do perform well under 765KV lines, but does not mean to imply that all animal performance in this study was excellent. For a group of animals-as-large as was involved in this study, some problems can be expected.

None of the eleven farm operators indicated in any of the bi-monthly reports submitted throughout the two-year study or during investigator's visits to the farms that they observed any health problems with their animals that they thought were caused by the 765KV line. One report stated that horses appeared to avoid the high ground under the line, but another farmer stated that his cattle seemed to prefer to be under the line.

Neither health, behavior, nor performance were affected by the electric or magnetic fields created by the 765KV line.

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