

STATE OF MINNESOTA - COUNTY OF WABASHA  
DISTRICT COURT - CIVIL DIVISION  
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Greg Siewert and  
Harlan Siewert,  
dba Siewert Holsteins,

Plaintiffs,

vs.

Xcel Energy,

Defendant.

Case No. C5-04-498  
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DEPOSITION OF  
Robert J. Gustafson, Ph.D.  
January 29, 2007  
Columbus, Ohio  
Lead: Charles Bird, Esquire  
Firm: Bird Jacobsen & Stevens

FINAL

JANE ROSE REPORTING 1-800-825-3341

APPEARANCES:

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On behalf of Plaintiffs.

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On behalf of Defendant.

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On behalf of Defendant.

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I N D E X

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WITNESS PAGE  
ROBERT J. GUSTAFSON  
EXAMINATION  
(By Mr. Bird) 6

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EXHIBITS MARKED  
Exhibit No. 304 6  
(Curriculum Vitae)  
  
Exhibit No. 305 6  
(Article: Response to "Equipotential Planes,  
A Figment of the Imagination"  
  
Exhibit No. 306 6  
(Abstract: Equipotential Planes, A Figment  
of the Imagination)  
  
Exhibit No. 307 6  
(Abstract: The Hazardous Multigrounded  
Neutral Distribution System and  
Dangerous Stray Currents)  
Exhibit No. 308 6  
(Abstract: The Grounding of Power Systems  
Above 600 Volts: A Practical View Point)  
Exhibit No. 309 6  
(July 28, 2006, letter to O'Brien from  
Gustafson)  
Exhibit No. 310 6  
(Deposition Notice)  
  
Exhibit No. 311 6  
(Article: Cows, Ground Surface Potentials  
and Earth Resistivity)

I N D E X

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EXHIBITS	MARKED
Exhibit No. 312 (May 26, 2005, letter to Gustafson from O'Brien)	6
Exhibit No. 313 (Handwritten notes)	6
Exhibit No. 314 (Metatec Associates Document MT06-114)	6
Exhibit No. 315 (8/23/06 memo to O'Brien from Gustafson)	6
Exhibit No. 316 (Cover page of: Final Report of the Science Advisors to the Minnesota PUC)	6
Exhibit No. 317 (Cover page of: Effects of Electrical Voltage/Current on Farm Animals)	6
Exhibit No. 318 (Cover page of: Stray Voltage and Dairy Farms, NRAES-149)	118
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Exhibit No. 322 (April 6, 1994, letter to Gustafson from Gerald Bodman)	129
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I N D E X

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EXHIBITS

MARKED

Exhibit No. 324

205

("Behavioral Experiments Quantifying  
Animal Sensitivity to AC and DC Currents)

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1 PROCEEDINGS

2 - - -

3 And, thereupon, Exhibit Nos. 304-317 were marked  
4 for purposes of identification.

5 - - -

6 (Witness sworn.)

7 MR. BIRD: We've marked some exhibits here,  
8 304 to 317. For the record, on 316 and 317, those two  
9 being the Final Report -- 316 is the Final Report of  
10 the Science Advisors to the Minnesota Public Utilities  
11 Commission dated July 31, 1998. Counsel have agreed  
12 that all we're going to do is mark that cover page just  
13 to indicate what it is because we all know what the  
14 report is and we all have copies of it, and it's a  
15 document that has 47 pages.

16 Then Exhibit 317 is the so-called red book.  
17 Actually, it's a United States Department of  
18 Agriculture publication called, "Effects of Electrical  
19 Voltage/Current on Farm Animals: How to Detect and  
20 Remedy Problems," and, again, we're only going to mark  
21 the cover page for the same reasons as noted with  
22 respect to Exhibit 316.

23 Is that agreeable, counsel?

24 MR. O'BRIEN: That's correct.

25 - - -

1 ROBERT J. GUSTAFSON,  
2 being by me first duly sworn, as hereinafter certified,  
3 deposes and says as follows:

4 EXAMINATION

5 BY MR. BIRD:

6 **Q. What is your current status with The Ohio**  
7 **State University?**

8 A. My current status is I'm Associate Dean for  
9 Undergraduate Education and Student Services in the  
10 College of Engineering and a professor of food, ag and  
11 biological engineering.

12 **Q. What percentage of your time is involved in**  
13 **the former?**

14 A. Probably 95 percent of my time.

15 **Q. Are you teaching classes now?**

16 A. I teach some. Last year I taught three  
17 classes. This year I'm probably only teaching one.

18 **Q. Are you currently teaching a class?**

19 A. No.

20 **Q. Are you engaged at this point in any ongoing**  
21 **research relative to agricultural engineering?**

22 A. No.

23 **Q. Are you engaged in any research at present**  
24 **with respect to the issues of stray voltage?**

25 A. No formal research, no.

1       **Q.       When is the last time that you were actually**  
2       **involved formally in stray voltage research?**

3       A.       In a funded research project, probably the  
4       last funded project would have been at University of  
5       Minnesota, and I left there in '87.

6       **Q.       1987. I know that you've done some writing**  
7       **since '87. Has that been in collaboration with others,**  
8       **either summarizing the research you did previously**  
9       **or -- I think as part of the red book you got together**  
10       **with some other scientists and collaborated on certain**  
11       **summaries; right?**

12       A.       That would be a reasonable characterization.

13       **Q.       When is the last time you did any writing --**  
14       **and outside of litigation, of course -- in the field of**  
15       **stray voltage?**

16       A.       Would be the IEEE paper done last summer.  
17       It's marked as one of the exhibits.

18       **Q.       Is that the response to Zipse's?**

19       A.       Yes.

20       **Q.       Other than that, when was the last time?**

21       A.       What I'm looking for is the NRAES  
22       publication, which was in 2003, I think would have been  
23       the other.

24               MR. BIRD: We'll mark the cover of this too,  
25       if that's okay.



1 MR. O'BRIEN: Sure.

2 MR. BIRD: Let's do it at a break. I'm  
3 going to call that exhibit next, whatever that is.

4 MR. O'BRIEN: 318.

5 MR. BIRD: We'll call it 318. We're marking  
6 the cover page of a publication of Natural Resource,  
7 Agriculture and Engineering Service.

8 THE WITNESS: Actually, it's the Northeast  
9 Regional Agricultural Engineering Service. No. You're  
10 right. They did change the name. I stand corrected.  
11 Used to be. I stand corrected.

12 BY MR. BIRD:

13 **Q. NRAES-149, Stray Voltage in Dairy Farms**  
14 **proceedings from April 9-11, 2003, in which you**  
15 **participated, and it looks like you did what's called a**  
16 **stray voltage overview; right?**

17 A. Correct.

18 **Q. All right. Have you ever been on the**  
19 **Siewert farm?**

20 A. No.

21 **Q. Is it your intention to visit the Siewert**  
22 **farm at all before you testify in this case?**

23 A. Not unless requested to.

24 **Q. You don't believe it's necessary for you to**  
25 **visit there in order to render the opinions you're**

1 **intending to give in this case?**

2 A. That is correct.

3 **Q. All right. We've talked about the documents**  
4 **you've reviewed, and you've brought those with you.**  
5 **Based upon -- Let's see. Did you have that list? I**  
6 **could just take a look at, go over that very quickly.**

7 **MR. O'BRIEN: Let's just mark this.**

8 - - -

9 **And, thereupon, Exhibit No. 319 was marked**  
10 **for purposes of identification.**

11 - - -

12 **BY MR. BIRD:**

13 **Q. Showing you what's marked Exhibit 319. Are**  
14 **those the documents that you've looked at in this case?**

15 A. Yes. This is just a summary of the titles  
16 on the letters that came to me documenting what  
17 documents came.

18 **Q. And those are things that were sent to you,**  
19 **not necessarily that you reviewed in detail; correct?**

20 A. That is correct.

21 **Q. Those that you've looked at in more detail**  
22 **are the exhibits that were a part of the Reilly**  
23 **deposition?**

24 A. That is true.

25 **Q. And what is your reason for being interested**

1       **in reviewing those exhibits more than the other**  
2       **documents?**

3       A.       Because they dealt more with the electrical  
4       aspects in the case.

5       **Q.       Do you know Mr. Reilly?**

6       A.       Yes.

7       **Q.       Have you met him in the past?**

8       A.       Yes.

9       **Q.       And have you met him in the context of this**  
10       **type of litigation?**

11       A.       There and at professional conferences and  
12       things like that.

13       **Q.       What is your current charge for your**  
14       **services?**

15       A.       \$120 per hour.

16       **Q.       And does that charge vary at all whether**  
17       **it's reviewing documents, attending depositions, going**  
18       **to trial?**

19       A.       Excuse me. I usually charge \$1,200 a day  
20       for time I spend away from Columbus.

21       **Q.       Now, do you have a separate business entity**  
22       **set up for this purpose, or is it just run as a sole**  
23       **proprietorship?**

24       A.       I do not have a separate business set up for  
25       it.

1       **Q.       The money that you earn, does that go to the**  
2       **university or does it go to you directly?**

3       A.       Goes to me directly.

4       **Q.       Do you know how much you earn per year?**

5       A.       It's varied. Last year, I remember it was  
6       under \$1,000. Previous years, it would have been  
7       somewhat more than that.

8       **Q.       I'm showing you what we have here; it's**  
9       **Exhibit 310. Take a look at this. Have you seen that**  
10       **before?**

11       A.       Yes.

12       **Q.       Okay. Item two requests a bibliography,**  
13       **list or copies of any and all articles, publications,**  
14       **treatises or published documents upon which you've**  
15       **received or relied in forming any opinions as to**  
16       **whether electricity was a cause -- a potential cause of**  
17       **problems on a dairy farm, including the Siewert Dairy.**  
18       **Have you gathered that list?**

19       A.       The list I would rely on from my own  
20       articles are those that are in the vitae statement, and  
21       I think the USDA red book is a good bibliography as  
22       well as the subsequent one done by Dr. Reinemann,  
23       University of Wisconsin. So those are the  
24       bibliographies I would rely on.

25       **Q.       When you're saying you're relying on them,**

1       **you believe that those -- the documents in your own**  
2       **curriculum vitae represent credible scientific**  
3       **information --**

4       A.       Yes.

5       **Q.       -- upon which experts in your field would**  
6       **normally and typically rely?**

7       A.       Yes.

8       **Q.       Would the same hold true with respect to the**  
9       **bibliography in the red book?**

10      A.       Those are more comprehensive. I'm not sure  
11      I would say I would rely on all the articles in there.  
12      Those are just more comprehensive that I would go to  
13      pull out relevant articles.

14      **Q.       If I were to ask you which articles in the**  
15      **red book you relied upon, would you be able to create**  
16      **that list for me? I mean, I can do it now or have you**  
17      **just spend a little time afterwards and you can send me**  
18      **a list through Mr. O'Brien.**

19      A.       You're really asking which ones I would view  
20      as most pertinent to what our discussion is today.

21      **Q.       Yes, and that you felt were credible.**

22      A.       I could do that.

23      **Q.       And with regard to Dr. Reinemann's list, can**  
24      **you do that as well? I brought that list with me.**

25      A.       Okay. Yes, I could do that. So let me be

1 clear. What you'd like is just to know -- Tell me  
2 again what it is that you would like to have.

3 **Q. Well, what I'm looking for is a listing of**  
4 **the documents in the bibliography of both the red book**  
5 **and -- what's the other --**

6 **MR. O'BRIEN: Dr. Reinemann's summary of**  
7 **literature.**

8 **Q. -- Dr. Reinemann's literature summary that**  
9 **you feel are credible and that you'd rely upon.**

10 **All right. Then go to item three. And,**  
11 **again, these are items we asked you to bring today.**  
12 **Copies of any personal communications or correspondence**  
13 **you have had with any of the authors of the items**  
14 **listed in number two above, including e-mails, letters,**  
15 **fax, memoranda, or however stored, in the time frame**  
16 **'85 to the present.**

17 **So what I'm looking for is communications**  
18 **you've had with those persons that you find to be**  
19 **credible when you reviewed this list of materials. You**  
20 **did read this before you came here?**

21 **A. Yes, I did. I really don't keep personal**  
22 **communications files in that way. The only thing I**  
23 **could think of -- which, I apologize, I didn't think of**  
24 **before -- is that I may have some communications**  
25 **relative to the Zipse paper development. I think**

1 that's about the only ones that I could probably  
2 recover at this point in time.

3 **Q. What you're saying is you don't have any**  
4 **files relative to any of the papers you've written back**  
5 **and forth to the various places that -- I mean, I just**  
6 **don't know how you keep your files, but --**

7 A. No. I have files of the completed papers,  
8 but I don't have other correspondence sorts of things  
9 with people that would be behind it.

10 **Q. You participated, for example, in producing**  
11 **the USDA red book; right?**

12 A. Correct.

13 **Q. So I'm assuming you had conferences**  
14 **regarding that; correct?**

15 A. Correct.

16 **Q. And I'm just guessing, but I'm suspecting**  
17 **you had telephone conference calls as well --**

18 A. Yes, we did.

19 **Q. -- and that you were taking notes about**  
20 **various things. Where are they?**

21 A. I have not retained those over time. Once  
22 the document was completed, I didn't try and keep that  
23 sort of developmental material.

24 **Q. You just threw it away?**

25 A. Yes.

1       **Q.       Do you keep any personal correspondence over**  
2       **the years on this type of --**

3       A.       On these sorts of things, not really.

4       **Q.       Well, when you say "Not really," that means**  
5       **you might.**

6       A.       I'm sorry. No, I don't have a file of  
7       correspondence on these things.

8       **Q.       And do you have a list of these various**  
9       **research papers, refereed or not, related to stray**  
10       **voltage?**

11       A.       The ones that I've done are cited in my  
12       vitae.

13       **Q.       But do you have them laying around in a box**  
14       **or in a file drawer at your office?**

15       A.       Oh, yes, I have -- Yes.

16       **Q.       You have a stray voltage file?**

17       A.       I have files at home primarily of papers  
18       regarding stray voltage, yes.

19       **Q.       Would it be true then that you don't have**  
20       **any notes or records of any sort related to your**  
21       **involvement with this publication that we've been**  
22       **referring to as the red book, which is Exhibit 317**  
23       **here?**

24       A.       I don't think I do. I can certainly check,  
25       but I don't think I do.



1       **Q.       We'd ask that you check for that. And I'm**  
2       **looking for any type of information, however stored,**  
3       **which means I'm looking for digital data on it as well,**  
4       **e-mails and such.**

5               **And somehow you did come up with an e-mail**  
6       **here. I don't know where it is, but we marked**  
7       **something that -- Yeah; it looks like this was an**  
8       **e-mail here, Exhibit 315.**

9       A.       Correct. That was the e-mail to Mike, yes.

10       **Q.       And you must have saved that somewhere in**  
11       **your digital file.**

12       A.       Well, I printed it out at the time, I  
13       believe. It probably still is stored in the archive of  
14       the e-mail system.

15       **Q.       And that's what I'm wondering, I mean, if**  
16       **you have -- if there's any kind of a method you have**  
17       **for saving important e-mails and records.**

18       A.       Not that's got any organization to it that  
19       would be around a particular topic. Plus, the red book  
20       one would have been back in '90 -- late '80s into early  
21       '90s. I seriously doubt I'd be able to resurrect any  
22       of the e-mail correspondence if we had any at that  
23       point in time.

24       **Q.       Showing you what's marked as Exhibit 312, is**  
25       **that when you were first contacted in connection with**

1       **this case?**

2       A.       Yes. I believe Mr. O'Brien had contacted me  
3       by phone, likely, and this would have been a  
4       confirmation of that contact.

5       **Q.       And what was the date of that?**

6       A.       May 26, 2005.

7       **Q.       And at that time what were you asked to do?**

8       A.       I was asked to be available primarily for  
9       the electrical aspects, setting perspective on the  
10      research that's been done, the history and development  
11      of stray voltage information, and probably,  
12      particularly, the more recent was the Zipse paper or  
13      papers.

14      **Q.       And what you're saying is this "Response to  
15      the Equipotential Planes, a Figment of the  
16      Imagination," Exhibit 305?**

17      A.       Yes.

18      **Q.       You were asked to get involved in that?**

19      A.       Right; be prepared to explain or describe  
20      that particular article in particular.

21             MR. O'BRIEN: I guess I want to clarify  
22      something. It may be the way the question was asked.  
23      Your article 305 wasn't a response to a request made in  
24      this lawsuit.

25             MR. BIRD: You can't testify, can you? I

1 mean --

2 MR. O'BRIEN: I'm asking him.

3 MR. BIRD: No, you can't ask him or suggest  
4 answers either, Counsel. I think his answer will  
5 stand.

6 BY MR. BIRD:

7 **Q. I'm looking at Exhibit 305. When did you**  
8 **first -- Well, when was that submitted to IEEE?**

9 A. I'm trying to think. It was presented --  
10 I'd have to go back to check dates, but I think it  
11 would have been submitted like in December of '05 or  
12 January '06, something like that, and then presented  
13 later that spring.

14 **Q. All right. It was presented at a time after**  
15 **you'd been retained on this case for the purpose in**  
16 **part of responding to Zipse's article; correct?**

17 A. That may -- Timing-wise, that may well be  
18 true.

19 **Q. When did you first see the draft of Zipse's**  
20 **article which is marked here as Exhibit 306?**

21 A. It would have been some months ahead of when  
22 I submitted a response. I'd have to go back and, you  
23 know, try and maybe check my calendar or something to  
24 see, but probably about six months ahead of that at  
25 least.

1       **Q.       All right. Now, did you have some**  
2       **collaboration with LaVerne Stetson on preparing this?**

3       A.       Yes.

4       **Q.       And what was that collaboration?**

5       A.       LaVerne is the second author on the response  
6       paper.

7       **Q.       Who wrote the response?**

8       A.       I wrote the bulk of it. I mean, I wrote it,  
9       and then LaVerne contributed assessment to it. I asked  
10      some other colleagues to contribute ideas as well.

11      **Q.       And do you have communication or --**

12      A.       I probably do have some of that  
13      communication.

14      **Q.       Can you provide me that communication by way**  
15      **of any kind of notes or e-mails or other kind of -- I'm**  
16      **interested in knowing what you have when you first**  
17      **received a copy of the Zipse paper and any**  
18      **communications you had with anybody at IEEE or**  
19      **otherwise relative to being invited to respond or**  
20      **coordinating the response or drafting the response or**  
21      **finally submitting.**

22               **Did you attend the meeting where the paper**  
23      **was presented?**

24      A.       Yes.

25      **Q.       What occurred at that time?**

1 A. At the particular session where these papers  
2 were presented -- There were several papers presented  
3 during that particular session. I mean, it was like a  
4 regular kind of professional technical society  
5 technical session or technical paper session.

6 **Q. Well, what happened? Did you listen to**  
7 **Mr. Zipse's presentation?**

8 A. Yes.

9 **Q. Do you recall anything that happened at that**  
10 **time?**

11 A. Well, yes. He presented his paper. I  
12 presented mine. There was one other presentation or a  
13 couple other presentations. Then there was a panel  
14 discussion following or a panel time that the audience  
15 could ask questions and make comments as well.

16 **Q. Were you on the panel?**

17 A. Yes.

18 **Q. Who else was on the panel besides yourself?**

19 A. Mr. Zipse, and I can't remember the name of  
20 the person that presented one of the other papers. I'd  
21 have to look that up.

22 **Q. If you could get me that name of the other**  
23 **person.**

24 A. Sure.

25 **Q. To your knowledge, does a tape recording or**

1 **videotape recording of that exist?**

2 A. It was videotaped. My understanding is  
3 there is a video of that whole session.

4 **Q. Do you have a copy of that?**

5 A. I do not have a copy of it.

6 **Q. The video, is that something that was just**  
7 **normally done in the normal course of their business or**  
8 **was there special arrangements made to have that**  
9 **videotaped?**

10 A. It's my understanding that Mr. Zipse had  
11 made arrangements to have it videotaped.

12 **Q. Okay. One of the things that we've**  
13 **discussed here today is Exhibit 315. Apparently you**  
14 **had some contact with somebody at IEEE about**  
15 **Mr. Zipse's paper after it was presented; correct?**

16 A. Correct.

17 **Q. And then you corresponded with Mike there.**  
18 **Is that Mike O'Brien?**

19 A. Yes.

20 **Q. And who is the individual that you**  
21 **contacted?**

22 A. Mr. Bill or William Moylan; and he was part  
23 of the conference organizing team.

24 **Q. And was that a telephone call that you're**  
25 **referring to or was it e-mail or what was it?**

1 A. I believe it was a telephone call.

2 **Q. Were there any e-mails you had with Mr.**  
3 **Moylan?**

4 A. There may have been prior to the conference  
5 just some preparing papers or the paper. I don't  
6 believe there were any around this particular -- at  
7 that particular time.

8 **Q. Well, obviously, if there are e-mails to**  
9 **Moylan regarding Zipse's paper, that's something I've**  
10 **already requested. But I'm asking you in particular**  
11 **related to this exhibit, this inquiry or conversation,**  
12 **communication, if you will, that you had, I'd ask you**  
13 **also to search your records to see if you have any**  
14 **notes or e-mails or any other type of data relative to**  
15 **that communication. Okay?**

16 A. Certainly.

17 **Q. All right. Now, what was your purpose in**  
18 **contacting Mr. Moylan?**

19 A. Just to help clarify how IEEE viewed the  
20 papers presented at a meeting relative to their  
21 refereed publications.

22 **Q. And what's the name of their refereed**  
23 **publication?**

24 A. It's the IEEE Transactions of Industrial and  
25 Commercial Power Systems.

1       **Q.       And IEEE Transactions, is that a separate**  
2       **publication?**

3       A.       Yes.

4       **Q.       How often does that come out?**

5       A.       I don't know.

6       **Q.       If I read this correctly, this fellow**  
7       **indicated to you that Mr. Zipse was informed that his**  
8       **submission was not being considered for publication.**

9       A.       That is correct.

10      **Q.       And do you know this Mr. Moylan?**

11      A.       I've met Mr. Moylan, yes.

12      **Q.       Did you work with him on any committees?**

13      A.       No.

14      **Q.       Have any other papers presented in -- I**  
15      **think it was May -- Isn't that when the presentation**  
16      **was -- of '06?**

17      A.       I think that's correct.

18      **Q.       Have any other papers that were presented at**  
19      **that time since been published in the Transactions?**

20      A.       I don't know. I don't follow that  
21      particular IEEE Transactions to know whether they have  
22      or not.

23      **Q.       Do you know whether or not, in fact, at this**  
24      **point Zipse's paper has been published in the**  
25      **Transactions?**



1 A. No.

2 **Q. How would you find that out?**

3 A. I'd go back and do a search of that  
4 particular Transactions.

5 **Q. What's the typical, from the time a paper is**  
6 **presented, if you know -- I don't know if you're**  
7 **involved at all in this process, but if something is**  
8 **being considered for publication, what's the time frame**  
9 **from initial presentation at a meeting to the time that**  
10 **it actually comes out in the Transactions?**

11 A. I'm speculating a bit because I don't know  
12 the IEEE process in detail, but from the journals I've  
13 worked with and have been associated with, a minimum  
14 would probably be a year.

15 **Q. Okay. Are you currently on the editorial**  
16 **board of any peer reviewed publications?**

17 A. Yes. I'm an associate editor for the  
18 Information and Electronic/Electrical Systems Division  
19 of ASABE.

20 **Q. ASA --**

21 A. -- BE, American Society of Agricultural and  
22 Biological Engineers.

23 **Q. And what's the name of their publication?**

24 A. They have several, but the principal one  
25 would be the Transactions of ASABE and Applied

1 Engineering.

2 **Q. The name is called Applied Engineering?**

3 A. Yeah. That's a separate journal from the  
4 Transactions.

5 **Q. Are there any other publications that you do  
6 any editorial work?**

7 A. Not at this time.

8 **Q. Have you in the past, let's say, 10 years  
9 been asked to review submissions from other periodicals  
10 that are peer reviewed?**

11 A. Yes.

12 **Q. Can you tell me what those are?**

13 A. In the last 10 years, Journal of Dairy  
14 Science, American Society of Engineering Education. I  
15 don't immediately think of any others outside of the  
16 ASABE system I can think of right now.

17 **Q. Well, I noted that, in reviewing some of  
18 your prior testimony, you apparently were called upon  
19 to do some peer review work in connection with the  
20 submission made by Hillman and Graham. Do you recall  
21 that?**

22 A. Oh, at that point in time I was actually  
23 division editor for the IET division of ASA, and so it  
24 was my responsibility to handle or manage the peer  
25 review of articles coming into that particular

1 division.

2 **Q. The red book that we have, is that in your**  
3 **view a peer reviewed publication?**

4 A. No, it is not peer reviewed in the sense of  
5 being published by a technical professional society.

6 **Q. Now, you know that there are -- I'm assuming**  
7 **you know that there's methods that are used by**  
8 **researchers relative to providing credible summaries of**  
9 **other scientific material.**

10 A. Yes.

11 **Q. Are you familiar with that process?**

12 A. Yes. There are -- Definitely doing review  
13 articles in the domain is a common practice.

14 **Q. And isn't one of the criteria to make sure**  
15 **that protocols have some type of similarity or**  
16 **uniformity in order that you're going to be merging the**  
17 **data?**

18 **MR. O'BRIEN: Object to the form.**

19 A. If you're going to develop a summary, you  
20 have to be very careful that you don't mischaracterize  
21 or put things together that don't belong together, if  
22 that's what you're asking.

23 **Q. Well, if you're going from raw results with**  
24 **a sample size of 10 and another one with a sample size**  
25 **of 20, but there's different cows and there's different**

1       **time periods and there's, frankly, different things**  
2       **they're actually testing for, there's different methods**  
3       **for cow contact, I mean, what does the protocol require**  
4       **in order to make sure that you're comparing apples to**  
5       **apples when you're providing a summary?**

6       A.       Well, certainly whoever is doing the summary  
7       needs to understand those differences and be aware of  
8       those and cognizant of those as they put the summary  
9       together.

10      **Q.       Well, that's for sure. I'm just wondering**  
11      **if you're aware of any specific protocols that are in**  
12      **place in the scientific community in order to do that.**  
13      **I'm talking in general now. There are protocols for**  
14      **summaries, aren't there?**

15      A.       Well, I'm not -- I'm not sure I could point  
16      to one at this point that says, "This is a protocol for  
17      doing this type of summary of the literature in the  
18      area."

19      **Q.       I take it it's your testimony here that the**  
20      **contents of this red book in your view is credible and**  
21      **ought to be looked at by the finder of fact in this**  
22      **case?**

23      A.       Yes.

24      **Q.       Even though it's not a refereed publication?**

25      A.       Yes.

1       **Q.       So, generally speaking, you don't have a**  
2       **hard rule that something has to be peer reviewed in**  
3       **order to be submitted in a court of law; correct?**

4       A.       There can be credible materials that are not  
5       peer reviewed.

6       **Q.       Okay. I'm just going to read to you**  
7       **something that I think may hit the nail on the head**  
8       **here, and I'm just going to ask you if you agree with**  
9       **it.**

10      A.       Okay.

11      **Q.       And this is an article from an entirely**  
12      **different field, but actually has to do with**  
13      **orthodontics.**

14                They're discussing here evidence-based  
15      **systematic reviews of literature. "The evidence-based**  
16      **paradigm has three hierarchical model levels. Model**  
17      **one derives its support from the personal experience of**  
18      **the practitioner and is not really evidence based, even**  
19      **though it is part of the classification." Do you agree**  
20      **with that?**

21      A.       Okay.

22      **Q.       "Evidence-based model two is a combination**  
23      **of a clinician's experience and, more importantly, an**  
24      **evaluation of the best available research data. Data**  
25      **gathered from studies of samples are considered**

1 superior to case studies and anecdotal reports.

2 "The third and highest model of  
3 evidence-based information, model three, is the  
4 systematic review in which an exhaustive search of the  
5 literature is performed, and then an expert panel  
6 selects only a limited number of worthy studies that  
7 are included in a statistical procedure called  
8 meta-analysis," which is, in paren, "(a statistical  
9 analysis that combines the results of many studies).  
10 Systematic reviews are designed not only to identify  
11 all relevant information, but also to evaluate the  
12 quality of the information and then summarize the  
13 results from the strongest studies, i.e. blind  
14 prospective longitudinal studies with randomized  
15 control trials."

16 Do you agree with that?

17 A. Well, I can certainly see the structure that  
18 they're setting up there. If you have the type of data  
19 that they're referring to to do a meta-analysis, it  
20 certainly would be the highest level of review one  
21 could do.

22 Q. Was there a meta-analysis done as described  
23 with respect to the red book?

24 A. The meta-analysis that I would characterize  
25 there I think is kind of between your level two and

1 level three in that the protocols of the various  
2 experiments that were done would not allow them to be  
3 statistically combined in the sense of doing one  
4 overall statistical analysis in the way it's described  
5 there, or at least what I think I heard coming out of  
6 that, so I think it would really be kind of a partial  
7 way to the highest level meta-analysis.

8 **Q. Would you be able to go to the bibliography**  
9 **in the red book and identify for me those limited**  
10 **number of studies that were done that had the highest**  
11 **quality and that were considered by you folks in**  
12 **connection with the graph on page 3-22, graph 3-4?**

13 A. I could certainly identify relevant research  
14 reports or papers, the bibliography thereto, but that  
15 graph also embeds within it the experience of the  
16 authors working on that particular publication and  
17 pulling all that together as well. I'd have to  
18 acknowledge that.

19 **Q. It includes some memory data from the**  
20 **authors is what you're saying?**

21 A. Or their judgment in how to express all this  
22 into one -- in one simple chart like that.

23 **Q. The problem I've got with that chart is it's**  
24 **going to show up in the courtroom as being the gospel**  
25 **according to you guys, and there has been no**

1       **meta-statistical modeling of any of these studies upon**  
2       **which that graph is based; correct?**

3       A.       Not in a sense of trying to put all the data  
4       in one statistical analysis, that is correct.

5       **Q.       I mean, you are a scientist; right?**

6       A.       Yes.

7       **Q.       And you recognize and realize that what**  
8       **we've got here on this graph is something that's going**  
9       **to be presented in a court of law, and it will be**  
10       **represented to this jury as the collective wisdom of**  
11       **the scientists that prepared that report, you being**  
12       **among them?**

13       A.       Yes.

14       **Q.       And what I'm saying is, you're going to**  
15       **raise your hand and talk to this jury under oath, and I**  
16       **want to know what you believe to be the foundation in**  
17       **science for what's plotted on that chart. I want not**  
18       **just some guys getting together in the room and saying,**  
19       **"Well, let's make up this chart based upon our**  
20       **collective wisdom." Where is the science that backs**  
21       **this up?**

22       A.       The science is, I think, in the papers that  
23       it's based on, and then it does rely on the judgment of  
24       those persons in how to display that material into that  
25       chart.



1       **Q.       The problem I've got is that you don't have**  
2       **any information personal on cow response in terms of**  
3       **milk production, do you?**

4       A.       As far as controlled studies that we've done  
5       on milk production over time, no.

6       **Q.       Is there anybody that's in the list of**  
7       **authors there that has such experience?**

8       A.       It would be -- The people at Cornell would  
9       have worked in that milk -- milking area, as well as  
10      the USDA people of Beltsville, and then the -- not  
11      necessarily the authors, but the work at Ontario had  
12      milk production aspects to it.

13      **Q.       All right. So you've identified what;**  
14      **Gorewit and -- How do you say that other guy's name?**  
15      **Aneshansley?**

16      A.       Aneshansley.

17      **Q.       Those two had input in this graph; correct?**

18      A.       Their papers, yes.

19      **Q.       I'm talking about their mind, what was in**  
20      **their mind from their past experience, because you've**  
21      **said there's two bases; one is the papers, which I'm**  
22      **going to have you identify shortly, those that you felt**  
23      **were the credible scientific papers; and then,**  
24      **secondly, there was some collective judgment, and**  
25      **you've ruled yourself out of that; and I want to know**

1       **who those people were. One was Gorewit, one was**  
2       **Aneshansley, and Lefcourt from Beltsville; correct?**

3       A.       Correct.

4       **Q.       And then who is the guy from Ontario?**

5       A.       I'd have to disagree with your statement I  
6       ruled myself out of being part of the process of  
7       interpreting the data. I'm trying to think -- May I  
8       look at the book?

9       **Q.       You're referring now to Exhibit -- What is**  
10      **it?**

11      **MR. O'BRIEN: 317.**

12      **Q.       Yeah, 317, the red book.**

13      A.       The person from New Liskeard College of  
14      Agricultural Technology, Paul Gumprich, was a  
15      contributor that dealt with production issues.

16      **Q.       He dealt with production issues?**

17      A.       Yes.

18      **Q.       Isn't Ontario that place where they just**  
19      **passed that new regulation about stray voltage?**

20      A.       I understand they have some bill pending or  
21      something like that. I don't know the details at this  
22      point.

23      **Q.       I thought it actually had passed, but you're**  
24      **saying you don't know. Were you asked to contribute to**  
25      **that?**

1 A. I've had some phone conversation, but  
2 nothing has followed up on that.

3 **Q. With this fellow?**

4 A. No. With people from what used to be  
5 Ontario Hydro, is now Hydro One, something like that.

6 **Q. I suppose they're worried about this law**  
7 **passing up there.**

8 A. I suspect they are.

9 **Q. And how about your friend there, that Paul**  
10 **Gumprich, have you talked to him about that law up**  
11 **there?**

12 **MR. O'BRIEN: Objection to form.**

13 A. No.

14 **Q. Is Gumprich still doing some research?**

15 A. I do not know.

16 **Q. Go ahead. I interrupted you. I apologize**  
17 **for that.**

18 A. Just as a quick review, I think those would  
19 be the principal parties that were involved in doing  
20 some of the research publications that involved  
21 production.

22 **Q. All right. So it's Gorewit, Aneshansley,**  
23 **Gumprich and Lefcourt?**

24 A. Yes, and there may have been coauthors on  
25 papers they've done, people at those locations.

1       **Q.       I understand that, but I'm talking about the**  
2       **contributors at the meeting, I mean, that contributed**  
3       **to the red book.**

4       A.       That would be the -- I think that would be  
5       the set.

6       **Q.       All right. So just so we're clear, you**  
7       **provided me with a statement of how this graph was**  
8       **created. It was based, A, on scientific research**  
9       **studies which are included in the bibliography, and**  
10      **then by the collective judgment of the scientists**  
11      **involved, but there were four upon which the group**  
12      **principally relied for the milk production information;**  
13      **right?**

14      A.       For the research data.

15      **Q.       For the research?**

16      A.       Yes.

17      **Q.       And for the collective view, I mean their**  
18      **mindset, on what that data showed; right?**

19              **MR. O'BRIEN: Objection to form.**

20      A.       Well, many of these people also have a good  
21      deal of field experience working in the area as well,  
22      so their own judgment is not based solely on the  
23      research, published research.

24      **Q.       Well, is field experience important and**  
25      **helpful then, in your view?**

1 A. Yes.

2 **Q. And credible opinions can be based upon**  
3 **field research?**

4 A. That can be an element of developing  
5 credible opinions, yes.

6 **Q. So, I mean, you know, again, looking at**  
7 **this, the things that I read you, I mean, as you get**  
8 **down to anecdotal type information, it becomes less**  
9 **helpful from a scientific standpoint.**

10 A. Yes.

11 **Q. And as you raise in terms of credibility and**  
12 **get up to a, you know, meta-statistical model, it**  
13 **becomes better at being predictive of or at least**  
14 **proving the hypothesis.**

15 A. I concur.

16 **Q. And what you're saying is that your group**  
17 **did something in between, and you really didn't get**  
18 **into, for purposes of the red book, statistical**  
19 **modeling?**

20 A. Not statistical modeling in the way of  
21 trying to combine data sets together.

22 **Q. Now, if you would go to the bibliography in**  
23 **the red book and point out to me those studies that you**  
24 **believe were the studies that supported the graph on**  
25 **3-4.**

1       A.       This may be a little bit iffy doing it just  
2       based on the titles. It's been a while since I've  
3       looked at the details of some of these papers, but I'll  
4       do the best I can on this.

5       **Q.       What I'm looking for are the prime ones,**  
6       **those you feel stand out in your mind as being the**  
7       **major contributors to the data points that are plotted**  
8       **on that graph.**

9       A.       From that context, I think I would bring in  
10       two papers by Aneshansley, one in 1988, "Stray Voltage  
11       Effects of Machine Milking;" then the second by  
12       Aneshansley and others, "Effects of Discontinuous  
13       Voltages Applied to Waters." I should retract that.  
14       I'm not sure that one deals specifically with  
15       production.

16               There's one by Gorewit, 1984, "Effects of  
17       Electrical Current on Milk Production and Animal  
18       Health." I think the Gorewit again in 1985,  
19       "Mechanisms Involved in the Adrenalin Induced Blockade  
20       of Milk Ejection in Dairy Cattle," and Gorewit, 1989,  
21       "AC Voltage on Water Bowls: Effects on Lactating  
22       Holsteins."

23               I hope I haven't missed any of the Gorewit  
24       ones there.

25               Then there's one in 1985, Henke Drenkard and

1 others, "Milk Production, Health, Behavior, and  
2 Endocrine Responses of Cows Exposed to Electrical  
3 Currents During Milking."

4 Then there's several works by Allen  
5 Lefcourt. I'd have to actually go back to see which  
6 ones specifically deal with milk production itself. I  
7 know this Lefcourt, 1985, "Effects of Intermittent  
8 Electrical Shock on Responses Related to Milk Ejection"  
9 deals with milking.

10 I think those would be some of the principal  
11 publications in a quick look through, recognizing I  
12 haven't -- This is more than 15 years ago.

13 **Q. I understand that. And should you in review**  
14 **of your deposition -- You get a chance -- I don't know**  
15 **if you can do that or not, but we're probably going to**  
16 **recommend that you read it. If you happen to come up**  
17 **with any additional ones, you can add them to your list**  
18 **after you've gone through. I'm interested in getting**  
19 **all of those that you believe support the, you know,**  
20 **graph 3-4 on page 3-22. Okay?**

21 A. With respect to the milk production aspect  
22 of it.

23 **Q. Milk production, yeah, right.**

24 **Now, in going through this, I noted that**  
25 **Norell did some papers back in 1982 and '83. It's on**

1 **8-8 of the bibliography there.**

2 A. Yes.

3 **Q. Are those two separate papers or are they**  
4 **the same thing?**

5 A. I believe they would cover primarily the  
6 same body of research. The first one was a paper  
7 presented at a meeting; then the second was actually a  
8 refereed publication.

9 **Q. The same data, though, was used for both?**

10 A. I'd have to go back and check to make sure  
11 because Rick did a couple different experiments along  
12 the way, and I don't know if there's a hundred percent  
13 overlap between those two, but they would cover some of  
14 the same thing.

15 **Q. Where is that Norell fellow at this time?**

16 A. I believe he's at the University of Idaho.

17 **Q. Is he an engineer?**

18 A. No. He's, I believe, an extension dairy  
19 scientist.

20 **Q. Do you know if he's done any additional**  
21 **writing in this area?**

22 A. Not that I'm aware of.

23 **Q. Do you keep up to date with him?**

24 A. I haven't, no.

25 **Q. All right. I want to get back to that in**



1       **just a bit, but I just wanted to ask you some -- Go**  
2       **back to your notice of taking deposition. Go to item**  
3       **four. I was looking for a list of all cases in which**  
4       **you've testified by deposition or trial, including the**  
5       **names of the parties, names of the counsel, venue of**  
6       **the action, party or attorney who hired you, and the**  
7       **amount you were paid.**

8       A.       Again, I apologize. I tried to work on that  
9       list or something like that a couple years ago, and I  
10      have a list of most of that data. I just forgot to  
11      print it out and bring it today, so I can get that to  
12      you.

13      **Q.       All right. Thank you. And you had provided**  
14      **us with a CV.**

15      A.       Yes.

16      **Q.       And then I asked you for all writing you've**  
17      **done on the topic of stray voltage or stray current.**  
18      **Is that included in your CV?**

19      A.       Yes.

20      **Q.       And then seven, I asked you for a list of**  
21      **all presentations you've made on the topic of stray**  
22      **voltage to any person, company, corporation, energy**  
23      **co-op, association, insurance company, or any other**  
24      **organization, society or group, including all writings**  
25      **produced for each presentation. Do you have that?**

1 A. I did not try to put all that together.

2 **Q. Do you have that somewhere?**

3 A. Not organized, no.

4 **Q. Is that something you can put together or --**

5 A. It would take days to put that together. To  
6 go back through calendars would be about the only way I  
7 could think about doing something like that.

8 **Q. So what do you mean calendars? You have**  
9 **paper calendars of some sort?**

10 A. For some years, yes. More recent years, I  
11 might have an electronic calendar.

12 **Q. Well, have you given presentations to**  
13 **various co-ops and associations and insurance**  
14 **companies?**

15 A. I don't recall any insurance companies. I  
16 certainly have done to co-op groups, other  
17 associations, many technical society presentations, of  
18 course.

19 **Q. How many cases -- Again, you're going to**  
20 **give this to me, but, roughly speaking, how many cases**  
21 **have you been involved in?**

22 **MR. O'BRIEN: Stray voltage?**

23 MR. BIRD: Yes.

24 A. Stray voltage, over the years, and I'll have  
25 to look at this list myself, but I'd say probably 60 to

1 70.

2 **Q. Now, have you ever been involved in a case**  
3 **on behalf of a plaintiff, a farmer, in Minnesota?**

4 A. In Minnesota? I don't believe so, no.

5 **Q. How about in Wisconsin?**

6 A. I don't think so.

7 **Q. And I think I read that there was one farmer**  
8 **in Ohio that you were involved with.**

9 A. Yes.

10 **Q. But that didn't go to trial?**

11 A. That's correct. That was a -- What do you  
12 call it? -- mediation.

13 **Q. Were you involved in the testing in that**  
14 **case or --**

15 A. I did testing on the farmstead in that case,  
16 yes.

17 **Q. What levels of electricity did you find?**

18 A. By the time I arrived, it was in the -- it  
19 was relatively low. I think it was less than a volt at  
20 that point in time, but that was after the system had  
21 been -- well, the utility was rebuilding the system a  
22 couple of days before I got there, so the data I had  
23 that I personally took was much later -- was later.

24 **Q. And were you actually hired by the farmer or**  
25 **did you just somehow get involved in the mediation as a**

1       **neutral?**

2       A.       I was involved as a neutral through the  
3       extension connection.

4       **Q.       So you weren't really representing the**  
5       **farmer. You were trying to mediate the dispute?**

6       A.       That is correct.

7       **Q.       All right. And then has there ever been a**  
8       **case where you've actually testified at a trial on**  
9       **behalf of a farmer?**

10      A.       Not at trial. I don't recall that I have.

11      **Q.       Have you ever been hired by a farmer?**

12      A.       Yes.

13      **Q.       And what state was that in?**

14      A.       Maryland.

15      **Q.       Was that one time that you were hired by a**  
16      **farmer then?**

17      A.       That's the only one that jumps to my mind  
18      right now, yes.

19      **Q.       When was that that you got hired by the**  
20      **farmer?**

21      A.       Probably in the late '80s.

22      **Q.       Since the late '80s, you haven't been hired**  
23      **by a farmer, and you've never testified at trial on**  
24      **behalf of a farmer?**

25      A.       Since that period of time, no.

1       **Q.       All right. When is the last time you**  
2       **testified at a trial in a stray voltage case?**

3       A.       I literally don't recall. I'd have to go  
4       back and look at my calendars to tell you.

5       **Q.       I'm wondering if in going through**  
6       **your -- You know, you said you'd put this thing**  
7       **together. If you could provide me with a list of those**  
8       **cases in which you've testified and the name of the**  
9       **utility that hired you.**

10      A.       I'll do the best I can.

11      **Q.       Okay. You were familiar with Mr. O'Brien**  
12      **before getting involved in this case?**

13      A.       Yes.

14      **Q.       You testified, you know, at his request in**  
15      **other cases for Northern States Power?**

16      A.       Yes.

17      **Q.       And do you recall the names of any of those**  
18      **cases?**

19      A.       I believe the Gumz, G-u-m-z -- is that a  
20      correct spelling? -- case would have been one.

21      **Q.       Any others?**

22      A.       Again, I'd have to go back to notes to come  
23      up with names. I can remember the farms I've been on,  
24      but I don't remember the names and stuff.

25      **Q.       Do you think there are other cases that**

1       **you've been hired to act as an expert consultant where**  
2       **the entity that was being sued was either Excel Energy**  
3       **or Northern States Power besides Gumz and this one?**

4       A.       That could well be. I certainly couldn't  
5       rule it out.

6       **Q.       Have you met this Forster fellow?**

7       A.       Yes.

8       **Q.       How about Brian Gunther, have you met him?**

9       A.       Yes.

10       **Q.       Have you met this Dr. Reinemann from**  
11       **Madison?**

12       A.       Yes.

13       **Q.       Have you worked with him at all?**

14       A.       Yes.

15       **Q.       You worked with him on what?**

16       A.       Primarily through the American Society of  
17       Agricultural and Biological Engineers, there, and then,  
18       of course, as colleagues doing similar research, I've  
19       been following his research that he's done since I  
20       became less active and he became more active in that  
21       area.

22       **Q.       You became less active in terms of actually**  
23       **doing funded studies back in '87. You know, looking at**  
24       **the red book, there's nothing cited by Reinemann there,**  
25       **and that was published in 1994 or '91?**

1 A. '91.

2 **Q. '91. So then his research began after 1991?**

3 A. It was beginning about that point in time.

4 **Q. Did you and he collaborate at all in putting**  
5 **together, you know, the models, the protocols for any**  
6 **particular research?**

7 A. I recall times talking with Doug about  
8 different research studies, but never -- I don't think  
9 I was -- and I visited their location before. I don't  
10 think I've ever actually been a part of one of their  
11 funded projects, so to speak.

12 **Q. There's a fellow that's going to testify in**  
13 **this case by the name of -- Is it Eric Jackson?**

14 **MR. O'BRIEN: Yes.**

15 **Q. Do you know him?**

16 A. No, not really.

17 **Q. And then Dagenhart.**

18 MR. BIRD: What's his first name?

19 MR. O'BRIEN: Johnny Dagenhart.

20 **Q. Johnny Dagenhart, have you ever met him?**

21 A. I don't believe so.

22 **Q. Do you know Reilly?**

23 A. Yes.

24 **Q. Have you met Reilly?**

25 A. Yes.

1       **Q.       And under what circumstances have you run**  
2       **into him?**

3       A.       I actually invited him to do a paper for  
4       ASABE at one point in time, I believe, and I met him, I  
5       think, probably through one of these particular cases.  
6       After I'd read some of his materials, it was a delight  
7       to get to know him at that point in time, and  
8       subsequently I've talked to him around different  
9       technical papers and things like that.

10      **Q.       Do you consider him a credible scientist?**

11      A.       Absolutely.

12      **Q.       You'd rely on the things that he said or**  
13      **testified to?**

14      A.       Yes.

15      **Q.       He's apparently not a Ph.D.**

16      A.       That may well be. I haven't looked at his  
17      vitae.

18      **Q.       Well, I mean, a person doesn't have to be a**  
19      **Ph.D. in order to provide credible scientific**  
20      **testimony; is that correct?**

21      A.       That is correct, although I -- I'd have to  
22      look.

23      **Q.       He had you fooled all these years that maybe**  
24      **he was a Ph.D.; is that it?**

25               **MR. O'BRIEN: I'll object to the form.**



1       **Q.       Stuff he said sounded so good, it sounds**  
2       **like it came from a Ph.D.?**

3               MR. BIRD: I withdraw the question. All  
4       right.

5               THE WITNESS: I'll withdraw my answer that  
6       he does very credible work then.

7       **Q.       He does do credible work --**

8       A.       Yes.

9       **Q.       -- notwithstanding that he may not be a**  
10       **Ph.D.; correct?**

11       A.       That is correct. If he's not --

12       **Q.       If he's not, he's not.**

13       A.       Correct.

14       **Q.       Your judgment of his work wouldn't be**  
15       **affected.**

16       A.       No.

17       **Q.       All right. So the point I'm making here is**  
18       **that a person doesn't have to have certain letters**  
19       **after their name in order to give credible scientific**  
20       **testimony; correct?**

21       A.       That is correct.

22       **Q.       I wanted to ask you -- Let me see if I've**  
23       **finished with this first.**

24               Okay. Item eight is the studies that you  
25       rely upon in giving your testimony for purposes of the

1       **opinions you're going to give, which I understand are**  
2       **marked here as Exhibit 309. What studies do you rely**  
3       **upon for purposes of those opinions that you have**  
4       **personally evaluated for scientific integrity?**

5       A.       Well, certainly, as listed here, the USDA  
6       handbook; Minnesota Science Advisory Board is very  
7       helpful; the work that's been done at University of  
8       Madison since the red book are representative of the  
9       work I would go to.

10      **Q.       Well, see, that doesn't help me. I got two**  
11      **specific. I got the red book and I got the Science**  
12      **Advisors. And then you said the work that's been done.**  
13      **Can you provide me with that list of those that you**  
14      **have personally evaluated for scientific integrity? Do**  
15      **you see what I'm saying? In other words, by that --**  
16      **Just so you know what I'm saying is that you have**  
17      **actually not just read the studies, but you've been or**  
18      **had made available to you the data that forms the basis**  
19      **for that research and you believe that the data that's**  
20      **produced supports those studies.**

21               **MR. O'BRIEN: Objection to the form and**  
22      **foundation as to that to being the basis for scientific**  
23      **integrity. You may answer if you're able.**

24      A.       I can go through and list the Reinemann  
25      papers that I think are relevant to this particular

1 topic, if that's -- That I can certainly do.

2 **Q. Well, I --**

3 A. And that I think are credible to the topic.

4 **Q. And I'm asking you to go a step further**  
5 **here. Those that you personally evaluated for**  
6 **scientific integrity, and so --**

7 A. By "personally evaluated," you added some  
8 contingencies there of actually going further back to  
9 the original data that may be behind the paper itself,  
10 the raw data?

11 **Q. Right, yeah. Have you done that on any of**  
12 **Reinemann's research?**

13 A. Not that I recall, not going back to the raw  
14 data itself.

15 **Q. Have you gone back and inspected or**  
16 **evaluated any of the protocols that were used?**

17 A. I've certainly reviewed the papers carefully  
18 that they produced to document the protocols, yes.

19 **Q. The paper meaning the final refereed**  
20 **publication?**

21 A. Yes, or preceding papers that may have  
22 preceded that as well.

23 **Q. Have you gone back at all to look at what**  
24 **actually happened to see the notes of the people that**  
25 **were gathering the data on any of Reinemann's papers?**

1 A. No, I've not gone back and looked at their  
2 field notes or things like that.

3 **Q. Well, there's this -- I'm moving off of**  
4 **Reinemann, but just for example, were you aware that on**  
5 **the -- I think it was either Gorewit or Aneshansley**  
6 **that -- the so-called full lactation study? Remember**  
7 **that one?**

8 A. Yes.

9 **Q. That there were two cows pulled because they**  
10 **had a violent reaction?**

11 A. I understand that, yes.

12 **Q. All right. Did you ever go back and look**  
13 **and find out what happened to those cows and make an**  
14 **independent determination of whether or not removing**  
15 **them from that database or milk production data was**  
16 **proper in your view as a scientist?**

17 A. I didn't try and do an independent analysis  
18 of that, no.

19 **Q. Have you talked to either of those two about**  
20 **why they took out those two cows, what their basis for**  
21 **reporting data was without including the milk from**  
22 **those two cows that were removed?**

23 A. I don't recall any conversations that  
24 specific.

25 **Q. Until you get those questions answered, are**

1       **you able to rely upon that as a basis for opinions in**  
2       **this case, on that particular study?**

3       A.       I would include that particular study as  
4       just one of the set of studies that's relevant to  
5       understand the work.

6       **Q.       It's one of a set that you would include as**  
7       **part of -- you know, if you were going to do a**  
8       **meta-statistical analysis, you'd include that as one of**  
9       **a number of them?**

10      A.       Yes.

11      **Q.       But would that particular study come with a**  
12      **question mark, at least in your mind, that would have**  
13      **to be investigated?**

14      A.       If we're going to do a meta-analysis there,  
15      you'd have to understand it at that level of detail,  
16      yes.

17      **Q.       And, you know, you've been asked about this**  
18      **before in other testimony.**

19      A.       Uh-huh, yes.

20      **Q.       I think, you know, going back two, three,**  
21      **four years; correct?**

22      A.       Yes.

23      **Q.       And in that time frame, from the time that**  
24      **it's been first brought up, have you ever talked to**  
25      **Gorewit or Aneshansley?**

1 A. Not that I recall.

2 **Q. Well, you can pick up the phone and call**  
3 **them; right?**

4 A. Could.

5 **Q. And you haven't done anything since this**  
6 **question first came up to get the question answered**  
7 **about those two cows, what happened to those two cows**  
8 **and why did they get removed and why wasn't their data**  
9 **reported?**

10 A. If I did, I don't recall doing that.

11 **Q. Okay. If the data from those -- milk**  
12 **production data from those two cows were, in fact,**  
13 **included, I take it you're open to the possibility that**  
14 **the results from the study could be different?**

15 A. They would be -- They may be somewhat  
16 different, yes.

17 **Q. It might not support the conclusions if that**  
18 **data was included?**

19 A. One would have to look at that carefully.

20 **Q. Do you agree that stray voltage as a**  
21 **phenomenon exists?**

22 A. Yes.

23 **Q. And the existence of stray voltage isn't**  
24 **something that is any longer questioned by the**  
25 **scientific community; right?**

1 A. Yes, that's correct.

2 **Q. As a phenomenon?**

3 A. As a phenomenon.

4 **Q. And the existence of stray voltage is**  
5 **something that's been peer reviewed and the scientific**  
6 **community has concluded it exists?**

7 A. Yes.

8 **Q. And the causes of stray voltage have been**  
9 **peer reviewed; right?**

10 A. I'm not sure how I would say -- Papers that  
11 document that or describe that have been peer reviewed,  
12 yes.

13 **Q. And there has been peer review of a**  
14 **conclusion that stray voltage can come from off-farm**  
15 **sources?**

16 A. Yes.

17 **Q. And it can come through the utility?**

18 A. Yes.

19 **Q. So we don't need some peer review study to**  
20 **tell us that. You accept that as a scientist?**

21 A. Yes, as a scientist and an engineer, you  
22 know, that's -- that's a fact.

23 **Q. All right. And one of the ways that -- or**  
24 **the main way that cows get current is through the earth**  
25 **from a neutral-to-earth connection?**

1                   **MR. O'BRIEN: Objection to form.**

2           **Q.       On the utility side.**

3           A.       When you said "through the earth," that  
4           makes it difficult to answer that question with an  
5           affirmative.

6           **Q.       Why is that?**

7           A.       Well, they get current by getting across a  
8           potential that represents often one connection to the  
9           grounded neutral system and then something closer to  
10          earth potential, so it's really across two points in  
11          the system. Earth may be part of that system.

12          **Q.       Well, they --**

13          A.       So when you said "coming from the earth,"  
14          that I had difficulty in, you know, saying that's an  
15          accurate description of what's going on.

16          **Q.       Well, it can come from the neutral-to-earth  
17          ground, I mean, the current; right? And then it can  
18          go -- Depending on how close it is to the barn or  
19          whatever it is, the cow contact point, that  
20          neutral-to-earth voltage can travel through the ground  
21          and make contact with the cow?**

22                   **MR. O'BRIEN: Objection to form.**

23          A.       That I don't think is an accurate  
24          description of what happens.

25          **Q.       Okay. Well, I understood that**



1       **neutral-to-earth voltage that is right down that**  
2       **grounding wire can somehow get to the cow. Is that**  
3       **true or not?**

4       A.       That is correct.

5       **Q.       All right. And so that's not subject to**  
6       **debate in terms of the science; right?**

7       A.       Correct.

8       **Q.       That's been peer reviewed and peer reviewers**  
9       **have concluded that that phenomenon exists?**

10      A.       Correct.

11      **Q.       Now, when we get down to wherever it's**  
12      **grounded, tell me how it gets to the cow from there.**

13      A.       Generally, the easiest way to visualize this  
14      is you've got one connection to the cow that is  
15      attached to what you're describing as a grounded  
16      neutral system.

17      **Q.       How is it attached?**

18      A.       Cow may put, for example, her nose in a  
19      grounded water would be a good example, and then her  
20      feet represent the connection to potential away from  
21      that, so you are across part of what we call the  
22      neutral-to-earth voltage.

23      **Q.       Okay. If there's a line outside the barn**  
24      **that has a grounded neutral from a pole and that**  
25      **current is going right into the earth right there, can**

1       **that current go from earth to where the cow is?**

2               **MR. O'BRIEN: Objection to form.**

3       A.       That current is not going to go to where the  
4       cow is unless there's some connection via the grounded  
5       neutral system. We wouldn't expect any significant  
6       potential across the cow once that current has gone to  
7       the earth.

8       **Q.       What if the line is right next to the barn,  
9       the neutral-to-earth ground?**

10      A.       Again, to get the cow across, you've got to  
11      get it across a significant potential to really create  
12      a stray voltage problem, and doing that through the  
13      earth itself is highly unlikely.

14      **Q.       And what study concluded that?**

15      A.       It's more the analysis that one would do  
16      just looking at the circuit analysis of the situation  
17      that we're describing or the circuits that would  
18      describe this.

19      **Q.       So you're saying that if the current is  
20      going down into the earth, it's impossible for any of  
21      that current to end up at the cow; you know, if it's  
22      really wet conditions, it can't make contact with some  
23      metal adjacent to it in the ground that travels back to  
24      the cow?**

25               **MR. O'BRIEN: Objection to form.**

1 A. If you create a low resistance connection to  
2 a metallic object so that becomes part of the grounded  
3 neutral system, then you might be able to create a  
4 potential in a cow contact area.

5 **Q. So you're saying that if it's a -- What did**  
6 **you call it? A low --**

7 A. Low resistance or low impedance path.

8 **Q. Low impedance path. And the lower the**  
9 **impedance then between the grounded neutral line to the**  
10 **cow, the more likely it is that the current will travel**  
11 **and somehow get to the cow at a contact point?**

12 A. Correct.

13 **Q. All right. Is that a phenomenon that you**  
14 **recognize as potentially existing?**

15 A. Yes.

16 **Q. And there's been peer review on that?**

17 A. Well, there's certainly been careful  
18 description of the electrical systems that would show  
19 that to be true.

20 **Q. Now, has there been study of the symptoms of**  
21 **stray voltage?**

22 A. Yes.

23 **Q. Before I get to that, let me just back up.**  
24 **I've used the term "stray voltage." Are you**  
25 **comfortable with that?**

1 A. Yes.

2 **Q. And how do you define that, just so I have**  
3 **it on the record? What's your definition?**

4 A. A good definition, I think, right now is  
5 that stray voltage is --

6 **Q. You're reading from a paper. Maybe if you'd**  
7 **just tell me what exhibit that is.**

8 A. Sure. I'm reading from the Exhibit 305,  
9 page 3. It's the definition that's come out of the  
10 Applications Handbook and a Lineman and Summons  
11 Handbook -- Cableman's Handbook. Excuse me. It  
12 defines -- Stray voltage has been defined as a  
13 low-level voltage presented across points -- for  
14 example, drinking cup to rear hooves -- which will  
15 cause a current to flow through an animal when the  
16 animal simultaneously comes in contact with the points.  
17 And I see there's a typographical.

18 **Q. What's the typographical?**

19 A. The typographical -- I read it correctly.  
20 The typographical says "as animal" where it should say  
21 "an animal."

22 **Q. A-n --**

23 A. A-n.

24 **Q. -- instead of A-s. Okay.**

25 **Now, I was asking you the symptoms of it, of**

1       **stray voltage, in terms of what you would see in terms**  
2       **of animal response.**

3       A.       The general symptoms we've come to expect  
4       are really behavioral type responses, so animal  
5       nervousness, reluctance to enter like the milking  
6       parlor, maybe reluctance to address a waterer or a  
7       feeder are the principal behavioral symptoms that we  
8       can see.

9       **Q.       Nervousness is expressed in what way in the**  
10       **cow?**

11       A.       The cows may, again, be reluctant; they may  
12       be kicking more; they may be defecating more.

13       **Q.       Anything else?**

14       A.       Those are the ones that come to mind.

15       **Q.       Are there any physiological responses in**  
16       **terms of like milk letdown and --**

17       A.       Oh, sure, that -- I'm sorry. I should have  
18       included milk letdown as a visible symptom as well.

19       **Q.       Any disease responses that are typically**  
20       **seen, such as foot and hoof problems or mastitis that**  
21       **are commonly associated with it? Not that there aren't**  
22       **other causes for these conditions. I'm not suggesting**  
23       **that. But is this something that's commonly seen with**  
24       **a stray voltage herd?**

25       A.       In practice, not in research, you know, we

1 get reports that would say, yes, you see increased  
2 mastitis, which may well go along with lower  
3 production.

4 **Q. The response, behavioral response, that**  
5 **you've just listed -- and I'm going to get to the**  
6 **mastitis and the hoof thing. I'm going to exclude that**  
7 **for a moment. Those responses that you listed, they**  
8 **have been peer reviewed in the research; right?**

9 A. Well, they're certainly common observations  
10 accepted in the industry. Whether they've been peer  
11 reviewed in that sense, I wouldn't say that.

12 **Q. Well, there's an acceptance among**  
13 **scientists -- I think you're one of them -- that says,**  
14 **you know, if the cows don't have these things or some**  
15 **combination of them, then you don't have stray voltage;**  
16 **right?**

17 A. That is correct.

18 **Q. All right. And at least in that sense --**  
19 **and you've written that in peer reviewed publications?**

20 A. Yes.

21 **Q. All right. So there's acceptance in the**  
22 **scientific community that the set, of which you've**  
23 **listed these, of symptoms or some combination of those**  
24 **symptoms is a necessary condition for some conclusion**  
25 **that you've got stray voltage?**

1 A. That's what we would expect to see, yes.

2 **Q. What you expect to see. All right. And you**  
3 **add to that the caveat, of course, that these**  
4 **conditions that are behavioral responses can come from**  
5 **not only stray voltage, but a variety of other reasons**  
6 **and causes.**

7 A. Correct.

8 **Q. And a typical stray voltage investigation,**  
9 **for example, involves a farmer, you know, looking to**  
10 **their milking equipment and looking to their methods**  
11 **for prepping a cow, looking to their feeding regimen,**  
12 **and looking to all kinds of things before they finally**  
13 **come to stray voltage and try to look at that?**

14 **MR. O'BRIEN: Objection to form.**

15 A. Or at least doing those in parallel.

16 **Q. Well, you've seen in the past where farmers**  
17 **who have had a stray voltage problem have, you know,**  
18 **literally been pulling their hair out trying to find**  
19 **other reasons and trying to correct other things and**  
20 **then go to stray voltage; that's been something that**  
21 **you've seen?**

22 A. Yes.

23 **Q. Now, I want to turn to the mastitis. First**  
24 **of all, has that disease been associated with stray**  
25 **voltage?**

1 A. From our field work, we'd say yes.

2 **Q. Has any scientist studied that, as to**  
3 **whether or not at a high enough level of current, that**  
4 **mastitis is something that can be associated with stray**  
5 **voltage?**

6 A. I don't believe the research has shown that  
7 you directly produce mastitis from the stray voltage.

8 **Q. Are you satisfied as a scientist that that**  
9 **connection exists at a high enough current level?**

10 A. I'm satisfied that if we have the behavioral  
11 aspects that are causing problems, that there's a  
12 likelihood that that can contribute to a mastitis  
13 problem on the farmstead.

14 **Q. So you wouldn't be surprised then as a**  
15 **scientist to see mastitis on a farm that has stray**  
16 **voltage.**

17 A. That is correct.

18 **Q. And you wouldn't have difficulty as a**  
19 **scientist in drawing a conclusion that, if other things**  
20 **are ruled out, that this mastitis in some substantial**  
21 **part was caused by the stray voltage?**

22 **MR. O'BRIEN: Objection to form, foundation.**

23 **Answer if you're able.**

24 A. I would say that it may be related, not  
25 directly causal, but if we've got animal behavior



1 problems, then I would accept that that could be part  
2 of what might contribute to a mastitis problem.

3 **Q. And you would be willing to make that**  
4 **conclusion that there was an indirect relationship?**

5 A. Yes.

6 **Q. All right. And in terms of milk production,**  
7 **I take it there has been science to establish that milk**  
8 **production can be related -- loss of milk production**  
9 **can be related to stray voltage?**

10 A. If we get to a high enough level, yes.

11 **Q. Right. And that level is expressed in**  
12 **current; right?**

13 A. Correct.

14 **Q. It's the current, not the voltage, that**  
15 **causes the problem?**

16 A. Correct.

17 **Q. And that relationship, the relationship of**  
18 **current to loss of milk production, is something that**  
19 **has been studied?**

20 A. Yes, there's articles relating to that in  
21 the research literature.

22 **Q. And there's been a conclusion amongst**  
23 **credible scientists in peer reviewed publications that**  
24 **there is a relationship between current and milk**  
25 **production; correct?**

1 A. That there can be, yes.

2 **Q. Right. So it is no longer a subject of**  
3 **debate in the scientific community that at a certain**  
4 **current, low-level current, that there can be adverse**  
5 **effects in milk production?**

6 **MR. O'BRIEN: Objection to form.**

7 A. Certainly, if you can get to a high enough  
8 current level, you're going to have an impact on the  
9 animal which is going to impact production.

10 **Q. And the debate in the scientific community**  
11 **is what's that level of current?**

12 **MR. O'BRIEN: Objection to form.**

13 A. That's certainly a question that needs to  
14 continue to be addressed or has been addressed.

15 **Q. All right. And the studies that have been**  
16 **done vary in terms of the level of current necessary to**  
17 **have an adverse effect on milk production; right?**

18 A. Certainly there's some variability.

19 **Q. You haven't had a chance to look at**  
20 **Mr. Reilly's deposition testimony?**

21 A. No. That is correct; I have not.

22 **Q. Do you believe there's a difference in the**  
23 **resistance of a Jersey cow versus a Holstein cow?**

24 A. Just because of breed, not necessarily, but  
25 may well be because of size of animal.

1       **Q.       Has that been studied at all?**

2       A.       We have some data on different sizes of  
3       animals. It's fairly limited.

4       **Q.       Not enough data for you to draw conclusions?**

5       A.       Well, other than they're not dramatically  
6       different in what we would see.

7       **Q.       You did some research on resistance --**

8       A.       Yes.

9       **Q.       -- early on, and your research indicated**  
10       **that a common resistance for a dairy cow was what; 250,**  
11       **350, in that range, 250 to 350 ohms?**

12       A.       That would be characteristic of a minimum  
13       value for the body pathway of the animal.

14       **Q.       Body pathway.**

15       A.       One must recognize what we were trying to do  
16       is find minimum values, not common values, but minimum  
17       values that one could create.

18       **Q.       Well, do you have any of your data? Did you**  
19       **ever find a cow with a thousand ohms resistance?**

20       A.       I'd have to go back to the data to see,  
21       again, what the range is, and some of the Norell work  
22       would probably be -- and some of the summaries in the  
23       USDA book might refresh my memory on that, but I  
24       couldn't pull out specific numbers right now.

25       **Q.       I'm asking about you, whether you have a**

1       **memory in the resistance testing that you did of ever**  
2       **finding a thousand ohm cow?**

3       A.       For just the body resistance, I can't say  
4       specifically to you now, but I wouldn't rule that out.

5       **Q.       The other part you're talking about is the**  
6       **contact resistance?**

7       A.       Well, certainly, yeah, that's part of the  
8       circuit, what we're working with.

9       **Q.       Well, you know, the resistor that's put in**  
10       **the line on testing is now currently 500 ohms. What**  
11       **does that represent?**

12       A.       That represents to me a very low-level --

13       **Q.       But what is it attempting to capture; the**  
14       **body resistance of the cow and contact resistance or**  
15       **what?**

16       A.       It's somewhat representative of the body  
17       resistance of the animal.

18       **Q.       Because the contact resistance is the**  
19       **contact resistance. That's not added to that. I mean,**  
20       **you're going to have the same issue on contact whether**  
21       **you're -- you know, whatever you're doing; right?**

22       **MR. O'BRIEN: Objection to form.**

23       A.       Well, certainly the contact resistance is  
24       going to vary given the circumstances of the animal and  
25       how they're making that contact and the facility itself

1 would have a large effect on that.

2 **Q. Sure. And if a cow is standing in salty**  
3 **urine/manure, that's going to be a relatively low**  
4 **contact resistance?**

5 A. Relative to a dry surface, certainly.

6 **Q. Sure. Yeah. Would you agree with me?**

7 A. Yes.

8 **Q. It's not unusual for a cow next to a waterer**  
9 **to be standing in salty manure/urine/water combination?**

10 A. That is correct. It's going to be a  
11 relatively wet environment.

12 **Q. And the contact resistance is going to be**  
13 **close to zero in that situation; right?**

14 A. No, it's not going to be zero, but it would  
15 be a low -- relatively low value.

16 **Q. Could be an ohm?**

17 A. I'd have to go back and calculate again, but  
18 it's not -- It's going to be more than an ohm. It's  
19 going to be relatively small.

20 **Q. Would it be less than five ohms in that**  
21 **scenario?**

22 A. If you're talking about just the surface  
23 contact resistance through a small layer of manure, it  
24 could be in that range.

25 **Q. And if a cow has a sore on its foot, that**

1       **would increase or decrease the resistance? If whatever**  
2       **the fluid is through which it's being contacted could**  
3       **get through the skin because of a sore, that would even**  
4       **further lower contact resistance?**

5       A.       That may have some effect, yes.

6       **Q.       All right. And so the 500 ohms doesn't --**  
7       **is something that's put in place to represent the**  
8       **resistance of the cow?**

9       A.       Yes.

10      **Q.       All right. In your studies, you came up**  
11      **with cows that were 250 ohms or less; right?**

12      A.       I don't recall any at that low value for the  
13      full animal.

14      **Q.       But I don't think your research showed any**  
15      **cows over 700 ohms, the stuff that you did.**

16      A.       As a minimum value --

17      **Q.       Not a minimum value; as the value. Did you**  
18      **ever see a cow have a resistance greater than 700 ohms**  
19      **in your whole life?**

20      A.       I'd have to go back and look at the data,  
21      but just for the body resistance itself, it probably  
22      would be in that order of magnitude.

23      **Q.       Well, you keep on using the word "body**  
24      **resistance." Is there some other kind of resistance**  
25      **that a cow has other than body resistance?**

1 A. Well, certainly the contact resistances are  
2 very important in what kind of situation you have.

3 **Q. I'm just talking about the 500-ohm resistor**  
4 **that's commonly used now in testing and that you**  
5 **reflect in graph 3-4 in the red book; right?**

6 A. Correct.

7 **Q. All of the data on 3-4 in the red book is**  
8 **based upon data collected assuming 500-ohm resistance**  
9 **and then 1,000 ohms, too; right?**

10 A. No. It's using those two values to convert  
11 the current value, which we recognized earlier is  
12 really what the sensitivity was to, to an equivalent  
13 voltage, so it's using Ohm's Law with those two  
14 representative values.

15 **Q. Ohm's Law is not subject to scientific**  
16 **debate; right?**

17 A. I hope not.

18 **Q. I mean it's a -- you know, it's been peer**  
19 **reviewed for centuries; right?**

20 A. Yes; but, as an anecdote, George Ohm got  
21 fired from the university he was at at the time; and  
22 the treatise that originally contained Ohm's Law, he  
23 later got some international medals for it. But, yes,  
24 it's an accepted --

25 **Q. Scientific principle?**

1 A. -- scientific principle.

2 **Q. And that's volt equals current times**  
3 **resistance?**

4 A. Yes.

5 **Q. Voltage? All right. Current is expressed**  
6 **in milliamps?**

7 A. Well, in amperes.

8 **Q. Amperes, milliamperes?**

9 A. Milliamperes would be a thousandth of an  
10 ampere.

11 **Q. Right.**

12 A. So if you're using volts and ohms, you would  
13 need to use amperes for the current. If you're using  
14 millivolts, then you could use milliamps, but you have  
15 to be careful about the units, the size.

16 **Q. Right. And it's true that you need to know**  
17 **two of the three variables in order to calculate the**  
18 **third?**

19 A. Correct.

20 **Q. One of the things that scientists have done**  
21 **for purposes of 3-4 is to make an assumption that**  
22 **500 ohms represents resistance, body resistance, of a**  
23 **dairy cow?**

24 A. Yes.

25 **Q. And to the extent that that's wrong, then**



1 **the graph would be wrong.**

2 A. If that's an invalid or a poor assumption,  
3 then that would affect the values in the graph.

4 **Q. And if that's an invalid assumption, then**  
5 **farmers shouldn't be relying on that for purposes of**  
6 **doing stray voltage testing on their farm; right?**

7 A. If you accept that, yes.

8 **Q. And you agree with me today that 500 ohms**  
9 **isn't an accurate representation of dairy cows, is it,**  
10 **body resistance?**

11 A. I think for the use that it's made there, I  
12 think it's a reasonable assumption to make.

13 **Q. Well, what percentage of dairy cows in your**  
14 **view have resistances less than 500 ohms, body**  
15 **resistance?**

16 A. Body resistance in that setting? I'd have  
17 to go back to the data. It would be, in my mind, a  
18 fairly low percentage I would expect to be below that.

19 **Q. Well, you saw that Neubauer did some**  
20 **resistance testing on the Siewert herd, I take it?**

21 A. I don't believe I've seen that data.

22 **Q. He didn't come up with any cows that have**  
23 **500 ohms resistance.**

24 A. I haven't seen his data.

25 **Q. Well, if that were true, if the jury in this**

1       **case were to believe that that were true, then that**  
2       **graph wouldn't apply to the Siewert herd; right?**

3               **MR. O'BRIEN: I'll object to the form and**  
4       **foundation.**

5       A.       If that was -- were valid measurements and  
6       somehow these cows were lower -- somehow lower  
7       resistance than that, then you'd have to adjust that  
8       curve.

9       **Q.       And it's not a curve. It's a straight line.**  
10       **I mean, you've got a linear relationship the way that**  
11       **it's expressed there.**

12       A.       Yes. It's a way of describing in a general  
13       sense what we expect to happen.

14       **Q.       Well, I mean, if you were to learn that the**  
15       **assumption of 500 ohms is a wrong assumption for dairy**  
16       **cows, I take it you'd be the first, as a credible**  
17       **scientist, to disavow that graph; right?**

18               **MR. O'BRIEN: Object to form.**

19       A.       If I was convinced that that wasn't  
20       representative for that type of display of material,  
21       yes, I'd want to change it.

22       **Q.       How did you go about, when you were doing**  
23       **it, testing for body resistance of the dairy cow? What**  
24       **was your method?**

25       A.       The principal method would be having a bit

1 in the mouth, then having a cow standing on two  
2 separated, expanded metal plates that were in a wet  
3 condition, so the front hooves would be separate from  
4 the rear hooves. Then we'd put a known current through  
5 whichever path we were looking at, measure the voltage  
6 drop, and from that then we could calculate, using  
7 Ohm's Law, the resistance.

8 **Q. And you haven't been provided with the**  
9 **resistance testing that was done by Mr. Neubauer in**  
10 **this case?**

11 A. I don't believe I have.

12 MR. BIRD: Is it your intention to have him  
13 look at that, Mr. O'Brien?

14 MR. O'BRIEN: If we do, we'll let you know.

15 MR. BIRD: You know, I'm interested --

16 MR. O'BRIEN: I hadn't thought of it,  
17 actually, until today.

18 MR. BIRD: Well, just for the record, I  
19 mean, he has done this resistance testing, and I just  
20 want to tell you that. And, you know, I mean, his  
21 method is on videotape, and he's even got a description  
22 of exactly what he did. I think he actually had some  
23 clips or something that he used instead of a mouth  
24 thing. But then he had the two different tests, one  
25 where the cow was on some, I think -- was it a dry

1 surface? -- and then one where the cow was in, you  
2 know, manure/urine combo up a little bit on the hoof,  
3 up some distance on the hoof, two different  
4 measurements.

5 **Q. Would you expect the resistances might**  
6 **differ between those two methods?**

7 A. Oh, absolutely.

8 **Q. And I think under field conditions, you**  
9 **would expect that a cow may encounter manure, urine,**  
10 **straw, you know, whatever combinations that would**  
11 **get -- have access to current up some level on the**  
12 **hoof; right?**

13 A. Conditions are certainly going to vary, yes.

14 **Q. So the body resistance of a cow is going to**  
15 **be a function not only of their -- not body resistance,**  
16 **but it also is a function of how well the contact is on**  
17 **the hoof; right?**

18 A. If we look at the full circuit, yes.

19 **Q. I'm just in my mind trying to figure out how**  
20 **to define this so that I'm comfortable with the**  
21 **terminology we're using because we're using body**  
22 **resistance, which is represented by this 500 ohms, and**  
23 **then contact resistance is something different. Then**  
24 **there's a third thing you talked about, which is**  
25 **circuit resistance, and I think that whole concept was**

1       **discussed in the red book, and that second author --**  
2       **What was his name? That guy from -- What's his name?**  
3       **Laughlin or something? Ludington.**

4       A.     Yeah.

5       **Q.     Yeah. Ludington kind of described that**  
6       **as -- that there's source impedance, path impedance,**  
7       **contact impedance and impedance of the animal.**

8       A.     Correct.

9       **Q.     Those are the four things that make up the**  
10      **circuit impedance.**

11     A.     Yes.

12     **Q.     All right. The source impedance is what?**

13     A.     That would be whatever the voltage source  
14     is. You could think about a battery has a certain  
15     impedance in how much current it could put out, so what  
16     its characteristics are.

17     **Q.     And the path impedance?**

18     A.     That would be the resistance between the  
19     source and the first contact to the animal.

20     **Q.     And so if that's -- I want to go back to my**  
21     **example of, you know, neutral-to-earth grounding wire,**  
22     **you know, and then going right into the ground. The**  
23     **path impedance would be the earth between where that**  
24     **goes into the ground and wherever the cow can make**  
25     **contact; right?**

1 A. Assuming that object is not electrically  
2 bonded or grounded and that there isn't another path  
3 there, yes.

4 **Q. So to the extent the soil in that location**  
5 **is salty and is wet, that would have a tendency to**  
6 **lower the impedance, the path impedance?**

7 A. Yes.

8 **Q. And then the contact impedance, that's what**  
9 **we talked about. That's where the cow actually makes**  
10 **contact with the source of the current?**

11 A. Right; and you can look at that at the  
12 two points that the cow is making contact.

13 **Q. And there has to be a differential between**  
14 **the two of them?**

15 A. Well, there has to be two different  
16 contributions. You could think of the source -- or the  
17 contact resistance going into the animal and the  
18 contact resistance coming out of the animal.

19 **Q. All right.**

20 A. Just for completeness, then you've got the  
21 resistance of the path back from the animal as well to  
22 complete the circuit.

23 **Q. Right. Okay. So I want to move back a**  
24 **little bit then to this concept of the contact. The**  
25 **idea of -- to get the true body resistance of a cow,**

1       **you're going to want to make the best contact possible;**  
2       **right? Because if you have -- if you're measuring**  
3       **under dry conditions, you don't -- what you're showing**  
4       **then in terms of the number you're coming up with for**  
5       **the body resistance is going to be higher, or am I**  
6       **wrong on that?**

7       A.       Well, the body resistance itself is  
8       certainly going to be dependent on where you contact  
9       the body; and then if you want to get the true  
10      resistance of that path independent of the contact  
11      resistance, then you would want to minimize the contact  
12      resistance for that particular path.

13      **Q.       All right. But in order to do that, to get**  
14      **true body resistance, what we want to do is -- not "we"**  
15      **because I'm not a scientist, but you, as a scientist,**  
16      **you would want to minimize contact resistance in that**  
17      **to get true body resistance?**

18      A.       Yes; for whatever path you're trying to deal  
19      with, yes.

20      **Q.       So what you want to do then is like where**  
21      **the hoof makes contact, you want to make that almost**  
22      **zero or as close as you can get it to zero?**

23      A.       Yes; you like to minimize that.

24      **Q.       And you could do that by, you know, putting**  
25      **the cow in some salty water that goes up on their hoof**

1       **a ways?**

2       A.       Well, one needs to be careful because now  
3       you may be describing a different path if you bypass  
4       the hoof, for example, because we know the hoof is part  
5       of the path when they're standing there, so you have to  
6       decide what the body path that you're trying to measure  
7       is and then make sure you've got that path with minimum  
8       contact resistances.

9       **Q.       I'm just trying to figure out what occurs in**  
10      **field conditions on a typical farm, and I realize that,**  
11      **as a scientist, you have to, you know, control things**  
12      **and be -- but in order to minimize the contact**  
13      **resistance, you're agreeable with the notion that it**  
14      **should be as close to zero as we possibly can get it in**  
15      **order to get a true measure of the body resistance of**  
16      **the cow?**

17      A.       Of the path that you're trying to work with.

18      **Q.       Right.**

19      A.       Yes.

20      **Q.       Okay. I think I understand that.**

21             MR. BIRD: Just for the record then, if you  
22      provide Dr. Gustafson with that information and you're  
23      going to have him testify about it or any of the other  
24      guys that you know you're going to call that I haven't  
25      asked about, I mean, I'd like the opportunity to



1 probably just do a telephone depo or something to find  
2 out what his opinions are?

3 MR. O'BRIEN: Sure.

4 (Recess taken.)

5 BY MR. BIRD:

6 **Q. I want to go to the distinction you're**  
7 **drawing between so-called traditional stray voltage and**  
8 **earth current, you know, that was -- I think earth**  
9 **current was the subject of this Science Advisors thing**  
10 **in Minnesota.**

11 **What is the distinction between those two**  
12 **from your perspective?**

13 **MR. O'BRIEN: Objection to form.**

14 A. I would distinguish -- An earth current  
15 deals with a current flowing in the earth, somehow  
16 then, hypothesize, get tangled up with the animal, as  
17 contrasted to a circuit that deals with the grounded  
18 neutral system and the animal directly.

19 **Q. You don't have debate with the idea that**  
20 **neutral current that's grounded into the earth is**  
21 **present; I mean, neutral current can be in the earth.**

22 A. Correct.

23 **Q. And you don't have a problem with the notion**  
24 **that if that current somehow makes contact with the**  
25 **animal, that it could have adverse effects depending on**

1 **the magnitude of the current?**

2 A. Depending on the magnitude, certainly.

3 **Q. And it's then a question of determining**  
4 **whether or not the current can get to the animal?**

5 A. And at what magnitude.

6 **Q. And at what magnitude; right?**

7 A. Yes.

8 **Q. All right. I've seen in some of the prior**  
9 **testimony that you've done that you felt that it was a**  
10 **reasonable goal to get neutral-to-earth current without**  
11 **a resistor down to .35 volt? Am I saying that right?**

12 A. Well, you mixed current and voltage, but --

13 **Q. I'm sorry. I did.**

14 A. I would just correct it to say that if  
15 you're designing a system or modifying a system, that  
16 that's an achievable goal to have the neutral-to-earth  
17 voltage less than something like that on whatever  
18 facility you're working with.

19 **Q. And you're familiar with the recommendations**  
20 **coming out of the Wisconsin Public Service Commission**  
21 **before this 1991 report that had, you know, the level**  
22 **of perception at a half a volt?**

23 **MR. O'BRIEN: I'll object to form and**  
24 **foundation.**

25 A. I believe it had a level of action something

1 like that.

2 **Q. And then the Public Service Commission of**  
3 **Wisconsin in response or partly as a result of the red**  
4 **book report that we've marked here raised that to a**  
5 **volt; is that true?**

6 A. Right; they modified their recommendation of  
7 their procedure.

8 **Q. You're not a veterinarian.**

9 A. No.

10 **Q. And you're not an animal physiologist.**

11 A. No.

12 **Q. You don't know actually where cows perceive**  
13 **electric current, at what level?**

14 A. Well, I have done research on perception  
15 level for animals of electrical current, so, yes, I  
16 have studied the perception, primarily through  
17 behavioral representations.

18 **Q. But you don't -- Because you're not a cow,**  
19 **you can't be hooked up. There's some level before they**  
20 **jump and twitch that they might perceive it?**

21 A. That's correct.

22 **Q. And you don't know what that level is?**

23 A. There may be a level of perception before  
24 you get to response, yes.

25 **Q. Right. And what's been documented in the**

1 **literature is the actual behavioral response?**

2 A. Yes, that has been well documented in the  
3 literature.

4 **Q. Okay. Again, going back to this 3-4 graph**  
5 **or chart, which is most certainly going to be given to**  
6 **the jury in this case in one form or another and**  
7 **probably many, many, many times, this 500 ohm and then**  
8 **1,000 ohm, that's noted there; correct?**

9 A. Yes.

10 **Q. Just so we're clear what I'm talking**  
11 **about -- I don't know if you have a copy of it, but if**  
12 **you could go to page 3-22, figure 3-4, the note there,**  
13 **it says, "Voltage, right vertical axis, were estimated**  
14 **using a worst case circuit impedance 500 ohms and a**  
15 **more realistic impedance 1,000 ohms."**

16 **Now, the circuit impedance is a combination**  
17 **of all of the four; right?**

18 A. Of the four components we've talked about  
19 before, yes, that could be the definition of circuit  
20 impedance.

21 **Q. So that 500 ohms represents the entire**  
22 **circuit?**

23 A. In a worst case condition, yes.

24 **Q. Right. But the literature -- Much of the**  
25 **literature imposes 500-ohm resistor for the cow, to**

1 **represent the cow; right?**

2 A. While attempting to minimize the contact  
3 resistance, yes.

4 **Q. So aren't you -- I mean, it seems to me**  
5 **you're using two different things here to -- Does the**  
6 **500 ohms -- because I think you previously testified**  
7 **that the 500 ohms on that chart represents the body**  
8 **resistance of the cow, but this note says the entire**  
9 **circuit impedance, or is that a misprint?**

10 A. Well, under the worst case conditions, the  
11 primary component of this is going to be the body  
12 resistance of the animal.

13 **Q. What percentage of it in a typical case?**  
14 **Are you talking 95, 99, something like that, or --**

15 A. I'd have to go back and think about this.  
16 It's probably in the 90 percents.

17 **Q. Or more?**

18 A. Could be -- you know, probably be in the low  
19 90s.

20 **Q. Because circuit impedance, as we know from**  
21 **looking at Ludington's, is a combination of those four**  
22 **things; right?**

23 A. Yes.

24 **Q. Just so we know -- I got that somewhere. I**  
25 **think it came to -- It's on 3.5?**

1 A. Yes.

2 **Q. He's got that chart there showing the total**  
3 **circuit impedance is the source and the path and the**  
4 **contact and the cow?**

5 A. Yes.

6 **Q. And what you're saying is the cow has**  
7 **represented -- well, for the circuit, is at least**  
8 **90 percent?**

9 A. In the worst case conditions, yes.

10 **Q. Now I want to go back to the chart. Does**  
11 **the 500 ohms that's shown on the chart represent the**  
12 **cow impedance or the whole circuit, in your**  
13 **understanding?**

14 A. In my understanding, this would represent  
15 impedance where the cow is, so that would be probably  
16 the contact, the body of the cow, the contact part of  
17 the circuit.

18 **Q. Not the source and the path?**

19 A. It's assuming a worst case, so assuming  
20 those would be very small.

21 **Q. Well, worst case, the way they're saying**  
22 **worst case, that would be like -- that would be like**  
23 **the minimum that it could ever be; right?**

24 A. That would be what one would expect as a low  
25 value for the path resistance, yes.

1       **Q.       But the worst case to me means like that it**  
2       **just can't ever go below that. Is that true?**

3       A.       Well, I wouldn't -- I suppose you could set  
4       up configurations where you might get something lower  
5       than that, but it's not what I, in my judgment, would  
6       expect to see under normal operating conditions.

7       **Q.       Well, but, I mean, in your research, you had**  
8       **significant minority percentage of cows that you tested**  
9       **that were less than 500 ohms; is that true?**

10      A.       For the body resistance.

11      **Q.       But you're saying that's what we've got**  
12      **here; the 500 ohms represents the body resistance?**

13      A.       That's the primary part of it, yes.

14      **Q.       That's where I'm kind of a little bit**  
15      **confused, Dr. Gustafson, because worst case then isn't**  
16      **500 ohms, is it?**

17      A.       If I've got to make a judgment, which is  
18      what this is, and how to interpret current to voltage  
19      as to what values one would use to convert that to  
20      working in this area, I think 500 ohms is a good value  
21      to use for the worst case condition.

22      **Q.       Maybe you'd better explain that to me. How**  
23      **did you come up with that? I mean, did you come up**  
24      **with that number or did somebody else come up -- Who**  
25      **wrote this chart, by the way? Is that you?**

1 A. Well, this chart is the -- has the preface  
2 as it's a consensus of the group. The principal author  
3 on this particular segment was Aneshansley and Gorewit,  
4 so they probably did some of the writing, but --

5 **Q. But are they the ones who -- you know, in**  
6 **the methodology that was explained on how you guys did**  
7 **it, which is I think set out somewhere in the preface**  
8 **or something, what happened on a particular chapter was**  
9 **that the two principal authors would, you know, do the**  
10 **first draft, so to speak, and then send out; right?**

11 A. Uh-huh.

12 **Q. And is that what happened here, that this**  
13 **graph was created by those two fellows, and then you**  
14 **looked at it and then concurred with it?**

15 A. I don't recall the exact processes of, you  
16 know, what iterations were made on this particular  
17 chart, but that may well have been that they originated  
18 it. I know we -- you know, a number of us responded to  
19 it.

20 **Q. Okay. I want to ask you to do the same**  
21 **thing you did with regard to milk production, you know,**  
22 **where you go to the bibliography. Can you go to that**  
23 **bibliography and tell me what are the studies that are**  
24 **included in the bibliography that support this 500-ohm**  
25 **as being worst case? And, again, worst case, just so**



1       **we're clear, means that you would not expect under**  
2       **normal field conditions for there to be cows that would**  
3       **have resistances less than 500 ohms; right? Or is it a**  
4       **combination of the body and the contact?**

5       A.       It would be -- In my mind, it would be the  
6       body and the contact.

7       **Q.       Let's go to the bibliography, and tell me**  
8       **which are the research studies that you believe support**  
9       **that conclusion, because I'd like to read those studies**  
10       **to see if, in fact, they're -- you know, which I assume**  
11       **you did at the time; right?**

12       A.       Yes.

13       **Q.       You read those studies?**

14       A.       Yes.

15       **Q.       And you kind of put it all in your mind**  
16       **and --**

17       A.       That, along with the experience of working  
18       in the field sorts of things too.

19       **Q.       Okay.**

20       A.       Certainly the set that's at the bottom of  
21       page 3-5, the bottom of the left-hand column, the  
22       series there.

23       **Q.       Where are we at?**

24       A.       Page 3-5, bottom of left column, there's a  
25       series of articles that are cited there that would

1 certainly be a starting point. There may well be some  
2 references embedded within others that I'd have to dig  
3 deeper and get back to you.

4 **Q. Well, it seems like the lowest there is**  
5 **mouth to all hooves done by Norell, of which you were**  
6 **an author.**

7 A. Correct.

8 **Q. And that showed your N was 28. That's the**  
9 **number of cows you tested; right?**

10 A. Yes.

11 **Q. And those varied from 244 to 525?**

12 A. Yes.

13 **Q. How many of those 28 were under 500 ohms?**

14 A. I couldn't answer that without going back  
15 and looking at the paper and the data.

16 **Q. That's Norell, 1983, huh? Is that an**  
17 **ASAE paper?**

18 A. No. That was a Transactions of ASAE, 1983.

19 **Q. I have one here that was in '82.**

20 A. That may indeed have the same data. That's,  
21 as we mentioned earlier, likely the meeting  
22 presentation of much of the same information that was  
23 then later refereed and published.

24 **Q. The cows that you used, where were they?**  
25 **Where did you get them?**

1 A. University of Minnesota.

2 **Q. Where at?**

3 A. St. Paul.

4 **Q. So you went over to the St. Paul campus.**

5 **Were there any sick animals?**

6 A. Not that I recall.

7 **Q. Were there any animals with any hoof**  
8 **problems?**

9 A. I'd have to look at it, but I doubt if there  
10 were any with any serious visible hoof problems.

11 ---

12 And, thereupon, Exhibit No. 320 was marked  
13 for purposes of identification.

14 ---

15 BY MR. BIRD:

16 **Q. Take a look at that just for a minute. Is**  
17 **this the '83 article that's referenced there? I'll**  
18 **just show it to you to see if that is it.**

19 A. Yes.

20 MR. BIRD: Let's get that marked.

21 ---

22 And, thereupon, Exhibit No. 321 was marked  
23 for purposes of identification.

24 ---

25 BY MR. BIRD:

1       **Q.       Have you had a chance to look at that,**  
2       **Exhibit 320, in front of you?**

3       A.       Yes.

4       **Q.       Can you tell me how many cows were tested**  
5       **there?**

6       A.       It depends on which experiment we're talking  
7       about, but -- Let's see. There were 10 Jerseys in one  
8       experiment or part of the experiment; and then in the  
9       second part of the experiment there were 28 Holstein  
10      cows.

11      **Q.       All right. And the Norell, is that the same**  
12      **experiment then that's in Exhibit 321? I think it is,**  
13      **but take a peak at that.**

14      A.       Yes.

15      **Q.       The way I'm reading this, the abstract from**  
16      **Exhibit 321 says that the mean path resistances range**  
17      **from 359 ohms for mouth to all hooves pathway to**  
18      **738 ohms for front-rear hooves pathway.**

19      A.       That's correct.

20      **Q.       And the distribution for the mouth-all**  
21      **hooves pathway showed 25 percent of the population**  
22      **below 302 ohms and 75 percent below 441 ohms.**

23      A.       Correct.

24      **Q.       The mouth to all hooves pathway is not an**  
25      **unusual pathway, is it?**

1 A. No.

2 **Q. It's a very common pathway?**

3 A. Yes.

4 **Q. Well, given that, your own research, how can**  
5 **you let them get away with putting 500 ohms as the**  
6 **minimum, the worst case?**

7 **MR. O'BRIEN: Objection to form.**

8 A. In my judgment, under field conditions,  
9 500 ohms would be a reasonable value to assume as a  
10 worst case condition.

11 **Q. Yeah, but you tested and found that**  
12 **75 percent are below 441 ohms. How do you discount**  
13 **your own research then? Tell me why that is --**

14 **MR. O'BRIEN: Objection to form.**

15 **Q. -- that you discounted your own research and**  
16 **made the number higher than 75 percent of the cows that**  
17 **you personally tested that were healthy cows?**

18 **MR. O'BRIEN: Objection to form.**

19 A. In an experimental setting, we could get  
20 down to those kind of values. That's not what I would  
21 expect to see in an actual facility when cows are being  
22 exposed.

23 **Q. Are you aware of any testing that's been**  
24 **done in an actual facility with cows being exposed?**

25 A. I couldn't point to which ones right now,

1 but there are some values there, yes.

2 **Q. In an actual facility with cows being**  
3 **exposed, would you expect some percentage of those**  
4 **cows -- Strike that.**

5 All right. I see where you're going.  
6 You're saying that because the contact resistances  
7 would vary, that's why you're thinking the 500 ohms  
8 is --

9 A. Yes.

10 **Q. All right. But you've told me that the**  
11 **500 ohms represents body resistance and contact.**

12 A. That would be my interpretation, yes.

13 **Q. And you've also told me that it's common in**  
14 **farm situations for cows to have contact resistances**  
15 **with manure and salt and urine and combinations of that**  
16 **of five ohms or less.**

17 A. Well, it could be, for a given hoof,  
18 somewhere in that magnitude, yes.

19 **Q. For all four hooves, it could be that?**

20 A. Well, I wouldn't expect that.

21 **Q. It would be common under field conditions**  
22 **that cows would be standing all four hooves in manure**  
23 **and urine, a combination.**

24 A. In my judgment, I still would not expect it  
25 to get down to values much under that 500 ohms as a

1 total value.

2 **Q. I'm trying to figure out -- You know, we're**  
3 **parsing this out between the body resistance on the one**  
4 **hand. I mean, you have no debate with your research**  
5 **here.**

6 A. No.

7 **Q. That's true research.**

8 A. Correct.

9 **Q. That the body resistances, 75 percent are**  
10 **going to be less than 441 ohms; right?**

11 A. Correct.

12 **Q. So what you're saying is, to do simple**  
13 **arithmetic, that in a field condition, that a worst**  
14 **case scenario is that the contact resistance has to be**  
15 **59 ohms or higher?**

16 A. If we've done the math right, that's --

17 **Q. Well, 500 minus 441, is that 59? Yeah.**

18 A. Yeah. So, yes, yeah.

19 **Q. So that would be a worst case scenario in a**  
20 **farm?**

21 A. That's what we would -- Yes, using  
22 engineering judgment, which is what you're doing at  
23 that point, that's, I think, a reasonable value to  
24 assume.

25 **Q. For worst case?**

1 A. For worst case condition, yes.

2 **Q. And then for the most sensitive cows, which**  
3 **in your report was 244 ohms, a worst case scenario --**  
4 **Well, let's put it that way. Twenty-five percent of**  
5 **the population was below 302 ohms, so for 25 percent of**  
6 **those cows, a worst case scenario is that the contact**  
7 **resistance is 198 ohms.**

8 A. In that order of magnitude, yes.

9 **Q. And for that --**

10 A. May I correct part of what you said, just so  
11 we're not --

12 **Q. Yeah.**

13 A. Sensitivity and resistance are not one and  
14 the same, so the sensitivity which you've correctly  
15 identified earlier is based on the current value.  
16 Resistance is not really the indicator of sensitivity.  
17 It's the indicator of what level of current would flow  
18 through the animal.

19 **Q. Did I say sensitivity?**

20 A. Yes.

21 **Q. I shouldn't have said that. I meant**  
22 **resistance.**

23 **Have you measured contact resistance on a**  
24 **dry surface?**

25 A. Yes.



1       **Q.       What is it?**

2       A.       It can be thousands of ohms.

3       **Q.       Have you measured contact resistance on a**  
4       **wet surface?**

5       A.       That's what we ultimately did in this  
6       particular research, for example, is get a very wet  
7       surface that you're trying to make contact to.

8       **Q.       Then what was the contact resistance that**  
9       **you came up with for a wet surface?**

10      A.       That would be embedded within what's  
11      measured here.

12      **Q.       Show me what your numbers were. Where are**  
13      **they?**

14      A.       Well, it's part of that total number.

15      **Q.       It's part of the 302 ohms?**

16      A.       Yes.

17      **Q.       That includes contact and body resistance?**

18      A.       Well, that -- that includes contact in the  
19      way we had it set up, yes.

20      **Q.       So what I'm saying is -- Let me just be**  
21      **sure -- that 25 percent of the 28 cows that you**  
22      **measured had contact plus body resistance of less than**  
23      **302 ohms?**

24      A.       Yes, under the situation, the types of  
25      contacts we were trying to make.

1       **Q.       And 75 percent had contact and body**  
2       **resistance below 441 ohms?**

3       A.       Correct.

4       **Q.       What percent of that total was contact**  
5       **resistance and what percent was body resistance?**

6       A.       We can't determine that from this  
7       experiment.

8       **Q.       Did you ever try to determine that?**

9       A.       What we attempted to do was minimize the  
10       contact resistance by having this very wet floor,  
11       expanded metal, for the foot contact, and the bit in  
12       the mouth, but we did not try and measure that  
13       independently.

14       **Q.       Well, let me ask you this. Let's just say a**  
15       **cow is standing in manure, all four hooves, with urine**  
16       **combo, and puts the nose into the waterer. What would**  
17       **you expect the contact resistance to be in that**  
18       **scenario?**

19       A.       The contact or the total path?

20       **Q.       No. The contact.**

21       A.       I'd have to go back and think about that a  
22       little bit, just the area of contact and the  
23       resistivity of the material, go back through that. I  
24       don't have a number I could give you right now.

25       **Q.       Well, gosh; I'm really frustrated.**

1 A. What I am telling you is that, you know, in  
2 the judgment, we came to the consensus that that  
3 difference would be in the orders that you just talked  
4 about, the difference between what we can get to as a  
5 minimum value compared to what we would expect under  
6 real field conditions.

7 **Q. I'm trying to get from you what I think is a**  
8 **hypothetical based on real field conditions. You would**  
9 **agree with me that under real field conditions, it**  
10 **would be common for cows to be standing on a wet**  
11 **surface that would include some saline portion because**  
12 **of presence of urine and manure and putting its nose**  
13 **into a waterer. That is not at all uncommon on a dairy**  
14 **farm, is it?**

15 A. That is correct.

16 **Q. And what I'm asking you is what is the**  
17 **contact resistance in that circumstance? And are you**  
18 **telling me that it's going to be 200 ohms?**

19 A. It wouldn't surprise me to see 200 ohms,  
20 yes.

21 **Q. Would it surprise you to see five ohms?**

22 A. Yes, it would surprise me to see it that  
23 low.

24 **Q. Have you ever done any tests on that?**

25 A. We tried some things, but I couldn't point

1 to a specific one right now. It's been too long since  
2 I worked in that particular topic.

3 **Q. Has anybody studied contact resistances with**  
4 **respect to dairy cows under field conditions?**

5 A. That would be embedded, I think, in some of  
6 the data that's been done in some of the experiments  
7 where they put a known level of current and they have  
8 measured the voltage drop created by that current, so  
9 you can go back and get an estimate of that.

10 **Q. When a 500-ohm resistor is used in testing,**  
11 **that's in addition to the contact impedance; right?**

12 A. Yes, it is.

13 **Q. What is the contact impedance in that**  
14 **testing scenario?**

15 A. Well, if, indeed, you're making metal to  
16 metal contact at the one end, expect that to be very  
17 low, and then if you're using a salted, wet pad under  
18 pressure at the other end, I'd expect that to be low  
19 too. I've not sat down and tried to calculate what  
20 value that would actually be, but it would be pretty  
21 modest.

22 **Q. Well, how much? Less than five ohms?**

23 A. I don't know. I'd have to -- have to go  
24 back and play with the numbers on that.

25 **Q. But for purposes of the research data that**

1 **makes up this chart, much of it is based upon the use**  
2 **of a resistor with 500-ohm impedance; right?**

3 A. Of which?

4 **Q. On the chart.**

5 A. No. The chart is not based on that as far  
6 as the data that's collected. The data is collected  
7 measuring the level of current and sensitivity.

8 **Q. But it's a calculated level of current;**  
9 **right?**

10 A. Well, it's a measured level of current often  
11 in experimental setup done by measuring voltage drop  
12 across a known resistance.

13 **Q. And that known resistance is 500 ohms?**

14 A. No, not necessarily. It might be -- The  
15 value there is really not critical. You're just trying  
16 to set up a known value so that you know the current  
17 flow through the animal.

18 **Q. Let's take a look at that chart then because**  
19 **maybe I'm just totally misunderstanding the chart.**  
20 **Let's go to 3-22. I mean, there's a straight line**  
21 **that's a dotted line. Do you see that? It kind of**  
22 **goes from zero all the way up to vertical access of**  
23 **eight on the other end in terms of milk production**  
24 **response.**

25 A. Yes.

1       **Q.       And off to the right side, it says 500 ohms**  
2       **and 1,000 ohms.**

3       A.       Yes.

4       **Q.       And then it goes one, two, three, four.**  
5       **What does that one, two, three, four represent?**  
6       **Voltage?**

7       A.       Yes.

8       **Q.       So if somebody's going to measure -- If they**  
9       **measured two volts across a 500-ohm resistor, that's**  
10      **going to equate to -- to what? Is that going to equate**  
11      **to a milk production loss under this chart?**

12      A.       It's going to equate to four milliamps.

13      **Q.       And what does that give us in terms of**  
14      **production loss?**

15      A.       That puts you right in this domain that says  
16      "moderate behavioral" and just right at the cusp of  
17      where the intersection is between no loss of production  
18      anticipated and loss of production due to change -- not  
19      due to change in the animals.

20      **Q.       Production loss may be due to change in the**  
21      **animals. Does that mean it's due to electric current?**

22              **MR. O'BRIEN: I object. Misstatement of his**  
23      **previous testimony.**

24      A.       Well, my interpretation of this at this  
25      point in time is that, you know, where we have moderate

1 behavior, we may or may not have production loss, which  
2 you can see at the bottom, and any production loss  
3 there -- any loss in production is not due to change in  
4 the animals; it may be due to behavior of the animals.

5 **Q. Well, where does it show the milk production**  
6 **response on here?**

7 A. Well, this --

8 **Q. It doesn't have any because it says**  
9 **production loss may be due to change in animals. It**  
10 **doesn't say it's due to the electric current; right?**

11 A. Right.

12 **Q. Is there anything on this chart that shows**  
13 **that even at eight ohms or at eight milliamps that you**  
14 **can get a loss of milk production?**

15 A. You would expect if that occurs, it's going  
16 to occur due to animal behavior and then this  
17 production loss due to behavior.

18 **Q. Where does that show up, though, on the**  
19 **chart?**

20 A. The last column.

21 **Q. What column?**

22 A. "This production loss may be due to change  
23 in the animals."

24 **Q. But that says the production loss may be due**  
25 **to change in the animals, not to the current; right?**

1 **What does that mean, change in the animals?**

2 A. Well, their behavior is going to be severe  
3 enough that you're going to get into production  
4 problems.

5 **Q. So where do you have to -- How many  
6 milliamps is that under this chart?**

7 A. Under this chart, that roughly starts at six  
8 milliamps.

9 **Q. Under this chart, you have to have six  
10 milliamps to get any milk production loss?**

11 A. Well, it's -- We would expect it at that  
12 level. My interpretation is you might get some down  
13 here in the moderate, depending on the situation, but  
14 at that point we'd certainly start to expect that that  
15 would be common.

16 **Q. At four milliamps?**

17 A. In my experience, yeah, if we can see the  
18 equivalent of four milliamps, depending on other  
19 conditions, we may start seeing some behavioral  
20 problems that then relate to production problems.

21 **Q. At four milliamps?**

22 A. At four milliamps.

23 **Q. But not at two milliamps.**

24 A. I wouldn't expect it at that level, no.

25 **Q. Have you ever seen it at that level?**



1 A. No, not that I'm comfortable saying it  
2 happened because of the two milliamps.

3 **Q. So it's a function of current?**

4 A. It's a function of current, correct.

5 **Q. And is this chart based on Ohm's Law?**

6 A. Well, the conversion from current, which is  
7 really what the animal senses, to voltage is based on  
8 Ohm's Law. It's just strictly an application of Ohm's  
9 Law, assuming 500 ohms, assuming 1,000 ohms.

10 **Q. So it would be simply a calculation that if**  
11 **the resistance was really 250 ohms, your current would**  
12 **double; right?**

13 A. Well, if you assume 250 ohms, you could put  
14 another column here, and where this one says 400-500,  
15 it would say 200-250 would be half the value for the  
16 voltage to get the equivalent current. So if you have  
17 the resistance, you're going to have the voltage  
18 required to get that same current value.

19 **Q. All right. But if you're measuring**  
20 **two volts at 250 ohms, you're going to get eight**  
21 **milliamps; right?**

22 A. Yes; if we've done the math right, yes.

23 **Q. Yeah. So really what this study -- is this**  
24 **study -- I mean, the chart, is it based upon -- I'm not**  
25 **sure why you have the ohms on there then if you're**

1 **saying the information is based upon current. But the**  
2 **current -- Let me back up.**

3 **The current is a calculated number based**  
4 **upon a known voltage and an assumption on resistance?**

5 A. No.

6 **Q. Okay. What's it based on?**

7 A. The current is based on a measured or  
8 controlled value used in the experiment. You have to  
9 measure it to know what's occurring there. But that's  
10 the controlled variable in trying to determine the  
11 animal's sensitivity is the current. Then what this  
12 does, if you want to then know what that current level  
13 would be in terms of voltage, then you have to use  
14 Ohm's Law to convert back, and you have to assume a  
15 resistance value to do that.

16 **Q. All right. So in order to get a decline in**  
17 **milk production, all we've got to do is get four**  
18 **milliamps to the cow. That's what you're saying;**  
19 **right?**

20 A. Well, at that level, you may or may not  
21 create a production problem for the cow.

22 **Q. But, I mean, if I have a cow that's 200 ohms**  
23 **resistance and minimal to no contact resistance and I**  
24 **get two volts, I'm going to exceed your threshold of**  
25 **four milliamps; right?**

1 A. I think the way you're going is that the --  
2 the current through the animal is the critical value.

3 **Q. Right.**

4 A. Yes.

5 **Q. So in order to win one of these cases, the**  
6 **farmer has got to prove -- in your view, the minimum**  
7 **he's got to prove is he's got to get four milliamps**  
8 **into the cow at the cow contact point.**

9 A. Well, it has to be shown that you've got a  
10 source, that source is getting to the animal, and it is  
11 a magnitude large enough that it's going to impact the  
12 animals.

13 **Q. Okay. Now, going back to those two cows**  
14 **that were taken out of that full lactation study, do**  
15 **you know at what level of current that they had a**  
16 **violent reaction?**

17 A. I don't recall.

18 **Q. Would that be something you might want to**  
19 **know?**

20 A. Well, I could look that up. It's just for  
21 that one particular study.

22 **Q. One of the things that you mentioned is that**  
23 **cows -- you know, that the behavioral response is cows**  
24 **might not want to go in and get milked; right?**

25 A. That's correct, yes; reluctance to enter a

1 milking facility is an observed phenomenon, yes.

2 **Q. If cows don't go in and get milked, I mean,**  
3 **there's a cow behind that cow; right?**

4 A. Unless it's the last cow, yes.

5 **Q. That can screw up not only the cow that's**  
6 **reluctant, but all the other cows that are behind it?**

7 A. It can certainly impact your flow of cows  
8 through the parlor and your whole milking routine.

9 **Q. Right. And if a cow happens to get**  
10 **mastitis, just one or two or three or -- Let's say**  
11 **five percent of the herd gets mastitis from the stray**  
12 **voltage, in other words, gets a disease response. Do**  
13 **you recognize that that provides a pathway to transfer**  
14 **that pathogen to all the other cows, even cows that**  
15 **don't have a behavioral response?**

16 **MR. O'BRIEN: I'll object to the form.**

17 **Q. Right?**

18 A. Well, I'm not a mastitis expert, but just  
19 from my lay knowledge of that, if you've got a mastitis  
20 problem in the herd from any particular source, then  
21 you can have increased mastitis because of transmission  
22 between animals, depending on your milking routine and  
23 those sorts of things, yes.

24 **Q. But, I mean, through the use of the stray**  
25 **voltage, I mean, you can have indirect effects on cows**

1 **that are actually not affected by the current itself.**

2 **Do you agree with that?**

3 A. Secondary impact.

4 **Q. Sure.**

5 A. With the example you used, yeah, if -- if  
6 you've got a contagious element and you've got the  
7 potential to transfer that from one to another, then  
8 that would be a secondary impact.

9 **Q. From the farmer's perspective looking at**  
10 **this, he's got sort of a witch's brew of cause and**  
11 **effect; you don't know what preceded what; you know,**  
12 **what's the cart and what's the horse. He's trying to**  
13 **kill the mastitis, but if a few cows are continuing to**  
14 **produce the pathogen because of the stray voltage, it**  
15 **could be continually reinfecting the otherwise healthy**  
16 **parts of the herd; right?**

17 **MR. O'BRIEN: I'll object to form and**  
18 **foundation.**

19 **BY MR. BIRD:**

20 **Q. You'd agree with that, wouldn't you?**

21 A. Well, there's nothing unique to that  
22 relative to stray voltage. That's true with any sort  
23 of source of mastitis, and then depending on how that's  
24 dealt with.

25 **Q. Right. Then what percent of the herd, you**

1       **know, having a behavioral response to stray voltage are**  
2       **you comfortable with?**

3       A.       Well, I'd like to not see that condition or  
4       have any animals responding to stray voltage. I don't  
5       think it's necessary to tolerate a certain percentage  
6       responding.

7       **Q.       So you're saying it should be zero percent?**

8       A.       I think if you -- you know, if you want it  
9       to be, you could set up a condition there maybe, you  
10      know, by doing modifications to the farmstead or the  
11      wiring system. The inverse of that question, at what  
12      point do you take action, is a judgment or a management  
13      call that the producer would have to make.

14      **Q.       You accept the notion that the farm -- you**  
15      **know, one given farmer can have stray voltage on his**  
16      **farm in the same magnitude as another guy down the**  
17      **road, but one farmer will be a better manager and be**  
18      **able to manage around the stray voltage?**

19      A.       That certainly can happen.

20      **Q.       That doesn't mean the farmer that's not able**  
21      **to manage around the stray voltage is necessarily a bad**  
22      **farmer. He's just not as good as the guy down the**  
23      **road.**

24      A.       Yeah; doesn't have the same ways of dealing  
25      with it; I agree.

1       **Q.       One of the things I wanted to talk to you**  
2       **about was transients, and I'm more interested in**  
3       **definitional things here in terms of transients. What**  
4       **is the duration, time duration, of a transient, in your**  
5       **view?**

6       A.       Generally, when we're talking about  
7       electrical transients, we're talking about things that  
8       are less than one AC half cycle, so down in that less  
9       than 13 milliseconds, something like that, time frame.

10      **Q.       Is there a difference -- and then -- So we**  
11      **talk about transients on the one hand, and then on the**  
12      **other hand we talk about steady state. What does that**  
13      **mean?**

14      A.       Well, steady state means that you usually  
15      have a fairly constant value over time, that you're not  
16      having -- Transient usually represents kind of -- you  
17      can think of it like a spike occurs; where steady  
18      state, you know, for a reasonable period of time you're  
19      going to have a pretty steady value, and the changes of  
20      it are going to be fairly smooth, so to speak, rather  
21      than having sharp transient or sharp changes.

22      **Q.       So transient would be expressed in**  
23      **microseconds?**

24      A.       Yes, that's a time frame that often is used  
25      for transients. It may be up as large as in the

1 millisecond range and still be a transient, but most  
2 transients that we'd characterize we'd characterize in  
3 the millisecond range.

4 **Q. Right. And a millisecond is a millionth of**  
5 **a second?**

6 A. No. A thousandth of a second.

7 **Q. It is? What's a microsecond then?**

8 A. That would be 10 to the minus sixth or a  
9 millionth of a second.

10 **Q. All right. So I got my terms right. I'm**  
11 **just trying to get it right.**

12 A. Sure.

13 **Q. Is there a difference between a transient**  
14 **and short-term?**

15 A. Here we're getting into definitions, and  
16 these get to be used sometimes a little bit sloppily in  
17 practice.

18 **Q. That's why I'm trying to --**

19 A. But a transient would really be a short-term  
20 event. You may have short-term events that are longer  
21 than a transient. For example, a motor start is really  
22 kind of a short-term event. It is transient in that it  
23 changes, but it's not what electrically we'd usually  
24 call a transient event.

25 **Q. All right. What do you call it when like --**



1       **Let's say in a given area at 5:00 everybody turns on**  
2       **their air conditioners, and so the load on the line, I**  
3       **mean, changes, and, you know, if a farmer is graphing,**  
4       **you know, all of a sudden you've got voltage higher;**  
5       **what do you call that? Is that steady state?**

6       A.       That's just a change in the steady state  
7       level of voltage, yes. As the load changes on a  
8       distribution system or on the farmstead, you'd expect  
9       to see a change in the neutral-to-earth voltage level,  
10      and that's really a change in the steady state, what we  
11      call the steady state value.

12      **Q.       Okay.**

13      A.       So steady state does not mean it's constant  
14      for all time.

15      **Q.       All right. And, you know -- What's his**  
16      **name? Reinemann did some research on what he called**  
17      **short duration events. Those were transients as you've**  
18      **defined them; right?**

19      A.       He's -- Some of them are kind of long  
20      transients because they're one cycle or half cycle  
21      sorts of things. He's done a range of different  
22      things. So he's done some in what we call the true  
23      transient, very short, so he's done some things that  
24      are in the cycle, units of cycles, AC cycles, which are  
25      like one cycle, you could call it a transient, but it's

1 not a short-term transient; and then he's done some  
2 that would be more steady state, longer term.

3 **Q. Well, but the -- when he did the**  
4 **intermittent exposure study, that was -- he was doing**  
5 **transients; correct? Isn't that true?**

6 A. If we're thinking of the same study, I don't  
7 think so. The intermittent was intermittent in whether  
8 or not the current was there, but when the current --  
9 an animal was exposed to the current, it was at a  
10 constant value.

11 **Q. For more than the time of a transient?**

12 A. Yes.

13 **Q. Okay. Are you sure about that?**

14 A. Well, there's several different studies  
15 there, but the one where they were making -- I'd have  
16 to go back and look now because there's been a couple  
17 different protocols on that.

18 **Q. Okay. Is there anything -- I mean, do you**  
19 **scientists have a name for, let's say, a short-term**  
20 **increase in current that would be, let's say, anywhere**  
21 **from a quarter of a second up to five seconds? Is**  
22 **there a name for that, or is that just called steady**  
23 **state?**

24 A. In most terminologies, that would be thought  
25 of as a value that would be reasonably steady state

1 because it's quite a few AC cycles long.

2 **Q. You see, one of the things I'm struggling**  
3 **with is this. I'll just put it to you. The recording**  
4 **data that they've got out there will take a sample, you**  
5 **know, once every -- it will store data once every 10**  
6 **seconds or something, or once every 15 seconds, but you**  
7 **might have a motor start in there that would bring**  
8 **current way up, but then they have a ceiling on what**  
9 **they record, and then over that period, they average it**  
10 **out to come up with a number, and so we never see what**  
11 **that actual current was in the way these recording**  
12 **devices work. Are you familiar with that, --**

13 **MR. O'BRIEN: I'll object to form and**  
14 **foundation, but answer if you're able.**

15 **Q. -- that problem with the recording devices?**

16 A. You certainly have to understand and deal  
17 with the characteristics of whatever recording  
18 equipment you're doing, and in some cases how you  
19 configure that is going to be important to interpreting  
20 what's on that graph; whether that's a, as you pointed  
21 out, a peak value of the transient or peak value within  
22 a specified period of time, you know, is important to  
23 understand when you're looking at those charts.

24 **Q. I mean, do you try to account for that, I**  
25 **mean, in the information that you look at?**

1 A. Yes.

2 **Q. The fact that there's deficiencies in the**  
3 **recording devices?**

4 **MR. O'BRIEN: I'll object to the form of the**  
5 **question.**

6 A. You certainly have to understand the  
7 characteristics of the recorder and then the system  
8 overall.

9 **Q. Going to that page that you looked at in**  
10 **this 3-5, it says dairy cows have much lower body**  
11 **impedance than humans, less than one-tenth. Is that**  
12 **true?**

13 A. Here I'd rely on Pat Reilly's information,  
14 but under what we'd see in normal circumstances, in my  
15 experience, where you're dealing with the skin  
16 impedance, common paths, that would be true.

17 **Q. And contact impedances for cows are likely**  
18 **to be lower than for humans?**

19 A. Correct.

20 **Q. Because cows are nearly always in contact**  
21 **with moisture; right?**

22 A. They commonly are, yes.

23 **Q. Therefore, hooves are in close association**  
24 **with urine, water, and feces on concrete surfaces; is**  
25 **that true?**

1 A. Correct.

2 **Q. Okay. Now, does this red book study have**  
3 **anything in the bibliography that discusses contact**  
4 **impedances where four hooves are in close association**  
5 **with urine, water and feces on concrete surfaces? We**  
6 **know your studies, but yours didn't involve four hooves**  
7 **in close association with urine, water and feces on**  
8 **concrete surfaces, did they?**

9 A. No. We tried to actually make it worse than  
10 that by using expanded metal and salty water at that  
11 point, so -- Quite frankly, I'd have to go back and  
12 look at the various measurements recorded at that point  
13 in time and see what's there in the literature. I  
14 couldn't point to things right now.

15 **Q. Well, can you do that and give that to**  
16 **Mr. O'Brien? I mean, I'm interested in knowing what**  
17 **research you folks had at the time this was published**  
18 **that showed what the contact impedances were in that**  
19 **scenario where the cows are in contact with moisture**  
20 **and their hooves are in close association with urine,**  
21 **water and feces on concrete surfaces, and eating and**  
22 **drinking with moist mouths. That's not an unusual**  
23 **situation for a field condition, is it?**

24 A. Correct.

25 **Q. Can you do that?**

1 A. I will certainly attempt to.

2 **Q. And then, in addition, you think there's**  
3 **been some research done on that since this was**  
4 **published in 1991?**

5 A. There may have, but I will certainly agree  
6 to explore that also.

7 MR. BIRD: Okay. Great. Thank you.

8 All right. Should we take a break?

9 MR. O'BRIEN: Sure.

10 (Recess taken.)

11 - - -

12 And, thereupon, Exhibit No. 318 was marked for  
13 purposes of identification.

14 - - -

15 MR. BIRD: Just for the record, we have  
16 Exhibit 318 marked. And can we have the same agreement  
17 on that we did on the other two exhibits where we just  
18 mark the front page?

19 MR. O'BRIEN: Correct.

20 BY MR. BIRD:

21 **Q. Okay. Sorry for the delay, Dr. Gustafson.**  
22 **We're back on the record, and I wanted to ask you about**  
23 **Exhibit 321. Going to the second page of that, 1507,**  
24 **it's Table 1 I'm looking at, and it's entitled "Average**  
25 **Pathway Resistance Measured Under Dry and Wet Hoof-Grid**

1 **Contact Conditions," and it says, "Outlier Removed."**

2 **What does that all mean?**

3 A. As I recall, there was statistical tests on  
4 the data collected, and they had removed an outlier  
5 based on statistical tests done. Usually means a  
6 misrecorded number or something like that.

7 **Q. Okay. This was for the -- looks like it was**  
8 **done with Jerseys; right?**

9 A. That particular part of the experiment, yes.

10 **Q. Now, the pathway that we're talking about**  
11 **resistance is, again, the combo of the contact**  
12 **resistance and the body resistance of those Jersey**  
13 **cows?**

14 A. Yes.

15 **Q. All right. And what's the number for dry**  
16 **for, let's say, front to rear hooves?**

17 A. Front to rear hooves would be 1,562 ohms.

18 **Q. And then in wet conditions, it's 1,479?**

19 A. Correct.

20 **Q. That's got an X with a line over it. Does**  
21 **that mean the average or statistical mean or what?**

22 A. That means the mean.

23 **Q. With a standard deviation of 470?**

24 A. Correct.

25 **Q. The mean difference then is 83 --**

1 A. Yes.

2 **Q. -- between wet and dry conditions?**

3 A. Yes.

4 **Q. And then if we go to mouth to rear hooves,**  
5 **it was actually a negative 26 mean difference from dry**  
6 **to wet?**

7 A. Yes.

8 **Q. Which means that sort of, you know,**  
9 **counterintuitively, your contact got better when you**  
10 **went to wet or when -- when you were at dry conditions?**

11 A. Yes. It's a small value, but --

12 **Q. And, strangely enough, the resistance path**  
13 **in a Jersey seems to be significantly less from mouth**  
14 **to rear hoof than from mouth to front hoof; right?**

15 A. Yes.

16 **Q. And does that give you any insight into what**  
17 **the contact resistances are typically? Seems to me**  
18 **like they're all less than a hundred going from dry to**  
19 **wet conditions.**

20 **MR. O'BRIEN: I'll object to the form and**  
21 **foundation.**

22 A. That's just the difference in the contact  
23 resistance between those two conditions, so it wouldn't  
24 be the contact resistance itself.

25 **Q. Well, if you're going from dry to wet,**



1       **what's the difference between that? It's a difference**  
2       **in contact, isn't it?**

3       A.       The difference in contact resistance, right.  
4       It's not the resistance itself. It's the difference in  
5       contact resistance.

6       **Q.       All right. From dry to wet?**

7       A.       Yes.

8       **Q.       Now, if I compare that Table 1 with Table**  
9       **3 -- This is the N equals 28 Holsteins -- I'm getting**  
10       **front to rear hoof readings of significantly less than**  
11       **Jerseys; right?**

12       A.       Yes.

13       **Q.       Do you attribute that to just a different**  
14       **body makeup then of the particular breed of cattle, or**  
15       **how do you account for that?**

16       A.       It's probably most accountable just by size  
17       of the animal, and I don't recall if they were on  
18       exactly the same surface or not.

19       **Q.       Okay. But this is, again, total pathway**  
20       **resistance, which is a combination of the contact and**  
21       **the body resistance?**

22       A.       Yes, that would be the way we've described  
23       it.

24       **Q.       And these were all done under wet**  
25       **conditions?**

1 A. Yes, I believe that's correct.

2 **Q. You didn't happen to repeat the experiment**  
3 **you did with the Jerseys, that is, test them under both**  
4 **dry and wet conditions?**

5 A. I don't believe we did.

6 **Q. The data that you created, does that exist**  
7 **somewhere, like at the University of Minnesota?**

8 A. If any of the raw data is available, it  
9 would probably be through Dr. Norell.

10 **Q. In Idaho?**

11 A. In Idaho.

12 **Q. Is he older or younger than you?**

13 A. Younger.

14 **Q. Okay. Did you teach him or something?**

15 A. I was on his Ph.D. dissertation committee.

16 Dr. Appleman was actually his major professor.

17 **Q. Okay. I wanted to then ask you about Table**  
18 **7. That's entitled, "Observed Percent Response by**  
19 **Current Level for Mouth-All Hooves Shocks (n equals**  
20 **65)." What does that mean?**

21 A. That means there were 65 animals used in the  
22 experiment.

23 **Q. Did you use some of them twice?**

24 A. Well, there were repeated measurements, but  
25 I believe that would be 65 different animals.

1       **Q.       It would be 65 different animals? Because**  
2       **it says, "Experiment 2B," seven cows were -- Well, did**  
3       **you use seven cows, but shock them multiple times, so**  
4       **you got the N up higher or -- I'm just confused about**  
5       **the statistics here.**

6       A.       I stand corrected. It was seven cows with  
7       multiple observations.

8       **Q.       And what is this table showing me? I mean,**  
9       **at one milliamp, it shows a response percent of 13.8.**  
10       **Is that like one cow or is that like 13.8 percent of**  
11       **the 65 individual tests?**

12       A.       It would mean that you would expect cows to  
13       respond 13.8 percent of the time at one milliamp.

14       **Q.       And how are they responding?**

15       A.       This was after training with five milliamps  
16       to open the mouth.

17       **Q.       To what?**

18       A.       To open the mouth. Then we come back with  
19       randomized levels between zero and five, and when they  
20       would open the mouth due to current, that would be  
21       considered a positive response.

22       **Q.       Opening the mouth, is that a response that**  
23       **you saw to current?**

24       A.       That's essentially a trained response to the  
25       current.

1 **Q. Well, what causes the cow to open its mouth?**

2 A. It's just a response to the exposure to the  
3 current.

4 **Q. Meaning you get shocked and I'll open my  
5 mouth?**

6 A. Yes.

7 **Q. Like, "Oh, what's going on" type of thing?**

8 A. Well, this is with a bit in the mouth, so  
9 the mouth is part of the pathway for the current.

10 **Q. So maybe trying to get it out of there type?**

11 A. Right.

12 **Q. Okay. So you trained them at five amps.**

13 A. Milliamps.

14 **Q. Milliamps.**

15 A. You wouldn't have very many cows at  
16 five amps.

17 **Q. Yeah. I'm sorry. Point taken.**

18 **You trained them at five milliamps, and then  
19 repeated this experiment to see when they would open  
20 their mouth, at what current level, and that would --  
21 the idea there is to get a better handle on when  
22 they're actually perceiving the current?**

23 A. Correct.

24 **Q. And your finding was that 13.8 percent  
25 perceived the current at an amp?**

1 A. Milliamp.

2 **Q. Milliamp. Did you try it at like a half**  
3 **amp?**

4 A. No. The protocol here was zero, one, two,  
5 three, four, five.

6 **Q. At four amps you were getting a response of**  
7 **92.3 percent?**

8 A. At four milliamps, yes.

9 **Q. Is that the same four milliamps that's on**  
10 **the chart on that Exhibit 3-4 or Table 3-4?**

11 A. Yeah. A milliamp is a milliamp, yes.

12 **Q. Okay. I mean is that the same worst**  
13 **conditions, four milliamps, that we're talking about on**  
14 **that, that we have 92.3 percent response to?**

15 A. This is -- The conditions of this experiment  
16 is with the bit in the mouth and standing on expanded  
17 metal grate as a floor.

18 **Q. Okay. Then you graph that response rate.**  
19 **Is that Figure 4 or Figure 3 where you graph -- That's**  
20 **front to rear hooves on 3. Yeah, 4 is to all hooves,**  
21 **which correlates to Table 7 then?**

22 A. Correct.

23 **Q. Okay. And then you have your confidence**  
24 **interval there graphed as well?**

25 A. Yes.

1       **Q.       If one were to look at this chart here,**  
2       **Figure 4, and try to -- Does it correlate with the**  
3       **chart at 3-4 of the red book?**

4       A.       It's certainly a piece of data that was  
5       available and used as part of what we used to develop  
6       that consensus presented in that table.

7       **Q.       That table just shows a straight line, and**  
8       **there would be standard deviations off of that line;**  
9       **right?**

10      A.       There would certainly be variability.

11      **Q.       And so you plotted sort of a mean on that**  
12      **chart or what?**

13      A.       One could think of it in terms of a mean,  
14      yeah, or expect it.

15      **Q.       So there would be a confidence interval on**  
16      **both sides of the line that was plotted then in 3-4?**

17      A.       Yes.

18      **Q.       Then if I could take you up to Table 6, this**  
19      **is the front to rear hooves. I was a little confused**  
20      **because it -- You're referring there to escapes. What**  
21      **is an escape?**

22      A.       Well, again, here the animals were trained  
23      with a five milliamp current, that if they would raise  
24      a hoof, we would turn the current off, and so they're  
25      really escaping any further exposure to the current.

1       **Q.       Okay. And what you found out is when you**  
2       **trained them -- and then escape, the escape would mean**  
3       **once you put the bit in their mouth, do they raise the**  
4       **hoof or not?**

5       A.       This is front to rear hoof, so there's no  
6       bit involved here.

7       **Q.       Oh. But once you applied the two things,**  
8       **then they'd raise their hoof?**

9       A.       Correct. Well, you'd have them standing on  
10      two independent grates front to rear hoof, apply the  
11      current; they would learn that if they raised a hoof,  
12      then the current would be shut off.

13      **Q.       Well, I'm trying to figure out why at zero**  
14      **current they're raising their hoof.**

15      A.       Because cows, when they're just standing  
16      there, move around as well.

17      **Q.       Oh, so that's like -- that's like the**  
18      **meaningless part of this.**

19      A.       Yes. It's an unavoidable kind of baseline  
20      of movement.

21      **Q.       Okay. And then the different percentages,**  
22      **those are additive from the previous category or not?**

23      A.       No. They're differences between two  
24      categories, between, for example, zero and one, one and  
25      two; then looking whether that is a statistically

1 significant difference between the two categories.

2 **Q. All right. So if I were to take 43 minus**  
3 **18.3 --**

4 A. No. 43.3 minus 25 should give you 18.3.

5 **Q. All right. So what you found from this**  
6 **particular observation is that at a milliamp, you were**  
7 **getting an increase of five percent over just normal**  
8 **cow hoof lifting incidence?**

9 A. Yeah, that's what the data showed, although  
10 it was not a statistically significant difference.

11 **Q. And it wasn't because your N was only 60; is**  
12 **that it?**

13 A. I wouldn't think so. Sixty is a reasonably  
14 sized number.

15 **Q. Okay. So the first time you found a**  
16 **statistically significant difference was at what; three**  
17 **milliamps?**

18 A. Versus two milliamps, yes.

19 **Q. And then at four milliamps, you found your P**  
20 **was less than .01; right?**

21 A. Yes. Yes.

22 **Q. What you're looking for is a P less**  
23 **than .05; is that it?**

24 A. That's often considered a kind of a  
25 threshold value for statistical significance.



1       **Q.       Do you conclude from this the cows were**  
2       **actually perceiving things then for sure in that three**  
3       **milliamp range?**

4       A.       Correct.

5       **Q.       And then some suggestive data that they were**  
6       **perceiving it even earlier?**

7       A.       It's possible, although not -- certainly not  
8       proven by this data.

9       **Q.       All right.**

10       - - -

11       **And, thereupon, Exhibit No. 322 was marked**  
12       **for purposes of identification.**

13       - - -

14       **BY MR. BIRD:**

15       **Q.       I'm showing you what's marked as**  
16       **Exhibit 322. Can you identify that, please?**

17       A.       This is a memo written by Gerry Bodman dated  
18       April 6, 1994, to me.

19       **Q.       As I read this, apparently you wrote a**  
20       **letter to the Minnesota Public Utilities Commission on**  
21       **March 25th, 1994. Is that true?**

22       A.       Yes.

23       **Q.       Do you have a copy of that letter that you**  
24       **wrote?**

25       A.       Probably in a file somewhere.

1       **Q.       What file might that be in? Do you kind of**  
2       **keep a file of like, you know, important papers related**  
3       **to stray voltage or something?**

4       A.       Yes, I've got copies basically by state for  
5       some of the different publications.

6       **Q.       And apparently you wrote that letter in**  
7       **response to something that Bodman had written to the**  
8       **Minnesota PUC about the Minnesota study; is that true?**

9       A.       I'm going to have to re-read this a bit to  
10      make sure I'm correct.

11      **Q.       Have you finished reading?**  
12              **First of all, is this, to the best of your**  
13      **knowledge, a true and accurate copy of that letter that**  
14      **was sent to you by Mr. Bodman?**

15      A.       Yes.

16      **Q.       And then you may have a copy in your**  
17      **possession of the letter that you sent to the Minnesota**  
18      **Public Utilities Commission about that?**

19      A.       Yes.

20      **Q.       And, apparently, if I'm reading this right,**  
21      **previous to your letter to the Minnesota PUC,**  
22      **Mr. Bodman had written something that you interpreted**  
23      **as being critical about the USDA handbook, which we're**  
24      **referring to here as the red book?**

25      A.       I believe that's correct.

1       **Q.       Do you have a copy of that letter, in other**  
2       **words, the one that you were responding to when you**  
3       **wrote to the PUC?**

4       A.       I think I should have that as well.

5       **Q.       I'd like to get that as well, please.**

6               **Now, did you ever respond to this letter**  
7       **that was written to you by Mr. Bodman?**

8       A.       No, I don't believe we ever did.

9       **Q.       Did you ever talk to Mr. Bodman about it?**

10      A.       Not that I recall.

11      **Q.       The way I'm reading this, at least from my**  
12      **limited knowledge of it, he was speaking to you as an**  
13      **expert in the field and wanted to assure you that he**  
14      **was not challenging your integrity, that he considered**  
15      **you somebody on the other side of the stray voltage**  
16      **controversy, but, nevertheless, a respected adversary.**  
17      **Is that the way you interpreted it?**

18      A.       That's the way I interpreted what he said,  
19      yes. I certainly didn't take any personal response or  
20      personal offense in the way he said it.

21      **Q.       Well, do you likewise consider him a**  
22      **respected member of the, you know, stray voltage**  
23      **community that happens to differ with your opinion?**

24      A.       I certainly respect Gerry, but I don't agree  
25      with many of the things or some of the things he said.

1       **Q.       Has he, in fact, appeared in a number of**  
2       **cases with depositions in lawsuits where he was on the**  
3       **opposite side?**

4       A.       Yes, there has been.

5       **Q.       Did you ever in your own mind attempt to**  
6       **answer any of these questions that he posed, the list**  
7       **of eight questions?**

8       A.       Not in any formal way, no.

9       **Q.       Well, just so we're clear, you did get this**  
10       **letter around the time frame of April 6, 1994?**

11       A.       Yes, I'm sure I did.

12       **Q.       Have you ever since that time up to now**  
13       **attempted to look at the data used in preparing the**  
14       **graph, which is his request in number one?**

15       A.       Well, yes, from time to time I've gone back  
16       to different elements of the data just to refresh my  
17       memory, not necessarily to challenge what's said.

18       **Q.       Well, one of the things you may have looked**  
19       **back on is Exhibit 321, right, which is your initial**  
20       **research along with Dr. Norell?**

21       A.       Correct.

22       **Q.       I mean, you're not saying that your**  
23       **information in Exhibit 321 is bad data, are you?**

24       A.       No.

25       **Q.       Then if I can go to question two in the**

1 letter, on page 2 he says, "Accepting for the moment  
2 that the graph in the handbook represents a trend  
3 line," what's the standard deviation of the data from  
4 the normal that was published? Did you ever go back  
5 and try to figure that out?

6 A. No.

7 Q. Do you think that's possible?

8 A. No.

9 Q. Because you didn't use statistics to create  
10 the chart; right?

11 A. That's correct.

12 Q. You, instead, used the judgment of the  
13 people that participated in preparing that publication?

14 A. Correct.

15 Q. Then he asks you in question four: How do  
16 you account for the two cows that were thrown out of  
17 the Cornell and USDA studies because of their violent  
18 and/or other reactions which led researchers to fear  
19 for the animals' well-being?

20 Have you done anything to figure that out  
21 since 1994?

22 A. No.

23 Q. Did you do enough to find out that there, in  
24 fact, were two cows that were thrown out because of  
25 their violent reaction?

1 A. I believe in discussions with others, that  
2 was confirmed, that there were two cows that were  
3 eliminated.

4 **Q. Did you speak with Gorewit or Aneshansley or**  
5 **somebody to confirm that?**

6 A. I probably did, but I couldn't specifically  
7 recall that right now.

8 **Q. Well, as you sit here today, you're not**  
9 **challenging the premise of his question, are you,**  
10 **question number four, that there were two cows that**  
11 **were thrown out?**

12 A. No.

13 **Q. Then on question five, he's saying he's**  
14 **concerned about the fact that the data shown on the**  
15 **chart doesn't fit with the reports that you've**  
16 **published about your field findings. Do you disagree**  
17 **with that or agree with it?**

18 A. That would be his opinion. I don't agree  
19 with that opinion.

20 **Q. So you feel that your research as shown in**  
21 **Exhibit 321 squares with that?**

22 A. I think it's consistent, yes.

23 **Q. I take it you would concede that your chart**  
24 **could be wrong; right?**

25 A. I wouldn't anticipate, but, theoretically,

1 yes, you can come up with other data.

2 **Q. In question seven he asks you to explain the**  
3 **linear relationship of animal response to current and**  
4 **voltages shown in the handbook since your own data**  
5 **regarding animal response to current and voltage show a**  
6 **non-linear response; correct?**

7 A. Correct.

8 **Q. And we just went through that, I mean, in**  
9 **Exhibit 321. We showed that on Figure 4, that you have**  
10 **a non-linear response there.**

11 A. Yes. And if we did a much more detailed  
12 description of that, you might be able to refine that,  
13 but in presenting conceptually how this works and what  
14 to apply by the data, I still think that linear is a  
15 reasonable approximation.

16 **Q. Well, but, I mean, defense attorneys are**  
17 **using this in courtrooms to tell, as I said, jurors**  
18 **that this is literally the gospel truth in perception**  
19 **levels and when you can ever get a milk response. I**  
20 **mean, do you think that that chart was intended to be**  
21 **used for that purpose?**

22 **MR. O'BRIEN: Objection to form, foundation.**

23 A. I think that chart was intended to be used  
24 for educational purposes. If you want to include that  
25 as part of educating, then it would be available for

1 that kind of use.

2 **Q. So you think it's fair to use it in a**  
3 **courtroom?**

4 A. Yes.

5 **Q. Is it true from your perspective that the**  
6 **publication of that chart in the red book was**  
7 **controversial in the agricultural engineering**  
8 **community?**

9 A. I didn't view it as controversial. I think  
10 it did force us to come up with kind of a consistent  
11 way of describing things, and that took some time.

12 **Q. Well, there's been significant criticism of**  
13 **the chart by credible scientists. You're aware of**  
14 **that?**

15 **MR. O'BRIEN: Objection to form.**

16 A. There has been criticism.

17 **Q. But the people who have criticized it are**  
18 **credible scientists, aren't they?**

19 A. I don't know which --

20 **Q. Well, how about Mr. Bodman? He's a credible**  
21 **scientific investigator, is he not?**

22 A. I would question him.

23 **Q. You don't think he is?**

24 A. I think he has shown at times that he's not  
25 credible in his techniques and approaches.



1       **Q.       Is he credible with respect to his**  
2       **criticisms of that chart and the questions he's asking**  
3       **about the chart?**

4       A.       I didn't think so, no.

5       **Q.       So you don't think these are even legitimate**  
6       **questions to ask about the chart?**

7       A.       They're fine questions to ask. I don't  
8       think that they represent anything that is in error or  
9       incorrect about what was presented.

10      **Q.       Now, he refers there to LaVerne Stetson.**  
11      **And LaVerne Stetson and Mr. Bodman were colleagues at**  
12      **University of Nebraska; right?**

13      A.       Yes. LaVerne was with USDA Ag Research  
14      located at the University of Nebraska, Lincoln, and  
15      Jerry was with University of Nebraska Extension Service  
16      based in Lincoln.

17      **Q.       And you know LaVerne Stetson has been hired**  
18      **on numerous occasions, just as you have been, by**  
19      **utilities to provide testimony?**

20      A.       I know he's done some expert witness work,  
21      yes.

22      **Q.       But where he's come from is he's been hired**  
23      **by utilities, not farmers?**

24      A.       I don't know details of what cases he's  
25      done. The ones that I am aware of I think were

1 utility.

2 **Q. He was the main reporter for the Science**  
3 **Advisors group; right?**

4 A. He was a member of that board or that  
5 Science Advisory board, yes.

6 **Q. Do you know what role he played in it?**

7 A. I don't know the details of what all he did  
8 within it. I know he was an active member of it.

9 MR. BIRD: What exhibit is that? We marked  
10 just the cover page, I think. Yeah. Exhibit 316. I  
11 don't know. You probably have that here, don't you?

12 MR. O'BRIEN: No, I don't have that.

13 MR. BIRD: Do you have it, a copy of it?  
14 (Witness nodded head.)

15 BY MR. BIRD:

16 **Q. Okay. Now, did you participate at all in**  
17 **any of the research that was done to create this**  
18 **report?**

19 A. No.

20 **Q. As I understand it, this, the research end**  
21 **of it, was contracted to Dr. Reinemann. Is that right?**

22 A. Part of the research was contracted to him,  
23 the part that dealt with animal sensitivity. I think  
24 there may have been some other elements that were done  
25 by other parties.

1       **Q.       Now, this particular paper is simply a**  
2       **report to the Minnesota PUC?**

3       A.       Yes.

4       **Q.       Do you know whether it's been adopted by the**  
5       **Minnesota PUC to be accurate and to have the force of**  
6       **law in Minnesota?**

7       A.       Not that I'm aware of.

8       **Q.       Well, it says here that these are**  
9       **recommendations of the Science Advisors and do not**  
10       **necessarily reflect the views of the Commission.**

11       A.       Yes.

12       **Q.       Do you know anybody that works for the**  
13       **Minnesota Public Utilities Commission?**

14       A.       No, I don't think I do at this point.

15       **Q.       You don't recall?**

16       A.       I --

17               MR. BIRD: What was the name of that guy?

18               MR. O'BRIEN: Mr. Bierbaum.

19       **Q.       Do you know Bierbaum, Al Bierbaum?**

20       A.       Oh, yes; I met Al. I'm not sure he worked  
21       for them at the time that this would have been created,  
22       though.

23       **Q.       I think he testified that he did.**

24       A.       Really? Okay. I don't know Al well. I've  
25       met him.

1       **Q.       You know that he came from the industry in**  
2       **Iowa?**

3       A.       Yes.

4       **Q.       And then one of the people was Charles Polk**  
5       **from Rhode Island?**

6       A.       Correct.

7       **Q.       Polk did a paper that we've marked here**  
8       **pointing out some potential problems with the Science**  
9       **Advisors' report; right?**

10       **MR. O'BRIEN: Object to form.**

11       A.       He pointed out some things he thought could  
12       be looked at further.

13       **Q.       And it's your contention that Reinemann, in**  
14       **fact, did look at those things?**

15       A.       From the animal sensitivity question that he  
16       raised, yes.

17       **Q.       All right. I'm showing you Exhibit 311.**  
18       **What is it that, in looking at that, you believe**  
19       **Dr. Polk has raised as a concern?**

20       **MR. O'BRIEN: Objection to form.**

21       A.       I believe it would stem from his item number  
22       eight in the conclusion section on page 16 of the  
23       article. Want me to just read it?

24       **Q.       Yeah; read it into the record so we know**  
25       **what you're talking about.**

1 A. "At present it is not known whether and how  
2 the long-term exposure to step voltages above nine  
3 millivolts can affect health and/or milk production of  
4 dairy cows. This can only be established by laboratory  
5 experiments where major variables known to affect  
6 animal health can be controlled."

7 **Q. Let me just take a look at that.**  
8 **Do you know what he meant by "long-term**  
9 **exposure" there?**

10 A. That would be exposure over a time period of  
11 days, likely, to weeks.

12 **Q. Did you ever talk to him about what he meant**  
13 **by "long-term exposure"?**

14 A. No.

15 **Q. What research did Dr. Reinemann do to answer**  
16 **that question posed in number eight on page 16?**

17 A. He had research experiments that he followed  
18 up from the Minnesota Science Advisory Committee that's  
19 been published later. I'd have to do a little digging  
20 to find out the specific publication right now that tie  
21 to that part.

22 **Q. Is that something you can add to your list**  
23 **there so I can look at it?**

24 A. Certainly.

25 **Q. Is there more than one study that he did?**

1 A. As we sit here right now, I don't recall  
2 whether it was all in kind of one package or in parts  
3 that he may have done. I'd have to go back and look.

4 **Q. Okay. And the research that he did, do you**  
5 **know how long the trial was?**

6 A. I don't have that right off the top of my  
7 head. I'd have to go back to the paper to be reliable  
8 in answering.

9 **Q. Well, don't you think Dr. Polk, when he was**  
10 **talking about long-term, he was talking about certainly**  
11 **over a period of months or years?**

12 A. I don't know specifically right now what he  
13 meant by long-term.

14 **Q. You never talked to him about it?**

15 A. No. I've never met Dr. Polk.

16 **Q. Unfortunately, he's no longer with us.**  
17 **I mean, what is it; .09 millivolts, is that**  
18 **what he -- or nine millivolts, or what does he say?**

19 A. Nine millivolts, yes.

20 **Q. That's nine thousandths of a volt?**

21 A. Correct.

22 **Q. That's pretty low.**

23 A. Very low.

24 **Q. I mean, on your chart, on table 3-4 in the**  
25 **red book on page 3-22, that wouldn't even hardly show**

1 **up on your chart, would it?**

2 A. That's correct. That would be orders of  
3 magnitude lower than what we're displaying in that  
4 chart.

5 **Q. His concern was that, you know, there were a**  
6 **lot of short-term experiments that were in the**  
7 **literature and nobody had bothered to go look at**  
8 **long-term.**

9 **MR. O'BRIEN: Objection. Form, foundation.**

10 A. I think his concern was exposure at this  
11 particular level, not all levels, but this particular  
12 level, and characteristic of a longer term exposure.

13 **Q. You mean at precisely that number? Is that**  
14 **what you're saying?**

15 A. No, not precisely, but in that range of  
16 value.

17 **Q. Well, if he was concerned about nine**  
18 **millivolts, presumably he would be more concerned about**  
19 **a hundred millivolts; right? Would that make sense to**  
20 **you?**

21 A. That would make sense to me, yes.

22 **Q. All right. So given that your level of**  
23 **concern, so to speak, doesn't even begin until**  
24 **two volts, he was at a lot lower -- I mean, he was**  
25 **looking for long-term data for a smaller voltage**

1       **exposure; right?**

2               **MR. O'BRIEN: Objection; form and**  
3       **foundation.**

4       A.       Correct; he was looking at different -- a  
5       low-level exposure.

6       **Q.       And the data up to that point hadn't**  
7       **occurred over a period of months or years; right?**

8       A.       Not particularly the low levels he's talking  
9       about.

10       **Q.       Right. I mean, there was the one study done**  
11       **by Gorewit that was called a full lactation; right?**

12       A.       Correct.

13       **Q.       But that was at -- I don't know how many**  
14       **cows were involved in that, but -- Do you know?**

15       A.       Not without digging.

16       **Q.       But it was, you know, less than 10; right?**

17       A.       It would be in that order of magnitude.

18       **Q.       Mike shook his head, but -- He knows this**  
19       **stuff.**

20       A.       Then there would be the Ontario work which  
21       is longer term exposure as well.

22       **Q.       Is that that fellow that you mentioned**  
23       **that -- you were referring to the Ontario work?**

24       A.       Yes.

25       **Q.       I was going to ask you this. Are you aware**



1       **of any published research on the topic of stray voltage**  
2       **since 2003?**

3       A.       I haven't got precisely in my mind what  
4       papers were produced when, but there's not -- wouldn't  
5       be very many. The couple articles we referred to in  
6       the IEEE would have been since then.

7       **Q.       Oh, you mean the --**

8       A.       Zipse article.

9       **Q.       Zipse and your response?**

10      A.       Correct.

11      **Q.       Okay. That's published, but not peer**  
12      **reviewed; right?**

13      A.       Correct.

14      **Q.       Let me amend it to say peer reviewed**  
15      **research since 2003.**

16      A.       I don't recall specifically doing that kind  
17      of search, but I don't think of any right now.

18      **Q.       Are you aware if there's any research that**  
19      **has been done where there hasn't been anything**  
20      **published?**

21      A.       Not that I'm aware of.

22      **Q.       Are you aware of any research that's going**  
23      **on right now in the field of stray voltage?**

24      A.       As far as from animal aspects of things, not  
25      that I'm aware of.

1       **Q.**       Looking at the Science Advisors, I mean,  
2       that is one of the things that you were going to be  
3       talking about according to the letter that we got on  
4       your opinions, Exhibit 309. Maybe I should just ask  
5       you. On Exhibit 309, if I'm reading this right -- Did  
6       you write this, by the way?

7       A.       Yes.

8       **Q.**       I mean, somebody didn't write it for you and  
9       then you adopted it as your own?

10      A.       No.

11      **Q.**       Okay. So it's reasonable to expect that you  
12      knew what you were doing when you wrote it; right?

13      A.       I hope so.

14      **Q.**       Okay. And I'm just reading from the first  
15      sentence. "After reviewing materials received to date  
16      regarding this case, I would expect to testify  
17      regarding the following opinions." What are those  
18      opinions that are following? Where are they? Are they  
19      the dotted items there? Is that what you're going to  
20      testify to?

21      A.       Yes.

22      **Q.**       So your opinions in this case are limited to  
23      Zipse's work is not in accord with the scientific  
24      community? Is that one of your opinions?

25      A.       Correct.

1       **Q.       That the field bucket test does not document**  
2       **any hazardous situation, but it could be used to**  
3       **measure AC current through the animal?**

4       A.       Correct.

5       **Q.       Then the third is that the summary of the**  
6       **measurements on the farmstead, document MT06-114, would**  
7       **not demonstrate voltages expected to create a herd**  
8       **response?**

9       A.       Correct.

10      **Q.       Do you have any other opinions you think**  
11      **you're going to testify to in this case?**

12      A.       I don't know if it's an opinion or just  
13      related to interpretation of the documents structured  
14      above, the USDA handbook, Minnesota report.

15      **Q.       I mean, you're going to be offering an**  
16      **opinion that the handbook is a good source of**  
17      **information; is that what you're saying?**

18      A.       Yes.

19      **Q.       And you're going to be offering an opinion**  
20      **the Science Advisory Report on earth current is a**  
21      **source of --**

22      A.       Good information.

23      **Q.       -- good information? And then the research**  
24      **studies from the University of Wisconsin Madison since**  
25      **issuing of the Minnesota Science Advisory Report?**

1 A. Correct.

2 **Q. Okay. "These are also supported by a**  
3 **variety of publications based both on field studies and**  
4 **other research."**

5 A. Correct.

6 **Q. I'm interested then in knowing what are the**  
7 **other research studies from University of Wisconsin**  
8 **that you're going to be telling this jury are good,**  
9 **credible scientific research.**

10 A. Yes; we had that on the list here.

11 **Q. Oh, we already did?**

12 A. Yes.

13 **Q. Is it true that anything that has**  
14 **Reinemann's name on you're going to think is good**  
15 **research?**

16 A. I have great respect for the work he's done.  
17 That would generally be true.

18 **Q. And then you're talking about a variety of**  
19 **publications based upon field studies and other**  
20 **research. That's expanding this base of things that**  
21 **you're going to testify about, and I would like to get**  
22 **that. The reason I'm saying that is because I don't**  
23 **want to have you come up with something that I haven't**  
24 **looked at and see it for the first time when you get on**  
25 **the witness stand, so if you could give me that. What**

1       **I'm looking for is those things that you feel are**  
2       **credible and can be relied upon from your perspective**  
3       **with respect to stray voltage that you intend to use to**  
4       **support your opinions.**

5       A.       Okay.

6               MR. BIRD: And, for the record, Mike, I  
7       would have expected that list to be here today so I  
8       could at least look at it, but, depending on what it  
9       is, I may or may not want to ask him some further  
10      questions about particular studies. I'm just making a  
11      record here.

12             MR. O'BRIEN: Well, he told you basically at  
13      the beginning of the deposition where those lists would  
14      be found, and they just haven't been compiled.

15             MR. BIRD: I didn't know. Did I have  
16      specific reference to his report, though? I'm not sure  
17      if I did.

18      **Q.       But, in any event, is there anything else**  
19      **that you intend to offer opinions on besides what we've**  
20      **just discussed?**

21             MR. O'BRIEN: I may have him review that  
22      **resistance testing.**

23             MR. BIRD: Okay.

24      **Q.       Then besides that?**

25      A.       Not that I'm aware of.

1       **Q.       Okay. I take it you're not going to testify**  
2       **about specific levels of voltage or current at the**  
3       **Siewert farm; correct?**

4               **(Deposition interrupted.)**

5       **Q.       Do you have the question in mind?**

6       A.       Yes. The only thing I might be asked to  
7       respond to is, as I noted here, the summary document of  
8       measurements.

9       **Q.       What summary document? I'm not sure what**  
10       **you're saying.**

11       A.       It's --

12       **Q.       Oh, yeah. Okay. We marked that, didn't we?**

13               **MR. O'BRIEN: 314.**

14               MR. BIRD: 314. This is from Metatec  
15       Associates. Who is Metatec?

16               MR. O'BRIEN: Reilly.

17       A.       So this -- I mean this --

18       **Q.       You're going to comment on that?**

19       A.       I may comment on it.

20       **Q.       Okay. What are you going to testify to**  
21       **about that document? And that's Exhibit 314.**

22       A.       It would be, to summarize really the  
23       statement, it just does not demonstrate voltages I  
24       would expect to create a herd response.

25       **Q.       What do you mean by herd response?**

1 A. Production problems or health problems in a  
2 herd.

3 **Q. Are you an expert in the area of milk**  
4 **production related to stray voltage?**

5 A. I've certainly had a lot of experience in  
6 that area, worked with a lot of farms in that area.

7 **Q. Are you saying that -- Would those**  
8 **measurements account for behavioral responses?**

9 A. There may be some component of time here  
10 that are approaching levels that might be some  
11 perception level responses, but that's all I've seen.

12 **Q. And your basis for saying that is what?**

13 A. Just my experience working in the area.

14 **Q. So it's based upon -- Strike that. I mean,**  
15 **you're not currently going out on extension visits, are**  
16 **you, for stray voltage?**

17 A. Yes.

18 **Q. For stray voltage?**

19 A. Yes.

20 **Q. How often do you do that?**

21 A. Probably three, four times a year.

22 **Q. When is the last time you did it?**

23 A. It would have been sometime in November.

24 **Q. Did you find any voltages there at that**  
25 **place?**

1 A. We found some voltage at a fairly low level,  
2 although we were there after some other corrections or  
3 changes had been made to the system, so I'm not sure  
4 what had been there prior to when we were there.

5 **Q. Well, let me see this. Maybe you can help**  
6 **me to read this first line here. It says, "Loafing**  
7 **barn" -- Can you just read what that means?**

8 A. Loafing barn .086 volts without -- without  
9 an Rs, without a resistor; 0.42 volts with shunt  
10 resistor; and then Ro 548 ohms.

11 **Q. What does that mean?**

12 A. I'd have to go back and look at that right  
13 now to be -- I'm speculating, but I think that might be  
14 the source resistance in the circuit. I'd have to go  
15 back and confirm that.

16 **Q. Let me just try to read this over here. I**  
17 **didn't get this with your report, so I, frankly, didn't**  
18 **see it until this morning, actually, first time I saw**  
19 **it.**

20 **MR. O'BRIEN: Well, you got it with**  
21 **Mr. Reilly's report.**

22 MR. BIRD: Well, then, I guess I didn't put  
23 two and two together maybe because it says -- it said  
24 document MT06-114, and it doesn't -- I have no idea  
25 what that is, so, I mean --



1 THE WITNESS: Well, I apologize for not  
2 being clear on that.

3 MR. BIRD: I mean, if it meant Metatec or  
4 Reilly or something, I could have looked it up. But  
5 all I'm telling you is I'm a little bit confused now  
6 about what to ask you.

7 **Q. Without Rs, is that -- Rs, is that**  
8 **resistance?**

9 A. Yes.

10 **Q. And then 0.42 volts with Rs; Ro equals**  
11 **548 ohms. What does that Ro mean?**

12 A. I think that's based on additional  
13 calculation which would give you a sense of what the  
14 source resistance is in the circuit.

15 **Q. Does that make any difference?**

16 A. Certainly, because it's part -- remember  
17 when we talked about the Ludington diagram; there's a  
18 certain resistance in the source getting to the point  
19 where the contact by the animal might be made, and this  
20 is one way of using that data to give you an estimate  
21 of that value.

22 **Q. Okay. And then the parlor was .091 volts**  
23 **without resistance?**

24 A. Correct.

25 **Q. Then .085 with resistance, and Ro equals**

1       **35 ohms?**

2       A.       Correct.

3       **Q.       What does that mean?**

4       A.       That means that the source resistance in  
5       that particular circuit was smaller than the similar  
6       source resistance out in the loafing barn area.

7       **Q.       And what was the resistance?**

8       A.       Well, the second case, it was the 35 ohms.

9       **Q.       No, no, no. But the .42 with resistance,  
10       what was that?**

11       A.       That would be the shunt across the meter,  
12       like the 500-ohm shunt.

13       **Q.       Do you know what that was, what the number  
14       was, though?**

15       A.       Not without going back to the other -- to  
16       the original data.

17       **Q.       When you say original -- So you don't know  
18       that as you sit here today?**

19       A.       No, I couldn't tell you what the value is,  
20       specific value is, on that.

21       **Q.       Well, then, it would be important for you to  
22       know that to express a competent opinion, wouldn't it?**

23       A.       In that particular measurement, well, to  
24       replicate it, I'd have to know the value, but knowing  
25       that's kind of a standard approach to things, I don't

1 have any reason to question it.

2 **Q. So you're assuming 500 ohms resistance, give**  
3 **or take a little?**

4 A. Well, you could use a value different from  
5 500 ohms to make that calculation. It would still give  
6 you a valid result.

7 **Q. Because you need the voltage and --**

8 A. You need the open circuit voltage, and then  
9 you need the voltages with a known resistance; then you  
10 can calculate that source resistance.

11 **Q. Then the water cup to the floor is .58 volts**  
12 **without resistance and .461 volts with resistance.**

13 A. Correct.

14 **Q. You're going to be able to confirm for me**  
15 **what that Ro represents; right?**

16 A. I can do that, yes.

17 MR. O'BRIEN: May I cut in? Are you asking  
18 the last figure?

19 MR. BIRD: Yeah.

20 MR. O'BRIEN: Patrick Reilly said that was  
21 source resistance in his deposition.

22 MR. BIRD: He did?

23 MR. O'BRIEN: Yeah.

24 **Q. How does the source resistance affect how**  
25 **the cow -- I mean, the actual measurement, with**

1       **resistance, how does that affect it?**

2       A.       It affects that in when you look at the  
3       resistance of the total circuit, which is going to  
4       control how much current gets to the animal, it makes a  
5       difference there, so it's an additional kind of  
6       restriction, you can think about it, as in current  
7       getting to the animal. A high value here might  
8       represent an object that's not electrically bonded, so  
9       that you have a high resistance and very low  
10      probability of getting current through that circuit to  
11      the animal.

12      **Q.       I mean, if there's a voltage there, where**  
13      **are you measuring? At the cow contact point then?**

14      A.       Yes. Yes. An analogy here might be looking  
15      to see whether you've got a dead battery source there  
16      which would have a high source impedance.

17      **Q.       All right. Now, the strip chart recordings**  
18      **on the Metrosonics, do you know what the resistance was**  
19      **there?**

20      A.       As I look at this right now, no, I don't  
21      recall.

22      **Q.       Would you want to know that?**

23      A.       It would be helpful.

24              MR. BIRD: Do you know that answer? What's  
25      that answer?

1 MR. O'BRIEN: It's either 470 or 500. I  
2 can't remember. It's one of those two.

3 BY MR. BIRD:

4 **Q. So what that is is that they put a shunt**  
5 **resistor in and then took the measurement and got a**  
6 **volt for about 20 minutes around 6:00 p.m.?**

7 A. Correct.

8 **Q. It was around that time, or don't you know,**  
9 **that Mr. Siewert disconnected the system?**

10 A. I think I knew that when I was looking at  
11 this particular data, yes.

12 **Q. Okay. This 106 pages of voltages versus**  
13 **time recordings and other related data, you, I take it,**  
14 **haven't looked at this information yourself.**

15 A. I haven't looked at the data behind this,  
16 no.

17 **Q. What you're saying is that your opinion is**  
18 **going to be based upon Reilly's summary of the data?**

19 A. Correct.

20 **Q. And it's based upon the summary of the data**  
21 **that you don't think there's a problem?**

22 A. It's not consistent with what I'd expect to  
23 see for a problem.

24 **Q. And it looks like the water tank to the**  
25 **floor is a half to 1.4 volts with a 470-ohm resistor?**

1 A. For a 15-minute period, yes.

2 **Q. Right. And that's around 5:42:33?**

3 A. Yes.

4 **Q. Now, is that the same data as the one volt**  
5 **RMS? Excuse me. I'm sorry. I'm having trouble here.**  
6 **The one volt on the strip, Metrosonics strip, or is**  
7 **that different data?**

8 MR. BIRD: Did I go through all of this in  
9 his --

10 MR. O'BRIEN: I think so.

11 MR. BIRD: I can't remember if I did or  
12 didn't.

13 MR. O'BRIEN: To speed it up, the bottom one  
14 is the Neubauer testing.

15 MR. BIRD: It is?

16 MR. O'BRIEN: Yeah.

17 MR. BIRD: All right. Metrosonics is  
18 Gunther; right?

19 MR. O'BRIEN: Yes.

20 MR. BIRD: All right.

21 BY MR. BIRD:

22 **Q. In order to make sense out of the data,**  
23 **you've got to convert the measurements of volts and**  
24 **resistance to current because what you're looking at,**  
25 **frankly, is current?**

1 A. Correct; that's -- you have to recognize  
2 that what the animal senses is current, and you're  
3 going to have to translate voltage back into --

4 MR. O'BRIEN: I'll just tell you for the  
5 record I'm going to send that portion of Mr. Forster's  
6 deposition that you took in which he interprets  
7 Mr. Neubauer's testing differently than Mr. Reilly.

8 MR. BIRD: What?

9 MR. O'BRIEN: I don't even know if I've got  
10 Forster's deposition back yet. I don't think we do, do  
11 we?

12 MR. BIRD: I don't know.

13 MR. O'BRIEN: He interpreted Mr. Neubauer's  
14 testing results differently than Mr. Reilly did.

15 MR. BIRD: You mean like better in your  
16 favor?

17 MR. O'BRIEN: He thought it was a peak  
18 reading.

19 MR. BIRD: As opposed to RMS?

20 MR. O'BRIEN: As opposed to RMS.

21 MR. BIRD: Did you ask that about Pat  
22 Neubauer? What did he say?

23 MR. O'BRIEN: I can't remember.

24 BY MR. BIRD:

25 **Q. Do you know whether these are -- that the**

1       **readings that you're getting here -- or maybe it**  
2       **doesn't make any difference to you -- whether it's peak**  
3       **readings or RMS?**

4       A.       I don't know at this point whether they are  
5       peak or RMS.

6       **Q.       Wouldn't make any difference from the**  
7       **numbers, though; right?**

8       A.       From the numbers, I think my bottom line  
9       conclusion would be the same. I wouldn't expect for  
10      this to be creating a herd problem.

11      **Q.       Are you going to be testifying specifically**  
12      **that there was never a stray voltage problem at the**  
13      **Siewert farm?**

14      A.       No.

15      **Q.       Are you going to be testifying at all why**  
16      **the cows wouldn't cross the threshold into the parlor**  
17      **at the Siewert farm?**

18              **MR. O'BRIEN: Objection to form, foundation.**

19      A.       I don't -- I hadn't anticipated doing that.

20              MR. BIRD: Let's take five.

21              (Recess taken.)

22      BY MR. BIRD:

23      **Q.       Just in my mind, I don't get the source**  
24      **impedance thing, so I want to take another stab at it.**

25      A.       Okay.



1       **Q.       If you can go to 3-22 in the red book, I**  
2       **mean, what you're listing there, the 500 ohms column I**  
3       **think you've told me is a combination of the contact**  
4       **resistance and the cow resistance. For any given**  
5       **source resistance, would those numbers change at all?**

6       A.       If we assume these are measurements in the  
7       cow contact domain, no.

8       **Q.       I mean, if it's in the cow contact, can we**  
9       **basically, you know, eliminate the consideration of**  
10       **source resistance?**

11       A.       No.

12       **Q.       Why not?**

13       A.       We have to confirm using something like the  
14       resistor that the source has current producing  
15       capability that's going to remain adequate when you  
16       make that type of measurement.

17               That's not being helpful to you. I'm sorry.  
18       Let me describe this more carefully.

19       **Q.       You have to confirm the current going**  
20       **through?**

21       A.       You have to confirm that the source has the  
22       current producing capability of maintaining that  
23       current through the animal when the animal is actually  
24       there. That's what putting in the shunt resistor does  
25       for you.

1       **Q.       But if a shunt resistor is used -- Let me**  
2       **just take a, you know, "what if" type thing.**

3               **In this chart, you're not even considering**  
4       **source resistance by definition; right?**

5       A.       By definition, we're assuming insignificant  
6       source resistance.

7       **Q.       What does that mean?**

8       A.       That whatever source you're measuring has a  
9       current producing capability; it's going to create  
10      those kinds of numbers.

11              I've got to think how to say that in a  
12      different way that might be helpful to you.

13              If we go back to 3.5 -- Could we do that for  
14      a moment?

15      **Q.       Yeah. 2.5?**

16      A.       Page 3.5. The source resistance we're  
17      talking about is listed here and says Z sub source.

18      **Q.       Right.**

19      A.       If we make a voltage measurement without the  
20      resistor to simulate the cow contact and cow contact  
21      resistances there, we're measuring what we call an open  
22      circuit voltage, and because the internal impedance of  
23      our measurement device is very high, this path doesn't  
24      have to be very good, so to speak, to give you a  
25      voltage measurement there; so we then put in the shunt

1 resistor to reduce that path resistance of the part  
2 where we're measuring to the known value, and that then  
3 combined with the open circuit voltage allows us to  
4 calculate what the source resistance would be. An  
5 extreme case might be a metal object that is not  
6 grounded, and you measure to that, and you measure,  
7 let's say, a half a volt; and then you put the resistor  
8 on, and it goes down to essentially zero; what you've  
9 then detected is that you don't have a path there; you  
10 have what we call a very high source resistance.

11 An example of that might be if you connected  
12 to one of the switch boxes here on the wall to the  
13 floor, if measuring open circuit, you might measure  
14 voltage there. If the box is not grounded or had that  
15 green or bare wire tied, when you put that shunt  
16 resistor in, that voltage is probably going to go down  
17 to zero because it has a high source impedance there.

18 **Q. All right. So is it necessary to measure**  
19 **the voltage without the resistor first? Is that what**  
20 **you're saying?**

21 A. If you want to estimate the source  
22 impedance, you need to make both measurements. It  
23 doesn't matter which order you do them in.

24 **Q. Well, but if you had the resistor on and you**  
25 **get a voltage, what difference does it make if you know**

1 **the source resistance?**

2 A. Well, you don't know at that point without  
3 making the second measurement.

4 **Q. Well, that's the point. Why do you care**  
5 **about the source resistance if you're getting voltage**  
6 **with the 500-ohm resistor in place? You know that**  
7 **you've got -- By definition, you know that you've got**  
8 **enough current to go by the -- go through the resistor.**

9 A. At one level, that's correct, but to really  
10 understand the electrical circuit and what you're  
11 dealing with, you would want to do the second  
12 measurement and know that source impedance as well.

13 **Q. All right. So if somebody is getting with a**  
14 **500-ohm resistor a volt, will the current change based**  
15 **upon what the source resistance is?**

16 A. Yes.

17 **Q. How does that work? Tell me how that works.**  
18 **This is probably Electrical Engineering 101, but --**

19 A. A little bit.

20 **Q. Yeah.**

21 A. Well, if you make a specific measurement,  
22 it's going to be dependent on whatever the source  
23 resistance is, and if that source resistance changes,  
24 then that may change the value that you measure. I'm  
25 going to give you an example of that.

1           If we measured from this ungrounded object  
2           to the floor and measured a voltage, open circuit, put  
3           the shunt, and it goes away, we might come back and now  
4           bond that box, tie it to the grounding system like it's  
5           supposed to be via code, and then we would -- could  
6           dramatically change the source resistance. So by  
7           changing things in the electrical system, you might  
8           change that source resistance, so it's important to  
9           know, you know, what characteristic that is when you're  
10          making your measurements there.

11          **Q. All right. But that involves a change in**  
12          **the source resistance by virtue of some repair?**

13          A. Repair or some other change in the system,  
14          yeah.

15          **Q. All right. But let me just say this. Let's**  
16          **assume two different cases. In case number one, the**  
17          **result is one volt with a 500-ohm resistor, and the**  
18          **source impedance, let's say, is 200 ohms; and then the**  
19          **second one, it's one volt with a 500-ohm resistor, and**  
20          **the source impedance is 400 ohms. Okay? Do you have**  
21          **that in mind?**

22          A. Okay.

23          **Q. Is there any difference in those two cases**  
24          **in the current actually going to the cow?**

25          A. In your simulated cow there, no.

1       **Q.       Current is the same?**

2       A.       Correct.

3       **Q.       That's all I wanted to know. Okay. Now I**  
4       **think I'm understanding why you want to know the -- All**  
5       **right.**

6               **The research from Ontario that you referred**  
7       **to several times, is that in that red book, or is there**  
8       **some since that red book was published?**

9       A.       I'm not immediately seeing it, so it may  
10       well have been subsequent to the publication that that  
11       work was actually published.

12       **Q.       And you're looking for Gumprich as the**  
13       **author; is that it?**

14       A.       Yes, that's where I was starting.

15       **Q.       Now, you've on several times told me you**  
16       **were going to get me the list of publications that**  
17       **support your opinion that you rely upon. I'm assuming**  
18       **you're going to include those that were either authored**  
19       **by or in which Gumprich was the second author to come**  
20       **from Ontario?**

21       A.       I will do that.

22       **Q.       You've got another guy in here that's from**  
23       **Ontario, Hockin. There's maybe even a third.**

24       A.       There may have been an Extension person from  
25       Ontario, but he was not related to the particular

1 research done at New Liskeard.

2 **Q. Gumprich, is he an agricultural engineer?**

3 A. Yes, I believe he is.

4 **Q. Do you know what the source resistance would**  
5 **be for, let's say, wet, salty earth?**

6 A. That's -- It's not a question I can answer  
7 because the source resistance usually deals with the  
8 path from the electrical system to whatever object  
9 you're measuring from. Are you asking me to assume  
10 that that's through the earth itself --

11 **Q. Right.**

12 A. -- to get there?

13 **Q. Right.**

14 A. That would be dependent on the distance, the  
15 conductivity of the -- or resistivity of the materials,  
16 so I couldn't give you a specific number in just a  
17 general sense.

18 **Q. You would agree with me that the issue here**  
19 **is current going through the cow, and it doesn't make a**  
20 **whole lot of difference how it gets there if we can**  
21 **measure current going through the cow?**

22 A. Well, current through the cow is from the  
23 animal responses; I would agree there. To me, I still  
24 want to understand how that current is getting to the  
25 animal as well and make sure that that's validly

1 described as well.

2 **Q. Right. Well, I mean, there is such a thing**  
3 **as earth current; right?**

4 A. There is current that flows in the earth,  
5 yes.

6 **Q. Right. And if that current were at**  
7 **sufficient levels and made contact with a cow,**  
8 **depending on the level of that cow contact, it may or**  
9 **may not cause problems?**

10 A. If that current could produce a voltage  
11 differential between two points that the cow sees such  
12 that it's going to create a current through the cow at  
13 a problematic level, then you could get into problems.

14 **Q. So whatever way we look at it, we're looking**  
15 **at an application of Ohm's Law really?**

16 A. Absolutely.

17 **Q. Okay. There's nothing controversial about**  
18 **that. We talked about that already.**

19 A. Right.

20 **Q. Okay. I take it you don't have much**  
21 **knowledge of distribution systems and design of those?**

22 A. I have a basic understanding, but I've not  
23 done systems design. I wouldn't consider myself an  
24 expert in system design.

25 **Q. Are you able to, you know, competently talk**



1       **about the difference in neutral-to-earth voltages in,**  
2       **let's say, a single-phase versus a three-phase system?**

3       A.       Yes.

4       **Q.       Okay. Are you familiar with open delta-open**  
5       **wye?**

6       A.       Yes.

7       **Q.       What's your opinion on that?**

8       A.       They -- You can have neutral-to-earth  
9       voltage problems on an open delta-open wye system.

10      **Q.       Why is that?**

11      A.       Because it has a neutral current just like a  
12      single-phase system does, you can create -- you're  
13      going to have a neutral-to-earth voltage.

14      **Q.       And one of the things the literature talks**  
15      **about is load, and I think you wrote about or --**  
16      **actually in this red book somewhere about trying to**  
17      **balance the three phases on a three-phase line.**

18      A.       That's correct.

19      **Q.       And that's hard when the system has a whole**  
20      **bunch of single-phase customers; right?**

21      A.       Yes. It's difficult to get an absolute  
22      balance over time.

23      **Q.       That doesn't mean the power company**  
24      **shouldn't at least try to get it in balance.**

25      A.       Correct.

1       **Q.       Because it can be more out of balance or**  
2       **less out of balance; right?**

3       A.       Sure.

4       **Q.       And then if it's way out of balance, that**  
5       **can have an effect on the neutral-to-earth voltage;**  
6       **right?**

7       A.       Correct.

8       **Q.       And those neutral-to-earth voltages in a**  
9       **grounded system can be greater where there's heavy**  
10       **demand?**

11       A.       They can be, yes.

12       **Q.       And that affects the loading on the system?**  
13       **Is that the right word to use?**

14       A.       Well, you've got to factor loading on the  
15       system and then the system characteristics itself, so  
16       for a given system, as you increase the load or, in the  
17       three-phase system, the imbalance of load, you would  
18       expect an increase of neutral-to-earth voltage.

19       **Q.       Are you familiar with line sizes or not?**

20       A.       Wire sizing?

21       **Q.       Like a 6A copperweld?**

22       A.       I have a rudimentary knowledge of the  
23       different wire sizes, yes.

24       **Q.       I mean, if you're not going to be testifying**  
25       **about something -- Are you going to be testifying at**

1       **all about line sizes in this particular case?**

2       A.       Not that I'm aware of.

3               MR. O'BRIEN: I don't anticipate. We've got  
4       other people to address that issue.

5       **Q.       Do you have any opinion as to use of 6A**  
6       **copperweld?**

7       A.       From the modeling work I've done, that's --  
8       depending on the load, it can be very adequate. It's  
9       when you get to higher levels of load or current on the  
10      line that you've got to look at whether that wire size  
11      is adequate or not.

12      **Q.       What are the problems that can be caused by**  
13      **having 6A copperweld with higher levels of load?**

14               **MR. O'BRIEN: I'll object to form.**

15      A.       It would just be the resistance of the  
16      conductor itself.

17      **Q.       Would that have any tendency to increase or**  
18      **decrease neutral-to-earth voltages if you were using 6A**  
19      **copperweld where there was a heavy load?**

20               **MR. O'BRIEN: I'll object to the form,**  
21      **foundation.**

22      A.       Well, the magnitude of neutral-to-earth  
23      voltage is going to be dependent upon the resistance of  
24      the grounded neutral system, and one factor within that  
25      is the size of the neutral conductor itself, so as we

1 increase the size of that wire, we have some effect on  
2 the neutral-to-earth voltage.

3 **Q. Are you currently working on any other**  
4 **cases?**

5 A. I think I may have been requested to look at  
6 one other, but I don't have anything active at this  
7 point.

8 **Q. Who made that request?**

9 A. I think it may be Stuart Mondschein's firm.  
10 I can check that out if you want me to.

11 MR. BIRD: Yeah. That's Vogel and those  
12 guys in Madison; right?

13 MR. O'BRIEN: Yeah.

14 THE WITNESS: Yes; Denis Vogel.

15 BY MR. BIRD:

16 **Q. Have you ever given any kind of testimony to**  
17 **Minnesota Public Service Commission?**

18 A. I don't recall giving any testimony there.

19 **Q. Have you given any testimony to the**  
20 **Wisconsin Public Service Commission?**

21 A. Yes.

22 **Q. Do you have that testimony, a copy of it?**

23 A. I may have that.

24 **Q. If you have that, I'd like a copy of that.**

25 **One of the things that I've looked at and I**

1       **think you might be referring to is Reinemann came out**  
2       **with some kind of a paper, and I think it was around**  
3       **2003, in which there was a two-week study, and it was**  
4       **intermittent application of current for a couple of**  
5       **weeks, and there was 12 mid-lactation cows being used.**  
6       **Do you recall that?**

7       A.       Yes. I don't recall the details without  
8       looking back at the paper itself.

9       **Q.       And one of the things he commented on was**  
10       **that the serum interleukin-1 went up and serum**  
11       **interleukin-2 went down. Do you recall that?**

12       A.       I don't recall that specifically. I recall  
13       that type of information being in the paper.

14       **Q.       Well, do you have any knowledge as to**  
15       **whether or not -- well, first of all, what that is,**  
16       **serum interleukin-1 and serum interleukin-2?**

17       A.       It's hormone responses of the animal. I  
18       rely on my animal science and veterinary medicine  
19       colleagues to interpret the meaning of that.

20       **Q.       Okay. And do you know if serum**  
21       **interleukin-1 and 2 have anything to do with immune**  
22       **response?**

23       A.       I don't recall the connections on those  
24       particular ones.

25       **Q.       Is that -- that study I just talked about,**

1       **is that one of the research studies that --**

2       A.       Yes.

3       **Q.       -- you feel is reliable?**

4       A.       Yes.

5       **Q.       And we talked a couple of times about the**  
6       **two cows that were removed from the Cornell research**  
7       **because of their violent reaction, and you said you had**  
8       **followed up on it and found that, indeed, there were a**  
9       **couple of cows that had been removed; right?**

10      A.       That's my recollection at the moment. I  
11      think I did. It's a little vague right now, I must  
12      admit.

13      **Q.       Well, I thought you'd testified -- and the**  
14      **record will reflect what you said, but certainly you**  
15      **had the opportunity to call up Gorewit or Aneshansley**  
16      **and find out the answer; right?**

17      A.       Yes.

18      **Q.       They ought to know.**

19      A.       Yes. Yes.

20      **Q.       And one of the things that I read was that**  
21      **there actually was a video tape of those two cows and**  
22      **the video tape itself was destroyed. Do you know that?**

23      A.       I have no knowledge of whether there were or  
24      weren't tapes or what may or may not have happened to  
25      them.

1       **Q.       Again, that's something that you could call**  
2       **up Gorewit and Aneshansley and get an answer to?**

3       A.       Probably could.

4       **Q.       Were you involved at all in the peer review**  
5       **of the Gorewit and Aneshansley articles that were**  
6       **referred to in the red book?**

7       A.       Truthfully, right now I don't recall that  
8       I -- I can't confirm that I was or wasn't. I know I've  
9       seen their papers in different contexts. Whether I was  
10      officially a reviewer on any of those, I just don't  
11      recall.

12      **Q.       Were those the publications, the Gorewit and**  
13      **Aneshansley, that were published in the Journal of**  
14      **Science and peer reviewed?**

15      A.       What?

16      **Q.       Journal of Science. Were they in the**  
17      **Journal of Science?**

18      A.       Which publication were you referring to?

19      **Q.       I'm looking at -- Are you looking at the**  
20      **bibliography there?**

21      A.       Yes.

22             MR. O'BRIEN: Just to help, you mean Journal  
23      of Dairy Science?

24             MR. BIRD: Is that what it was?

25      A.       I think that's what you're referring to,

1 yes. On page 8-4, at the top of the right-hand  
2 column --

3 **Q. Is that one in the Journal of Dairy Science?**

4 A. That is a Journal of Dairy Science article.  
5 As we sit here right now, I'm not sure if that's the  
6 precise one you're referring to.

7 **Q. Did you review that one as a member of the**  
8 **team?**

9 A. I don't recall that I did.

10 **Q. Did you ever review any of Gorewit or**  
11 **Aneshansley's work for ASAE?**

12 A. I may well have. I'm not sure that they --  
13 whether they submitted any for the Transactions or not.

14 **Q. Well, if you reviewed somebody's work, would**  
15 **you keep a file on it, on what your review was?**

16 A. Not necessarily, no. I would submit it back  
17 to the division editor, and they would take it from  
18 there.

19 **Q. So you wouldn't keep your notes?**

20 A. Not necessarily, no.

21 **Q. Well, you say "Not necessarily." Does that**  
22 **mean it's possible that you did keep the notes? I'm**  
23 **just trying to --**

24 A. My general practice would be no.

25 **Q. Have you ever peer reviewed any of**



1       **Reinemann's work?**

2       A.       Yes, I've handled articles from Doug.

3       **Q.       How does that work on peer review? Can a**  
4       **writer request that a particular individual be on the**  
5       **review panel?**

6       A.       An author can suggest reviewers. In our  
7       system, they have an option to suggest reviewers. The  
8       division editor will assign those papers generally to  
9       an associate editor. That associate editor would  
10      identify the appropriate set of reviewers, which may or  
11      may not include those suggested persons.

12      **Q.       Do you know if you were suggested by**  
13      **Reinemann as being one of the reviewers?**

14      A.       I don't recall specifically. I think for  
15      some of his papers I probably was a division editor at  
16      that point in time, so it would have gone through me  
17      into the process itself and come back.

18      **Q.       As a division editor, then you get to pick**  
19      **the reviewers?**

20      A.       No. Actually, the associate editor picks  
21      the reviewers and then handles the reviews and makes  
22      the recommendation back to the division editor, who  
23      then makes the recommendation to the society.

24      **Q.       Let me see if I've got this straight. I**  
25      **mean, so as a division editor, you would assign the**

1 **task of picking the reviewers to the associate editor?**

2 A. That would be the general process, yes.

3 **Q. And you would have -- Along with that, I**  
4 **mean, would be -- because the paper would come to you,**  
5 **and along with that, the author's request, if he had**  
6 **any, on who the author wanted to review the paper?**

7 A. Yeah. I wouldn't characterize it as a  
8 request, but there is an opportunity to suggest  
9 reviewers.

10 **Q. They suggest reviewers.**

11 A. Correct.

12 **Q. As division editor, would you also be able**  
13 **to make suggestions to the associate editor as to the**  
14 **reviewers?**

15 A. That does happen from time to time, yes.

16 **Q. But the ultimate decision is up to the**  
17 **associate editor as to who to pick for reviewers?**

18 A. Yes.

19 **Q. And then it comes back to you, and you can**  
20 **approve those selections for reviewers?**

21 A. Generally you're not -- Unless the associate  
22 editor requests it, generally the associate editor does  
23 it on their own, doesn't come back and request approval  
24 of reviewers.

25 **Q. As a division editor for Reinemann's papers,**

1       **would you also have the opportunity to act as a**  
2       **reviewer?**

3       A.     Yes.

4       **Q.     So in that sense, you're wearing two hats?**

5       A.     Yes.

6       **Q.     Do you recall that happening with regard to**  
7       **Reinemann's work?**

8       A.     Well, I should correct that. I would be a  
9       reviewer in the sense that I would review the paper and  
10      look at the reviews of the people that reviewed it, you  
11      know, as they try and make that decision on whether or  
12      not to be recommended for publication or what changes  
13      might be necessary to make it acceptable for  
14      publication.

15      **Q.     So as a division editor, you don't get to be**  
16      **a reviewer other than reviewing other reviews; right?**

17      A.     Basically, that's correct, yes.

18      **Q.     All right. But in addition -- and what --**

19      A.     But in doing that, I mean, you're almost  
20      acting like a reviewer too because you've got to get  
21      into the details and understand it as well.

22      **Q.     Right. And if somebody wants to get**  
23      **something published, it behooves them to suggest to the**  
24      **division editor reviewers that he thinks might be**  
25      **friendly to their point of view; would that be true?**

1           **MR. O'BRIEN: I'll object to the form.**

2           A.       I suppose a person could use that as a  
3           strategy if they so desired.

4           **Q.       Well, you've seen that, haven't you?**

5           A.       I haven't seen very much of that in this  
6           community. Most of our authors don't take the time to  
7           recommend reviewers, so --

8           **Q.       Has Reinemann ever taken the time to**  
9           **recommend reviewers as far as you know?**

10          A.       I really don't recall. I actually wish they  
11          would take more time and suggest persons.

12          **Q.       Is that information public information?**

13          A.       Generally, no.

14          **Q.       Would it be possible to go back and find out**  
15          **who did reviews on any particular piece of work by**  
16          **Reinemann?**

17          A.       I wouldn't have the data because I file  
18          those back to the author in an anonymous -- You know,  
19          the reviewers are not identified unless they self  
20          identify, so I'm not -- at that point in time -- I'm  
21          not sure what I still have in my files from that period  
22          of time.

23          **Q.       Is there something about the integrity of**  
24          **the process that you want to keep those people's names**  
25          **confidential? Is that it?**

1 A. Correct. You want them done confidentially  
2 so they can give you their honest opinion or will give  
3 you their honest opinion.

4 **Q. Do you know the names of typical reviewers**  
5 **for this type of work? Not isolating to any particular**  
6 **one, but if you were division editor now and something**  
7 **came in on stray voltage from Reinemann, who would be**  
8 **the people that would come to your mind?**

9 A. People that come to mind could be some of  
10 the people at Cornell.

11 **Q. Gorewit and Aneshansley?**

12 A. Gorewit, Aneshansley, could be, but my  
13 general practice would be go look who's published in a  
14 particular area or who has presented papers in a  
15 particular area, would be knowledgeable of that  
16 particular topic, so that's kind of where you start  
17 looking for reviewers. And then in these animal  
18 topics, sometimes we will go outside of our own society  
19 if there's somebody in animal sciences perhaps or  
20 veterinary medicine that understands the topic to give  
21 a review from their perspective, so it may be a  
22 multidisciplinary review as well.

23 **Q. If you know the topic is controversial, like**  
24 **stray voltage, do you ever consciously seek to get what**  
25 **you know is likely to be a contrary opinion?**

1 A. I haven't personally done it. I view it as  
2 my own personal integrity of trying to get people who  
3 are going to give it a fair review. That's always been  
4 my goal.

5 **Q. But, I mean, like picking Gorewit for**  
6 **Reinemann, do you consider that a fair review in this**  
7 **field that's very controversial? You're picking**  
8 **somebody from the industry side that you know has**  
9 **already been involved in a lawsuit with Mike Behr and**  
10 **all kinds of stuff, you know.**

11 **MR. O'BRIEN: I'll object to the form of the**  
12 **question.**

13 **Q. That's what I'm saying. How do you get away**  
14 **from it in this field?**

15 A. It's a challenge because it is a relatively  
16 modest number of folks who are really heavily engaged  
17 in it.

18 **Q. Well, if you've peer reviewed any of**  
19 **Reinemann's work either as an editor or as a reviewer,**  
20 **would you be able to give me a list of those that**  
21 **you've done that?**

22 A. I may be able to give you -- I wouldn't know  
23 whether it would be a really complete list or not, but  
24 I may have some files.

25 **Q. Would you be able to give me any of your**

1 **notes or your suggestions as a reviewer if they exist?**

2 A. I would be willing to do that if I have it.

3 I'd probably need to check with my society to make sure  
4 they're comfortable with that.

5 **Q. Certainly. Okay. It's Dr. Appleman that's**  
6 **deceased; right?**

7 A. He is.

8 **Q. And he apparently died while this red book**  
9 **was in process.**

10 A. That is correct.

11 **Q. What was his field of expertise?**

12 A. Animal science.

13 **Q. Would you call him an expert in the area of**  
14 **stray voltage and its effect on animals?**

15 A. Yes. He, as a dairy scientist, brought that  
16 type of expertise to the table.

17 **Q. What is a type two error in a statistical**  
18 **study?**

19 A. Oh, boy; it's been a while since I taught  
20 statistics. Type of error when you assume something is  
21 correct and it's not, or you reject it when it is true,  
22 and I can't, to tell you the truth, right now tell you  
23 which one is which, type one or type two error.

24 **Q. Right now you don't --**

25 A. I just haven't got that on the top of my

1 head.

2 **Q. Are you going to be offering any opinions on**  
3 **earth current in this case?**

4 A. Well, as relates to the conclusions of the  
5 Minnesota Public Utilities Commission report, that  
6 would relate to earth current.

7 **Q. The Science Advisory?**

8 A. The Science Advisory. Thank you. And just  
9 my own knowledge of how electrical systems work would  
10 be important.

11 **Q. What opinions do you have in that regard?**

12 A. Well, I think we've really already addressed  
13 that in, you know, what we described earlier about lack  
14 of capability of creating potential difference across  
15 animal contact points.

16 **Q. That's because of the resistance?**

17 A. Well, it's because of Ohm's Law and how the  
18 current is distributed, magnitude current and what you  
19 can -- what voltage differential that could create.

20 **Q. One of the things that you're going to**  
21 **testify about is that the work of Zipse as reflected in**  
22 **the technical papers of the IEEE is not in accord with**  
23 **the scientific community; correct?**

24 A. Correct.

25 **Q. And are your comments on that reflected in**



1       **Exhibit 305?**

2       A.     Yes.

3       **Q.     All right. You submitted your response to**  
4       **Equipotential Planes after you got the initial proposal**  
5       **from IEEE on Zipse's paper; right?**

6       A.     Yes.

7       **Q.     All right. And then if I'm understanding**  
8       **this process correctly, the person who submits the**  
9       **paper as part of discussion can, you know, again, as**  
10      **part of the discussion, respond to the responses. Is**  
11      **that what happens?**

12      A.     In this particular society, they do that,  
13      yes.

14      **Q.     All right. And, in fact, that shows up here**  
15      **in Exhibit 306. There's a long discussion part where**  
16      **there's -- about the reviewers and so on and so forth.**

17      A.     Yes.

18      **Q.     And after that, do you get to then amend**  
19      **your response? In other words, do you see that**  
20      **discussion and then go back and change your response**  
21      **again?**

22      A.     The opportunity would be there to do that,  
23      yes.

24      **Q.     Did you do that in this case?**

25      A.     There may have been some modest changes

1 like, you know -- I couldn't tell you exactly what they  
2 are. There weren't any fundamental changes.

3 **Q. Well, one of the things that you'd discussed**  
4 **was that, in referring to the so-called test that**  
5 **Neubauer did, that all he was doing was creating a**  
6 **galvanic cell.**

7 A. Correct.

8 **Q. And then I think in response to that, at**  
9 **least from what I saw in the initial paper that you**  
10 **might have got and what was finally published, is that**  
11 **on Neubauer's test -- You can see this on page 6 of the**  
12 **Exhibit 306, that he specifically recognized galvanic**  
13 **action; tried to take that out by using the same metal**  
14 **or not dissimilar metals for contact points?**

15 **MR. O'BRIEN: I'll object to the form.**

16 A. Yeah, he referred to or added that  
17 particular segment, I think. I don't think it changed  
18 my opinion of what's actually happening in the test.

19 **Q. Explain that to me, why -- you know, given**  
20 **what he explained there of not using dissimilar metals**  
21 **for the contact, why he wasn't creating a galvanic or a**  
22 **battery, so to speak.**

23 A. In this particular paragraph, he just simply  
24 makes or states the opinion, "In this case, electric  
25 energy is used to force nonspontaneous chemical

1 reactions, the opposite of a galvanic cell." That  
2 doesn't convince me that what they were actually  
3 measuring wasn't due to the galvanic action.

4 **Q. So you fundamentally disagree with the**  
5 **so-called bucket test?**

6 A. As proof that the equipotential plane  
7 doesn't work, yes.

8 **Q. Can you give me that reasoning of yours in a**  
9 **nutshell? Why doesn't the bucket test -- why isn't it**  
10 **an accurate measurement?**

11 A. Well, it would apply a voltage  
12 differential -- Let me start over again. If that was  
13 created by a voltage differential across points of the  
14 cow, they're on equipotential plane, it would have to  
15 be of a magnitude that just is not reasonable or not  
16 measured in what the system has set up.

17 **Q. Well, explain that.**

18 A. If you go back to my own paper, you'd have  
19 to see that you'd have to have a voltage differential  
20 across the two sets of legs of the cow, and that means  
21 a voltage difference across the reinforcement mesh in  
22 the concrete, and to do that, the current level  
23 required to do that, given the resistance values, is  
24 just way too high to say that this is a likely or  
25 probable source.

1       **Q.       But they're measuring it, aren't they? Why**  
2       **isn't it a valid measurement if they're, in fact,**  
3       **measuring?**

4       A.       They're measuring, but how they're  
5       interpreting their measurements is not correct.

6       **Q.       And why is their interpretation off?**

7       A.       Because they're assuming that the source is  
8       a differential voltage across the concrete when that  
9       just is not a reasonable assumption.

10      **Q.       And why is that not a reasonable assumption?**

11      A.       Because the resistance of the concrete  
12      between those points or the rebar in the concrete would  
13      be too low or the acquired current through that because  
14      of the resistance would be too high to develop that  
15      kind of voltage across the animal.

16      **Q.       So what, in fact, were they measuring? The**  
17      **battery? Is that what you're saying?**

18      A.       Yes.

19      **Q.       And the battery is created because they're**  
20      **what; using dissimilar metals? Is that it?**

21      A.       Dissimilar materials, yes.

22      **Q.       I thought he addressed that by saying that**  
23      **they changed it to put, you know, copper and copper or,**  
24      **you know, the same metal.**

25      A.       No. That doesn't mean that the rest of the

1 circuit doesn't have different types of metals in it in  
2 the circuit as well.

3 **Q. Well, the metals would be -- I mean, if they**  
4 **used rebar -- And the only other metal in the concrete**  
5 **is rebar; right?**

6 A. Generally.

7 **Q. So then what would be wrong with that? Why**  
8 **aren't we taking galvanic action out of the equation at**  
9 **that point?**

10 A. Well, you've got copper conductors. You've  
11 got steel of different types that you're dealing with  
12 there. You've got just different materials as you move  
13 through the system.

14 **Q. You mean copper -- Where are the copper**  
15 **conductors?**

16 A. In the leads where the testing apparatus is.

17 **Q. So you're saying any kind of dissimilar**  
18 **metal anywhere on that circuit is going to create the**  
19 **galvanic action?**

20 A. One would have to be very careful about  
21 that, yes.

22 **Q. Well, is it possible to eliminate it?**

23 A. That's the technique of using this half cell  
24 is to try and take that parameter out of the circuit.

25 **Q. Well, didn't they do that, use a half cell?**

1 A. No, not that I'm aware of.

2 **Q. If they had used a half cell, then would**  
3 **their readings be correct?**

4 A. Well, they could get more correct readings.  
5 You still have to do it right to get -- Just throwing a  
6 half cell in there doesn't -- It's got to be used  
7 appropriately.

8 **Q. But the half cell has the benefit of taking**  
9 **out the galvanic action due to dissimilar metals;**  
10 **right?**

11 A. Yes, or you can -- in your measurement  
12 technique, as I understand it from primarily the  
13 corrosion people, that's a way of getting kind of a  
14 uniform testing procedure.

15 **Q. So your assumption now is they did not**  
16 **create a half cell, and that what their readings are,**  
17 **they're simply representative of galvanic action?**

18 A. As I recall the data I saw, yes.

19 MR. BIRD: Do you intend on giving him any  
20 further data in that regard? I mean if he's -- I  
21 understood that in response to this that they --

22 MR. O'BRIEN: They have never used the half  
23 cell --

24 MR. BIRD: Okay.

25 MR. O'BRIEN: -- to my understanding. I

1 believe I asked that of Mr. Neubauer and Mr. Zipse, and  
2 they both said they did not use the half cell.

3 MR. BIRD: Okay.

4 MR. O'BRIEN: If I'm wrong, give me some  
5 information, and we'll get you the information.

6 MR. BIRD: All right. I thought they had.

7 MR. O'BRIEN: They changed the type of  
8 conductor in the bottom of the bucket. That was my  
9 recall.

10 I'll do a formal request to you by letter  
11 asking that.

12 MR. BIRD: Sure. Good point.

13 BY MR. BIRD:

14 **Q. Then looking again at Exhibit 309, you say,**  
15 **"Although this approach could be used to measure the AC**  
16 **current flow through an animal, it is not an accepted**  
17 **approach to measurement of DC currents or AC stray**  
18 **voltage investigation." What do you mean by that?**

19 A. The circuit they've set up you could use to  
20 do an AC current determination. That's possible with  
21 what they've done. But you've then got to eliminate  
22 the DC part of that to make the AC measurement work.

23 **Q. But if all they're doing is measuring AC**  
24 **steady state, that doesn't have any DC component to it,**  
25 **does it?**

1 A. Correct, if you're just measuring true AC.  
2 You could with an oscilloscope look at that and see if  
3 there is a DC offset, you know, if you set your  
4 instrumentation up to do that as well.

5 **Q. Isn't that what they did?**

6 A. I don't believe that's what they did in this  
7 particular paper. They may have done something like  
8 that subsequently.

9 MR. BIRD: Okay. You might want to add that  
10 to your letter.

11 MR. O'BRIEN: I might have to have him  
12 explain that one to me.

13 BY MR. BIRD:

14 **Q. All right. But to measure AC current**  
15 **through the cow, that's an acceptable method?**

16 A. What is acceptable?

17 **Q. This approach could be used to measure the**  
18 **AC current flow through an animal?**

19 A. Oh, the instrumentation configuration that  
20 they used?

21 **Q. Right.**

22 A. Yes, you could do that.

23 **Q. You could do it, but did they do it right?**

24 A. To measure the AC component? I don't  
25 believe in what's reported in this paper that they



1 actually measured the AC component.

2 **Q. Well, the DC would show up as DC and the AC**  
3 **would show up as AC; right?**

4 A. Correct.

5 **Q. So the DC part of it is the galvanic part;**  
6 **right?**

7 A. That's what I would hypothesize was  
8 happening, yes.

9 **Q. All right. Now, if they were getting AC**  
10 **current through this bucket test, and all the power is**  
11 **off at the farm and the farm is isolated, where is the**  
12 **AC coming from?**

13 **MR. O'BRIEN: I'll object to form and**  
14 **foundation.**

15 A. I'd have to know what kind of magnitudes  
16 they're talking about, but you'd have to look  
17 carefully, make sure that the instrumentation system  
18 itself is not creating something you're measuring at a  
19 very low level there.

20 **Q. What if they're getting .4 volts, for**  
21 **example, AC?**

22 A. That could be a voltage gradient in the  
23 earth depending on the setup where you're looking.  
24 That sounds like a fairly high value, but, you know,  
25 you want to see the data behind that.

1       **Q.       Okay. And you haven't really looked at that**  
2       **data?**

3       A.       That's not familiar data to me on the AC  
4       measurements that you're talking -- that you seem to be  
5       talking about.

6               MR. BIRD: Are you intending to have him  
7       look at that?

8               MR. O'BRIEN: I'm not even sure what you're  
9       talking about now.

10              MR. BIRD: I think he testified that they  
11       got .4 volts out at the north end of the farm, power  
12       off.

13              MR. O'BRIEN: That's not a bucket test,  
14       though.

15              MR. BIRD: Well, I don't know what test they  
16       did. They got .4 volts out there. Am I wrong on that?  
17       I don't know.

18              MR. O'BRIEN: Now it's me testifying, but  
19       it's my understanding the bucket test measures current,  
20       not voltage.

21              MR. BIRD: Okay. Maybe it was -- You're  
22       right. Might have been milliamps; .4 milliamps it  
23       might have been.

24       **Q.       Let's amend my question to .4 milliamps.**

25       A.       I simply haven't seen what you seem to be

1 referring to as the data here to be able to understand  
2 what that might be.

3 MR. BIRD: All right. Well, if you submit  
4 to him new data along those lines, are you going to let  
5 me know --

6 MR. O'BRIEN: Yeah.

7 MR. BIRD: -- so I can come back again for a  
8 follow-up? All right.

9 BY MR. BIRD:

10 **Q. One of the things I thought you had**  
11 **testified to previously or written somewhere is that**  
12 **if .7 volts can find a pathway to the cow, that can be**  
13 **a problem. Is that true or not?**

14 A. There may be a statement in one of the early  
15 papers that we'd like to maintain an environment where  
16 we don't have that occurring. I don't think it says  
17 that that creates a problem.

18 ---

19 And, thereupon, Exhibit No. 323 was marked  
20 for purposes of identification.

21 ---

22 BY MR. BIRD:

23 **Q. Showing you what's been marked as**  
24 **Exhibit 323, November 1984, Issue 70, Appleman and**  
25 **Gustafson, and just look at that for a second to**

1       **familiarize yourself with it. I don't want to ask you**  
2       **questions without looking at it. But that looks to me**  
3       **like a publication that you were one of the authors,**  
4       **you and Appleman.**

5       A.       Correct.

6       **Q.       All right. And then let me just read to you**  
7       **what I'm talking about. In the first sentence, it**  
8       **says, quote, "In dairy cows, two distinct and important**  
9       **aspects of the interrelationship between stray voltage**  
10       **problems on the farm and dairy cow productivity can be**  
11       **identified. One is behavioral modification that**  
12       **increases in intensity when currents associated with**  
13       **neutral-to-earth voltages above .7 volts find a pathway**  
14       **through the cow." Right?**

15       A.       That's what we wrote back in '84, yes.

16       **Q.       Does that continue to be your point of view?**

17       A.       Be above that level, yes.

18       **Q.       Is it .7 volts or above?**

19       A.       Well, what I recommend to producers that I  
20       work with now, if I don't see things above about a volt  
21       and a quarter, I don't anticipate problems. So this  
22       was more conservative at that point in time than I  
23       would be now.

24       **Q.       At least based upon your research at that**  
25       **point, it was .7 volts. And you're saying you're not**

1       **comfortable with that anymore, that's too conservative?**

2       A.       I think that's a little more conservative  
3       than I am now, yes.

4       **Q.       But, nevertheless, that's what you wrote at**  
5       **that time --**

6       A.       Yes.

7       **Q.       -- based upon the information that you had**  
8       **at that time?**

9       A.       Yes.

10      **Q.       What you've done since then -- You did some**  
11      **research, independent research, up to '87?**

12      A.       Correct.

13      **Q.       And then you participated in this red book?**

14      A.       Correct.

15      **Q.       And then you read the stuff Reinemann did at**  
16      **Madison?**

17      A.       That and other work that's come out.

18      **Q.       And Gorewit and so on that we've talked**  
19      **about?**

20      A.       Correct.

21      **Q.       Has that other stuff caused you to change**  
22      **your mind? Is that it?**

23      A.       The whole body of knowledge we've worked  
24      with, yes.

25      **Q.       And this was neutral-to-earth voltages that**

1       **you were referring to there?**

2       A.       Yes.

3       **Q.       And that's neutral-to-earth voltages of .7**  
4       **volts measured without a resistor?**

5       A.       Protocol for measuring that would be without  
6       a resistor, yes.

7       **Q.       And you're saying you're amending that now**  
8       **to one and a quarter volts without a resistor to**  
9       **neutral-to-earth voltages?**

10      A.       Well, or above.

11      **Q.       That's your threshold?**

12      A.       That's my threshold of -- Really I think  
13      today we would more likely use the cow contact voltages  
14      and make recommendations based on that rather than  
15      neutral-to-earth voltage.

16      **Q.       Here it was .7 volts neutral-to-earth**  
17      **voltage.**

18      A.       Correct.

19      **Q.       And your testimony is that today you're**  
20      **looking at one and a quarter volts?**

21      A.       Yes, before I would start exploring more  
22      indepth or think you might have a problem.

23      **Q.       So one of the things you do when you go to a**  
24      **farm is you measure neutral-to-earth voltages --**

25      A.       Yes.

1       **Q.**       -- without a resistor.

2       A.       Yes.

3       **Q.**       **All right. And that helps you give some at**  
4       **least preliminary foundation as to whether you ought to**  
5       **take it further?**

6       A.       That's one parameter, yes.

7       **Q.**       **Do you know what the NEV's were measured in**  
8       **this case?**

9       A.       What I've seen is in that summary sheet.

10      **Q.**       **I don't think -- This one?**

11      A.       Yes.

12      **Q.**       **314?**

13      A.       Yes.

14      **Q.**       **I don't think he's written any**  
15      **neutral-to-earth voltages down here.**

16      A.       Oh, excuse me. These were the cow contact  
17      type voltages.

18      **Q.**       **Right.**

19      A.       Right now I don't recall looking at those.

20      **Q.**       **Other than what we've talked about, that**  
21      **Mr. O'Brien may send you some more stuff, is there**  
22      **anything further that you personally would like to do,**  
23      **you know, given the questions I've asked so far, in**  
24      **order to prepare for your testimony at trial?**

25      A.       Not beyond answering the questions for you.

1       **Q.       Beyond answering the questions that I've**  
2       **raised right now?**

3       A.       Correct.

4       **Q.       Do you know the type of isolation that was**  
5       **used at the Siewert farm?**

6       A.       No, I'm not sure I know which device was  
7       used.

8       **Q.       Now, what is a gradient?**

9       A.       A gradient would be a difference in a value  
10       between one point and another point.

11       **Q.       Does that mean -- When they talk about step**  
12       **potential, is that the same thing?**

13       A.       That would be a type of gradient, yes.

14       **Q.       Now, the studies that you did, you know,**  
15       **that you did you in collaboration with Cloud or**  
16       **Appleman or -- is it Norell?**

17       A.       (Witness nodded head.)

18       **Q.       Did you have somebody from the statistics**  
19       **people help develop a statistical model that had**  
20       **predictive value?**

21       A.       From time to time we consulted with our  
22       statistical service. Probably the person who did most  
23       of that would be Norell in design for his thesis work.

24       **Q.       Did you know Dr. Martin, statistician at the**  
25       **university?**



1 A. I knew him, not well, but know the name.

2 **Q. Would he be one of the guys that would be**  
3 **helpful to go to in terms of statistical modeling?**

4 A. He could be. I don't recall whether he was  
5 doing that sort of consulting at that point in time or  
6 not.

7 **Q. Now, we've talked quite a bit about contact**  
8 **resistance in this deposition. Would one of the things**  
9 **that affects contact resistance be the weight of the**  
10 **cow?**

11 A. That would be -- Yes.

12 **Q. Certainly a heavier cow would have an**  
13 **ability to, you know, press down or make firmer contact**  
14 **with a particular surface?**

15 A. Yes.

16 **Q. And would moisture also be one of the**  
17 **variables?**

18 A. Yes.

19 **Q. Would the presence of salt be one of the**  
20 **variables?**

21 A. Yes.

22 **Q. Would the depth of the material that's being**  
23 **stepped in be one of the variables?**

24 A. Yes.

25 **Q. Would the presence of like sores and things**

1       **on the cow's hoof be a variable?**

2       A.       That could be a variable in two different  
3       ways; one, from the sensitivity aspect, and then,  
4       second, from the actual resistivity of the material.

5       **Q.       Okay. Well, the skin itself as a pathway**  
6       **has a certain resistance?**

7       A.       Correct.

8       **Q.       And if we cut through the skin, then you're**  
9       **going to eliminate that part of the cow's resistance?**

10      A.       Correct.

11      **Q.       Does it make any difference if the cut -- If**  
12      **it's exposed to the contact area, does it make any**  
13      **difference whether the cut is a millimeter or**  
14      **10 millimeters?**

15      A.       Well, it would depend on where it is  
16      relative to nerves or things that would be sensitive.

17      **Q.       No. I'm talking about in terms of the cow's**  
18      **resistance.**

19      A.       It would -- it would make some difference,  
20      the magnitude of the area, yes.

21      **Q.       You've never quantified that?**

22      A.       No, I have not tried to quantify that  
23      specifically.

24      **Q.       Are you aware of any studies that have been**  
25      **done on cows that have foot or leg problems to**

1       **determine whether or not their resistance is changed at**  
2       **all by that condition?**

3       A.       I don't recall any that come to mind at the  
4       moment.

5       **Q.       You're aware that cows that have laminitis,**  
6       **for example, can get sores or abscesses that would**  
7       **expose them to the --**

8       A.       Just makes their foot more sensitive,  
9       whether it's electrical or not, yes.

10      **Q.       And it might have the effect of lowering the**  
11      **resistance of the cow?**

12      A.       It may.

13      **Q.       Is there anything else that would be a**  
14      **variable in the contact resistance?**

15      A.       I think you've hit the major ones. The  
16      material, the geometry of it would be the primary ones.

17      **Q.       Now, in order to get a differential, I mean,**  
18      **would it be -- If a cow has hind feet outside the barn**  
19      **and front feet on the wet concrete, would that be more**  
20      **likely to have a step potential or a gradient?**

21      A.       More likely depends on whether or not you --  
22      what's in the concrete in the two different areas and  
23      whether or not that's connected to the electrical  
24      system or not.

25      **Q.       Okay.**

1 A. So I can't say it would be more without, you  
2 know, a little bit more information.

3 **Q. And if a cow's hind legs were outside the**  
4 **parlor and front legs were inside the parlor, would**  
5 **that have -- would it be more likely to have a step**  
6 **potential there or a gradient?**

7 A. It could be, depending on how the parlor is  
8 constructed and how the holding area is constructed.

9 **Q. You've never been to the Siewert farm, so**  
10 **you don't know that?**

11 A. That is correct.

12 **Q. How old is Cloud now, just ballparkish?**

13 A. Seventies.

14 **Q. Is he still involved at all in doing any**  
15 **research or teaching or reviewing?**

16 A. I don't believe he's involved in it. He was  
17 primarily extension and worked with us some in  
18 research. I don't think he's engaged in that anymore.

19 **Q. Have you heard about switch-back modeling to**  
20 **the statistical research?**

21 A. That's a particular type of design,  
22 experimental design, switch-back design, yes.

23 **Q. Can you explain what that is in your**  
24 **understanding?**

25 A. Crudely, it would be when you have a

1 treatment, you go to the control condition and then  
2 switch back to a treatment. You're switching between  
3 the treatment and the control aspect.

4 **Q. Has there been any switch-back modeling in**  
5 **any of the stray voltage work done by Reinemann?**

6 A. I couldn't tell you right now.

7 **Q. How about Gorewit and Aneshansley?**

8 A. That may well be. I couldn't confirm that  
9 right now without going back and looking at the papers.

10 **Q. Well, do you have any reason to believe that**  
11 **if a cow has a loss of production because of being**  
12 **exposed to current that's in a particular lactation and**  
13 **then the current goes away, that the production is**  
14 **going to come back such that it will pick up what was**  
15 **lost?**

16 A. That may not happen, in a general sense,  
17 where we'd expect a recovery, so to speak.

18 MR. BIRD: I might be done, but I just want  
19 to look through what I've got here.

20 - - -

21 And, thereupon, Exhibit No. 324 was marked  
22 for purposes of identification.

23 - - -

24 BY MR. BIRD:

25 **Q. What I have here is -- I don't know exactly**

1       **what it is. It's called "Behavioral Experiments**  
2       **Quantifying Animal Sensitivity to AC and DC Current."**  
3       **Do you recognize that?**

4       A.       Yes. This is a paper that was done --  
5       Dr. Appleman and I collaborated on. Unfortunately, I'm  
6       not finding this in my own vitae to try and confirm  
7       exactly where this appeared.

8       **Q.       Do you recognize it, though, to be something**  
9       **that you participated in writing?**

10      A.       It certainly looks familiar.

11             MR. O'BRIEN: And now he's expecting the  
12      royalty.

13      **Q.       I just need to know whether you wrote it or**  
14      **didn't.**

15      A.       It's all materials that are familiar to me.  
16      Where it was -- you know, whether -- whether Bob put my  
17      name on this without really consulting me in detail, I  
18      couldn't say without trying to confirm more where it  
19      showed up or look through it in more detail.

20      **Q.       Well, I mean --**

21      A.       It's been quite a few years ago now.

22      **Q.       I would just simply like to know whether you**  
23      **acknowledge that this is something that you coauthored**  
24      **with Appleman or not, and I -- You're going to be able**  
25      **to get a copy of it. Can you review it in more detail**

1           **and just simply give me an answer to that question?**

2           A.       Certainly.

3           **Q.       All right. I wanted to read for you --**

4           A.       What was the exhibit number on that, please?

5           **Q.       324. And there's a section about field**  
6           **observed responses. Okay? And there's a whole list of**  
7           **them that come from Williams in '76, Appleman and Cloud**  
8           **1978, Fairbank in '77, Lillemars, Surbrook in '80,**  
9           **Jones in '81, Kirk and others in 1984, Stevens in '82**  
10          **and White in 1981. Okay? And some of those things**  
11          **are, one, intermittent periods of poor production,**  
12          **unexplained poor production, increased incidence of**  
13          **mastitis, elevated somatic cell count, increased**  
14          **milking times, incomplete milk letdown, extreme**  
15          **nervousness while in the milking parlor, reluctance to**  
16          **enter the milking parlor, rapid exit from the parlor,**  
17          **reluctance to use water bowls or metallic feeders,**  
18          **altered consummatory behavior such as lapping of water**  
19          **from the watering device.**

20                   **Are those all things that you agree that**  
21                   **you've seen from your own field observations or have**  
22                   **seen in the literature?**

23          A.       Yes.

24                   MR. BIRD: All right. Thank you. I'm done.

25                   - - -

1                   And, thereupon, the deposition concluded at  
2 approximately 4:47 p.m.

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1 CERTIFICATE

2 State of Ohio :

SS:

3 County of Pickaway :

4 I, Kendra Johnston, Notary Public in and for  
5 the State of Ohio, duly commissioned and qualified,  
6 certify that the within named ROBERT J. GUSTAFSON was by  
7 me duly sworn to testify to the whole truth in the cause  
8 aforesaid; that the testimony was taken down by me in  
9 stenotypy in the presence of said witness, afterwards  
10 transcribed upon a computer; that the foregoing is a  
11 true and correct transcript of the testimony given by  
12 said witness taken at the time and place in the  
13 foregoing caption specified.

14 I certify that I am not a relative,  
15 employee, or attorney of any of the parties hereto, or  
16 of any attorney or counsel employed by the parties, or  
17 financially interested in the action.

18 IN WITNESS WHEREOF, I have set my hand and  
19 affixed my seal of office at Columbus, Ohio, on this  
20 5th day of February, 2007.

21 \_\_\_\_\_  
22 Kendra Johnston, RMR, RPR,  
23 and Notary Public in and for  
24 the State of Ohio.

25 My commission expires July 14, 2007.

1                   ACKNOWLEDGMENT OF DEPONENT

2

3                   I, Robert J. Gustafson,  
4 do hereby certify that I have read the  
5 foregoing pages and that the same is a  
6 correct transcription of the answers given  
7 by me to the questions therein propounded,  
8 except for the corrections or changes in form  
9 or substance, if any, noted in the attached  
10 Errata Sheet.

11

12

13

14

\_\_\_\_\_  
Robert J. Gustafson  
Signed this \_\_\_\_ day of \_\_\_\_\_, 2007.

16

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18

E R R A T A

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PAGE LINE CHANGE REASON THEREFOR

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1 NOTICE TO READ AND SIGN

2

3 A copy of this deposition transcript  
4 is being provided to counsel for the witness  
5 by JANE ROSE REPORTING for signature.

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JANE ROSE REPORTING

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New York, New York 10011

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