

1 UNITED STATES PATENT AND TRADEMARK OFFICE

2 BEFORE THE PATENT TRIAL AND APPEAL BOARD

3
4 TETRA TECH CANADA INC., § CASE IPR 2019-00619
Petitioner, § PATENT NO. 7,616,329
5 VS. § -and-
6 §
GEORGETOWN RAIL EQUIPMENT § CASE IPR2019-00662
7 COMPANY, § PATENT NO. 9,441,956
Patent Owner. §
8

9 -----
10 CROSS-EXAMINATION OF

11 GREGORY T. GRISSOM

12 FEBRUARY 11, 2020
13 [REDACTED]14 -----
15
16 CROSS-EXAMINATION of GREGORY T. GRISSOM,

17 produced as a witness at the instance of the Petitioner,
18 and duly sworn, was taken in the above-styled and
19 numbered cause on February 11, 2020, from 9:12 a.m. to
20 12:45 p.m., before Molly Carter, Certified Shorthand
21 Reporter in and for the State of Texas, reported by
22 machine shorthand, at the offices of Holland & Knight,
23 LLP, 111 Congress Avenue, Suite 540, Austin, Texas,
24 pursuant to the Federal Rules of Civil Procedure.
25

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I N D E X

GREGORY T. GRISSOM

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EXHIBITS

NUMBER	DESCRIPTION	PAGE
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-None-		
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1 GREGORY T. GRISSOM,
2 having been first duly sworn, testified as follows:

3 E X A M I N A T I O N

4 BY MR. PARKER:

5 Q All right. Good morning --

6 A Good morning.

7 Q -- Mr. Grissom. I'm Aaron Parker from
8 Finnegan. We've met before.

9 A Uh-huh.

10 Q Can you please state your full name and address
11 for the record?

12 A Sure. It's Gregory Thomas Grissom. It's 107
13 Verrena, V-E-R-R-E-N-A, Way, Georgetown, Texas 78628.

14 Q And you understand that you're under oath now
15 today?

16 A I do.

17 Q Okay. And it's just like as if you'd be
18 testifying in court in front of a judge or jury?

19 A I do.

20 Q Now, have you been deposed before?

21 A I have.

22 Q Okay. How many times?

23 A Four or five.

24 Q Okay.

25 A Yeah.

1 Q So you understand I'll be asking you questions.
2 If you don't understand a question, then just please ask
3 me to rephrase it. But if you do answer a question, then
4 I will assume that you understood the question.

5 A Got it.

6 Q Is that fair?

7 A Yeah.

8 Q Okay. We'll try to take breaks about every
9 hour. But if you need a break in less than an hour, just
10 let us know.

11 A (Nodding head.)

12 Q Now, your Counsel may object to questions. I
13 will let him object. You know, if he starts to object,
14 let him object before you answer. And then you'll need
15 to answer the question unless he instructs you not to
16 answer. Is that fair?

17 A That's fair.

18 Q Okay. And during breaks, and you've probably
19 been told this in the past, but during breaks, you're not
20 supposed to discuss the substance of your testimony with
21 your Counsel. Do you understand that?

22 A Understood.

23 Q All right. Now, you said you've been deposed
24 four or five times. Have any of those been in patent
25 cases?

1 A Yes.

2 Q Okay. Were those District Court cases?

3 A We were previously in a litigation in the
4 Eastern District of Texas with a patent infringement case
5 before, so I was deposed as part of that.

6 Q Okay. When was the last time you were deposed?

7 A The last time I was deposed was probably last
8 spring, but that was in Canada.

9 Q Okay. So a separate, separate case?

10 A Yes.

11 Q Have you been deposed in an IPR or PTAB
12 proceeding? Are you familiar with those terms?

13 A This is really my first time through the IPR
14 process in this way.

15 Q Okay. Generally speaking, it's the same.
16 We've gone through the rules. And again, if you have any
17 questions, feel free to let us know.

18 A Okay.

19 Q Or let me know. All right. And so you do
20 understand that -- well, you prepared two declarations
21 relating to the IPRs. Are you familiar with those two --

22 A Correct. I did.

23 Q Okay. And one was relating to U.S. Patent No.
24 7,616,329?

25 A (Nodding head.)

1 Q And is it okay with you if I refer -- was that
2 a yes?

3 A Yes.

4 Q Okay. Are you okay if I refer to that as the
5 '329 patent today?

6 A Yes.

7 Q And the second declaration was relating to U.S.
8 Patent No. 9,441,956; is that correct?

9 A Correct.

10 Q Okay. And are you okay with me referring to
11 that as the '956 patent?

12 A Yes.

13 Q Okay. Are you familiar with both of those
14 patents?

15 A I am.

16 Q Okay. Now, you're an inventor on one of them;
17 is that correct?

18 A I am an inventor on the second one.

19 Q The '956?

20 A Yeah, I believe so.

21 Q Okay. All right. So --

22 A I believe that's correct. I'd have to --

23 Q Yeah.

24 A Okay.

25 Q I believe that's correct, too.

1 A Yeah, okay.

2 Q If we need to --

3 A All right.

4 Q -- look at it. I don't plan to ask you any
5 questions about that.

6 Okay. So we'll pull out the declarations.

7 Actually, why don't we go ahead and I'll provide you with
8 a copy of -- this is a declaration in the IPR 2019-00662.
9 This relates to the '956 patent. And it was Exhibit
10 2012.

11 MR. HERBERHOLZ: Are you marking these,
12 Counsel, as transcript exhibits?

13 MR. PARKER: I was planning to just leave it
14 marked as --

15 MR. REESE: Yeah, they're previously marked.

16 MR. HERBERHOLZ: Okay.

17 MR. PARKER: Yeah, since they're already
18 marked. I'll mark new exhibits.

19 Q (By Mr. Parker) So please take a look and
20 confirm that this is the declaration relating to the '956
21 that you prepared.

22 A (Reviewing document.) Yes, I recognize this.
23 Looks correct.

24 Q Let me go ahead and mark or introduce the other
25 one. This is, I believe, your declaration, Declaration

1 of Gregory T. Grissom in the IPR 2019-00619 relating to
2 the '329 patent. It is also marked as Exhibit 2012, but
3 because it's in the second, different IPR, I think we're
4 okay with that.

5 MR. HERBERHOLZ: Counsel, I think this is
6 probably a good time for me to make sure that I designate
7 the transcript of this deposition confidential protective
8 order material, pursuant to the stipulated protective
9 order that we have on file in this case.

10 MR. PARKER: Okay.

11 Q (By Mr. Parker) Please take a look at that. Is
12 that the declaration that you prepared in the '329
13 patent?

14 A Yes.

15 Q Now, when did you start preparing these two
16 declarations?

17 A I believe it was last fall time frame. I'd
18 have to -- I'd have to think about that for a second. I
19 know it was towards the end of, end of last year, middle
20 to the end of last year.

21 Q Now, how much time did you spend working on --
22 so, first of all, looking at the two declarations, take
23 time if you need to look through it, but can you confirm
24 that they're identical, aside from the cover page?

25 A They look -- they're very similar. They're

1 with regard to the patents that are related to one
2 another, so the foundation of the declaration is similar.

3 Q How much time, how much time did you spend
4 working on the declarations?

5 A I'd say a few hours.

6 Q Just a few hours?

7 A Yeah.

8 Q Okay. So like less than five?

9 A I worked, I worked with our Counsel on
10 preparing these documents and having discussions and
11 sending, you know, sending drafts and so on. And so I'd
12 say collectively, you know, five hours seems appropriate.

13 Q Okay. Combined for the two of them?

14 A They're very similar, as you pointed out.

15 Q So you mentioned working with Counsel. Who,
16 who was that?

17 A The gentleman sitting next to me, Dana
18 Herberholz.

19 Q Okay. Anybody else?

20 A And his firm, Parsons Behle.

21 Q Okay. Do you remember the name of the other
22 attorneys?

23 A Sure. Rex Johnson would have been involved,
24 and perhaps Chris Cuneo.

25 Q Now, did you, did you write the declaration?

1 A I, I have -- I worked closely with Dana on
2 preparing this. And so I would have -- we would have
3 discussed the content and what was in it, and then I
4 would have received a draft of that discussion. And then
5 we go back and forth several times, to verify all the
6 information is how I laid it out. And then I, of course,
7 approve it and sign it and make sure it's accurate.

8 Q So the content is yours, but not necessarily
9 all the words are --

10 A It's a collaboration.

11 Q Okay. Did you speak with anyone else in
12 preparing the declarations outside of Counsel?

13 A No.

14 Q Do you know who John Kainer is?

15 A Yes.

16 Q Okay. Who is he?

17 A John is the technical coordinator in our
18 inspection technology business at GREX, and he reports to
19 me.

20 Q Did you speak with him relating to this
21 declaration?

22 A I did not speak with John related to my
23 declaration.

24 Q Did you speak with him relating to something
25 else relating to these IPRs?

1 A I work with John every day, so we, you know, we
2 talk about a lot of things, you know, specifically a lot
3 of the technology that we're going to talk about today.
4 So I don't recall if I, if I spoke to John about my
5 declaration or his declaration.

6 Q Okay. So you're familiar with the fact that
7 he, he provided a declaration in both these IPRs as well?

8 A Yes.

9 Q Okay.

10 A I know you'll be deposing him tomorrow.

11 Q All right. So you may have talked with him
12 about his declaration but you're not certain?

13 A I honestly don't recall seeing his declaration.
14 I, you know, I trust whatever, whatever he has in his is
15 accurate. And so I wouldn't need to verify his
16 declaration. It's his statement.

17 Q Okay. So preparing for the declaration, you
18 don't think you talked to him or looked at his
19 declaration. How about preparing for the deposition
20 today?

21 A There was no significant collaboration between
22 John and I on our individual depositions. I mean, I saw
23 John briefly yesterday, and, you know, we were discussing
24 how traffic was going to be when we were coming down.
25 But it -- you know, he's, you know, he's got his

1 assignment to be deposed on Wednesday. I have mine to be
2 deposed today. It was -- I didn't dive deep into any,
3 any details with John about any of this --

4 Q Okay.

5 A -- honestly.

6 Q Good. Fair. We want honesty. So what did you
7 do to prepare then for today?

8 A You know, as I -- you know, in the last 24
9 hours, I just reminded, reminded myself or familiarized
10 myself with the declaration itself, and I probably spent
11 two hours just reminding myself of the patents and the
12 declaration prior to showing up here this morning.

13 Q Okay. And you did that yourself?

14 A Yeah.

15 Q Okay. Did you talk to anybody?

16 A Dana and I had some conversations about it
17 yesterday briefly; but otherwise, that was the extent of
18 my preparation.

19 Q Those were by phone, I imagine?

20 A Dana was at our office yesterday --

21 Q Oh.

22 A -- for a few hours. I was in meetings 90
23 percent of the day yesterday, not related to this.

24 Q And so there was no one else you spoke to in
25 preparation for today?

1 A No.

2 Q I'll just throw out, do you know Dr. Alan
3 Conrad Bovik?

4 A Yes.

5 Q Okay. Who is he?

6 A I met Dr. Bovik in -- before. I believe he's a
7 professor at the University of Texas. I believe that's
8 how I know him. But I've known him to be an expert in
9 evaluating aspects of our technology prior to, prior to
10 this litigation.

11 Q Okay. So he served, he served as an expert for
12 GREX in other patent matters?

13 A Correct.

14 Q Do you understand that he's serving as an
15 expert for GREX in this IPR?

16 A I do.

17 Q Have you read his declaration?

18 A I have not.

19 Q Have you spoken with him?

20 A I have not.

21 Q And so all of the questions I just asked you,
22 lumping everything together, there are two patents, two
23 IPRs, but are all the answers the same for both the '329
24 and the '956?

25 A Yes.

1 Q Okay. You looked -- you thought for a second.

2 A Well, you asked me a lot of questions, so I'm
3 trying to think what I said or --

4 Q Right. So the amount of time you spent
5 preparing was a combination related to both, both IPRs;
6 is that correct?

7 A Sure.

8 Q Okay. And when you said you reviewed your
9 declarations, I mean, they are basically identical. But
10 you reviewed each declaration?

11 A Yes.

12 Q So let's look at, since I think we've
13 established that they are essentially identical -- and
14 again, if you notice that they're not as we go through
15 things, let me know. But why don't we look at the '329
16 declaration. So that's Exhibit 2012 from IPR 2019-00619.
17 And turn to Paragraph 4, please. And go ahead and read
18 that paragraph if you want to familiarize yourself with
19 it.

20 A (Reviewing document.) Okay, I'm good.

21 Q So in this paragraph, you mention GREX's
22 automated track inspection technology includes an Aurora,
23 an Aurora -- and I'd like you to make sure I'm
24 pronouncing, I'm saying this right. Is it X "one" or is
25 it X "I"?

1 A X "I".

2 Q Okay. So we've got Aurora as the first, Aurora
3 Xi as the second, and then Aurora Xiv; is that right?

4 A Yeah, we call it X "four," but yeah.

5 Q That's confusing.

6 A Yeah. It's -- we pay a marketing firm to come
7 up with confusing concepts.

8 Q Fair enough. All right. So Aurora, Aurora Xi,
9 and Aurora Xiv. That's correct?

10 A Correct.

11 Q Okay. And then there's also something called a
12 BallastSaver system.

13 COURT REPORTER: A what? I'm sorry.

14 MR. PARKER: A ballast, B-A-L-L-A-S-T, saver
15 system.

16 Q (By Mr. Parker) Is that correct?

17 A That's correct.

18 Q Okay. What is the BallastSaver system?

19 A The BallastSaver system is a LIDAR, L-I-D-A-R,
20 system that essentially shines lasers on the track,
21 collects the signal that returns when it hits an object,
22 and it creates, creates a, kind of a topographical map
23 of -- we use it to assess the cross-section of a railroad
24 bed.

25 And it determines whether there's deficient

1 ballast or rocks in the track structure. So its primary
2 purpose is to survey a railroad track and determine if
3 there's enough rock in the cross-section.

4 Q Okay. So the rock is what is -- ballast is the
5 rock --

6 A Correct.

7 Q -- that's on the track? Or next to the track
8 and under the track? All that's included in --

9 A All that's -- so when we say ballast, we're
10 referring to the rock that's in the cribs of the ties, on
11 the shoulders of the ties.

12 Q When you say cribs of the ties, what do you
13 mean?

14 A That's the space in between two ties.

15 Q Okay. So like if the ties are -- in the
16 longitudinal direction of the tie, like that's
17 horizontal, I guess perpendicular to the rails, right?
18 So that's, you're talking about between ties in that
19 manner?

20 A Yeah. When I say crib, I'm just referring to
21 the rock that, the volume of rock that is in between two
22 adjacent ties. And let's just say within the rails. And
23 that's, that's essentially called the crib.

24 Q Okay. So the BallastSaver system is to assess
25 essentially that the ballast is, you have the proper

1 amount of rocks, filler, all that stuff?

2 A Correct. It creates a survey of where you're
3 deficient in material so you can then, therefore, come
4 back and unload material, and the correct volume of
5 material, in those areas.

6 Q So throughout your declaration, you refer to
7 the Aurora systems. Is the BallastSaver system included
8 in the Aurora systems? Or is that a separate --

9 A It's a stand-alone technology. It can be
10 operated in isolation or it can be operated on the same
11 platform as our tie inspection system. But the
12 technology itself is, is different.

13 Q Okay. So when you refer to Aurora systems,
14 unless you say BallastSaver, then it's not intended to
15 include that technology?

16 A Correct.

17 Q And the BallastSaver system is sold separately
18 to customers, apart from the Auroras or --

19 A It can be.

20 Q Okay.

21 A It can be bundled as part of the service or it
22 could be operated in isolation.

23 Q Is it a separate vehicle?

24 A It could be.

25 Q Okay. So there is such a thing as a

1 BallastSaver, like is that a high rail vehicle as well
2 or --

3 A Yes.

4 Q Okay.

5 A We have vehicles that are independent
6 BallastSaver vehicles, and we also have vehicles that
7 are, have combined technologies on them.

8 Q Okay. So you could have an Aurora, like a
9 truck that -- is it Aurora technology as well as the
10 BallastSaver?

11 A That could be on one platform, yes.

12 Q Okay. And is there any combination of -- could
13 any of the three Aurora systems be combined with the
14 BallastSaver?

15 A Yes.

16 Q Okay. Now, you mentioned -- so in your
17 declaration again at Paragraph 4, the Aurora, the Aurora
18 Xi, and the Aurora Xiv. Are those used, systems used to
19 identify various aspects of the railroad track?

20 A Yes. I'd say primarily, whenever you hear
21 Aurora, it's going to be focused on tie inspection or
22 cross-tie inspection as its fundamental offering.

23 Q And that's, that's your answer for all, all
24 three of the Aurora systems?

25 A Correct.

1 Q Do the Aurora, do the Aurora systems also
2 analyze other aspects of the track other than the ties?

3 A The primary deliverable is tie condition data.
4 There are -- there is other functionality in terms of
5 mapping assets or identifying physical plant items along
6 the railroad track. But the primary deliverable is tie
7 condition data.

8 Q So the Aurora, the original Aurora, does that
9 generally use -- it generally uses lasers and cameras to
10 scan the railroad track? Is that correct?

11 A That's correct. The standard Aurora offering,
12 which everything else is built upon, uses lasers and
13 cameras to inspect the track.

14 Q And then the Aurora Xi, that involves a new,
15 different type of technology, is that correct, an x-ray
16 technology?

17 A Correct. So the Aurora Xi system uses the same
18 standard Aurora system, but also adds in an x-ray
19 backscatter technology to the offering.

20 Q Can you explain what x-ray backscattering
21 technology is?

22 A Sure. So we put an x-ray source on a truck,
23 and it shines a fan beam down on the track, and there's a
24 detector that hovers above the track in between the two
25 rails. And as the x-rays hit the tie, if it's a hollow

1 tie, the x-rays will pass through it, and so no signal
2 will be returned.

3 If it's a solid tie, those photons will bounce
4 off the tie, come back to the detector, and we're able to
5 compute the density or strength of the cross-tie as an
6 additional metric for tie grading.

7 Q So there can be levels of hollowness, I guess,
8 in the tie? And then based on the signal you receive in
9 response, you can tell, you know, whether that's a
10 problematic tie or what? You grade them, I guess? Is
11 that what you said?

12 A That -- your explanation is fair. We can get a
13 signature off the tie as to how structurally sound it is.

14 Q And that is for wood ties only, wooden ties; is
15 that correct?

16 A Wooden ties only.

17 Q And to go back to the original Aurora, or you
18 said the standard Aurora, is that used to analyze wooden
19 ties and concrete ties?

20 A Yes.

21 Q All right. So the Aurora, we've got wooden
22 ties and concrete ties; and then the Aurora Xi, we have
23 just wooden ties?

24 A The x-ray system itself is only effective on
25 wooden ties, but we could use an x-ray truck to inspect

1 concrete ties, because the standard Aurora system's on
2 that as well. We just wouldn't use the x-ray part of it.

3 Q So in that sense, it would still be essentially
4 functioning like the standard Aurora?

5 A Correct.

6 Q So the Aurora Xiv -- I'm going to get this
7 wrong. I'm struggling with it every time I say it.
8 Sorry. So I apologize if I'm speaking slowly. The
9 Aurora Xiv, that -- can you explain what that is?

10 A Yeah. So we started to build a larger high
11 rail truck, and, and so the latest version of our high
12 rail truck houses four different technologies. And so we
13 had already branded the x-ray system Xi. And so the Xiv
14 was just our marketing firm's vision for branding a
15 bigger truck with four different technologies on it.

16 Q And what are those technologies again?

17 A It would be the standard Aurora system, both
18 the wooden tie and the concrete tie orientation.

19 There's -- so there's two different measurements being
20 made there. And then the x-ray system, and then the
21 BallastSaver system.

22 Q Okay. So when we do talk about the Xiv, we're
23 including the BallastSaver --

24 A Yes.

25 Q -- system. Okay. And that's all on one truck?

1 A Correct.

2 Q And how does that affect -- I know we haven't
3 talked about this yet -- but there's various speeds, from
4 what I understand, that these systems can, you know,
5 operate up to.

6 A Uh-huh.

7 Q Can you kind of just explain that, what the
8 speeds are for the Aurora, the Aurora Xi, and then the
9 Xiv?

10 A Yeah, most of our speed limitations have to do
11 with the platform itself, or the truck itself. There's
12 only -- so you can only operate a truck so fast on a
13 railroad, or a high rail vehicle. And so the standard
14 Aurora systems were a smaller platform, like an F-250.
15 And, and so those, those we can run a little faster. But
16 that technology, I mean, we rarely get above 40 miles an
17 hour with that, and most -- and mostly, you know, I'd say
18 between 20 and 35 miles an hour.

19 And the Xi system, the original Xi systems we
20 put on an F-550 platform originally. And those are
21 limited by regulation to 25 miles an hour on a railroad
22 track. And our next generation, the Freightliner
23 platform, is similar. It's regulated to only travel at
24 25 miles an hour, just because of the size of the vehicle
25 and dynamics and all those things.

1 So typically we're inspecting, you know, with
2 the bigger trucks at 25 miles an hour, and the smaller
3 trucks, you know, maybe up to 35 or 40 miles an hour.

4 Q I'm not from Texas, so I just want to make sure
5 I understand this. A Freightliner, that's a type of
6 pickup truck, or truck; is that right?

7 A It's a type of truck.

8 Q Okay.

9 A But it's a really heavy duty, big vehicle.

10 Q Okay. And then like the F-250 and 550, those
11 are like Ford models?

12 A Correct.

13 Q Okay. Just wanted to make sure I was clear.
14 So Freightliner's not a GREX thing. It's just an
15 industry known truck.

16 A Anyone can go buy any of those platforms and --
17 yes.

18 Q Okay. So please stay on the same declaration
19 and go to --- actually, let's go to Page 4. And there's
20 a, there's a photograph of a railroad track, and it looks
21 like it's been annotated to identify portions of the
22 track. Did you create that image?

23 A I didn't create the image, but the image is
24 accurate.

25 Q Okay. Now, in Paragraph 7 -- so in that image,

1 it identifies the rails, clip, a spike, ballast, tie
2 plate, and a tie; is that correct?

3 A Correct.

4 Q Then the Paragraph 7 right below it, it says,
5 "The rails, ties, plates, pads and fasteners shown in
6 Figure 1 above collectively constitute the railroad
7 track." But the terms fasteners and pads aren't included
8 in the image, so I just want to be clear as to what those
9 refer to.

10 A A fastener would be, would be a clip or a
11 spike.

12 Q Okay.

13 A So there's two examples of fasteners in the
14 picture. Now, pads are not called out. And pads would
15 typ- -- you would typically find those on concrete ties
16 underneath the rail seat, but not on wooden ties like you
17 see in this picture.

18 Q Okay. And when you say the rail seat, can you
19 explain what you mean by that?

20 A Underneath the base of the rail.

21 Q Okay. Can you look at Paragraph 10 now,
22 starting on Page 5?

23 A Yes.

24 Q And you can go ahead and read that if you want
25 to read it, just so you're familiar with it.

1 A (Reviewing document.) I'm okay -- I'm familiar
2 with it.

3 Q So you note in that paragraph, "Georgetown
4 developed the Aurora systems to automate the process of
5 tie grading and inspection." And then it further says,
6 "Georgetown's Aurora systems detect track defects." Is
7 that correct?

8 A I guess where are you reading that at?

9 Q Oh. So the beginning of the paragraph,
10 "Georgetown developed the Aurora systems to automate the
11 process of tie grading and inspection." That's the first
12 sentence.

13 A Correct. Yeah.

14 Q Okay. And then skip the next sentence.

15 A Okay.

16 Q The following sentence says "Georgetown's
17 Aurora systems detect track defects." Oh, and then --
18 sorry, I must have -- "detect track defects." And I
19 stopped there. I'm not intending to --

20 A Yes.

21 Q -- skip any other part. I just wanted to make
22 sure --

23 A Yeah.

24 Q But those are accurate statements?

25 A I just lost following you because you skipped

1 that one sentence and then flipped the page. So yeah,
2 I'm with you. I recognize my declaration says all that,
3 and I agree with it.

4 Q Okay. And then Paragraph 12, starting on the
5 bottom of Page 7, the beginning you note, "The Aurora
6 systems include algorithms to process the digital data to
7 measure tie plate cutting and other track defects." Do
8 you read --

9 A Correct.

10 Q Okay. And that's an accurate statement?

11 A Yes.

12 Q And we talked about -- I don't want to
13 repeat -- but the Aurora systems, all three of them are
14 used to identify defects and determine the condition of
15 wooden cross-ties; is that correct?

16 A All three of them do determine the condition of
17 wooden cross-ties, yes.

18 Q And all three of the Aurora systems are also
19 used to identify defects and determine conditions of
20 concrete ties?

21 A In certain orientations of the Aurora system,
22 it can be set up to inspect concrete ties. But there are
23 some changes to the cameras that have to occur.

24 Q Can you explain that in more detail?

25 A Sure. When you inspect concrete ties, we're

1 mainly focused in the rail seat area. And so we put up a
2 higher resolution lens on the cameras to get more
3 accuracy about the measurements in the rail seat area.

4 Q And so when you -- those are like physical
5 changes you have to make to the vehicle?

6 A Yes. Unless the vehicle has four cameras -- so
7 a standard Aurora system has two cameras and two lasers.
8 And so if we wanted to have the wood orientation and the
9 concrete orientation, we would need to add another two
10 cameras with those high resolution lenses on them, and
11 two more lasers.

12 Q Okay. So for inspecting concrete ties, you
13 need potentially four cameras and four lasers?

14 A That's correct. And a good question for John
15 would be tomorrow, I think we've had the development in
16 place that we're only using two lasers and four cameras.
17 So you just change the geometry of the cameras to all
18 work off the same laser line. So I guess my answer is
19 ~~I'm unsure that it's four lasers, four lasers on our~~
20 latest version.

21 Q Okay. And you mean the latest version may be
22 four cameras and two lasers?

23 A Correct.

24 Q And that latest version is the Xiv?

25 A Yes.

1 Q When you're in this -- again, so when you have
2 four cameras and whatever, whether it's two or four
3 lasers and you're, with the intent of being able to
4 detect concrete ties, are you also able to still detect
5 everything that you could have measured relating to
6 wooden ties?

7 A Yes.

8 Q Okay.

9 A Yeah. The goal there is to be able to collect
10 anything you come across in one pass.

11 Q Okay.

12 A So you've got your concrete geometry set up,
13 you've got your wood, you know, hardware set up, and
14 you're able to just, whatever you come across, you can
15 collect and inspect.

16 Q So for a layperson to understand, when would
17 you typically have wooden ties versus concrete ties?

18 A Concrete ties are generally found on more high
19 density lines or high traffic lines. They usually
20 represent about 10 percent of the North American market.
21 And sometimes you'll see wood and concrete ties
22 interspersed, like maybe concrete ties in curves and wood
23 ties in tangent. So there's times where they could be
24 interspersed on a line.

25 Q Okay. But often the concrete ties, you find

1 those more in cities and things like that perhaps, or --

2 A No, real high tonnage lines.

3 Q Oh, okay.

4 A Like coal routes, trans-con, anything that's
5 coming from like the port inland, a lot of trains, a lot
6 of traffic, very high -- railroads measure traffic
7 in million gross tons. So we call that MGTs. And
8 whenever you have a really high MGT line, the economics
9 would favor a concrete installation, because concrete
10 ties are more expensive.

11 Q Okay. But they last longer typically?

12 A They -- they do. Yes.

13 Q Back to the, all three Aurora systems, all
14 three are used to identify defects and determine the
15 condition of the rail?

16 A Not the condition of the rail. The primary
17 deliverable of those systems are they deliver the
18 condition of the tie.

19 Q So they do not -- they don't analyze the
20 condition of the rail, in general. It's just the tie?

21 A Correct.

22 Q Are all three Aurora systems used to identify
23 defects and determine the condition of the fasteners,
24 like the spikes and clips?

25 A We analyze the fastener and catalog the type of

1 fastener.

2 Q What do you mean by you analyze the fastener?

3 A We, we inventory what type of fasteners are
4 there and if they're present or not.

5 Q Okay. So it's important to know whether you've
6 got a missing spike or a missing clip or something like
7 that. And all three systems can determine whether you
8 have a missing spike or clip?

9 A That's fair.

10 Q How about do all three systems identify defects
11 or determine the condition of the ballast?

12 A The only system that looks at the ballast is
13 the BallastSaver system. The Aurora system focuses on
14 the ties.

15 Q So the original Aurora did not -- there was no
16 aspect of the original Aurora that analyzed the ballast?

17 A Correct.

18 Q What about rail joints, do all three Aurora
19 systems identify defects and determine the condition of
20 rail joints?

21 A We identify rail joints with the Aurora system.

22 Q When you say identify, what do you mean by
23 that?

24 A Identify if a rail joint is present.

25 Q Okay. So similar to fasteners, the Aurora

1 system is designed to determine whether a rail joint is
2 present or missing?

3 A Correct. Not -- well, present -- if it's
4 missing, you've got a problem. But it's an inventory
5 type of assessment to allow a customer to know what's out
6 there.

7 Q Okay. And what about rail base, do all three
8 Aurora systems, are they able to identify defects or the
9 condition of the rail base?

10 A We do have algorithms that look at the rail
11 base for a phenomenon called rail base corrosion. It's
12 only used for a couple of customers. And it's only
13 really relevant in situations where you have tunnels,
14 because of the moisture and electrification, and the rail
15 base tends to deteriorate. It's not something we do very
16 often. So we do look at the rail base for that.

17 Mostly, however, we're looking at
18 characteristics of the cross-tie itself. And all these
19 other things are in the field of view and able to be
20 analyzed.

21 Q Okay. And when you say "in the field of view,"
22 you mean in the field of view of your systems?

23 A Correct.

24 Q Okay. So they're capable of identifying
25 whether things -- whether other aspects of the track are

1 missing or damaged, but you're saying that's perhaps not
2 necessarily the primary goal?

3 A We get paid to provide cross-tie condition.
4 And then anything else besides that is ancillary or
5 supplemental. Or if it's in the field of view and a
6 customer has a specific request, if we can develop an
7 algorithm to collect it, we will. But if we weren't
8 providing the tie condition data, we wouldn't really have
9 a service we were offering.

10 Q Now, do each of the Aurora systems include
11 numerous algorithms that are used to identify the
12 different types of defects that we've been talking about?

13 A Yes. There's multiple algorithms associated
14 with the Aurora system.

15 Q And that's with the original Aurora?

16 A Yes.

17 Q And the Aurora Xi also includes multiple
18 algorithms that help you identify defects on various
19 aspects of the rail?

20 A Yes.

21 Q And same goes for the Xiv?

22 A Yes. So just so I don't get confused, anything
23 that has the word Aurora in it has the standard Aurora
24 system on it. So if you say the word Aurora, you've got
25 a 3D laser profiling, cameras, lasers, system in place.

1 Anything that follows that, Xi, Xiv, that's -- those are
2 just add-on technologies to the fundamental Aurora
3 technology, which is in place on everything.

4 Q Okay. And so that original Aurora had numerous
5 algorithms used to identify numerous different types of
6 defects in the rail?

7 A There are many algorithms within the Aurora
8 software.

9 Q And then it follows that those same algorithms
10 are also now in the Xi and the Xiv, but there are
11 additional algorithms?

12 A Correct.

13 Q So if you'll go to Paragraph 8, please.

14 A Sure.

15 Q On Page 5. Just take a look at that, please.

16 A (Reviewing document.) Okay.

17 Q The second sentence starts with, it says,
18 "Accurately grading ties requires measurement of tie
19 plate cutting." Do you see that?

20 A Yes.

21 Q What other measurements are taken into account
22 when grading wooden ties?

23 A If you're looking at a tie, you'd consider the
24 surface condition, whether there were checks and splits
25 on the tie itself.

1 Q I'm sorry. What was the first word you used?

2 A Like checks.

3 Q Checks?

4 A Like missing pieces of wood. You know, if
5 there's cracks going through it. But this paragraph
6 refers to the most fundamental measurement of tie
7 inspection, which is determining whether a plate is
8 sunken or not, because it creates a significant safety
9 issue. If that plate cuts into a tie, it alters the
10 geometry of the railroad track and creates a significant
11 problem.

12 Q But that's just one of the measurements that is
13 taken into account in grading the tie?

14 A The most important measurement, but one of the
15 measurements.

16 Q So here I'm going to hand you what's been
17 marked as Georgetown Rail Exhibit 2015. And this is an
18 exhibit to your declaration, I believe, in the -- in both
19 of them. But the version I'm handing you is relating to
20 IPR 2019-00662. Have you seen this document before?

21 A Yes.

22 Q What is it?

23 A This is a copy of Railway Track and Structures
24 magazine from June 2012.

25 Q I might have handed you the wrong one. Sorry.

1 You can hold on to that one.

2 I'm going to give you what was Georgetown Rail
3 Exhibit 2014 from the same IPR, the 00662. This is also
4 an exhibit to your declaration. Are you familiar with
5 that document?

6 A Yes.

7 Q What is it?

8 A This is a copy of Railway Track and Structures
9 magazine from November 2010.

10 Q Now, if you turn to page, it's Page 38 of 52 of
11 the exhibit. It says -- it's labeled GREX 657180 in the
12 bottom right-hand corner.

13 A Okay, I'm there.

14 Q Okay. And there's -- in the middle of the
15 page, or the middle column, there's a header that says
16 "Georgetown Rail." Do you see that?

17 A Yes.

18 Q Okay. And that -- go ahead and you can take a
19 look at that if you're unfamiliar with it.

20 A (Reviewing document.) Okay.

21 Q So the third paragraph under the Georgetown
22 Rail section says, "GREX also recently enhanced Aurora's
23 pattern recognition systems to more accurately discern
24 and locate both the tie and tie plates; upgraded the
25 wood-tie grading system to increase the number of

1 attributes wood ties are graded on, as well as provide
2 additional flexibility in calibrating to
3 customer-specific criteria." Did I read that correctly?

4 A Yes.

5 Q So I just want to ask a few questions about
6 that. This is November 2010, and it's talking about
7 recent enhancements to the Aurora -- is it talking about
8 the original or standard Aurora?

9 A Yes.

10 Q So prior to this article, if you can remember,
11 I guess what was added or what was new here in 2010?

12 A So let me go ahead and say that I started at
13 GREX in 2011, so I'll preface my answer with that, and
14 then I'll ask you to repeat the question.

15 Q Okay. So it talks about recent enhancements in
16 Aurora's pattern recognition system. And since this was
17 a November 2010 article, do you have knowledge of what
18 the system was like prior to those enhancements?

19 A I know, in general terms, what functionality is
20 included in the offering. Again, I started with GREX
21 about a year later. But the offering would have been
22 somewhat similar in November of 2010 to what it was in
23 October of 2011 when I started.

24 Q So do you understand what the upgraded wood-tie
25 grading system refers to?

1 A Like any technology offering, there's always
2 development and improvements. And so Aurora, unlike
3 anything else -- or like anything else, is a constant R&D
4 software, hardware development project that has to
5 continue to evolve to, to improve its accuracy and meet,
6 you know, industry expectations.

7 So this would have been -- 2010 would have been
8 seven or eight years in our development cycle, and many
9 millions of dollars in developing the software, hardware,
10 and the orientations and the algorithms.

11 And so this is an update to the industry that
12 GREX continues to invest in the technology. And the
13 recent, you know, enhancements and development have
14 improved the offering once again.

15 Q But you don't have any reason to believe that
16 the statement where it says the upgrade of the wood tie
17 grading system to increase the number of attributes wood
18 ties are graded on, you have no reason to believe that's
19 incorrect?

20 A I have no reason to believe that's incorrect.

21 Q Okay. So am I right that that implies that
22 there were a certain number of attributes that wood ties
23 were graded on, and that at some point prior to the
24 writing of this, they increased the number of attributes
25 that the wood ties were graded on in the Aurora systems?

1 A Yes, that's what it says. I believe it
2 reflects an evolution of algorithm development, and
3 probably stems from on-track walking, auditing, and just
4 making the deliverable better.

5 Q At the bottom of that paragraph, it says, "In
6 addition to these enhancements, GREX has refined Aurora's
7 ability to locate and identify rail base corrosion and
8 rail seat abrasion." Is that a correct reading?

9 A Yes.

10 Q And that rail base corrosion is what you
11 discussed earlier? Is that correct?

12 A That's correct.

13 Q Okay. So that's an aspect of the, sounds like
14 the original Aurora -- well, maybe it had -- but here
15 it's talking about refining that technology, so making it
16 better in its ability to identify rail base corrosion?

17 A That's fair.

18 Q Okay. Same goes for rail seat abrasion. I
19 don't think we've talked about that yet. What is that?

20 A So rail seat abrasion is a phenomenon that
21 happens on concrete ties, and it's where the base of the
22 rail wears away the tie pad, and then abrades into the
23 surface of the concrete tie.

24 And somewhere around 2006, 2007, there were a
25 couple of derailments related to that failure mode, and

1 it became a significant industry push to identify areas
2 that had rail seat abrasion. And thus it was added to
3 the, or included in the Aurora offering. And I do know
4 it was included way before 2010, as I mentioned, because
5 there were some big events in, you know, 2006 time frame.

6 Q Okay. So it's your understanding that adding
7 or enhancing the rail seat abrasion capabilities of
8 Aurora was a critical feature that was added?

9 A It's an important feature, yes.

10 Q And then the next paragraph, it's talking about
11 an example of -- it says BNSF. Is that a customer of
12 GREX's?

13 A That's correct. The Burlington Northern
14 Santa Fe Railroad.

15 Q Okay. And they used, at least in this time
16 period, Aurora to identify rail seat abrasion problems?

17 A In 2010 we would have been working with BNSF on
18 testing the rail seat abrasion functionality.

19 Q So that was a pretty significant thing in 2010
20 as well, not just in 2006-'07?

21 MR. HERBERHOLZ: Objection, form.

22 THE WITNESS: 2010, it was still a big, big
23 issue. Once again, once the railroads had those
24 derailments related to the rail base corrosion, it became
25 a priority for them to find out where those locations

1 were. And so refining that ability and improving the
2 accuracy of those measurements was important.

3 Q (By Mr. Parker) So this, this portion, I mean,
4 BNSF is a, it's a large rail -- I don't know how to
5 explain it, but they're one of the larger railroad
6 companies?

7 A Yes.

8 Q How do you --

9 A They're considered a Class 1 railroad, a
10 30,000-mile network. And so they're one of the biggest
11 railroads in North America.

12 Q So this Washington Metropolitan Area Transit
13 Authority, I think that's -- is that the Washington, DC,
14 like Metro --

15 A Correct.

16 Q -- subway system? So the rail base corrosion
17 and rail seat abrasion you guys work with like
18 metropolitan subway systems to inspect track as well?

19 A We typically work with commuter railroads, some
20 transits. The bulk of our business, though, is with the
21 Class 1 railroads. But we do have other short line
22 commuter and transit customers.

23 Q So is the WMATA a customer?

24 A Yes.

25 Q Okay. That's a pretty big one. The nation's

1 capital. We're familiar with it.

2 A You guys probably ride that.

3 Q Right. So thanks for your work.

4 All right. You can turn the page, please. And
5 if you need a break, I should be done -- I'll be done
6 with this --

7 A We're not quite an hour yet. I'm okay.

8 Q Okay.

9 A You wanted to turn the page to which page?

10 Q Yeah, sorry. The next page. It should be
11 GREX 657181 at the bottom.

12 A Okay.

13 Q And I just wanted to point you to the Aurora
14 advertisement. Do you see that on the right side of the
15 page?

16 A Yes.

17 Q It says, "3D scans of the entire track at
18 speeds of up to 40 miles per hour." And so that's what
19 we talked about. This must be the -- this is, again, the
20 original Aurora, the standard Aurora?

21 A Correct.

22 Q Okay. And then there's a bunch of bullet
23 points below that. And I just want to take you through
24 those and have you confirm that those are all important
25 aspects of the system, of the Aurora. They analyze the

1 surface of wood ties?

2 A Yes.

3 Q And it says, "Assign up to four wood tie
4 grades." What does that refer to?

5 A There's typically a four grade system for
6 assessing tie condition. Some of our customers have gone
7 to a five grade system. But it's just, it's a system
8 that just let's you know the condition of the cross-ties.
9 So a 4 would be a failed tie; a 3 would be a bad tie; a 2
10 would be a marginal tie; and a 1 would be a good tie.

11 Q And so how, how are those grades -- those
12 grades are assigned based on the many attributes that the
13 ties are graded on?

14 A Sure. We developed a predictive model that
15 takes into consideration and weights variables to
16 generate that grade.

17 Q Okay. So a lot of measurements are being made,
18 and then you're getting measurements, and then those
19 are -- that's the variables you're talking about? And
20 then you weigh certain measurements over other ones? I
21 just want to make sure I understand.

22 A Yeah, there's measurements that are collected
23 on the tie, and some of those are significant predictors
24 of tie condition, such as the plate cutting measurement.
25 And predictors of condition like that go into the grading

1 models. So if you had significant plate cut, you'd have
2 a poor tie grade.

3 Q Which other attributes are significant within
4 that determination?

5 A So when we build a model or a grading model,
6 it's specific to an individual railroad's grading scheme.
7 And so how individuals grade ties on a railroad, we build
8 a model that predicts that process. And so there are
9 other things that go into a model, such as splits.

10 You know, we talked about the surface
11 condition, warpage, skewness, obviously plate cutting.
12 And so all of those things may be included in a model.
13 Some of those things are always included in a model, like
14 plate cutting.

15 Q What about surface condition? Is that always
16 included?

17 A Variations of surface condition are usually
18 included. How they're weighted changes between
19 customers.

20 Q What exactly does the surface condition refer
21 to?

22 A Surface roughness, checks and splits again.
23 The way, I mean, obviously the physical characteristics
24 of the surface of the tie give you indications about its
25 structural soundness. They're not perfect predictors.

1 Some, some railroads weight the way a tie looks in
2 different ways.

3 Q And you said splits. I mean, are cracks
4 different than splits?

5 A I'll use it interchangeably.

6 Q Okay. Same thing though?

7 A Yes.

8 Q So back to this list, let's go, just to finish,
9 measure vertical plate cut. Is that what you've been
10 talking about, plate -- tie plate cutting?

11 A That's correct.

12 Q Okay. Locate rail base corrosion. And that's
13 what we talked about with respect to concrete ties?

14 A Yes. Excuse me. Rail base corrosion is the
15 base of the rail defect that could be on any, any tie
16 material.

17 Q Okay.

18 A Not just concrete.

19 Q Okay. So that applies to wood as well?

20 A Yes.

21 Q Okay. Rail seat abrasion, is that the one that
22 only applied to --

23 A Correct.

24 Q Okay. All right. So rail base corrosion,
25 that's important for analyzing wood tracks and concrete

1 tracks, correct?

2 A Yes. Because it's talking about the rail.

3 Q Okay.

4 A Which is independent of the tie type.

5 Q Thanks. Got it. And then the next bullet,
6 identify signs of rail seat abrasion, that applies to
7 concrete tracks only?

8 A Correct.

9 Q And then "perform virtual track walks safely
10 from your office." I saw that in reference to the WMATA.
11 Is that something that is relevant to the Class 1
12 railroads too?

13 A Yes.

14 Q Okay. What exactly does that mean, virtual
15 track walks?

16 A So when you inspect track, you collect a bunch
17 of data, image data. And this is just referring to
18 someone being able to log on to their computer, you know,
19 log on to our servers and view the track from their desk.
20 So if they received one of our reports and they wanted to
21 dig into the findings a little deeper, or if they had an
22 issue on track, they can pull those files up and look at
23 them on a viewer.

24 MR. PARKER: Okay. We can take a quick break
25 if you want.

1 THE WITNESS: That's fine.

2 MR. HERBERHOLZ: Ten minutes?

3 MR. PARKER: Sure.

4 (Recess from 10:15 a.m. to 10:31 a.m.)

5 Q (By Mr. Parker) Did you and your Counsel talk
6 at the break?

7 A Just about miscellaneous non -- topics that
8 don't involve this deposition. But yes, we did talk.

9 Q Okay. Nothing about the substance of --

10 A No.

11 Q -- the deposition? Okay. And you understand
12 you're still under oath?

13 A I do.

14 Q Okay. I won't say that every time, but after
15 the breaks, you're still under oath. So if you can
16 confirm that, then --

17 A I confirm.

18 Q Okay. Thank you. All right. Let's look at
19 the other, I think I gave you two exhibits, right? And
20 we've only looked at one. The June 2012 Railway Track
21 and Structures magazine. Do you have that?

22 A I've got it right here.

23 Q Okay. And that's, again, Exhibit 2015 in the
24 00662 IPR. Can you -- so this is -- you're familiar with
25 this article? Or this is a magazine that's been turned

1 into an exhibit?

2 A It's a magazine, yes, and I am familiar with
3 it.

4 Q Okay. Let's go to Page GREX 656792 in the
5 lower right-hand corner.

6 A I'm there.

7 Q Okay. And this is an Aurora, Aurora
8 advertisement page, I guess; is that correct?

9 A Yes.

10 Q And the date of this, again, was June 2012, so
11 two years -- or a year and a half after the last one that
12 we looked at?

13 A Yes.

14 Q Those -- so you see to the left where there's
15 like a heat map, it looks to me like as a layperson, sort
16 of a heat map of -- what is that showing?

17 A Those are images of the Aurora system, and the
18 colors indicate height. So it's a height profile. So
19 the different colors that would make you think it was a
20 heat image are actually changes in elevation.

21 Q Okay. What is it showing? What -- is the
22 black line down the middle of the rail?

23 A That is the rail, and it's black because it's
24 outside the field of view vertically.

25 Q It's too high?

1 A Correct.

2 Q So the pink portions on either side of the
3 rail, what are those?

4 A Those are fasteners.

5 Q So what are you, what are you looking at? I
6 mean, not you, what is a customer looking at if they get
7 that representation?

8 A So if you're looking at the top left-hand
9 picture, circular picture, that is a concrete tie. I can
10 tell because the railhead is out of the field of view,
11 which means we're focused very narrowly on the rail seat
12 area. And I can also tell because there's elastic
13 fasteners or clips in that picture, so those are all
14 clues to me that this is a concrete tie scan.

15 Q And is that used to determine whether there are
16 issues with the rail seat abrasion?

17 A Correct.

18 Q Okay. So this is a concrete tie, but this
19 again is output from the standard Aurora system?

20 A Correct.

21 Q Whichever version existed in 2012?

22 A Correct.

23 Q What is the -- why don't we just go down to the
24 next image. You see the one below it?

25 A Yes.

1 Q What does that show?

2 A That's an image of rail base corrosion. And
3 you can see the edge of the rail there flaking off, and
4 that's a signature of that defect.

5 Q So the yellow vertical line is the rail, and
6 the little gaps that you're saying on the left side,
7 that's the rail actually flaking off?

8 A Yes.

9 Q Okay. Can you tell if that's a wood or
10 concrete tie in this situation?

11 A I can't tell for sure, but I'm guessing --
12 we're using the concrete setup for Aurora. The head of
13 the rail is out of the field of view. It's obviously
14 rail base corrosion defect. So it could be a, it could
15 be a -- I don't see a tie plate, so I'm guessing it's a
16 concrete tie.

17 Q Okay. So this Aurora advertisement -- and
18 again, that's something, an output that you would get
19 from the Aurora that was being sold at that point in
20 time?

21 A Yes.

22 Q Okay. How about the bottom?

23 A The bottom is a wood tie image that would be
24 output from the system.

25 Q And what is that one intended to show?

1 A In this case, it's just the image itself. I
2 don't think it's supposed to show anything in particular,
3 just a -- it's an advertisement, so it's just an
4 indicator that we're inspecting wood ties as well.

5 Q So people -- experts in the field or just
6 people in the railroad field would be able to look at
7 this advertisement and understand the various aspects
8 that the Aurora can provide to them in terms of
9 inspecting the track, correct?

10 A Yes.

11 Q If you could turn to the next page, please. In
12 the bottom right-hand corner of Page GREX 656793, there's
13 a, looks like a GREX section. You see that?

14 A Yes.

15 Q Okay. In the bottom paragraph, it says, "Greg
16 Grissom, vice president engineering at GREX." Is that
17 you?

18 A That would be me.

19 Q So as of June 2012, you were the vice president
20 of engineering at GREX?

21 A That's correct.

22 Q Then it goes on to say, "Greg Grissom says that
23 wood tie grading" -- wait. Sorry. I think that it must
24 be missing a word under the circle. Do you see where the
25 holes are poked in it? I can't tell.

1 But it says that "wood tie grading, Aurora
2 measures 25 variables (including plate cut, splits,
3 warpage, roughness and other variables) to determine a
4 tie score for each tie based on a statistical method."
5 Is that an accurate statement?

6 A That's accurate.

7 Q So as of June 2012, this version of the Aurora
8 measured 25 variables, one of which was plate cut, other
9 is splits, warpage, roughness. So it lists four, right,
10 but there's other variables that -- in your opinion, does
11 that refer to 21 others?

12 MR. HERBERHOLZ: Objection, form.

13 THE WITNESS: So there are lots of variables
14 and measurements collected. What we're after are the
15 ones that are predictors of tie condition, and
16 specifically predictors that match a railroad's criteria
17 for tie condition. And so while we measure 25 variables,
18 they may not all be predictors for a given customer or
19 something that can be repeatably assessed by a human
20 inspector.

21 And so what we do when we create a grading
22 model is we try to model it off of a human expert tie
23 inspector. And once again, some of these variables are
24 always in a model, like plate cut is always in one of the
25 grading models, and then some of these other variables

1 may not be good predictors of condition for a given
2 grading scheme.

3 Q (By Mr. Parker) But there are 20 -- as of 2012,
4 there were 25 variables that were measured?

5 A In some way, shape or form, there were 25
6 variables or measurements collected.

7 Q And the customers could even come up with their
8 own way to use those measurements if they had their own
9 type of grading system?

10 A The customers rely on us to build the condition
11 model to match their grading criteria.

12 Q But there could be a particular situation in
13 which they're really concerned about something, and they
14 can guide you or they can provide you with that
15 information, and then you can use their feedback to
16 determine exactly how that, those aspects should be
17 graded?

18 A Sure.

19 Q Okay.

20 A Sure. We can walk track with them, and they'll
21 give us input. Actually, what we do is we have them just
22 grade 1500 ties over and over, and then we go create the
23 model with, with all the predicting variables. And we
24 walk track again until we converge on something that
25 actually matches at a very high rate of what that

1 inspector's looking at.

2 And so we're asking them the first time through
3 what they're keying on. And so, you know, they'll say,
4 "Look, I'm looking at this tie. It has plate cut, so I'm
5 downgrading it." And then, and then through those
6 discussions, we kind of converge on a predictive
7 analytical model that mimics that inspector.

8 Q Okay. And so that can vary from customer to
9 customer?

10 A Yes.

11 Q Okay. I can't remember if we -- regardless,
12 what is warpage?

13 A Warpage is just, as you would assume, just like
14 the bending of a tie. If you think of like a warped
15 board on a deck or something like that, just the, the
16 changing of the orientation of -- it's usually like a
17 moisture effect or, of just a tie coming out of shape or
18 a piece of wood coming out of shape.

19 Q So that could be -- depending on where you are
20 in the country, for example, that could be more of an
21 issue in moist areas, areas that are wetter or that --

22 A Warpage itself is not, is not a key variable in
23 most of our models. It's rare that you -- it's a
24 phenomenon that we can measure, but it's not really often
25 seen. I can't think of too many examples. You know,

1 with, when I've been on track over the years, I've said
2 this is a track that has a lot of warpage. It's just,
3 it's just a physical measurement that we can make, and
4 it's part of one of those 25s that we make that may or
5 may not be a predictive condition variable.

6 The only time I can really think about warpage
7 being a factor, I remember one of our customers asked us,
8 they had plastic ties. They had composite ties, which
9 are some form of plastic, fabricated cross-tie. And they
10 tended, with thermal or temperature effects, tended to
11 bend.

12 And we -- they wanted to know where those ties
13 were in the track, and we felt like the warpage
14 measurement might be an indicator of a plastic tie. So
15 we tried that. I don't think we were very successful,
16 but that was one occasion where I thought that
17 measurement might be effective.

18 Q So are there many customers or railroad
19 companies that use plastic ties or composite ties?

20 A There are railroads that use plastic ties, but
21 they're not very significantly used. So I said concrete
22 ties are about 10 percent. I'd say 1 percent or less are
23 plastic ties.

24 Q Is that a more recent phenomenon, or is that --

25 A They've been trying to fabricate plastic or

1 composite ties since at least early to mid '90s.

2 Q Are those like somewhat similar to those
3 composite decks, some of those companies like --

4 A Yes.

5 Q Okay. So when you called out warpage, I mean,
6 I'm assuming -- it says you said this, but why would you
7 have called out warpage? Because it's something that
8 could be easily measured?

9 A Yes.

10 Q Okay.

11 A I mean, we're collecting height data and three
12 dimensional data, so you want to measure whatever you can
13 to learn about what you're measuring. And so it was one
14 of the things that we were able to measure.

15 Q The other variables, I think we established
16 that there would be about 21 others, and I know that's a
17 lot to remember, but can you name some of those other 21
18 variables?

19 A A lot of like physical-dimension stuff, like
20 length of tie, width of tie, whether it's skewed or not.
21 I'm trying to think what else would be relevant. A lot
22 of the variables have to do with just capturing
23 information, pixel information on the tie.

24 So I know, I know we use what's called a blob
25 analysis to grab a bunch of pixel data on the tie. And

1 then there's some statistical metrics that can look at
2 those areas and then create variables that may or may not
3 predict tie condition.

4 So there's a lot of statistical analyses that
5 is done with the data of a tie. And, and so, you know, I
6 can't name every single thing that we're collecting, but
7 we're collecting information on the tie and we're trying
8 to figure out what's driving the condition.

9 Q So what -- the blob analysis, are there
10 specific aspects of the tie that that is used on?

11 A That's more the surface condition assessment.
12 And so if you have, if you have a split or -- that will
13 show, that will show up as, you know, being a lower
14 elevation on the tie. It will be, it will appear darker
15 on the tie. And so lots of splits on a tie might be a,
16 you know, an indicator, might show up in the data, and
17 might show up in a blob analysis that might show,
18 indicate, you know, poor tie condition.

19 Q Okay. And so you say splits. I mean, we
20 talked about that, that's also referred to as cracks?

21 A Yes.

22 Q Is that something separate or is there only --
23 I mean, you might see splits or cracks in the blob
24 analysis, but then you also have a measurement for
25 splits?

1 A It all shows up in the data on the surface of a
2 tie and framing that data and looking at it. And that's
3 where you would assess if there's cracking or splits in
4 it. But I'm using those two words interchangeably.

5 Q Okay. And can you assess the size of those
6 splits, not just the presence or the size the cracks?

7 A Sometimes in length-wise they could go all the
8 way across the length of a tie, which is 8½ feet long.
9 And, you know, thickness-wise, you know, quarter inch,
10 half inch, maybe as thick as an inch at times.

11 Q But you can assess that? Aurora can assess,
12 measure the size of those cracks?

13 A We can assess the surface condition. Now,
14 exactly how those computations are made, probably isn't
15 best for me to answer. You have a guy tomorrow that will
16 probably be able to give you more information there.

17 Q So John Kainer you think would know --

18 A Yes.

19 Q --- more about those aspects?

20 A Yes.

21 Q Okay. And what about the depth, the depth of
22 cracks?

23 A We can't really discern depth. The x-ray
24 system can discern depth. The surface system is just
25 assessing the height of the pixel that it's collecting.

1 So splits would be at a lower height, so they would show
2 up on the scan.

3 Q So the x-ray system is better though for, for
4 determining, I guess, just generally speaking, the
5 severity of the cracks, because it can measure --

6 A The depth of it.

7 Q The depth? Okay. Is severity of a crack or a
8 split something that's measurable, that Aurora measures?

9 A It's important if you have a split that goes
10 all the way through the tie, then yes, that's kind of a
11 fatal condition. So that's important.

12 Q Okay. And that's something that you can
13 measure with the Aurora or only the Aurora Xi?

14 A The Xi, the x-ray system is the only system
15 that will tell us how deep it goes because those photons
16 will pass through a deep crack and never return back.
17 And so we can assume that that's a deep crack.

18 The surface condition is just going to tell you
19 what, exactly what I'm saying. It's a surface
20 assessment. It's going to tell you patterns that it
21 finds on the surface of the tie.

22 Q Okay. Now, are things like spike height, is
23 that something that -- is that one of the variables, or
24 is that just something --

25 A We measure height. So spike height is

1 something that we can compute.

2 Q Okay. So the original Aurora and then all of
3 these systems measure height, so you can measure any of
4 the features we've been talking about all day pretty much
5 in terms of the height of those features along the rail.

6 A Yes.

7 Q And so that includes spikes, other types of
8 fasteners, tie plate, rails?

9 A Anything within the field of view, you can
10 measure the height of that asset.

11 Q Okay. And you say within the field of view.
12 Because, for example, you showed -- we talked about that
13 one picture where you couldn't see the rail top because
14 it was outside the field of view?

15 A Typically our field of view goes from one end
16 of the tie to the other. And, and then the depth of the
17 rail section, probably the top of the rail to the
18 bottom -- to the surface of the tie, because obviously
19 we're not seeing past that with the system, so we
20 obviously, we try to capture the whole track in our field
21 of view.

22 The concrete tie system does not span the whole
23 field of view of the track. It's focused on, let's say,
24 maybe less than half of the tie on each side.

25 Q Okay. Like on Page 656792, the first picture

1 we talked about, the circle at the top?

2 A Yep.

3 Q Okay. So it's kind of like the rail is almost
4 in the middle, and then you've got a couple of feet or
5 whatever on each side?

6 A There's a couple -- there's a distance in the
7 middle that is not included in the concrete tie
8 inspection right now. But you could use the wood
9 orientation to capture the whole tie. If you want, if
10 you wanted information on the concrete tie in the middle
11 of the tie, you could back the resolution off, just use
12 the wood orientation and capture the whole tie.

13 Q Okay.

14 A But the wood, the wood setup is meant to
15 include the track structure from one end of the tie to
16 the other.

17 Q And is curvature, I mean, is that something
18 different than warpage? I mean --

19 A Curvature refers to the degree of curve that
20 the railroad track is traversing. So, you know, tangent
21 means you're on a straight piece of track. Curve is
22 obviously a curve. And through our GPS navigation
23 systems, wheel encoder, and there's a gyro in there, we
24 can compute the curvature of the railroad track, which is
25 an alignment type of computation, just like a roadway or

1 something, and not necessarily, you know, condition.

2 It's just what is there.

3 Q Okay. And so that's something that the
4 original Aurora enables you to do with measurement, and
5 then also the current version and the Xi? Or I guess all
6 of them?

7 A Yes.

8 Q All three?

9 A We like to know if ties are in curves because
10 they deteriorate faster in curves, and it's just good
11 information to know where you're out in the world.

12 Q And the Aurora, whether it's -- is it included
13 in these 25 variables but -- or is it, maybe it's just
14 another aspect of what you guys are, the pictures you're
15 taking, but can you -- you can determine if there's a
16 missing tie?

17 A We can.

18 Q Okay. And a broken tie, like if it's broken
19 right in half or --

20 A Yeah.

21 Q Okay. And those are all aspects or variables
22 that were, the first Aurora could identify?

23 A Yeah. The Aurora offering would have been able
24 to find broken ties. If you think about a broken tie,
25 it's going to be, you know, severed and one end is going

1 to be sticking up much higher than the other. And that
2 would manifest itself in something that we could detect.
3 And I would expect that functionality to have been there
4 before I was there, but it certainly is there after I was
5 there.

6 Q And maybe this next sentence that we were
7 looking at back on the other page, 656793, onto the next
8 page, 794, it says, "The system records height
9 measurements at regions of interest on the tie and on the
10 base of the rail." And so -- oh, this is talking about
11 concrete -- "and then performs calculations to output RSA
12 measurements." But I guess that's relating to concrete
13 ties.

14 But just generally speaking, you said you
15 measure -- you're measuring height. So you're able to
16 look at any aspect of -- and I'm sorry if I keep asking
17 this. I just want to make sure I understand.

18 With the technology that's included in the
19 original Aurora and now the subsequent versions, you can
20 really look at all features of, and based on the heights,
21 determine whether things are missing, whether things are
22 broken, all those features?

23 A Yeah. We create a three dimensional map of the
24 track. And when we do that, we can take measurements
25 along the track.

1 Q And we talked about decay earlier. Decay is
2 another assessment that can be made with the Xi, correct?

3 A The x-ray system would show indications of
4 decay.

5 Q But that would not have been involved in the
6 original Aurora?

7 A I'll take -- I'll add to that comment, because
8 prior to developing Xi, one indication of decay is when a
9 plate would, tie plate would sink, or cut into a tie. So
10 if it was a hollow tie and it was -- and that had
11 decayed, and over many, many millions of axle loads,
12 eventually that plate would sink in.

13 So tie plates sinking in to a tie are an
14 indication of a weak tie that could be susceptible to
15 decay. And then the x-ray also gives you a more internal
16 look at decay, where you might be able to identify that
17 before it manifests itself as a tie plate cutting into
18 the tie.

19 Q So even in the original Aurora, for example, in
20 the middle of a tie, could you have assessed decay if --
21 I mean, it's possible that as wood decays, it wears away
22 and you would be able to tell that height difference as
23 well, right, even in the middle of a tie?

24 A If a tie is decaying and you don't have an
25 x-ray signature, the first time you're going to know it,

1 with an automated system, is when the plates sink in.

2 All the wheel loading from a train is over the
3 rails, which is then distributed through the rail to the
4 base of the rail to the tie plate. And so all the
5 dynamic forces are there underneath the tie plate. And
6 that's -- the tie plates then sink in to the tie over
7 time. And so that would be an indication of weak tie
8 condition underneath the bearing area of the tie plate.

9 A lot of times, through spike holes and things,
10 water infiltrates into the tie, too, so that moisture,
11 all the load is supported there, and then you've got
12 moisture, you've got cycles of loadings, you know, all
13 the dynamics associated with that.

14 So that's why the measurements that you make in
15 the, in the plate region, the tie plate region, are so
16 important, because that's where all the loading is. And
17 they're an indicator of, strong indicator of the
18 condition of that tie.

19 Q The x-ray capabilities in the Xi, that's not
20 focused on the tie area? It's focused on the rest of the
21 tie?

22 A The x-ray data is focused in between the two
23 rails. And the reason it's focused in between the two
24 rails, if we look at my declaration on Page -- it's the
25 '329 declaration, Page 7, Figure 4. That's a picture of

1 an x-ray capable vehicle. And that black encapsuled,
2 encapsuled structure with the orange flaps kind of
3 hanging down, that is where the x-rays are shined down
4 upon the track.

5 So the rails themselves act as shielding, to
6 keep the -- to contain the x-rays within there. So as
7 part of the design of that system, we had to work with
8 industrial radiography standards and public standards on
9 what, what levels of radiation could, could leave the
10 track bed.

11 And so the design completely encapsulates and
12 surrounds the x-rays to keep them in between the two
13 rails. And so we're only getting data signatures of the
14 x-ray system in that area, because it would be too hard
15 to shield the x-rays outside of the rail.

16 Q So it's -- but it is, it's capturing decay that
17 occurs in the middle of the tie?

18 A Correct.

19 Q Okay.

20 A From one tie plate to the other.

21 Q So that was a problem that was important enough
22 for you to develop technology to try to address?

23 A Yeah. I think the early detection of decay is
24 the value add there. And so instead of waiting purely
25 for one day your tie plates to just cave into the tie --

1 although there's variations of that, so you want to know
2 over time how your tie plates are sinking in.

3 But then you also want to know, inwardly to
4 outwardly, how fast is that tie decaying. And so both
5 measurements, both pieces of information are telling you
6 a comprehensive story about the condition of the tie.

7 Q Okay. They're both important.

8 A Yes.

9 Q On -- back to that same exhibit, Page GREX
10 656794, there is a, the second paragraph, there's a quote
11 from, I think it's Lynn Turner, talking about the results
12 of the new enhancements. It says, "The results are
13 improved grading models, onboard diagnostics, enhanced
14 ballast detection, enhanced tie plate and plate cut
15 algorithms, and enhanced GPS identity." What does GPS,
16 enhanced GPS identity refer to?

17 A The location information of where a tie is in
18 the world. So it's important to be able to get back to
19 an exact tie. So we assign differential GPS as well as
20 other location information to a tie, so that someone
21 ultimately can get back to an exact tie.

22 Q So the -- again, here we're talking about the
23 original Aurora, or at least -- that doesn't help. In
24 2012 at least, the Aurora included this GPS technology --

25 A Yes.

1 Q -- to permit you to track. Okay. When did
2 that begin? Do you know?

3 A It would have been desirable to have a GPS
4 system in its infancy. I mean, knowing where you are in
5 the world is very important. Our ultimate goal is to
6 provide a tie condition. But if you don't know where
7 that tie is or you can't get back to that tie, it's not
8 very valuable.

9 Q So that's something that's key to your
10 customers, being able to locate those ties after you've
11 identified them as being problematic?

12 A Yes.

13 Q And so the GPS capabilities in the Aurora that
14 we're talking about in 2012, those are -- those still
15 exist in the current version?

16 A Yes. But like anything else, you're always
17 improving. I mean, GPS service, there's a variety of new
18 providers. There's been advancements in those areas. So
19 we're always looking to provide the best location
20 information that we can provide.

21 Q So the 2012 Aurora had the capability. Then
22 you believe there were enhancements in the GPS
23 capabilities for the Xi, and likewise now in the Xiv?

24 A The Xi and Xiv are irrelevant. I mean, it's --
25 whenever we talk about Aurora, we're talking about the

1 fundamental surface assessment that all of those
2 subsequent technologies rely on. And the GPS is a part
3 of that.

4 And, you know, the way that we handle GPS, I
5 know, for instance, a lot of times you can imagine you
6 get bad GPS information. So we've added things like
7 common filterings and other data processing techniques
8 that assess GPS, make GPS more reliable and the location
9 information improved. And those are things that we
10 continually look at.

11 Q So, and I keep referring to the new ones. But
12 basically what's happened here is from the first exhibit
13 we looked at, the 2010, even before that, Aurora was
14 developing, right? You had functionalities back then,
15 but you've been improving it over the years, and that's
16 continued to happen, and now we have these new versions,
17 but those have basically just added onto the improvements
18 that Aurora has and continues to have?

19 A I mean, Aurora's been in development since
20 2003. And many tens of millions of dollars and people
21 investment, and it's something we continually invest in
22 every year.

23 Q All right. I think I'm done with that one.
24 I'm handing you what's marked as Georgetown Rail Exhibit
25 2017, also in the 00662 IPR. This was an exhibit to your

1 declaration. What is this? Or do you recognize this
2 document?

3 A This is a copy of Railway Age magazine from
4 March 2011.

5 Q Are you familiar with this magazine?

6 A Yes.

7 Q And this edition as well?

8 A Yes.

9 Q If you turn to page -- this one does not have a
10 GREX number at the bottom, but so turn to Page 18 of 56,
11 please. It says Cover Story at the top. Are you on that
12 page?

13 A Yes.

14 Q And there's a section Products for High
15 Productivity. And then it says Georgetown Railway
16 Equipment Company. Do you see that?

17 A Yes.

18 Q Okay. I wanted to go down towards the bottom.

19 ~~So this is -- we took these out of time.~~ This is March
20 2011. So this was the year before the one we just looked
21 at.

22 A Yes.

23 Q But about halfway down to the bottom, you know,
24 below the picture, is a sentence that says, "The ability
25 to provide precise GPS location information for items

1 such as switches, crossings, obstructed ties, and
2 clusters of failed ties has been added to aid the
3 railroad supervisor in assessing overall track health to
4 better plan maintenance activities." Did I read that
5 correctly?

6 A Yes.

7 Q Is that an accurate statement?

8 A Yes.

9 Q So that's just talking about what we were
10 saying, what you just told me, that GPS is very important
11 so you can find, you know -- here we haven't talked about
12 clusters of ties. But that can be an issue, I guess,
13 where you find multiple ties together or near each other
14 that are damaged?

15 A Correct. As you can imagine, having several
16 failed ties in a row is a safety issue.

17 Q Okay. And then the next sentence, "GREX also
18 recently enhanced Aurora's 'pattern recognition system'
19 for improved ballast detection on ties and tie plate
20 measurements." This is -- that's not relating to the
21 BallastSaver, correct?

22 A That's correct. What is being said there is to
23 accurately grade a tie, you have to be able to see a tie.
24 And, of course, there's lots of rocks or ballasts on a
25 railroad track. And so you have to develop algorithms to

1 assess whether the tie is obstructed by rocks.

2 And this, this sentence here is, is discussing
3 improvements to identifying when rocks are on a tie that
4 would prevent looking at the surface of the tie, but then
5 also when rocks are on the tie plate.

6 And once again, when you want to measure plate
7 cutting, you've got to have a clear view of the tie plate
8 and the tie. And so these algorithms would be key to
9 making sure the surface of the tie plate was unobstructed
10 and the surface of the tie was unobstructed so you could
11 make those key measurements for condition.

12 Q So that's a separate assessment or algorithm
13 relating to the ballast, but that is included in the
14 Aurora system?

15 A It's included in the Aurora system. This is
16 not referring to the BallastSaver technology. This is
17 referring to just an algorithm to assess whether the
18 surface of the tie or tie plate are obstructed.

19 Q Is that important to your customers?

20 A If you have an obstructed tie plate and
21 obstructed tie, you're going to make poor measurements,
22 and thus you're going to have inaccurate data. So yes,
23 it's important that we have accurate data.

24 Q The next sentence says, "Finally, the
25 mathematical algorithms to collect and measure up to 25

1 various tie assessment metrics, including splits,
2 warping, tie skewing and spike height, were improved,
3 allowing for flexibility in calibrating inspections to
4 customer-specific criteria, as well as further refining
5 Aurora's ability to locate and identify rail base
6 corrosion early, where applicable." Is that accurate?

7 A That's accurate.

8 Q And this is what we've been talking about.
9 We've talked about a lot of those, you know, the
10 capability to assess all of those features. The one I
11 don't think we talked about yet perhaps is tie skewing.
12 What does that refer to?

13 A That's the rotation of a tie. So as you can
14 imagine, you would want a tie to be relatively
15 perpendicular to the rails. And if the tie rotates,
16 that, the angle that it rotates is called a skew angle.

17 Q What kind of problems can that cause if there
18 is a skew angle?

19 A It's just not ideal geometry. You know, if you
20 have one tie that's slightly skewed, it's not that big of
21 a deal. But you just want to make sure that mostly your
22 ties are, you know, perpendicular so they can more
23 effectively handle the loadings of the railroad
24 environment.

25 And, you know, a lot of times rails, when

1 they're under heat or cold, will expand and contract.
2 And that will sometimes cause ties to, to move along with
3 that, those longitudinal forces. And so there could be
4 an indication of, of a rail issue that's manifesting or
5 giving you clues that it's happening in the form of
6 skewness.

7 The other, the other reason skewness might be
8 important is when railroads surface their track, they use
9 tampers that take arms and place them within the cribs to
10 vibrate the ballasts. And if ties are skewed, or if
11 there's not adequate distance between them, it's harder
12 to surface the track.

13 So it's just physical information about, about
14 the ties themselves. Rarely are they a factor in
15 condition or how we report condition. It's just
16 something that we can measure, so we do.

17 Q What do you mean by surface the track, just as
18 a layperson?

19 A So if you imagine vertical profile of a track,
20 a lot of times tracks become fouled. So imagine the
21 rocks degrading underneath the tie on your load, creating
22 a bunch of dust particles. So that ballast section
23 becomes fouled and not able to drain. And so railroads
24 will go in there and remove that material and put new
25 material in to promote the drainage of the railroad track

1 structure.

2 Surfacing refers to the technique to stabilize
3 that ballast once you bring in new materials, so you're
4 essentially vibrating it so it settles and compacts and
5 maintains the vertical alignment of your track, and then
6 also doesn't have it settle, you know, the first time you
7 run trains over it.

8 Q Okay. So that's an important feature for
9 railroads to do, to be able to understand -- to be able
10 to surface properly?

11 A It's a key maintenance function, yes.

12 Q I'm done with that one. One more. This is
13 Georgetown Rail Exhibit 2016, also from the 00662 IPR,
14 which is also an exhibit to your declaration. Do you
15 recognize this document?

16 A Yes.

17 Q And what is it?

18 A This is a copy of an article that was taken
19 from Railway Track and Structures magazine in October of
20 2013.

21 Q So this is the most recent of the exhibits from
22 your declaration that we've looked at so far; is that
23 correct?

24 A Correct.

25 Q And on the -- I think the GREX section of this

1 article starts on the second page and goes on to the
2 third page. Do you see that?

3 A Yes.

4 Q On the second page, or the third page, below
5 that picture at the top, the second paragraph begins --
6 I'm sorry, I guess the paragraph above it. Maybe we need
7 to review. Starts on the other page. It refers to a
8 walking inspector requiring a clear view of the track to
9 perform at an optimum level. And then I think it talks
10 about -- this is the ballast covered ties that we just
11 talked about; is that correct?

12 A Correct.

13 Q Okay. And then there's a statement from, I
14 believe it's Lynn Turner. Who is Lynn Turner?

15 A Lynn Turner was the vice president of sales and
16 marketing for GREX up until about 2014.

17 Q So at this time he was still employed --

18 A Yes.

19 Q --- at GREX? Okay. So he's talking, the next
20 paragraph he says, "Originally" -- this is a quote --
21 "Originally, Aurora was unable to distinguish these
22 ballasted ties."

23 So that was the, the first Aurora could not
24 kind of deal with -- it did not have algorithms to be
25 able to identify when there were rocks on the tie plate

1 in the tie?

2 A Were not --

3 MR. HERBERHOLZ: Objection -- sorry. Objection
4 hearsay, form. Go ahead.

5 THE WITNESS: Were not effective ones, or ones
6 that needed to be better.

7 Q (By Mr. Parker) Okay. And so those improved?
8 And we just talked about, I think the last one we talked
9 about, it was something that was touted that GREX could
10 do, correct?

11 A Yeah. It's key to be able to identify when the
12 track is obstructed and where it's obstructed and to
13 advise a customer that we can't inspect this portion of
14 track because it's covered in rocks or covered in
15 ballast.

16 Q Okay. So then it goes on, kind of in the
17 middle of that paragraph, "When Aurora now encounters
18 ballast covered ties, it has been taught to recognize the
19 obstructing ballast and identify the areas of ties that
20 are still visible." Is that an accurate reading?

21 A Yes.

22 Q So Mr. Turner is touting this new ability to
23 identify if there's obstruction based on ballast as a key
24 feature of the Aurora as of 2013; is that correct?

25 A Yes. He's alerting the industry that the

1 system has that capability. And from the prior versions
2 that you've put in front of me, or that were in my
3 declaration, that was mentioned before as well.

4 So it was pretty key to, to everyone to
5 understand that you have to, you have to be able to
6 identify when -- you have to be able to operate in the
7 railroad environment. And the railroad environment has
8 obstructions. And you need to be able to identify those
9 obstructions.

10 Q And then the next sentence says, "Using a
11 percentage of visibility calculation." So is that the
12 calculation that we've been talking about relating to the
13 ballast?

14 A Yeah. What we mean there is we had a threshold
15 that we kind of arbitrarily came up with. It's like if
16 we can't see half of the tie, then we're going to kick
17 out, kick out a, you know, cannot grade the tie. If
18 it's, you know, if we could see half or more of the tie,
19 then we would attempt to grade it.

20 And so it's just, it's just -- sometimes half
21 of the track is covered in ballast. Sometimes all of it
22 is. Sometimes just a few rocks are on the tie. But
23 having that analysis in place, you know, before you make
24 those measurements, before you deliver measurements that
25 are going to be inaccurate, you should have a algorithm,

1 or several algorithms to assess obstruction.

2 Q Then the last sentence in that paragraph says,
3 "Plate cut can also be measured and made a part of the
4 overall assessment." And that's just referring to plate
5 cut being an additional measurement that you can make
6 that may be relevant?

7 A Yeah, that's correct. Every time we're talking
8 about doing wood tie inspection, it's a very significant
9 key measurement, so we always bring up the fact that we
10 can accurately do it.

11 Q I'm done with that one. So we've talked about
12 tie grades being, I don't want to say calculated,
13 determined based on all the calculations that we've
14 talked about, right, the various features of the track
15 that we've established that Aurora is able to measure; is
16 that correct?

17 A We've talked about a lot of tie grading
18 variables, some of them more important than others, yeah.

19 Q But those can be used, can be used to grade the
20 ties. I mean, you said there's a 4 or 5 grade, depending
21 on the customer? Is that accurate?

22 A That's correct.

23 Q Okay.

24 A We provide a 4 or 5 grade condition assessment
25 that's driven off of those variables.

1 Q Now, the Aurora systems, do they generate
2 reports based on these tie grade scores?

3 A Yes.

4 Q What do those look like?

5 A So, typically, a customer deliverable will
6 have, for every tie it will have a tie number. It will
7 have its location in the world, its GPS, lat/long. It
8 will have whether it's in a curve; if it's in a curve,
9 what degree of curve it's in. It will have four plate
10 cut measurements associated with that tie. And then it
11 will have overall condition grades, our condition grade
12 for that tie. And essentially that's the deliverable.

13 If there's other information -- excuse me.
14 There also is whether or not that tie is in a crossing, a
15 bridge, or a switch as well. And so where that tie is,
16 the key plate cutting measurements, the key condition
17 grade, whether it's in a curve or tangent, and whether
18 it's a specialty truck tie or a tie in a bridge, switch,
19 or crossing.

20 Q And you mentioned condition grade or condition
21 metrics. What do those refer to again?

22 A The condition score that's provided.

23 Q Okay. That's the 1 to 4 or 1 to 5 that we
24 talked about?

25 A Yes.

1 Q And that, again, is determined based on
2 weighting of variables that you measured?

3 A Yes.

4 Q And based on what that customer is concerned
5 about or has told you?

6 A Yes.

7 Q Okay. Is the improper positioning of a tie a
8 relevant feature, either for wooden or concrete ties, or
9 is that kind of subsumed with the skewing measurements
10 and some of the others?

11 A We measure tie-to-tie distance. And if that
12 tie-to-tie distance is too large, you probably need to
13 insert a tie there. So that's important, if that gap is
14 too big.

15 You know, once again, so we measure, we measure
16 tie-to-tie distance, and that could have some advantages
17 for that surfacing discussion we had earlier. If you
18 know, if you know you have tight tie spacing or -- that
19 might impact your ability to surface effectively, or what
20 type of machine you surface with. It's just good
21 physical information to know.

22 Q And that's for both wooden and concrete ties?

23 A Sure.

24 Q What is rail seat deterioration? Is that
25 different from corrosion?

1 A Rail seat abrasion and rail seat deterioration
2 are the same thing. It just refers to the rail seat
3 abrading into the concrete tie.

4 Q Okay. And those -- that's something that we
5 obviously discussed, but all versions of the Aurora can
6 measure that; is that correct?

7 A The Aurora surface technology, the 3D laser
8 profiling technology can measure that on concrete ties.
9 And that system is, is through all those offerings.

10 Q Right. If we use the four cameras and the --

11 A Yeah, yeah.

12 Q Okay. Pad wear, I know we talked about pads,
13 but what is pad wear?

14 A Pad wear refers to the, the degradation that
15 happens before you get into the tie. So the rail seat
16 will abrade away a pad first, and then get into the tie.
17 So by measuring the base of the rail and the elevation of
18 the tie, you can discern how much pad wear you have. And
19 if you have -- if your pad wear exceeds the thickness of
20 the pad, you can discern that you're now abraded into the
21 tie.

22 Q So pad wear is another feature that the Aurora,
23 if it is equipped with the concrete capabilities, can
24 measure?

25 A Yes. It assumes a pad thickness. And when

1 that measurement exceeds the pad thickness, you then know
2 that the rail itself is now starting to abrade into the
3 tie.

4 Q Can that same Aurora system assess the
5 condition of insulators?

6 A So insulators are the piece of plastic that go
7 between a clip and the base of the rail. It's a piece of
8 plastic.

9 Q Okay.

10 A And we would be able to tell if the insulator
11 is present or not.

12 Q Okay. Not if there was an issue with it, just
13 if it's present?

14 A Correct.

15 Q And then what about joint bars? What is a
16 joint bar?

17 A A joint bar is when two pieces of rail are
18 bolted together with two bars on each side and then bolts
19 running through the rail. A lot of times, if you have a
20 rail defect and you cut it out, you'll bolt it back
21 together, or you could weld it back together, depending
22 on the railroad and the situation.

23 Joint bars are not ideal. They're a
24 maintenance nightmare in track, so you try to avoid
25 having joints.

1 Q But if a track is known to have them, then you
2 can identify -- or Aurora can identify if a joint bar is
3 present?

4 A Correct.

5 Q Okay. But not whether -- but what about
6 whether there's an issue with it?

7 A We started identifying joint bars because it's
8 important to know if you have poor tie condition under a
9 joint bar. At a joint bar, you have higher impact loads,
10 because of the anomaly in track. And if you don't have
11 good supporting tie condition, you could have increased
12 vertical deflection, which is a derailment risk. So our
13 first goal to incorporate joint bars identification was
14 so that we could assess the tie condition under the joint
15 bar.

16 Q So knowing where they are is a good first step
17 to that?

18 A Yes.

19 Q Yeah. Now, is that relevant to wood and
20 concrete ties?

21 A Yes. But mostly, mostly wood. In concrete
22 ties, you're going to have a lot more continuously welded
23 rail, which eliminates joints. Those are once again more
24 of your high tonnage lines, lots of trains, you know,
25 millions and millions of axle loads. And you don't

1 typically want to have jointed rail on those lines.
2 Thus, you're more -- it's more likely you'll find more
3 joints on wood track.

4 Q And now, we've been talking about tie plate
5 cutting off and on today. That does not, is not relevant
6 for concrete ties, is that correct, because they don't
7 have tie plates?

8 A The same phenomenon is in play. It's just that
9 concrete ties don't have a tie plate. They're fastened
10 directly to the tie, with the tie pad. So once again,
11 all that axle loading from trains is going from the wheel
12 of the train through the rail. And all that stress is
13 going through the base of the rail, and that's where
14 you're getting all those dynamic abrasive forces that are
15 going on.

16 And so what's going on in the rail seat is
17 equally as important for both wood ties and concrete
18 ties. We just refer to the one measurement as plate
19 cutting because there's a tie plate there, and then the
20 other measurement we refer to as rail seat abrasion.
21 There's no tie plate. But it's the same, similar type of
22 analysis.

23 Q It's similar in that you're measuring height,
24 right, but the algorithm for measuring rail seat abrasion
25 is not identical to the algorithm for measuring tie plate

1 cutting?

2 A They're not identical because on the wood tie
3 one, you want to identify that a tie plate is there, and
4 then you want to find -- you want to take measurements
5 from the edge of that tie plate to the surface of the
6 tie. So those steps would be not the same. In the
7 concrete example, you'd find the base of the rail and
8 you'd find the surface of the tie, but you wouldn't go
9 look for a tie plate.

10 Q Okay. So the Aurora -- you explained that it
11 has the capability for both wood and concrete, but you
12 have an algorithm for tie plate cutting, but you also
13 have an algorithm for rail seat abrasion. So there's two
14 separate algorithms.

15 A Yes.

16 Q What does the term "tilt correction" mean?

17 A Tilt correction refers to a computation that's
18 done -- when a vehicle is going down the track and it's
19 rocking back and forth, we have to account for that and
20 make sure the measurement is not impacted. And
21 typically, we do that with the concrete tie analysis,
22 because it's higher resolution, and we've seen impacts
23 there. So we account for the rocking of the vehicle to
24 improve the accuracy of the measurement.

25 Q And is that -- so you say "we do that." The

1 Aurora has a tilt correction capability?

2 A Yes.

3 Q Has every version of the Aurora had that
4 capability?

5 A It would have been discovered along the way in
6 development as a necessary computation to handle the
7 vehicle dynamics. I would guess in the very, very early
8 early versions of Aurora it didn't exist. But, you know,
9 as rail seat abrasion became more of an industry need,
10 and as we walked more track, those enhancements would
11 have been identified and included in the offering. And I
12 also know that we have intellectual property and patents
13 that spell out that approach.

14 Q Okay. But it's in the current version of the
15 Aurora?

16 A It's in the current version of Aurora, in the
17 rail seat abrasion calculation.

18 Q Okay. Now, do the Aurora systems include
19 technology for calibrating the lasers and cameras to
20 improve accuracy?

21 A We have several calibration practices that we
22 use to ensure that the geometry of the lasers and cameras
23 hasn't moved, and that we can ensure repeatability of the
24 measurements in both directions. And so there's a couple
25 of calibrations that are done with different frequencies

1 to make sure that the data is consistent that's coming
2 off the vehicles.

3 Q And that's been in place for how long?

4 A A long time. And the more, the more production
5 data we got over the years, the more we identified things
6 that we could improve. So like anything else, those
7 processes have evolved over the last 17 years.

8 Q So since you've started at GREX, you've always
9 had calibration capabilities?

10 A We've had --

11 Q In the Aurora. Sorry.

12 A We've had calibration processes, and those have
13 evolved and improved with my tenure at GREX.

14 Q Do you want to take another quick break?

15 A I wouldn't mind. That would be fine.

16 Q Yeah. Cool.

17 A And it doesn't have to be ten. Maybe like --

18 Q Five?

19 A Five is good, yeah.

20 Q Yeah, that's fine. Okay.

21 (Recess from 11:36 a.m. to 11:51 a.m.)

22 Q (By Mr. Parker) Did you and your Counsel speak
23 during the break?

24 A We did.

25 Q About the substance of the deposition?

1 A We did not.

2 Q About the weather?

3 A Not the weather.

4 Q So we've discussed the market at least relating
5 to concrete, plastic and wooden ties. Now, does -- I'll
6 go ahead and introduce another exhibit from your
7 declaration. This is Georgetown Rail Exhibit 2013, again
8 from the 00662 IPR. It was an exhibit to your
9 declaration. I apologize for the small text. Do you
10 recognize this document?

11 A I do.

12 Q And what is it?

13 A This is a financial summary of the Aurora
14 business unit from 2003 to September of 2019.

15 Q And what was your intent with providing this
16 document as part of your declaration?

17 A This document shows the commercial success of
18 the Aurora system over that period of time.

[REDACTED]

[REDACTED]

[REDACTED]

22 Q Okay. When was the Aurora first sold?

23 A The first revenues that we are showing were in
24 2006.

25 Q And do you recall what version or how many

1 variables were being assessed and analyzed at that point?

2 A That was five years before I started at GREX,
3 so I don't think I can accurately answer that.

4

[REDACTED]

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7 Q Right. But then the Xi adds what you've
8 mentioned as, you know, earlier detection of the
9 internal --

10 A Uh-huh.

11 Q -- aspects based on that technology?

12 A Yeah.

13 Q Okay. So you said the tie grading deliverable,
14 and that's -- you mean, you're referring to the grading
15 system we talked about that incorporates the summed
16 weighted condition metrics? Is that accurate?

17 A That's correct.

18 Q Okay. So when did that -- when was that first
19 offered to your customers?

20 A The vision of the Aurora system since its
21 inception was to grade a cross-tie in a more accurate,
22 reliable, efficient way than a human walking inspector.
23 So the vision was to provide a condition grade on every
24 tie, at high rates of speed, with high repeatability and
25 accuracy.

1 Q So that was the vision. But when were you able
2 to provide that to your customers?

3 A There was a long development cycle to first get
4 the technology figured out, in terms of orientation of
5 hardware, the types of hardware we would use, the types
6 of cameras, the types of lasers, the types of processors,
7 the software itself, the environmental challenges of
8 operating technology on a railroad, you know, validating
9 all of the measurements and models. And all of that took
10 a lot of time.

11 And then you also have to keep in mind that the
12 railroad, in over 100 years, hadn't figured out how to do
13 this. And so there was a lot of proving that this could
14 be done and this could be accepted and this could replace
15 a human inspection. So that took a long time.

16 So the vision was there always to provide the
17 condition grade. Part of it was R&D, heavy investment,
18 heavy development, proving the concept, proving to an
19 industry it worked. And I would say all the way up until
20 2012 we were still fighting that battle of industry
21 acceptance.

22 And there was some meters of success along the
23 way of customers seeing value in it earlier than others.
24 But right around the beginning of 2012 was when the first
25 significant domino fell, and we saw our business grow in

1 terms of more customers, more miles, investing in more
2 trucks, more assets, more software, more people, all of
3 those things that go along with a growing business.

4 Q So by the beginning of 2012, you were providing
5 the, that grading system for ties to the customer?

6 A Yes.

7 Q Okay.

8 A The customer has always hired us to provide a
9 condition grade or condition assessment of a tie. And
10 that's what we get paid to do.

11 Q So even before 2012, the grading -- the rating
12 of the, based on the weighted metrics --

13 A That was there.

14 Q -- that was all there?

15 A That was there. Yeah.

16 Q Okay. So you mentioned, I mean, kind of the
17 story and how -- you mentioned manual track inspection.
18 What, like what is the market currently for manual track
19 inspection? Like how -- can you talk to that?

20 A Historically, you know, railroads had walking
21 inspectors that had a counter, or a clicker, if you will.
22 And for them to figure out how many ties they were going
23 to install in a particular area, they'd have a human, or
24 several dozen people walking, walking the lines, making a
25 subjective grade in a fraction of a second, or a second,

1 as to whether that tie should come out of track or stay
2 in track. And gets to the end of that mile with a count,
3 that inspector could be having a good day or bad day,
4 that inspector could be on the last mile of the day,
5 might be getting tired, might be thinking about what's
6 for dinner, you know, just -- there was a lot of
7 subjectivity and a lot of errant results and a lot of
8 waste in the tie programs.

9 And so it was desperately needed to have an
10 automated system that was subjective, repeatable, you can
11 measure, you could go back, you could not have to go back
12 on track to validate what you saw. You've got a record
13 of it. You know where your problem areas are. You know
14 where your worst performing areas are, your best
15 performing areas.

16 All of a sudden, now you've gotten rid of a
17 whole bunch of waste in your tie program. And a typical
18 railroad who's going to buy 3 or 4 million ties a year at
19 \$100 a piece installed, so, you know, you're talking
20 about 3 or \$400 million of capital money every year.

21 And so getting, developing a system that was
22 reliable and repeatable, and taking the subjectivity out
23 of a human inspection has gone a great way to saving the
24 railroads a lot of money.

25 Q Does the Federal Railroad Administration still

1 require manual inspections?

2 A There are aspects of inspections that have to
3 be done still. In terms of tie inspection, they don't
4 prescribe a human has to inspect a tie, but the FRA has
5 lots of regulations with inspecting track and frequency
6 of inspecting track.

7 They have regulations of a certain condition
8 that your track has to be in based upon what track class
9 it is. So if it's a higher speed track, it has to be in
10 better condition. So there's regulations of all those
11 things in place.

12 There's also certain inspections that have to
13 happen that are mandated. I'm talking about like track
14 geometry, and rail, ultrasonic rail inspection. Those
15 are things that have to happen with certain frequency.

16 The railroads choose to use our technology
17 because they see the value and the benefit in their
18 capital programs, in the safety, in the objectivity of
19 the data. And thus the value proposition is there, and
20 it's universally there, because all of the Class 1s at
21 one point in time, and most of them right now are using
22 it.

23 Q So you don't know, though, how much track is
24 still inspected manually, like in the market, the broad
25 market?

1 A I guess I don't know. I just know, I just know
2 who's using our system.

3 Q But even your customers, don't they still do
4 manual track inspection?

5 A There would be some aspects of a local road
6 master doing some manual inspection of areas that he or
7 she was concerned about. How much of that, at what
8 frequency, I mean, there's definitely regulations in
9 place there.

10 Q Okay. But you're not sure about them?

11 A No, I'm sure about them. They're there. I
12 just don't know how much is --

13 Q Okay.

14 A -- you know, how much is there. I know our
15 data is instrumental in building the tie programs for the
16 Class 1 railroads.

17 Q So do you offer any sort of -- you meaning
18 GREX -- offer any sort of manual track inspection
19 services?

20 A We do not.

21 Q Okay. So if your customers are, they may be
22 using your technology for some of their inspection, but
23 then if they're going to do some manually, they have
24 their own people to do it?

25 A That's true.

1 Q Okay.

2 A And they may, they may go out there and mark
3 the ties manually once they have all the grades and the
4 ties identified. Some railroads have steps where they
5 have employees go walk the track and physically mark the
6 ties to be removed. We also have a tie marking service
7 that we've created that works off of the Aurora data that
8 automatically paints the ties as well, the ones that
9 should come out. And so those are, those are offerings
10 that we have in the market.

11 [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

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[illegible]

22 Q Okay. And earlier you talked about if certain
23 customers wanted certain aspects, then that goes into
24 their, their initial report? Like if someone told you
25 they were more concerned about, you know, visualizing the

1 curve, or whatever it may be, is that something that you
2 would then incorporate into that FTP'd report that goes
3 to them first?

4 A Yeah, if there was something additional that
5 someone wanted to see, we would put that in the report
6 for them.

7 Q Okay. So the measurements taken, if they've
8 indicated to you we're interested in, you know, whatever
9 it may be, the ballast feature that the original Aurora
10 had, then you would include that in the report?

11 A We identify if the track is obstructed in the
12 report, yes.

13 Q Oh, okay.

14 A Yeah.

15 Q You do that anyways.

16 A Yeah. The customer wants to know why you -- if
17 you don't provide a grade, ultimately they want to know
18 the condition of that tie. If you don't provide -- if
19 you can't provide a grade, they want to know you can't
20 provide a grade.

21 Q Okay. That makes sense. Do you have any idea
22 how much revenue GREX generates from the BallastSaver on
23 a yearly basis?

24 A So that's a bit of a complicated question
25 because BallastSaver is a technology that we originally

1 developed to sync with our ballast unloading business.
2 And so we sell technology that goes on ballast cars to be
3 unloaded, that works off a survey. And historically,
4 that survey was manual, and someone would say, "We want
5 about this much ballast unloaded," which equated to so
6 many ballast gates being opened and unloaded.

7 So we developed BallastSaver as a system to
8 survey the track and figure out where it was deficient
9 and tie all that location information together
10 automatically and feed that survey to that train with our
11 technology on it to unload it.

12 So that -- so we developed BallastSaver to be
13 an add-on so we can continue to sell those kits and
14 operate those services. So from that perspective, it was
15 an investment in continuing to grow and have that
16 business.

17 It's a technology that lends itself to being on
18 an inspection platform. So we might as well, while we're
19 on-track, collect that information too. If a railroad
20 wants us to give them an estimate as to how deficient
21 they are in ballast, we can.

22 COURT REPORTER: As to how what?

23 THE WITNESS: If the railroad would like to
24 have an estimate of how much ballast they were missing,
25 we can collect that with the Aurora vehicle and give them

[REDACTED]

[REDACTED]

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12 Q Now, you mentioned -- obviously, there's two
13 patents that are at issue here that we've been talking
14 about, but you mentioned other patents throughout the day
15 as we've been talking, you know, I think during the tilt
16 correction discussion you mentioned, BallastSaver you
17 might have mentioned patents. So you understand that --
18 or GREX alleges that there are numerous patents that
19 cover the Aurora technology or the Aurora systems; is
20 that correct?

21 MR. HERBERHOLZ: Objection, form.

22 THE WITNESS: There are several patents that
23 address the Aurora technology.

24 Q (By Mr. Parker) And you, GREX marks those
25 patents on their website?

1 A We do.

2 Q And on your trucks?

3 A We do.

4 Q And you don't have any reason to believe that
5 the patent numbers that are marked on those trucks are
6 incorrect, do you?

7 A They're correct.

8 Q Okay. And same with the website, the patents
9 identified under, I think -- I think there's different
10 pages, right? There's a different page for Aurora, then
11 Xi and -- X "one" -- no, Xi, and then Xiv. Right? Each
12 of those pages I believe on the website has a list of
13 patents; is that correct?

14 MR. HERBERHOLZ: I'm going to object to scope.
15 Go ahead.

16 THE WITNESS: I would expect all of our patent
17 numbers listed on our website, on our trucks and our
18 advertisements are all correct. I would be very
19 disappointed in our staff if they weren't.

20 MR. PARKER: Why don't we take a very, very
21 short break. I think we're about done.

22 (Recess from 12:40 p.m. to 12:45 p.m.)

23 MR. PARKER: All right. Well, Mr. Grissom, we
24 don't have any further questions.

25 THE WITNESS: Okay.

1 MR. PARKER: We appreciate you taking the time
2 to join us today.

3 THE WITNESS: Thank you very much.

4 MR. HERBERHOLZ: No redirect for me. Thank
5 you.

6 (Deposition concluded at 12:45 p.m.)
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PAGE/LINE	CHANGE	REASON FOR CHANGE
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GREGORY T. GRISSOM

1 UNITED STATES PATENT AND TRADEMARK OFFICE

2 BEFORE THE PATENT TRIAL AND APPEAL BOARD

3
4 TETRA TECH CANADA INC., § CASE IPR 2019-00619
Petitioner, § PATENT NO. 7,616,329
5 VS. § -and-
6 GEORGETOWN RAIL EQUIPMENT § CASE IPR2019-00662
COMPANY, § PATENT NO. 9,441,956
7 Patent Owner. §
8
9

10 REPORTER'S CERTIFICATION

11 CROSS-EXAMINATION OF GREGORY T. GRISSOM

12 FEBRUARY 11, 2020

13
14 I, MOLLY CARTER, Certified Shorthand Reporter in and
15 for The State of Texas, hereby certify to the following:

16 That the witness, GREGORY T. GRISSOM, was duly sworn
17 by the officer and that the transcript of the
18 cross-examination is a true record of the testimony given
19 by the witness;

20 I further certify that pursuant to FRCP Rule
21 30(e)(1), that the signature of the deponent:

22 _XX_ was requested by the deponent or a party before
23 the completion of the deposition and returned within 30
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1 contains any changes and the reasons therefor;

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7 Further, I am not a relative or employee of any
8 attorney of record in this cause, nor do I have a
9 financial interest in the action.

10 Certified to by me on this 13th day of February
11 2020.

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