UNITED STATES
INTERNATIONAL TRADE COMMISSION

In the Matter of:	)	Investigation No.
CERTAIN LIGHT-EMITTING DIODE	)	337-TA-1213
PRODUCTS, FIXTURES, AND	)	
COMPONENTS THEREOF	)	

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UNITED STATES INTERNATIONAL TRADE COMMISSION

Washington, D.C.

BEFORE THE HONORABLE CLARK S. CHENEY

Administrative Law Judge

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United States

International Trade Commission

500 E Street, Southwest

Washington, D.C.

Wednesday, May 5, 2021

EVIDENTIARY HEARING, Volume III - REMOTE PROCEEDINGS

The hearing commenced remotely, pursuant to the notice of the Judge, at 9:01 a.m. EDT

Reported By: Marjorie Peters, RMR, CRR, FAPR

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** Index appears at end of transcript **

P R O C E E D I N G S

(9:01 a.m.)

JUDGE CHENEY: Okay. We're on the record now in the 1213 Investigation.

We are on day 3 of the evidentiary hearing. When we left off yesterday, we were listening to testimony from Cree's final expert, Dr. Katona.

Before we resume Dr. Katona's testimony today, why don't we see if there's any housekeeping matters from the parties that we should address, starting with counsel for Complainant, Cree.

MR. ERWINE: Good morning, Your Honor.

This is --

JUDGE CHENEY: Good morning.

MR. ERWINE: -- Richard Erwine.

There are exhibits from the four witnesses yesterday that the parties would like to move into evidence, that would be for Dr. Lebby, Mr. Negley, Mr. Edmond and Dr. Wetzel. I believe the parties have agreed on the list of exhibits to be moved into evidence.

JUDGE CHENEY: Okay. Hearing no objection, the list of exhibits will be admitted into evidence. Please coordinate the list with the court reporter for accuracy.

(Exhibits, as submitted by counsel and reflected in the attached index, were received into evidence.)

MR. ERWINE: Thank you, Your Honor.
JUDGE CHENEY: Anything else from Cree?
MR. ERWINE: That's it, Your Honor.
JUDGE CHENEY: What about from RAB?
MR. ROUSH: Nothing from RAB, Your Honor.
JUDGE CHENEY: Okay. Why don't we have Dr. Katona return to the stand.
Good morning, Dr. Katona, I'll remind you that you remain under oath as you resume your testimony this morning.
THE WITNESS: Good morning, Your Honor.
JUDGE CHENEY: Good morning to you.
Mr. Hamstra, please proceed when you are ready.

CONTINUED DIRECT EXAMINATION

BY MR. HAMSTRA:

Q. Good morning, Dr. Katona.
A. Good morning.
Q. I think we left off discussing 750 grams. I believe we completed that. So let's move onwards.
Dr. Katona, what is --
JUDGE CHENEY: Mr. Hamstra, if you will allow me to just set the stage a little.
We're now talking about the '449 Patent, Claim 10, we just finished talking about element 10(e) as labeled by Cree. Continue from there.

MR. HAMSTRA: Thank you, Your Honor.

BY MR. HAMSTRA:

Q. All right, Dr. Katona, what does element 10(f) require?

A. Yes. 10(f) is at least one of the at least one solid-state light emitter mounted on the trim element. So the photographic images of the front of the fixtures here show, on the left, the recessed retrofit products with the light-emitting diodes shown in their mounting space on the trim elements. On the right of the performance downlight, also the light-emitting diodes mounted directly on the trim element.

Q. So what did you conclude about this element, Dr. Katona?

A. That for both the recessed retrofit and the performance downlight products, there is at least one of the at least one solid-state light emitters mounted on the trim element.

Q. Dr. Katona, let's turn to your slide 53 regarding the trim element, defining the trim element space.

First of all, what interpretation of trim element space did you apply?

A. The interpretation I applied was the Court's construction, which is shown here as, "A volume of space

defined by the interior of the trim element, and planes orthogonal to the device axis, at the uppermost and lowermost points of the trim element."

Q. Can you explain how you map those requirements to the recessed retrofit and performance downlight products?

A. Sure.

So the starting point is to define the device axis. So both for the recessed retrofit and the performance downlight products, the device axis is defined as the center of the diameter of the lighting fixture. And that's shown in both the image from CAD file CPX -- sorry, CX-0485C for the recessed retrofit products, and the CAD file CX-0487C for the performance downlight products, with the turquoise dashed arrow that runs through the center of the fixture.

And then the uppermost and lowermost orthogonal planes are shown with the shaded darker blue, and the red then highlights the volume of space defined by those planes.

Q. Dr. Katona, let's turn to your slide 54.

Element 10(h) requires the first driver component in the trim element space. Can you explain how you reached your conclusion regarding that element with respect to the recessed retrofit products?

A. Yes.

So the image from the previous slide, in this case, for the recessed retrofit products from the CAD file is shown on the right here to remind us of where the trim element space was defined. And then the photographs of the images from the recessed retrofit products, CPX-0029, are shown on the left.

The first one is the whole structure, and that's configured to be inserted into the ceiling. And you can see it as a full device. And then it's broken open in the second figures to show where the driver components are within that trim element space.

Q. Turning to your slide 55, can you address the same element with respect to the performance downlight products?

A. Yes.

So the -- again, the corresponding, I guess from two slides ago now, the image from the CAD file that we referenced showing the trim element space is shown on the right of this figure, and then in this case, the back side or the uppermost orthogonal plane is ripped open to expose the driver components contained within it.

Q. So, Dr. Katona, what conclusion did you reach regarding whether the recessed retrofit and the performance downlight products include a first driver component in the

trim element space?

A. That both of the -- both recessed retrofit and performance downlight products do contain a first driver component in the trim element space.

Q. Let's turn to your slide 56.

What does element labeled 10(i) require?

A. 10(i) requires that, "Wherein, if not more than about 15 watts is supplied to the electrical connector, at least one solid-state light emitter will illuminate so that the lighting device will emit white light of at least 500 lumens."

Q. How did you conduct your analysis with respect to this element 10(i)?

A. So in this case, we're looking specifically at recessed retrofit products again, and again, I'm speaking specifically about the R4 and R6 SKUs.

So from the spreadsheet that was supplied by RAB, JPX-0048C, again, these were sorted first by the SKU numbers, and then, in this case, we have the column 4 from the left shows the lamp lumens, and they're sorted by sort of low to high, all exceeding 500 lumens.

Q. The element also mentions "not more than about 15 watts."

What did your analysis of this spreadsheet show with respect to the recessed retrofit products?

A. Yeah. Sorry. It's a little earlier where I'm at than where you're at. I'm still getting going.

The input watts are in column 3, and the -- again, all of the R4 and the R6 SKUs are less than 15 watts. So the highest one here is 14.

Q. Dr. Katona, the right-most column reads, "Color Temp."

What does that refer to?

A. So those are different colors of light temperatures. So the color temperature corresponds to what an observer sees from a black-body emission. So 2700 kelvin, for instance, would be a little bit warmer, or orangish-red. White compared to the 4,000 kelvin, which is, as shown here, neutral. But these are all sort of standard white light color temperatures for those in the industry.

Q. Let's turn to your slide 57.

How did you conduct your analysis with respect to the 6-inch performance downlight products in this element 10(i)?

A. So similar to the recessed retrofit shown on the other page, in this case, the performance downlight products with the SKU starting with C6R were sorted from the spreadsheets supplied by RAB.

Then similarly, they were sorted from sort of

low to high lumens, and correspondingly, low to high input watts, showing that these do indeed have -- at least in the case on the top part of the graph, all the input watts are less than 15, and the lamp lumens are -- lumens out are greater than 700.

Q. Dr. Katona -- oh, sorry. Go ahead, why don't you complete your thought?

A. I was just making sure, I said greater than 500, not 700. They're 700 exactly.

Q. Thank you.

The lower three you include there listed input watts of 18. What conclusions did you draw regarding the performance downlight products with a nominal input power of over 15 watts?

A. So these products, while shown here in the table as input watts of 18 watts and lumens of 1500, are all enabled with dimming circuitry. So on the bottom is an excerpt from the performance downlight data sheet, CX-0598, which shows they have what's called 0 to 10 volt dimming. The way that works loosely, is if you've got 10 volts, it's not dimmed at all, and 0 volts would be -- or I think opposite of that, sorry.

But the -- it has dimming capability to go sort of with a dimming voltage, adjust the input watts down to provide less light than what the full brightness spec sheet

shows here.

So as an example, at 50 percent dimmed, the input watts would be approximately 9, and the lamp lumens -- corresponding lamp lumens would be approximately 750 lumens. So there's not an exact linear relationship on these typically, but they're relatively close.

Q. Dr. Katona, based on that analysis you just provided, what did you conclude regarding the 6-inch performance downlight products, and the watts and light output limitations?

A. Base on this, my conclusion is that all of the 6-inch performance downlight products with C6R SKUs do meet this element.

Q. Dr. Katona, we see some color temperatures on the right again on this slide 57.

Could you describe the -- how those would be perceived?

A. Similar to the other slide, this is a range of -- on the far right column, a range of standard white light SKUs from the black-body curve. So in this case, 3,000, 3,500, and 4,000 kelvin.

Q. Dr. Katona, turning to your slide 58, you include some testimony from a Mr. Barna of RAB.

How does this testimony relate to your opinion that the recessed retrofit and performance downlight

products emit white light?

A. It's my understanding that Mr. Barna agrees that the products do indeed emit white light. There's some Q & A that's shown on the left from his deposition.

It's JX-0122C, and then also on the right, the exhibit CPX-0693C, referencing the specific color temperatures, which we saw in the previous slide, 2700 kelvin, 3000 kelvin, 3500 kelvin and 4000 kelvin that are sort of construed to be white light.

Q. Dr. Katona, based on all of your analysis, what conclusion did you reach regarding whether the recessed retrofit and performance downlight products infringe Claim 10 of the '449 Patent?

A. My conclusion is that they do indeed infringe Claim 10 of the '449 Patent.

Q. Dr. Katona, did you also consider technical domestic industry with respect to the '449 Patent?

A. I did.

Q. Turn to your slide 60.

Which products did you analyze in your analysis of technical domestic industry?

A. I looked at the CR4T LED downlight with data sheet CX-0843, the CR6T LED downlight with data sheet CX-0837, the CR6T-G LED gimbal light with CX-0838, the CR4 LED downlight with data sheet CX-0835, CR6 LED downlight

with data sheet CX-0836, and the DS4 LED surface mount disk light with data sheet CX-0844, and the DS6 LED surface mount disk light with data sheet CX-1899.

Q. Based on your analysis of these products and their related materials, which product did you identify as representative of the Cree Lighting domestic industry products?

A. For structural purposes, I analyzed the CAD file, which is shown here for the CR6T LED downlight, CPX-0834C.

Q. So let's turn to the preamble.

What did you conclude about whether the Cree Lighting domestic industry products are lighting devices?

A. My conclusion is they are all, in fact, lighting devices. The image here shows a downlight. You can visibly see the LEDs on the front side of the little array of rectangles on the front for -- providing illumination.

Q. Turning to your slide .62.

Were you able to identify a trim element in the Cree Lighting domestic industry products?

A. I was. So similar to the analysis before on the RAB products, the -- this product does have a structure that forms a flange that's shown on the bottom of the image on the right from the CAD file, CPX-0834C.

The structure is configured to abut against the

mounting surface, defines the outward-facing surface of the lighting device and is configured to be inserted into an opening in the mounting surface.

Q. Is your response to RAB's arguments regarding the trim element any different with respect to the domestic industry products than it was with respect to the infringement analysis you performed?

A. It is not.

Q. Dr. Katona, let's turn to slide 63.

Were you able to identify an electrical connector in the Cree Lighting domestic industry products?

A. I was.

So we're looking at a side view from the CAD file here. The blue shaded area highlights the area of electrical connection.

Q. Let's turn to your slide 64.

Can you provide your analysis regarding element 10(c), at least the first driver component?

A. Yes.

So first, I used the Court's construction, again, that any component that is part of the driver and is involved in performing the functions of the driver.

So from the CAD file here, part of the -- part of the trim element has been made transparent to show the chamber that encloses at least the first driver component.

So they're made visible.

The green arrow is sort of pointing to that area where they're contained.

Q. Turning to your slide 65, what does element 10(d) require?

A. 10(d) requires at least one solid-state light emitter, and, again, this is a relatively easy one. The solid-state light emitters are easily visibly shown on the front of the lighting device.

Q. Turning to your slide 66, were you able to determine whether the Cree Lighting domestic industry products weigh less than 650 grams?

JUDGE CHENEY: Counsel, is that the question you intended to ask?

MR. HAMSTRA: Thank you, Your Honor.

Q. Were you able to determine whether the Cree Lighting domestic industry products weigh less than 750 grams?

A. I was. They actually weigh less than both, but the C6RT -- all of these photographs show physical measurements of the products.

So the C6RT is on the left, and the -- it's shown as CPX-0137, weighing 266.49 grams.

The C4RT is in the center, CPX-0138, weighing 141.75 grams. The CRT-G is on the right here, CPX-0139,

weighing 372 grams.

So all far less than 750 grams.

Q. Let's turn to your slide 67.

Could you show the weights of the remaining Cree Lighting domestic industry products?

A. Sure.

From left to right, the CR4 is shown on the far left, CPX-0141, weighing 248 grams. The -- did I say 248 grams?

The CR6, CPX-0140, weighing 366 grams. The DS6, CPX-0143, weighing 176 grams, and the DS4, CPX-0142, weighing 240.97 grams.

So, again, all far less than the 750 grams.

Q. Let's turn to your slide 68.

What does this element 10(f) require?

A. 10(f) requires at least one of the at least one solid-state light emitter mounted on the trim element. The image from the CAD file, CPX-0834C here highlights the position of the at least one solid-state light emitter mounted on the trim element.

Q. Turning to the next slide, what did you conclude regarding whether the Cree Lighting domestic industry products, the trim -- whether the trim element in those products defines the trim element space?

A. So my conclusion is they do. Again, in this

case, I'm using the Court's construction of volume of space. The volume of space that we're going to speak about is highlighted with red.

Again, starting with the device axis being the center of the diameter of the fixture, the uppermost and lowermost orthogonal planes of the trim element are shown with the darker shade of blue, and the volume that's defined by those with red.

Q. So, Dr. Katona, what did you conclude about whether the Cree Lighting domestic industry products include a trim element defining a trim element space?

A. The products do have a trim element defining a trim element space.

Q. Let's turn to your slide 70.

Dr. Katona, were you able to identify a first driver component in the trim element space?

A. Yes. So we're looking, again, back at the image from the CAD file, CPX-0834C, where part of the trim element has been rendered as transparent so that we can see into the lighting device.

You can see the driver component's contained within that area, which was previously highlighted as red as being the trim element space.

Q. Finally, let's turn to what you've identified as element 10(i) regarding the input watts and lumen output.

How did you conduct your analysis with respect to this element?

A. Yes. So, again, this is the -- the element where we're looking for not more than 15 watts supplied to the electrical connector, and the lighting device emitting white light of at least 500 lumens.

So analysis of the data sheets of these products, and for the C6RT, the data sheet is CX-0837, as shown on the far left.

C4RT's data sheet is CX-0843. And the CRT-G's data sheet is CX-0838.

The first thing to look at -- one is to make sure that they're all white light. So the column 4 is the CCTs, and we can see that these are the same types of color temperatures that we've looked at before. 2700, 3000 kelvin, 3500, and 4000 kelvin are standard white light color temperatures.

Then the input watts are shown on the row 2 of these data sheets with the output lumens as row 1. So the devices primarily are -- or the majority here are all less than 15 watts with lumens far in excess of 500 lumens.

There's a note in the bottom of the data sheet here that says, "Dimmable to 5 percent."

So for the products, similar to our discussion on the RAB products, for those that have an input watt

greater than 15, they can be dimmed down below 15 watts, and in each of the cases here, my analysis of the output lumens would indicate that in such a dimmed condition, their output light will still be far in excess of 500 lumens.

Q. Will that output light be in excess of 500 lumens at less than 500 watts of input?

JUDGE CHENEY: Also did you want to check that question again?

Q. Will that light output be greater than 500 lumens at less than 15 watts of input power?

A. Yes. So, for example, if we look at the C6RT on the far left, just by way of example. So that one has input watts of 21 watts with an output lumens of 1650 lumens.

If -- again, let's take an example of dimmed to half of its -- half of its light output or 10-and-a-half watts in to the device, we would expect to have roughly 825 lumens of light output.

Q. Dr. Katona, what did you include about -- conclude regarding whether the C6RT, C4RT, and CRT-G products satisfy this element 10(i)?

A. That they do, in fact, satisfy the element of the Claim 10(i).

Q. Let's turn to your slide 72.

Could you provide your analysis of this element with -- excuse me -- with respect to the remaining products?

A. Yes. So the remaining products are shown here. The CR4, with data sheet CX-0835, the CR6 with data sheet CX-0836, the DS4 with data sheet CX-0844, the DS6 with data sheet CX-1899.

In this case, things are a little bit more straightforward to look at. For all of these devices, the input watts are less than 15 watts, and that's, again, shown in row 3 of the data sheets.

Actually, for the first two, it's in row 3. For the DS4 and the DS6, it's in row 2.

The initial delivered lumens are in the row, in both cases, one above the input watts, showing that they are all in excess of 500 lumens.

Q. Dr. Katona, what did the CCT -- well, first of all, what does "CCT" stand for?

A. Correlated color temperature.

Q. What did the correlated color temperature in these data sheets you excerpted tell you about whether these products emit white light?

A. Similar to the other devices, they have the standard white light designations or color temperatures, ranging from 2700 kelvin up to 4,000 kelvin. And I see the

DS4 is not available in 3500 kelvin, but it's in the other color temperatures.

But these are all standard white light color temperatures.

Q. Dr. Katona, what conclusion did you reach regarding whether the Cree Lighting domestic industry products, in fact, practice Claim 10 of the '449 Patent?

A. That these products do all, in fact, practice Claim 10(i) of the '449 Patent.

Q. Dr. Katona, did you have an opportunity to consider secondary considerations of non-obviousness with respect to both patents you analyzed?

A. I did.

Q. What did you conclude about whether secondary considerations support non-obviousness of the asserted claims of the '270 and '449 Patents?

A. My conclusion is that they do, in fact, support non-obviousness of the '449 Patent.

Q. Dr. Katona, let's turn to your slide 74.

What does this slide set forth?

A. These are the considerations of non-obviousness that I considered.

Q. Turning to your slide 75, I think we kept the counterparties off these so we can discuss in open court.

First, what did you conclude or what is your

understanding of whether the '270 and '449 Patents have been licensed?

A. My understanding is the '270 and '449 Patents both have been licensed by other parties.

Q. Could you identify those licenses for the record?

A. Shown here on the slide, the license agreements are JX-0077C, CX-0465C, CX-0473C, CX-0342C and CX-0345C.

Q. Dr. Katona, let's turn to your slide 76.

What conclusions did you reach regarding whether RAB product documentation indicated a long-felt need for improved thermal management offered by the '270 Patent?

A. So in the case of the '270 Patent, here, we're looking back at the data sheets from the products we discussed yesterday afternoon.

The FFLED product data sheet, CX-0489, specifically advertises superior thermal management, and superior thermal management achieved with an external airflow fin, which is the technology we were speaking about.

Similarly, the CANVAS LED products shown with data sheet CX-0596 advertises the same thing, superior thermal management, and this time, they use the term "airflow technology."

The FALCOR products, CX-0488, similarly

advertise superior thermal management with external airflow fins.

And the EZLED products, data sheet CX-0823, advertise superior thermal management with external airflow fins.

So presumably, this is important for some reason, and I think we have spoken to its importance yesterday.

Q. Were you virtually here for the testimony of Mr. Wilcox and Mr. Bakewell on, I believe, Monday?

A. I was here for the majority of it. I was not here for every minute of it.

Q. Sure.

Did you hear any testimony regarding the commercial success of Cree Lighting's technical domestic industry products practicing in the '270 Patent?

A. I did. At least from the view of a technologist, they're relatively successful.

Q. Let's turn to your slide 77.

You reference an RAB patent on this slide. Could you explain -- first of all, can you identify the title of that patent?

A. Yes. So the RAB patent here is titled "Light Fixture With Airflow Passage Separating Driver and Emitter."

Q. Is that CX-458, Dr. Katona?
A. Yes, that's CX-0458.
Q. To what date does that patent claim priority?
A. That patent claims priority of September 12, 2011.
Q. How does that claimed priority date compare to the priority date of the '270 Patent?
A. It's approximately five years later than the priority date of the '270 Patent.
Q. What does the RAB patent CX-0458 indicate to you about RAB's need for the invention of the '270 Patent?
A. So the -- there's an excerpt from that patent shown on the right, CX-0458, and highlighted in that excerpt is, "The airflow channel minimizes thermal conduction between the emitter and the driver housings, and maximizes thermal conducted cooling for at least one of the emitter housing and the driver housing," which is exactly the technology we were speaking about yesterday with regard to the '270 Patent.
MR. HAMSTRA: Thank you, Dr. Katona. I think that's all my questions for you.
I pass the witness, Your Honor.
JUDGE CHENEY: Is there cross-examination for Dr. Katona?
MR. ROUSH: Yes, Your Honor.

JUDGE CHENEY: Please proceed when you are ready, Mr. Roush.

MR. ROUSH: Brad Roush on behalf of Respondent, RAB Lighting.

CROSS-EXAMINATION

BY MR. ROUSH:

Q. Good morning, Dr. Katona. I have a few follow-up questions for you.

A. Okay.

Q. Can you pull up CDX-003.0021?

A. Is that in the folder labeled "Katona cross"?

Q. This is from your own demonstrative exhibits.

A. Oh. You're pulling it up. I'm sorry, I thought you were asking me to pull it up.

Q. Sorry.

Ted, can you pull up CDX-003C.0021.

A. Yes.

Q. Does this show the FALCOR product?

A. Yes. This shows the FALCOR product.

Q. This figure shows a circuit board; correct?

A. This figure shows a printed circuit board.

Q. Several surface mounted LEDs are also shown; correct?

A. There are several surface mounted LEDs.

Q. The surface mounted LEDs are connected to the

same printed circuit board; correct?

A. They are connected to the circuit board.

Q. Each of the mounted LEDs is connected to the same printed circuit board; correct?

A. Yes. Those are all connected to the same printed circuit board.

Q. Can you turn to CDX-003.23?

The chip-on-board -- these are chip-on-board LEDs shown here; correct?

A. Those are chip-on-board LEDs.

Q. Each of the chip-on-board LEDs shown here is mounted to its own ceramic substrate; correct?

A. No, that's not correct. The chip-on-board -- the ceramic substrate itself is the chip-on-board LED module. So they're not mounted to another ceramic.

Q. Okay. But the chip-on-board shown here have a ceramic substrate; is that correct?

A. I'm not certain if those are a ceramic substrate or a metal core printed circuit board.

Q. Each of the chip-on-board LEDs shown here has its own circuit board; correct?

A. The chip-on-board LED module acts like a circuit board, yes.

Q. Each of the chip-on-boards shown here has its own encapsulant; correct?

A. Yes, there's an encapsulant on each of these.

Q. Thank you. I want to turn to the '449 Patent now.

Dr. Katona can you -- or, Ted, can you pull up, CDX-003.0054?

I want to talk about the dispute over the limitation, the first driver component in the trim element space.

Dr. Katona, do you agree that the dispute between you and Dr. Shackle over whether RAB's recessed retrofit and performance downlight products meet the first driver component in a trim element space limitation comes down to what constitutes the trim element?

A. I believe I agree with that.

Q. That this dispute is essentially the same for both RAB's accused products, the recessed retrofit product and the performance downlight product; correct?

A. I believe that's correct, yes.

Q. Trim element has been construed as, "A volume of space defined by the interior of the trim element, and the planes orthogonal to the device at the uppermost and lowermost points of the trim element"; is that correct?

A. I believe you said the trim element was defined that way, which is not correct.

Q. Actually, I meant trim element space.

The trim element space has been construed by -- as, "A volume of space defined by the interior of the trim element, and the planes orthogonal to the device axis at the uppermost and lowermost points of the trim element"; is that correct?

A. Yeah. It's -- that sounds correct.

Q. So you're not opining that the trim and the driver housing in RAB's products are part of the same structure; correct?

A. That the -- I'm not opining that the -- that there is a unitary structure.

Q. Okay. So you can turn to CDX -- or, Ted, can you pull up CDX-003.0048?

As shown here in your slide 48, the driver and the trim are separate structures; correct?

A. The driver -- you mean the driver circuit board?

Q. Well, the trim is made out of one material; correct?

A. When you say "trim," do you mean the trim or trim element? I'm not sure what you're specifically saying here.

Q. Show -- I'm just going to point you to the figure on the left. I believe it's the left-hand picture of CPX-0029. This shows --

A. Yeah.

Q. This shows the trim element; is that right?
A. Not as it's been defined in my report, or in the testimony I just gave.
Q. Okay. Sorry. This shows a -- one component of what you're saying is the trim element; is that correct?
A. Yes.
Q. Can you take a look at the photo on the right? I see -- yeah. Actually, the -- the -- what's shown in the green arrow here, that's the driver component; is that correct?
A. That's correct.
Q. That's a separate component; correct?
A. From the white thing below it?
Q. Yes.
A. Yeah. You can see it's physically separated. They're connected with a wire that feeds through, yes.
Q. The white component in the picture shown here performs a different function than the driver component shown in green; correct?
A. Yes. That's correct.
Q. Can you --
Ted, can you turn to slide 42?
Dr. Katona, are you opining that the blue arrows shown here are defining the trim element?
A. Yes.

I mean, just to be technically accurate, those are straight lines, and there's contours on the structure, so it's not exactly -- it would follow the contours, but it's representative, if that makes sense.

Q. So the space here shown in white, that's not part of the space between the blue arrow and the physical structure.

You're not contending that's part of trim element, are you?

A. No.

Q. Now, can you pull up --

Ted, can you turn to slide 46.

This is language you rely on from the patent in support of your opinion as to what constitutes a trim element.

It says, "In some embodiments of the trim element can comprise at least one chamber that is shaped so that it can accommodate any of a variety of driver modules and/or power supply modules (or one or more components thereof involved in)..."

And is it goes on.

"....involved in receiving current supply to a lighting device."

This language here, it's only referring to some embodiments; correct?

A. It specifically says, "in some embodiments," yes.

Q. In the '449 Patent, there's not a single figure showing the trim element shape such that it can accommodate a driver component; correct?

A. Well, I guess -- I guess that depends on which part you're saying is the trim element. So I am not -- I'm not clear on the question.

Q. Sure. Ted, can you please pull up the '449 Patent, JX-003. Can you turn to Figure 1 of the '449 Patent. Can you identify the driver subassembly in Figure 1?

A. I believe the driver subassembly is 101.

Q. Can you identify the trim assembly in Figure 1?

A. Let's see. So I believe that the -- I think -- I don't remember if they call it the trim element subassembly, I think is the exact language. I don't have the patent right in front of me. It is 102.

Q. In Figure 1, the driver subassembly is outside of the trim subassembly; correct?

A. The driver subassembly is outside of 102.

Q. Is there any figure in the '449 Patent where the driver subassembly is inside the trim subassembly?

A. So there's -- of the trim element subassembly; correct?

Q. Correct. Is there any figure in the '449 Patent where the driver subassembly is inside of the trim subassembly?

A. So I think the figures in the '449 Patent show them before -- before they're joined together. So they're -- it's shown broken up in parts.

So the trim element subassembly and the driver element subassembly are shown separately.

Q. Ted, can you pull up RDX-0015.002?

Do you agree or disagree that the red bracketed portion, which has been identified as the power supply enclosure in RAB's products corresponds to the driver assembly depicted in Figures 3 and 4 of the '449 Patent?

A. So the -- I'm sorry. You said the red bracketed -- could you actually repeat the question? I'm sure --

Q. Sure. Let me explain.

A. There's a lot going on on the slide.

Q. So the right here, the -- is RAB's accused products, the recessed retrofit products, and the performance downlight products.

A. Mm-hmm.

Q. Bracketed in red is the power supply enclosure; correct?

A. It's what Dr. Shackle has called the power

supply enclosure, yes.

Q. Do you agree with Dr. Shackle that this would be the power supply enclosure?

A. I don't think I ever called it that in my report.

Q. What would you call it?

A. It's -- in my report, I specifically refer to as part of the trim element.

Q. Like, I'm asking you as separate, alone, what is identified here as the power supply enclosure, what would you call what's bracketed here in red?

Do you have a name for that?

A. I would call it, based on the patent specification, the part of the trim element, the chamber that contains the driver electronics.

Q. I believe earlier you testified that, I mean, the sort of components shown in blue and the components shown in red here are separate components; correct?

A. Just to clarify -- you have blue brackets on the right, and a blue box on the left. I'm not sure which blue and red you're talking about now.

Q. Sure.

Ted, can you zoom in on the RAB recessed retrofit product.

I believe earlier you agreed that what's shown

here is not a single unitary structure; is that correct?

A. That's correct.

Q. So -- go ahead.

A. Just to be clear, it's -- I mean, until they're assembled, it's not. They're manufactured as two pieces.

Q. Okay. So the piece shown in red is manufactured separately from the piece shown in blue; correct?

A. That would be my understanding, yes.

Q. So can you -- what would you call the piece shown in red?

A. Do you mean as it's -- comes off the molding machine, or in the image that I'm looking at here?

Because the image I'm looking at here, I have referred to it as a part of the trim element.

Q. Yeah. Any symbols -- you know, entities, they can have multiple components. So what would you call the component shown here in red?

A. I guess I would call it whatever RAB internally calls it when they're making it.

Q. Okay. So you earlier mentioned that -- you said, quote, when it comes off molding machine.

What would you call --

A. I am assuming -- I am assuming this is a molded product. I don't know that for a fact.

Q. Okay. So you said eventually these components

are attached together; is that correct?

A. That's correct.

Q. So let's say, prior to these components being attached together, what would you call what's shown here in red?

A. Again, I guess I would refer to it as whatever is in the drawings from RAB that they call that part.

Q. Okay. Well, then, if they called it the power supply enclosure, would you agree with that?

A. I mean, whatever they're using internally for their designation of their parts, I'm not going to relabel their parts, so I -- that's fine.

Q. Actually, let me ask you a different question.

Would you agree here that what's shown in red is housing the driver components?

A. The part in red here does create the chamber that then encloses the driver components.

Q. Okay. So we -- could we call it the driver component housing?

A. I'm not sure why you're asking me to rename the -- I'm trying to be very specific with the language, and -- so it's -- again, what I have referred to it in my reports is that it's a part of the trim element that then encloses and contains the driver components.

Q. Okay. So what's shown here in red contains the

driver components; is that correct?

A. It does.

Q. So can we zoom back out.

Would you agree now -- can you turn to the left at -- for the '449 Patent, what's been -- it's called the driver subassembly 101. In the '449 Patent 101 is -- contains the driver components; is that correct?

A. Yes. In the embodiment shown here, the driver components are contained within 101.

Q. So do you agree or disagree that what's shown in the patent as component 101 corresponds to what you agreed houses the driver components in RAB's products?

A. There's similarity between these two in that 101 gets attached to the bottom structure and creates a structure that then gets inserted into a ceiling, creating the lighting device.

So similar to what's on the right, yes.

Q. Yes. And also in RAB's products, the -- what's housing the driver component gets attached to the bottom structure, which is inserted into the ceiling; is that correct?

A. The -- the entire structure, yes, is inserted. The combined structure is what's intended to be inserted into the ceiling.

Q. Ted, can you pull up RDX -- actually, turn to

slide 3, RDX-0015.003?

This is a figure and supporting text from US Patent 7,614,769, the Sell, RX-021.

Are you familiar with the Sell reference before, Dr. Katona?

A. Yes, I have seen the Sell patent before.

Q. During the prosecution of the '449 Patent, the claims were amended to add the trim element space limitation to overcome the Sell reference; correct?

A. There were a number of things added along the way, and Sell was part of the prosecution history, yes.

Q. In referring to the Sell reference shown here, do you see the shell 34, flange 40, and side wall 42 shown in blue?

I can --

A. Yes.

Q. Can you see the photo?

A. I can see it. That's okay. I got it.

Q. What's shown here in blue, the shell 34, flange 40, and side wall 42 of Sell, this meets the construction of the trim element; correct?

A. Do you mean it meets the Court's construction of trim element?

Q. Yes. What is shown here in blue, the shell 34, flange 40, and side wall 42 of Sell meets the Court's

construction for trim element; correct?

A. Presumably, that can be inserted into a ceiling, and defining the orthogonal planes. Just the -- I guess the one question I'm asking, are you asking in the context of the entire device, or just is that blue highlighted disk, does it meet the construction?

Q. As -- as shown here, what is shown in blue from Sell Figure 3, does that meet the Court's construction for trim element?

A. If you just had a disk of plastic or metal like that, I guess it could meet the Court's construction, yes.

Q. What's shown in red, power supply 66, that's a driver; correct?

A. Yes. That's a driver.

Q. In Sell, the power supply 66 is outside of the trim element space; correct?

A. It's outside of what you and Dr. Shackle have just defined as the trim element space.

Q. Okay. So using your definition of trim element space, is the power supply 66 inside or outside of the trim element space?

A. I actually -- I talked about this in my deposition. I didn't offer an opinion on what the trim element space is for Sell.

Q. Are you able to offer opinion today?

A. The -- I mean, I think it can be -- I'm not real -- so a couple -- I'm not sure how this product is sold in its final form, so I'm not -- or if it was ever sold, to be honest.

So I'm not sure exactly how it gets assembled into the ceiling. So it does depend a little bit on that facet of the device.

Q. So sitting here today, can you tell me whether or not what -- the power supply 66 shown in red of Sell is inside or outside of the trim element space as construed by the Court?

A. It could be. Depending on the final configuration of this light.

Q. It could be inside or it could be outside?

A. Yes. It could be both.

So you've defined the trim element as the blue, and if that's the final structure that is meant to be inserted into the ceiling and abut up against it, then it would be outside it.

If that structure goes up, and there's something different, then it could be within it.

So I don't know from this how the -- the final form of this lighting device.

Q. So you can't tell me whether or not the power supply 66 in Sell is inside or outside of the trim element

space as defined by the Court?

A. Not without more information on this. I'm saying that it could be inside or outside.

Q. You were asked about this at your deposition; correct?

A. I was.

Q. Can we turn to slide 43?

JUDGE CHENEY: Just for the record, we're in RDX-0015.

BY MR. ROUSH:

Q. This slide shows the Sell reference Figure 3 compared to the RAB's accused products. As shown, the driver housing -- or the housing with the driver components to the side is shown in red and the trim element is shown in blue.

Do you agree that the location of the trim element -- strike that.

Do you agree the location of the driver housing in RAB's products is indistinguishable from the location of the power supply in Sell?

A. I don't -- I don't know that I'd use the word "indistinguishable." I can see -- I guess I would use the word "analogous."

Q. So the -- in your opinion, the location of the driver housing in RAB's products is analogous to the

location of the power supply in Sell?

A. So once again, the location of what you're calling the driver housing is analogous to the red-shaded area of Sell.

Q. Do you have any reason to disagree with what's being called the driver housing?

A. Well, again, in your figure, you have shown the trim element as different than what I defined it in my reports.

Q. But the driver -- but what's shown in red, the driver housing, that is housing the driver components; correct?

A. I'm just merely pointing out that you're using different language than I use in my reports, and asking me to, then, adopt that language.

To the extent that the red is as you defined it as a driver housing, which is different than what I've defined in my reports, the driver is contained within that red area.

Q. Do you agree or disagree what's shown here in red on the right and labeled "driver housing" contains the driver component for RAB's products?

A. Yes. The part that is part of the trim element that you're defining as the driver housing does contain -- it's the chamber that contains the driver.

Q. Now, I want to --

JUDGE CHENEY: Counsel, before you move on. You described this as slide 43. Do you want to clear up the record?

MR. ROUSH: My apologies. RDX-0015.004, slide 4 of the presentation.

JUDGE CHENEY: Okay. Thank you.

BY MR. ROUSH:

Q. Next, I want to turn to your opinions on secondary considerations.

Can you pull up -- I believe you identified three licenses or four -- five licenses.

Ted, can you pull up CDX-003.0075?

Did you do any analysis as to the number of patents in each of these licenses?

A. I did not.

Q. Are these portfolio licenses?

A. I do not know the specifics of each of these licensing agreements. What I can comment on is I did work in the industry, and people don't sign licensing agreements lightly, but I don't know the specifics of these. I haven't been asked to analyze the economics of these licensing agreements.

Q. So you don't know -- you don't have any information as to why these licenses were entered into?

A. I don't know the -- what drove each and every party's decisions on the licensing agreements, but what I do know is the patents I was asked to opine on are a part of the portfolio, if it's a portfolio, of patents that are included in the license.

Q. So just to be clear, it could be, for example -- there could be, for example, 10 patents in license, or hundreds of patents in licenses -- or in the licenses, you would not know; is that correct?

A. I do not know.

Q. Could we turn to slide 76 of CDX-003?

Did you do any analysis as to whether -- as to whether there was customer demand for the thermal management in these products listed here?

A. So I didn't go speak with any of RAB's customers, if that's what you're asking.

What I do know is that there is a demand for high efficacy lighting and long lifetime lighting, both of which rely on thermal management.

Q. Did you compare RAB's products or Cree's products to any other products in the marketplace?

A. No, I didn't do a competitive analysis of the products.

MR. ROUSH: No further questions.

JUDGE CHENEY: Okay. Dr. Katona, I just have, I

think, a couple of questions for you.

THE WITNESS: Sure.

JUDGE CHENEY: Could we have CDX-0003C, slide 71, put up?

Do you recall the testimony that you gave about the domestic industry product C6RT that is summarized in this slide?

THE WITNESS: I do.

JUDGE CHENEY: In connection with that product, you were describing the expected lumen output if the input wattage were to be dimmed.

Do you recall that?

THE WITNESS: I do, Your Honor.

JUDGE CHENEY: Is the expected -- let me start again.

Is the relationship between input wattage and output lumens linear for this device?

THE WITNESS: In these devices, Your Honor, they're very close to linear. And linearity of that characteristic is one of the things that can make products more desirable than others. But from experience making dimmed devices, the determination that I made was that with the approximately linear relationship, these products were so far in excess of what the claim language met that they would have -- they would be extremely undesirable if they

didn't meet that level of linearity.

So they're approximately linear.

JUDGE CHENEY: Are you aware of any other witnesses or evidence in this investigation that hold a different view about the linearity of these domestic industry products when they are dimmed?

THE WITNESS: I'm not, Your Honor.

And I guess the other thing, there's a note down on the bottom, dimmable to 5 percent. So typically, the linearity tends to be best at the high end of the output power, and it gets worse when you get to very low power.

So all the powers we're talking about around 15 watts would be in the region of dimming that one would expect the linearity to be -- hold the most, I guess.

They tend to get very non-linear at the -- you know, when you're down at close to zero power.

JUDGE CHENEY: The question I asked you was specifically about the domestic industry product C6RT, but do you hold the same opinions for the other dimmable domestic industry products who have a maximum input power greater than 15 watts?

THE WITNESS: I do, Your Honor.

JUDGE CHENEY: Okay.

This concludes the questions that I have for this witness. Is there any redirect?

MR. HAMSTRA: No, Your Honor.

JUDGE CHENEY: Okay.

Thank you, Dr. Katona, for getting up so early to join us this morning.

THE WITNESS: Thank you, Your Honor.

JUDGE CHENEY: Thank you for your testimony. It's helped me understand the case. You may step down.

Will Cree call any more witnesses for its case-in-chief?

MR. ERWINE: No, Your Honor, that concludes our affirmative case.

JUDGE CHENEY: Okay.

Let's now turn to RAB's defense. RAB, will you please call your first witness?

MR. MOSKIN: RAB calls as its first witness Mr. Ross Barna.

JUDGE CHENEY: Welcome, Mr. Barna. If you will please raise your right hand, I will administer the oath.

I have not heard your sound, so...

MR. MOSKIN: I think Mr. Barna is muted.

JUDGE CHENEY: Let's go off the record for just a moment.

(Off the record.)

JUDGE CHENEY: We're back on the public record after taking a moment to work out some technical issues to

connect RAB's first witness, Mr. Barna, with the virtual hearing.

Mr. Barna, I'm going to administer the oath, if you will please raise your right hand.

ROSS BARNA,

a witness, having been first duly sworn, was examined and testified as follows:

THE WITNESS: I do.

JUDGE CHENEY: Thank you.

Please proceed with your examination, Mr. Moskin.

MR. MOSKIN: Thank you, Your Honor.

DIRECT EXAMINATION

BY MR. MOSKIN:

Q. Would you please state your full name for the record?

A. My name is Ross Alexander Barna.

Q. Are you employed?

A. I am employed by RAB Lighting.

Q. Can you tell us briefly what positions you hold and what are your responsibilities at RAB?

A. Sure.

I am the CEO and chairman of RAB Lighting. As CEO, I am responsible for setting the strategy and executing the strategy of the business while protecting the

interests of the employees, the shareholders, and our customers.

As chairman, I'm responsible for the governance of the organization.

Q. Can you describe for us, at least at a high level, the history of the company?

A. Sure.

RAB was started by my great grandfather and my grandfather in the 1940s. After World War II, a lot of Americans wanted to start new families and build new homes, so the modern construction industry, as we know it, was created.

My great grandfather was a salesman for General Electric. He sold light bulbs. My grandfather was an engineer and had -- they worked together to innovate a new, safer way to power outdoor lighting fixtures.

It used to be that the wires were on the outside. Not great for electrical safety.

So their first innovation was to put the wires on the inside of the outdoor light fixture. It was a lot safer that way.

The business was started right here in New York City, where I am today, in the Bronx. Yes.

Q. And --

A. Yes.

Q. Where does RAB's business exist today? Where are its locations?

A. Sure. Our headquarters is in New Jersey. We have offices in New York City, and facilities in New Jersey, California, Illinois, and Texas.

Q. From its beginning selling weather-resistant outdoor lighting products, can you tell us, at least briefly, how the company was evolved, where it is now?

A. Yeah. So after that first innovation, there were other innovations. One that I think is particularly interesting is our explosion-proof product lines that my grandfather devised.

Those were used in areas where there are highly flammable materials. I remember when I was growing up, one of the pictures my dad brought home was from the NASA space shuttle launchpad where they used our products to ensure that when they were loading fuel onto the booster rockets, there were no sparks when the lights were turned on and off.

Unfortunately, my grandfather died before I was born, and my father had to take over the business to support his mom and his sister when he was quite young.

He was able to make quite a few innovations as well. He was the first to commercialize outdoor motion sensors that many people have above their garages. And

that innovation, among many others, led to the growth of our commercial indoor -- or our commercial outdoor lighting business, which is kind of the foundation for what RAB is today.

Q. How many employees does RAB currently have?

A. Approximately 370.

Q. Can you describe how you became involved with the company?

A. Sure. Yeah.

I was waiting to join the PhD program at the University of Utah's computer science program, and over the summer -- you know, I was a poor college student and over the summer, my dad said, hey, do you want to come by RAB and help us out?

You know, I had a very strong computer background. And so I hung out for the summer, and realized pretty quickly that RAB needed significant help in the area of digitization.

At the time -- this was 2001, and there was a lot of paper running the business. So I started that journey, put in a new ERP system, and by the time I was doing that, I knew how every part of the business worked, so I took over the operations, and finally expanded to other areas, eventually becoming CEO.

Q. I'm sorry. Eventually becoming CFO?

A. CEO.
Q. Does RAB now sell LED lighting devices?
A. Almost primarily, yes.
Q. When did it begin doing so?
A. Well, LED lighting for RAB really began around the same time as the patents in this case. The whole lighting industry in that 2006-2007 time frame was really abuzz with the promise of LED lighting technology, but the reality at that time was that it was very expensive.

RAB really prides itself in our ability to make affordable products that can be sold in every town and city in the United States. At that time, kind of the average price -- selling price of an LED lighting fixture was above $1,000, really outside the reach of most people.

So while we experimented internally with the technology, we felt that it was too expensive.

Then if you recall the housing crisis, and economic disaster of 2008, the interesting thing -- interesting and relevant part of that was that at the time, the flat panel television industry was in transition from fluorescent backlighting to LED backlighting.

And the capacity for building those LEDs had been built over that 2007 year, which really created quite an unusual inflection point when everybody stopped buying TVs all at once, and there was all of this excess capacity

for making LEDs.

It created a dramatic drop in the cost of LEDs, which enabled us to commercialize the first $99 LED light fixture in late 2008.

Q. What was that called?

A. That was called the WPLED10.

When we did that -- which was, you know, a tenth of the price that LED lighting was selling for at the time. When we did that, we sold about what we thought we would sell in a year in two months. And that was when I realized that I had to put all of the resources of the business behind LED, which would be the future, and turned out to be.

Q. So what percentage of the RAB product line now is in LED lighting?

A. Almost all of it. There are only a few tiny little bits that aren't LED. And to be perfectly honest, those products people put LED light bulbs in them anyway, so it's primarily LED.

Q. Such as...

A. The LED --

Q. No, no, no. What are the products into which your customers put LEDs anyway?

A. Oh, landscape lights. So they're called like pagodas. They're -- you see them along like the paths of

houses, and they have the little kind of slanted tops on them.

We just haven't gotten around to, you know, redesigning them.

Q. Who are your principle customers?

A. We sell exclusively to electrical distributors in the USA.

Q. How -- can you just describe briefly the supply chain to electrical distributors?

A. Sure.

So electrical distributors are businesses. They range in size from Ma and Pa locations to multibillion-dollar global corporations. Essentially what they are is they're a warehouse that holds all of the electrical products that electricians need to build and maintain homes, commercial buildings, industrial buildings.

They're in every town and city in the United States.

Q. Do you have any understanding or appreciation what the RAB brand represents in the industry?

A. Yeah. I mean, I think if you ask those electricians -- you know, if you meet any of them -- maybe they come to work on your house, and you say, hey, do you know RAB? What's that brand really about?

What they'll say is, wow, you know, RAB has

really been an innovator over decades in terms of having great quality product that's energy efficient and affordable.

Q. Has RAB received any awards or recognition for its product design or service?

A. Yeah. Absolutely.

We've had -- I'm very proud of the awards that we've gotten over the last decade or two, both from industry groups such as the DLC, even for the US Department of Energy, for product design, for product efficiency.

Q. Are you familiar with or can you describe how RAB's product development process works?

A. Sure.

I may be the CEO, but I'm also kind of the head product guy. So the way our product development works is I sit down with our marketing and salespeople. We talk with our customers.

We come up with a product roadmap. The product roadmap has a number -- you know, covers a longer-term period, and defines really where we're going to be investing in our product lines, and where we will be innovating and how.

Then when it comes time to begin the work on a new product, I personally write the specifications for that product, including, you know, what it will look like, what

it will cost, how it will work, where we're going to spend our efforts innovating the colors, the light quality, the efficacy, the amount of light, how the light will be distributed. All of those things.

I then transition our work to the team of engineers, and designers, and supply chain experts, and they make it real.

Q. How large is this team of designers and engineers?

A. It's on the order of 50 people.

Q. Do you have a sense whether RAB was ahead or behind the lighting industry in moving into LED lighting products?

A. The answer to that is kind of both.

You know, as I mentioned, we were kind of on the outside looking in when it was really frothy in that 2006-2007 period, and everything was really expensive.

So in some ways, we were behind because we didn't want to jump in too early because it wouldn't match with kind of our DNA in terms of the products that you could make in those years were just very expensive. It wouldn't have made sense.

But when the economic crisis hit, many companies had large layoffs and kind of buckled down, and weren't investing, whereas we put the pedal to the metal and were

really investing heavily.

You know, the way I judged it, you know, how far ahead we were for that -- you know, over the last decade, is it seemed to be usually about two years ahead, and the way you could judge it was basically looking at your product -- the percentage of your revenue coming from LED lighting.

Obviously, I knew the percentage of my revenue that was coming from LED lighting, but most of my competitors are actually public companies, and the analysts on the earnings calls would always ask them, you know, what percentage of your revenue is coming from LED lighting, and they'd answer, and that's how you can kind of see how far ahead you were.

So we started off behind, but we quickly pulled out ahead for many years.

Q. Was the LED lighting industry as a whole moving more aggressively into LED -- excuse me.

Was the lighting industry as a whole moving into LED lighting products in the teens in this century?

A. Yeah. I mean, I describe it as a gold rush.

Q. Why was that?

A. Everybody was jumping in. Companies that didn't even make lighting were suddenly making lighting. The big change was that, you know, as a lighting manufacturer,

before LED lighting, you were making products that people bought because they needed light.

Once LED came along, you were selling products that were cash flow grade investments. People would invest in upgrading their lighting from older technology to LED technology because it could save them 70 percent, on average, of their electrical bill that they were spending on lighting.

So it went from being an, oh, yeah, I need a light, to, hey, I can make money as someone who owns a building or a home, or save money by replacing my lighting with LED.

Then to make -- to further compound the situation, the utility companies, the people who generate electricity in the US, recognized this, and started providing utility rebates that would, in some cases, cover the full cost of the product and the installation to do that upgrade, because if you're a utility company, and -- and this was what was happening in the early 2000s, if you're a utility company and you're selling too much of your product, electricity, you will eventually have to build a power plant or improve your grid, your energy grid. Those are incredibly expensive things to do. It actually makes more economic sense for a utility company to pay its customers not to buy its product, not to buy more

electricity than to build a new power plant.

So this dynamic became very apparent in the teens, and it really fueled amazing growth in the industry.

Q. Were there improvements in LED lighting efficiencies that helped fuel the growth as well?

A. Yeah. I mean, when I mentioned, you know, kind of the idea of lighting becoming an investment, the return on investment was dependent really on two factors:

Factor number one, what's the cost of the lighting upgrade? How much does the product cost? How much is the labor? How much utility rebate are you getting?

And then how much energy are you saving? And when a product is more efficient, it saves more energy.

So efficacy was a huge part of -- and continues to be a huge part of the decision to buy and upgrade to LED lighting.

To compound that further, the utility companies started creating benchmark levels above which they would pay their rebates. And if the efficacy wasn't high enough, the product wouldn't get a rebate. So it's -- efficacy is incredibly important.

Q. Do you have an understanding of what fueled the improvements in the efficiency of LED devices?

A. Mm-hmm. For sure.

The improvements are almost entirely fueled by improvements in the LED chips and the LED phosphors. You could literally have the same exact product from a fixture perspective in terms of driver, thermal management, the fixture itself. The optical system can be the same. And every year, you could get quantum leaps in terms of efficacy just by the LED manufacturer giving you a new chip that -- with better phosphors or better manufacturing process on their side.

Really significant work was done in that space over the last decade. And continues to be today.

Q. Okay. Starting with your own products, do you have an understanding of how LED lighting devices generate white light or warm white light?

A. Sure. Yeah.

In RAB products, all of them, the white light is created with a blue LED chip, or die, words are used pretty much interchangeably, and a yellow phosphor. When the blue light travels through the yellow phosphor, it undergoes what's called a Stokes shift.

Basically, the frequency of the light is shifted in a way that the human eye perceives white light.

Q. Are there any RAB products that use any other methods of generating light?

A. No.

Q. Does RAB use any products that we've heard mentioned of the combination of red, green and blue chips, the LED dies, does RAB have any products that use this method?

A. No. RAB does not use RGB, RGBA or RGBW techniques to create white light.

Q. Does RAB have any products that use this -- the method that's been described as BSY+R?

A. No RAB products use the BSY+R technology.

Q. So is it correct to say that RAB products all use phosphor conversion technology?

A. All RAB products use phosphor conversion technology, that's right.

Q. Okay. Do any RAB products use red LEDs in generating light?

A. No, RAB does not use red LEDs to generate white light.

Q. Do any RAB products use any LEDs other than blue?

A. Actually, yeah. We use -- we have some products that are really popular in coastal areas where there are nesting sea turtles. We use amber LEDs there because, you know, if you use a white light, the sea turtles will get distracted and go the wrong way; instead of making it to the ocean, they'll die. But that's a very niche business.

Q. Are you at least generally familiar with the two lumen per watt patents at issue in this case, the '819 and '531 Patents.

A. Oh, yes, I have read them a number of times.

Q. Did RAB ever consider using the BSY+R approach described in the two patents?

A. Well, actually, I remember the first time I saw it. My friend called me over because he wanted to install what I think at the time might have been the Cree LR6 downlight at his mom's house, and he knew I was in the lighting industry, and he was like, hey, I got this cool thing, come check it out.

I went over there, and I took a look at it, and I looked inside. You know, I took the lens off, and I looked inside because I was just curious about it. And I saw, you know, something very innovative that I'd never seen before, which was this kind of -- these unusual LEDs that powered it up.

I'm like, well, they're kind of greenish and there are these red ones. And I remember seeing this technology and looking at circuit board, and seeing all the control circuitry that was required to support. I guess it was required to, you know, have the right driver currents for each one of those LEDs to get the right color point.

I'm thinking to myself, wow, you know, RAB

wouldn't -- this wouldn't work for RAB. It's too expensive. And I don't even know how it would scale up to higher output applications, because it was so -- it took up so much space; whereas, at the time, RAB was using COB -- almost exclusively COBs. You know, where the cool thing about COBs is you can pack a lot of current density into a very small space so you can get a huge amount of light output.

The BSY+R, which I think at the time they were calling it like a true white, or something like that. I just saw it, and I was like, yeah, that's not something that we're going to pursue.

Q. After that -- well, first of all, just -- I don't know if it's been mentioned in the record before, can you explain, what is a COB?

A. Yeah. The last witness mentioned it a few times. It's a chip-on-board device. They come in various flavors. You can have an aluminum circuit board substrate or a ceramic substrate. It's a really cool process because it's all robotic. The tiny little LED die are placed robotically, because they're so small, onto this substrate, and then wired using these tiny little golden wires, robotically wired together, and then an encapsulant, a phosphor encapsulant is put over the top of it.

So that technology was really what fueled a lot

of our growth, you know, from 2000 -- from our first product in 2008 all the way to today.

Q. After that one experience seeing the Cree product, did you continue to see Cree products using the BSY+R approach in the market?

A. No, I just -- I didn't. I'm not sure it was very successful.

Q. Mm-hmm.

I touched on this earlier. You described your involvement in product design. Can you just clarify or make clear, what is or are the principal things you have seen or you do employ to improve efficiency of your own products?

A. Yeah. I mean, you can kind of scratch the surface on efficacy with optical design. Optical losses aren't typically that significant.

Drivers, I mean, we have dabbled around the surface. The technology to improve efficacy there is still today not really that great. You're making tradeoffs. You know, it's kind of like physics. Power conversion is, like, a really well-understood thing. There's nothing much different between a laptop power supply and an LED driver. So there's really not much there.

It's all in the LED chip and phosphor technology. That's where the innovations have been, that's

where they're going to be in the future.

Q. What percentage of RAB's products today have an efficacy level of at least 60 lumens per watt?

A. Substantially all of them have at least 60 lumens per watt.

Q. What percentage of RAB products today have an efficacy level of at least 85 lumens per watt?

A. Substantially all of them have at least 85 lumens per watt.

Q. You mentioned earlier you follow what your competitors do.

Do you have a sense of what range your competitors' products fall in terms of efficiency?

A. Oh, absolutely.

I would say that they're very similar to ours. The whole industry kind of moves together because we're dependent on the technology coming out of the LED chip and phosphor manufacturers.

Q. Are you familiar with Cree Lighting?

A. Yes.

Q. Do you consider Cree Lighting to be a competitor?

A. Not particularly. You know, we have similar product portfolios in some ways, but we go to market very differently.

We sell -- you know, as I said, we sell exclusively to electrical distributors in the USA.

Cree pursues what I would call an omni-channel strategy. I guess another way of saying that is they'll sell to anybody, anywhere.

Q. Okay. One last question. In your estimation, could RAB do business if it could no longer sell LED lighting devices of 60 lumens per watt or higher?

A. So you cut out for a second. Could you please repeat the question?

Q. Sure.

In your estimation, could RAB continue in business if it could no longer sell LED lighting devices of 60 lumens per watt or higher?

A. No, absolutely not.

MR. MOSKIN: I have no more question, Your Honor.

JUDGE CHENEY: Okay.

Is there cross-examination for this witness?

MR. ERWINE: Yes, Your Honor.

JUDGE CHENEY: Okay. We'll pick up that cross-examination after our morning break. We're going to take now a 15-minute break.

Mr. Barna, I'll ask you to refrain from discussing your testimony with anyone during the break.

You can leave your camera and microphone on mute, and we'll see everyone back here in 15 minutes.

We're off the record.

(Whereupon, the morning break was taken, 10:44 a.m. - 10:58 a.m.)

JUDGE CHENEY: Okay. We're back on the record now.

(Audio interference.)

JUDGE CHENEY: Let's go off the record for just a moment.

(Off the record.)

JUDGE CHENEY: We're back on the record now in the 1213 Investigation.

Before our morning break, we were hearing the direct testimony of Cree's first witness -- I'm sorry. Let me start over.

We were hearing the direct testimony of RAB's first witness, Mr. Barna.

Mr. Moskin, please continue your direct examination.

MR. MOSKIN: Your Honor, I have no further questions for Mr. Barna.

JUDGE CHENEY: Oh, that's right. You mentioned that before the break.

Mr. Erwine, you mentioned that you have some

cross-examination.

MR. ERWINE: I do, Your Honor.

JUDGE CHENEY: Please proceed.

MR. ERWINE: Thank you, Your Honor.

CROSS-EXAMINATION

BY MR. ERWINE:

Q. Good morning, Mr. Barna.

A. Good morning, Mr. Erwine.

Q. My name is Rich Erwine.

(Audio interference.)

(Clarification requested by the Court Reporter.)

MR. ERWINE: Okay. Great. Thank you very much.

BY MR. ERWINE:

Q. Mr. Barna, I'm Rich Erwine. I'm an attorney representing Cree Lighting. I will be asking you some questions here today.

Now, Mr. Barna, you mentioned that RAB used something called blue-shifted yellow for white light?

A. I didn't say that.

Q. Did you -- you were talking about RAB's -- what RAB uses for white light source; is that correct?

A. I did speak about that. That's correct.

Q. All right. Did you refer to the use of a blue LED chip along with the yellow phosphor?

A. Sure did.

Q. Do you understand that to refer to or sometimes be referred to as blue-shifted yellow?

A. I have heard that terminology here at the hearing, but I have not heard it used in the industry before.

Q. How is it defined or used in the industry?

A. Well, just like I said, you know, blue LED chip with a yellow phosphor.

Q. Okay. You understand, sir, that that's not a new technology; correct?

A. I understand that.

Q. The blue chip was invented in the early 1990s by Shuji Nakamura; correct?

A. Couldn't say who invented it, but he did win a Nobel Prize for his work in that area, so I'm sure he was part of the team.

Q. The combination of the blue light plus the yellow phosphor was designed in the mid-to-late 1990s; correct?

A. I don't know. There are some experts who will be testifying later who could probably better answer the historical questions about that invention.

Q. All right. Now, you mentioned in your testimony that you were aware of LLF's BSY+R technology; is that correct?

A. Yeah. At the time that I first became aware of it, it was a Cree product. Pretty sure it was the LR6, and I think the technology at the time was known as true white technology.

Q. Do you recall the time frame when you saw that technology?

A. I'd call it the early teens.

Q. Okay. I think you said you saw the inner parts or inner aspects of that device?

A. Yeah. I took the lens off to look at the circuit board.

Q. You're aware that Cree at that time sometimes marked those products like the LR6 with patents?

A. I mean, it would be a good idea to do that. We do that with our products. I can't speak to Cree's marking practices, although I have heard their -- yes. I can't speak to them.

Q. Okay. Do you have a specific recollection of seeing any patents when you -- identified in that product when you looked at it?

A. I do not recall seeing any patent markings on or inside the product, but it was a while ago, and I probably wasn't looking for them.

Q. All right. You also mentioned that RAB uses something called COBs or chip-on-board; is that correct?

A. We do.
Q. Does RAB manufacture COBs?
A. No. We don't manufacture any LEDs.
Q. Do you know who does?
A. Yeah, there are many companies who do.
Q. Are you aware of the fact that Cree manufactures COB LEDs?
A. As a matter of fact, yes. Cree has sold us and attempted to sell us COBs.
Q. Now, Mr. Barna, you provided some testimony concerning RAB's corporate testimony; is that correct?
A. I'm not sure I understand the question.
Q. In your direct examination, did you provide some testimony concerning RAB's history?
A. Yes. Yes, I did.
Q. You discussed RAB's history and the number of employees RAB has in the United States; is that correct?
A. I did.
Q. All right. I think you testified that RAB has facilities in New Jersey, New York, Illinois, Texas and California; is that right?
A. Correct.
Q. In Illinois, Texas and California, those facilities are primarily used for distribution; is that correct?

A. That's correct.

Q. Okay. Now, let's talk briefly about RAB's New Jersey facilities.

The New Jersey facilities are RAB's corporate headquarters; correct?

A. Correct.

Q. RAB's New Jersey facilities contain a warehouse that occasionally gets some inventory for distribution; is that right?

A. I don't think that's a reasonable way to describe our New Jersey facilities.

Q. Okay. You're aware that you were deposed in this investigation; correct?

A. I was deposed.

Q. You recall answering a similar question on that subject?

A. I answered a lot of questions. It was an all-day deposition.

Q. All right. Well, let's pull up your deposition and take a quick look.

Mr. Jay, if you could pull up deposition at line 31 -- I'm sorry. Page 31, lines 4 through 10.

If you see it -- Mr. Barna, do you see the question, "I imagine there isn't any distribution from the corporate headquarters; is that right?

"Answer: There is. That building contains both the office and a warehouse, and occasionally some inventory from that warehouse will get distributed."

Were you asked that question?

A. Looks accurate. I would answer it that way again, but oversimplification, I would say. There's more going on in New Jersey than just that.

Q. Okay. Now, to that point, RAB also has engineering resources in its New Jersey facility; is that correct?

A. We did pre-COVID.

Q. Do you now?

A. Our engineers are mostly working from home. Some of them do occasionally go into the New Jersey facility on an as-needed basis. For social distancing purposes, it's best for everybody to work from home right now.

Q. Understood.

RAB also has engineering resources in China?

A. RAB does not have engineering resources in China.

Q. Okay. So all of RAB's engineering resources are located in the United States?

A. That's correct.

Q. Okay. Now, you then would agree that it's

important for RAB to have US-based engineering resources, even if its products are manufactured overseas?

A. I am not sure I understand why you're asking that question or how to answer it.

Q. So you can't speak to whether or not it's important for RAB to have US-based engineering resources even if its products are manufactured overseas.

A. Oh, sure. Sure. Thanks for clarifying.

I don't think it matters where the products are manufactured. As a matter of fact, we do manufacturing in New Jersey using our union workforce.

Engineering capabilities in the US are of critical importance to RAB.

Q. You mentioned manufacturing. Now, RAB does its -- the majority of RAB's manufacturing occurs outside the United States; is that correct?

A. RAB does not manufacture anything outside of the United States.

Q. All right. Thank you very much. Let me ask it a little bit differently.

You agree that RAB's products are manufactured -- the majority of RAB's products are manufactured outside the United States?

A. Absolutely.

Q. You testified that there are some assembly that

occurs in the New Jersey facilities; correct?

A. Mm-hmm. Much like -- oh, sorry. Go ahead.

Q. No. I didn't mean to interrupt your answer.

A. Much like we heard from Cree, there's a long tail in the lighting industry to the many varying versions of our products.

You know, it's typical of most lighting companies that, you know, the product offering contains lots of different colors, and mounting methods, and drive currents, and all of these different things.

It makes sense, much like Cree does, to contract manufacture core products in high volumes, and then the long tail is typically assembled here in the United States. Much like Cree does.

Q. You -- sorry to interrupt you again. I apologize. One of the issues with remote.

Now, you would agree that you would classify that assembly in the United States as light assembly; correct?

A. Yeah.

Q. Okay. And the products that RAB assembles in the United States are occasional sales for oddball items; is that correct?

A. Yeah. It's just like I said earlier. It's kind of that long tail. You know, the things that sell

occasionally, but when you add them up, there's a lot of them.

Q. Okay. But to confirm, the majority of RAB's products are manufactured overseas by others; correct?

A. The majority of RAB's products are contract manufactured overseas, just like Cree does.

Q. RAB, then, imports those products into the United States; correct?

A. RAB imports those products into the United States, just like Cree does.

Q. In fact, RAB Lighting is the importer of record on all of its products in the US; correct?

A. Yep. RAB is the importer of record for the products that we import into the United States.

Q. Now, you mentioned today that you set the design for RAB's products; is that correct?

A. I think what I said was I set the strategy, the roadmap, but, yeah, I -- I kind of -- in terms of design concept, yes.

Q. Okay. Then I think you said or you testified that you pass those designs or strategies to teams of engineers and designers; correct?

A. Mm-hmm. That's right.

Q. I think you said that was in the order of 50 people; is that right?

A. That's on the order of 50.
Q. All of those engineers are located in the United States; is that correct?
A. Those engineers -- there are some engineers that aren't located in the United States, but I'd say, at this time, the majority of them are.
Q. Where are those engineers that are not located in the United States; where are they located?
A. There are some engineers located in China.
Q. Do you know how many of those engineers are in China?
A. I think that -- the ones who work on -- the engineers who work on new product development, it's a small number. A handful. Maybe four.
Q. Pardon my confusion, Mr. Barna. I just want to make sure I have the record straight. I thought I had asked you earlier if there were any engineering resources outside the United States, and you said no.
A. Did you ask me engineering resources or did you ask me engineering employees?
Q. Well, I would have assumed that that would capture engineering employees. Apologies if you didn't understand that.
A. Yeah. Yeah. Well, it's not a question of understanding. There's a difference between contract

engineering and employees; right? I'm sure Cree also has contract capabilities that they leverage, say, in, I don't know, Mexico.

Q. I appreciate your speculation about Cree Lighting, Mr. Barna, but it would be helpful if we could just focus on RAB.

A. Absolutely. I'm just giving you an example so that you can understand what I'm saying.

Q. Thank you very much for that.

A. Mm-hmm.

Q. Now, I think you said there were approximately 50 engineers in the United States; is that correct?

A. I think the 50 referred to the number of RAB employees that work on new product development. It's a mixture of engineers, supply chain, professionals, marketing people, yeah.

Q. All right. Would you classify it as -- as it being important that those engineers are in the United States?

A. Yeah. Absolutely. Absolutely.

Q. Why is that?

A. I mean, the -- to be really -- to be really effective at innovating, you need to be able to be together. I mean, that's one of the challenges that we have today with COVID, is working together. I'm sure

you've seen it, you know, with your own team.

And, you know, when we can be together here in the US, it's -- it's important to be physically together so you can work on these projects.

Q. Understood.

Mr. Barna, RAB owns its own patents; correct?

A. That's correct.

Q. Do you know how many patents that RAB owns?

A. I don't know the exact number, but it's significant.

Q. RAB believes that it's important to protect its intellectual property; correct?

A. Yeah. I'd say that RAB values both RAB's intellectual property and the intellectual property of others.

Q. And, in fact, RAB has asserted patents recently itself; correct?

A. Yes, we have.

Q. And RAB filed a lawsuit against Cree Lighting in Delaware in December of 2020; is that right?

A. That's correct.

Q. All right. Now, you testified that RAB and Cree Lighting are not -- not really competitors; is that right?

A. Mm-hmm.

Q. You believe that Cree Lighting's channel

strategy is different from RAB's?

A. Yeah. Different go-to-market strategy, different channel strategy, for sure.

Q. But you acknowledged that Cree Lighting does some business in the electrical distribution channel?

A. Sure.

Q. Now, according to them, you have not really heard of them as a competitor?

A. I'm sorry. Is that a question?

Q. It is.

A. Could you rephrase that as a question?

Q. Yeah. Yeah.

According to you, you have not really heard of them as a competitor; correct?

A. Yeah. They don't really come up on my radar screen as a competitor.

Q. But you do agree that Cree Lighting provides LED lighting products to electrical distributors; correct?

A. I don't know anything about the nature of Cree Lighting's sales information, so...

I assume they do. I mean, I have heard that they do, but I don't want to speculate.

Q. But you don't actually know how much business Cree Lighting conducts within that electrical distribution channel?

A. Of course not.
Q. All right.
MR. ERWINE: Thank you very much, Mr. Barna. I have no further questions.
THE WITNESS: Pleasure speaking with you, Mr. Erwine.
MR. ERWINE: Likewise.
JUDGE CHENEY: I have no questions for this witness.
Is there any redirect?
MR. MOSKIN: Just one question, Your Honor.

REDIRECT EXAMINATION

BY MR. MOSKIN:
Q. Mr. Barna, you spoke about RAB's purchase of COBs, particularly from Cree.
Did you mean from Cree Lighting or from Cree, Inc.?
A. Well, at the time that Cree was trying to sell us COBs, I believe it was one company, and I think it was probably Cree, Inc. I think Cree Lighting, as a standalone, only happened like a year or two ago. This would have been years ago.
MR. MOSKIN: Okay. No further questions.
JUDGE CHENEY: Okay.
Thank you for joining us today, Mr. Barna. You

may step down.

Will Cree please call its next witness -- I'm sorry. I've been in the force of habit of saying Cree for a couple of days.

Will RAB please call its next witness?

MR. ROUSH: Yes. RAB Lighting will call Dr. Peter Shackle.

Good morning, Dr. Shackle.

JUDGE CHENEY: Before we get into the examination, Dr. Shackle, can you see and hear me?

THE WITNESS: I can see and hear you.

JUDGE CHENEY: Great.

Before we start your examination, I'm going to ask you to take the oath, if you would please raise your right hand.

PETER SHACKLE, PhD,

a witness, having been first duly sworn, was examined and testified as follows:

THE WITNESS: I do.

JUDGE CHENEY: Thank you.

Please proceed with your examination, Mr. Roush.

MR. ROUSH: Okay. Brad Roush on behalf of RAB Lighting, Your Honor.

DIRECT EXAMINATION

BY MR. ROUSH:

Q. Dr. Shackle, would you please state your full name for the record?

A. Peter W. Shackle.

Q. Dr. Shackle, have you prepared a set of demonstrative exhibits to help illustrate some of your testimony here today?

A. Yes, I have. The projectionist has them.

Q. Ted, can you pull up RX-855?

Dr. Shackle, do you recognize the document on the screen?

A. Yes. That's a part of my CV, including education.

Q. Ted, can we turn back to the demonstratives?

Dr. Shackle, can you provide a brief summary of your educational history?

A. Sure.

I had a bachelor's degree in physics from the University of Birmingham in the UK, where I graduated as the top student in the class.

Then I have a PhD in physics from Trinity College, Cambridge, UK.

In my professional career, I have authored 61 United States patents, mostly in the area of lighting electronics.

MR. ROUSH: Your Honor, I proffer Dr. Peter

Shackle as a technical expert with respect to LED lighting in this investigation.

JUDGE CHENEY: Is there any objection?

MR. ERWINE: No objection, Your Honor.

JUDGE CHENEY: Hearing no objection, Dr. Shackle will be accepted as a technical expert with respect to LED lighting.

BY MR. ROUSH:

Q. Dr. Shackle, can you turn to RDX-004.003?

Does this slide describe the level of a person of ordinary skill in the art that you're applying here today?

A. Yes, those are the definitions I've been working under.

Q. In considering your opinions relating to the validity of the asserted claims of the '270 Patent and '449 Patent, do you understand that the claims of an issued patent must be proven -- or presumed to be valid, and must be proven invalid by clear and convincing evidence?

A. That is my understanding.

Q. In considering your opinions relating to infringement of the assert claims of the '270 and '449 Patents, do you understand that infringement must be proven by a preponderance of the evidence?

A. That is also my understanding.

Q. So I want to first discuss with you your opinions concerning US Patent 9,261,270, the '270 Patent.

Were you asked to provide a technical analysis concerning the '270 Patent?

A. Yes, I was.

Q. The following slide provides -- shows the cover of the '270 Patent, JX-004.

Do you recognize this exhibit?

A. I do indeed recognize it.

Q. You can provide -- before we -- the following slide identifies the constructions for the '270 Patent.

Are you applying those constructions here today?

A. That's exactly the constructions I'm applying.

Q. Now, can you provide a brief summary of the claimed technology of the '270 Patent?

A. The '270 Patent describes a lighting fixture which has the LEDs at one end, and the LED driver at the other end inside a chamber, and the LED modules are outside the chamber, and there's an air gap in between the chamber with the driver, and the LED module.

So you can get air, water, usually wind and rain going through the gap.

Q. Do you understand that Cree Lighting is asserting Claims 1 and 2 of the '270 Patent in this investigation?

A. That's my understanding.

Q. Does the following slide provide a summary of your opinions with respect to non-infringement for the '270 Patent?

A. That's correct.

Q. Can you turn your attention to the following slide?

Does this show RAB's FALCOR products?

A. Yes. I recognize it. I have them in my laboratory.

Q. Thank you, Dr. Shackle.

Do you recognize the figures on the following slide?

A. Yes. I do recognize Dr. Katona's infringement analysis.

Q. This is his infringement analysis for the FALCOR product?

A. Correct.

Q. According to Dr. Katona, where is the claimed air gap in the FALCOR product?

A. He's shown it by a light blue dotted line with an arrow, two of them.

Q. In your opinion, does the FALCOR product meet the limitations of the -- of Claim 1 of the '270 Patent?

A. No, it does not.

Q. Why does the FALCOR product not meet the limitations of Claim 1?

A. Because the Claim 1 of the '270 Patent was written in the context of a fixture like that shown on the left, in which the components we're talking about, the LED module and the LED driver chamber are contained in an enclosure, a casing which is -- it's like a box in which the components are contained.

So if you don't have an outer structure containing these, then it takes away the whole point of having an air gap in the middle of this structure, which is the thing that's being claimed.

Q. So is it your opinion to satisfy the air gap limitation, a light fixture must have an air gap inside of it?

A. Yes. The operative word is inside of it.

A classic example is, unless you have that understanding, you would have a driver in New York connected by long wires to LED modules in San Francisco, and that would meet the requirements of the claim, which is obviously ridiculous.

Q. Does the '270 Patent specification disclose anywhere that the air gap does not need to be surrounded by the walls of the structure?

A. No, it does not.

Q. Can you next turn to the CANVAS/EZ LED products.
Does this show RAB's CANVAS/EZLED products?
A. Yes, I recognize those.
Q. Does the following slide show RAB's FFLED products?
A. Yes, I recognize the FFLED products.
Q. Can you turn your attention to the following slide RDX-004.01. This shows pictures of the CANVAS/EZLED and FFLED products.
What is shown in the green boxes that were used to annotate these pictures?
A. Those green boxes are highlighting COB, or COB LEDs. Each LED is fixed into a COB holder, which is used to mount them in.
And the holders are screwed onto the fixture. So the COBs, which are the square things in the middle, are thus being fixed onto the fixture.
Q. When you say COB, is that -- is that the same thing as chip-on-board?
A. Yes. COB is an abbreviation or acronym for chip-on-board.
Q. Claim 1 recites at least one LED module outside the chamber.
Do you agree with Dr. Katona that the COB LEDS and the CANVAS/EZ LED and FFLED products meet this

limitation?

A. No, I disagree because these are not modules. They are COB LEDs, which is a completely different item.

Q. Dr. Katona testified that each of the COB LEDs in these products is an LED module because it's a fixed array multiple LEDs.

Do you agree with this?

A. No, I disagree. The lighting industry has a very special meaning for the word "array," and we have it on this next slide here.

This is an extract from the IES Lighting Handbook, which as a member of the IES, I have at home. It gives a definition of an LED array or module.

The two words "array" and "module" are used interchangeably.

Q. So can you pull up RX-0114.

Dr. Shackle, do you recognize RX-0114?

A. Yes. That's the book I have at home.

Q. I think we can turn back to the demonstrative presentation.

Is the IES handbook updated yearly?

A. It's -- on average, it's updated about every eight to ten years. It's an enormous book. The picture you just showed did not bring out that it's about a foot across and about four or five inches thick. Very fine

paper.

It takes a large number of committees of high-powered people to put it all together, and to update it, and that's the reason it takes so long.

Q. Is the definition of array different to everyday use of the word outside the lighting industry?

A. Indeed. The lighting industry uses the word "array" in quite a different way to the rest of world.

In the outside world, you could have cars lined up in a dealer parking lot, and that would be described as an array. However, in the lighting industry, an array, which is synonymous with a module, is a very special word, and it refers to LED packages, which are mounted onto a circuit board of some kind.

Q. Now, you can see here the definition provided on the slide says one or more LEDs.

In your opinion, what is meant in the IES definition by the word "LEDs"?

A. In order to understand what is meant by LEDs by the IES, you have to understand that this is written for IES members, people who are assembling light fixtures, for example.

Such people cannot handle LED die because the LED dies, such tiny things; you cannot pick them up with your fingers in practical manner.

So the IES members are expected to be working with LED packages, which is something big enough that you can join wires onto it or solder onto a circuit board.

So in this definition that you have on the screen here, the word "LED" means an LED package and a packaged LED die.

Q. How is a COB LED different from a -- from a LED array or module?

A. Okay. The difference is huge, and in the slide we have up at the moment, on the left you have an LED module. It's likely to be about 8 or even 10 inches across, and it's got LED packages soldered onto it to make the function.

Now, on the right, you have a COB LED, COB LED, and to get the scale right, that thing is about the size of a large postage stamp. So imagine if you were a lighting manufacturer, and you ordered from a distributor a 10-watt -- supply of 10-watt LED modules, you would be expecting something that looks like what's on the left, 8 or 10 inches across.

If instead what turned up was a 10-watt COB, the thing on the right, which is the size of a large postage stamp, then you'd be pretty upset because a COB LED is totally different to an LED module.

Q. Thank you.

Do you recognize what's shown on the following slide, slide 16?

A. Yes. This is the -- a page from the website of Samsung, who is a manufacturer of the LEDs for RAB.

Q. How does Samsung's website identify COBs and LED modules?

A. Well, you see that they have totally different categories. The COB LEDs are highlighted in the box on the left, and the LED modules, which -- COB LEDs we're talking about is postage stamp size items. The LEDs modules, which may be things that are 8 or 10 inches across are in the box on the right-hand side.

So Samsung, the one factory may make all of these products, but they market them quite separately and differently to each other.

Q. Can you turn your attention to the following slide.

This shows an additional website. What's shown on this slide?

A. This is a picture of the Digi-Key website where they deal with LED products. Digi-Key is the preeminent distributor of electronic components in the United States.

What's of interest here is that they have COBs as a whole different category to modules.

Q. Thank you.

In your opinion, has Dr. Katona shown that the CANVAS/EZ LED and FFLED products have at least one module outside the chamber?

A. No, he hasn't because what those products have is LED COBs. And I fear that Dr. Katona may be the only person in the United States lighting industry who doesn't know that a COB is a different thing to a module.

Q. So -- thank you.

Let's move on to your opinions concerning whether the limitations of Claims 1 and 2 of the '270 Patent are disclosed by the prior art.

Are Claims 1 and 2 of the '270 Patent disclosed by the prior art?

A. Indeed they are anticipated by a piece of prior art, which we refer to as Ewington.

Q. Ted, can you pull up RX-0732.

This is a copy of US Patent publication 2005/0128752.

Dr. Shackle, do you recognize this exhibit?

A. Yes. That's the cover page of the Ewington patent, which I just mentioned to you.

Q. Ted, can you turn back to the slide presentation? Can we turn to RDX-004.019?

Can you briefly summarize the invention of Ewington?

A. In brief, because we'll get into more detail shortly, Ewington describes a spotlight in which you have LED drivers, or the LED driver, in a chamber at one end of the spotlight, and you have an LED module towards the other end with an air gap ventilated by holes for wind and rain to blow through in the middle between them.

Q. When was the Ewington reference published?

A. June 16, 2005.

Q. Can you turn back to JX-004 -- or, Ted, can you pull up JX-004, and will you turn to page 2?

Do you understand that the -- Dr. Shackle, that the earliest filing date for the '270 Patent is September 30, 2006?

A. Yes, I see that.

Q. Thank you.

Ted, can we go back to the slide presentation, and can you turn to RDX-004.020?

Can you turn your attention to the slide which shows Figure 1 of Ewington?

How does Ewington Figure 1 operate?

A. I'm going to simplify this a little because there will be a chance for more detail later on in this presentation, I think.

So simplifying it a bit, 24-volt power is connected to the connector marked 112, in green at the top.

And DMX control signals go in through the connector marked 110 at the top.

The left-hand end labeled 101 in purple is the cover of the chamber which contains the LED driver circuitry.

Next to that, separated by a partition, is an air gap which has holes in it around the outside. The holes are labeled 106. Those holes go through into an air gap chamber inside.

A little further to the right, you can see a raised part on the casing labeled 102, and that is where an LED module is on the inside, and which shines light out of the end on the right.

Q. Thank you.

Can you now turn your attention to the following slide, which shows Ewington Figure 2?

How does Ewington Figure 2 operate?

A. Again, I'll give more detail in some subsequent slides, but the general way in which it is operating, you can see in this picture, the casing, 101, which I mentioned on the left, and you can see input feedthrough for power, 112, on top left, and you can see the input for DMX signals next to it, 110, also on the top left.

Inside the chamber, 220, are various pieces of power circuitry, most importantly being the LED driver,

224, which is mounted on a partition, 218, which goes vertically up from top to bottom.

On the right-hand side of that, you've got a ventilation chamber, 215, which we just pointed to at the bottom in a vague kind of way, and that ventilation chamber, 215, has two halves, and the input half, which is 217, 217 is down at the bottom right, and an output half, which is 216.

In between those two halves, there's a cutout in the partition which divides the two halves. The partition is 212. There's a cutout in partition 212, which is where fan 214 sits.

And fan 214 sucks in air from the holes we referred to previously, and then blows them out again so the other half of the same holes.

On the right side of chamber 215, you can see a sort of arrangement of teeth which is actually the fins of a cooling -- cooling device.

Affixed to the right side of that, you can see all the LEDs, 202, in an LED module.

Q. Thank you.

I want to turn your attention to the following slide. Does Ewington disclose all of the limitations of Claim 1 of the '270 Patent?

A. Yes, it does. Every one.

Q. Does -- the preamble of Claim 1 recites a light fixture.

Does Ewington meet this limitation?

A. That is definitely a light fixture.

By the way, I am a card-carrying member of the Illumination Engineering Society. I can vouch that that is a light fixture. In particular, it's a spotlight.

Q. Claim 1 next recites a chamber.

Does Ewington disclose the claimed chamber?

A. Yes, it does. In this picture, the chamber is highlighted in a sort of shade of blue verging on purple. And you can see the -- some driver electronics inside it.

Q. Is the chamber the electronics chamber, 220?

A. That's correct.

Q. Claim 1 also recites at least one power circuitry driver within the chamber.

Does Ewington disclose this limitation?

A. Yes. The power circuitry driver is 224, which is now highlighted in red.

Q. So in your opinion, the -- what is shown here, 224, the power supply, 224, qualifies as a driver?

A. Yes. It takes in constant voltage, 24-volt DC power, that feeds through 112, and it puts out constant current, DC power, to the LED array. And anything which takes in constant voltage and puts out constant current,

for an LED array, qualifies as an LED driver.

I just -- in more detail, it's the level of the constant current which comes out is fixed by a controller, 226, which is next to the LED driver.

Q. This is the only limitation that Dr. Katona is opining that is not met by Ewington. In particular, Dr. Katona's opining that the power supply unit, 224, of Ewington is not an LED driver.

Do you agree with this opinion?

A. I completely disagree. You can go to online catalogs of LED drivers, and there are pages of different kinds of 24-volt LED drivers which are available.

In particular, I was able myself to go through the catalogs and find a driver which was precisely the right shape and size of what's described in this picture, and has the right current and voltage levels as well.

So not only is this definitely a driver, you'll find it described in the catalogs, and you could go and buy one today if you wanted to.

Q. Thank you.

Now I want to turn your attention to the following slide. Claim 1 of the '270 Patent also requires at least one LED module outside the chamber.

Does Ewington disclose this limitation?

A. Yes, he does. You can see the chamber, again,

highlighted in the bluish-purple color, number 220. The limit, the outer limit of that chamber is a partition, 218, which is a sort of faint, very pale green in color going up from top to bottom.

Now, the LED module or array is on the right side of that partition, so the LED module is outside of the chamber.

Q. The LED module, is that shown as 202 in Figure 2 of Ewington?

A. That's correct.

Q. Is the LED module of Ewington generating heat?

A. Yes, all LED modules generate heat. And in this case, you can see the LED module is fixed onto that heat sink which has all the teeth. I'm trying to see what number is attached to it. It's probably 204, but you can see the teeth going all the way up from top to bottom.

Q. Is the power supply unit, 224, of Ewington also generating heat?

A. Yes, the power supply generates heat. And the heat from both of the units, the LED module and the power supply, is carried away by the wind and rain, which is encouraged to enter through the holes on the outside, and go through the heat exchange chamber, 215.

Q. Thank you.

I want to turn your attention to the following

limitation. At least one air gap between the chamber and the at least one LED module.

Does Ewington disclose this limitation?

A. Yes. Ewington shows an air gap which has been colored in green in this picture. And in particular, it has two sides. On the right side is an intake half of the air gap, and that's marked as 217, and on the left side in dark green is an output side of the air gap, which is 216.

The fan, 214, pulls wind and rain in from the holes on the outside, and sucks them into the inlet side where they pass and exchanges heat with the fins of the -- those blue colored things sticking out, the pale blue. That's the fins which are cooling the LED module. So the air blows past those fins, goes through the fan, 214, and then get blown out of the holes on the outside, which, in an earlier figure, were marked 106.

Q. Thank you.

The last limitation of Claim 1 of the '270 Patent is the air gap permitting air/water-flow therethrough.

Does Ewington meet this limitation?

A. Yes. The -- in this picture, you can see clearly now, the holes on the outside which are labeled 106. Each of those holes is actually divided into two by the partition 212, that's called a baffle plate in this

picture. You can see the key on the right, and the number 212 is bottom center of the figure. That's a plate going all the way up from top to bottom, and that's what divides the inlet half of the air gap from the out -- on the right, from the outlet half, which is on the left.

So not only does -- do the holes permit wind and rain, and air and water to flow through those holes, but that flow is encouraged by the action of the fan, 214, which is shown in a sort of a purply color right in the middle there.

So the wall air and water flow, much like wind and rain, is not just permitted, it's actually encouraged by the action of the fan.

Q. Thank you.

Can we now turn to Claim 2?

Claim 2 recites, "The light fixture Claim 1, wherein the chamber is defined by a housing."

Does Ewington meet this limitation?

A. Yes. In this figure, we have once again highlighted the electronics chamber with the purple kind of color, purply-blue, and the housing is actually marked on the bottom right corner of this figure as 102. This is the casing which goes all the way around the whole thing. It's the same thing continuously marked as 101 on the top left corner, goes around -- all the way around.

Internally, there is the partition, which we have referred to before as 218, which divides off the end of that casing to form a chamber.

So that chamber is defined by the housing, 202, which goes around the whole thing.

Q. That chamber is the electronics chamber, 220?

A. Yes, that's correct.

Q. Thank you, Dr. Shackle.

I want to switch now to the US Patent 8,777,449, JX-003. Were you asked to analyze technical issues related to this patent?

A. Yes, I was.

Q. The following slide, slide 31, contains the cover page of the '449 Patent.

Do you recognize this document?

A. Yes, I recognize the '449 Patent.

Q. Can you briefly summarize the claimed technology of the '449 Patent?

A. Very briefly, it's describing a downlight which has a trim element, which has a sort of flange, which is intended to go -- rest against a wall or ceiling, and there's a hole in that wall or ceiling through which the body of the trim goes, and the rest of the downlight is behind it.

So it's a downlight, and specifically it's

intended to be a retrofit kit for a downlight that was previously -- these were compact fluorescent or an incandescent lamp.

Q. Does the following slide set forth the claim constructions for the '449 Patent that you are applying here today?

A. Yes. We have been using those constructions throughout.

Q. Do you understand that Claim 10 of the '449 Patent is the only claim that is being asserted by Cree Lighting in this investigation?

A. That's my understanding.

Q. So I want to discuss with you your infringement and technical prong opinions concerning RAB's recessed retrofit and performance downlight products and the technical prong product of Cree Lighting's retrofit downlight products.

Do you understand that Dr. Katona has testified that RAB's recessed retrofit and performance downlight products meet the limitations of Claim 10 of the '449 Patent?

A. That is my understanding, and I disagree with him on that.

Q. Do you understand that Dr. Katona's also testified that Cree Lighting's recessed retrofit downlight

products practice the Claim 10 of the '449 Patent?

A. That is my understanding, and once again, I disagree with him.

Q. Does the slide shown here summarize your opinions with respect to the technical prong and infringement issues for the '449 Patent?

A. Yes. That's correct.

Q. And do you recognize the figures shown on slide 35?

A. Yes. This shows the CAD diagram of a RAB performance downlight that's been annotated by Dr. Katona.

Q. Dr. Katona's testified that the driver components are inside the trim element space because the driver housing is part of the trim element.

Do you agree with this opinion?

A. I disagree with that.

Q. Is it your opinion that the -- there are driver components in the space within the driver housing?

A. The driver housing, which is shown in red on the right hand -- at the top of the right-hand picture has driver components inside it.

Q. The construction of -- in this investigation of trim element space is shown on the left.

In your opinion, has Dr. Katona properly applied this construction to the products at issue?

A. This is a very good definition, which is extremely helpful at this point in the case, and I think that Dr. Katona has misinterpreted -- misinterpreted it completely.

Q. Does the specification teach the driver housing is part of trim element?

A. No. Here's a key figure, Figure 5 from the specification, and it points to item 109, this sort of basin-shaped thing right at the bottom middle.

That item in the text of this specification, it says, "This is the trim element." That thing, 109.

So when you talk about trim element, that is the thing we're talking about, this basin-shaped thing with flat rim, which is intended to go against a wall or ceiling.

Q. Is the driver housing part of another subassembly in the '449 Patent?

A. Yes. The driver housing is part of the driver subassembly. The '449 Patent refers to three subassemblies: the trim subassembly and the mixing chamber subassembly also, so you have three subassemblies.

When you add parts to the trim element, which we have spoke about a moment ago, then by adding parts such as LEDs and various screws to it, you get the trim subassembly.

When you add drivers, parts to the driver casing, you get the driver subassembly, and of less importance to us at the moment, there's an assortment of parts, which make up a so-called mixing chamber subassembly.

When you put all three of these subassemblies together, then you have what the specification calls a lighting device.

Q. So the driver subassembly and trim subassembly are separate structures in the '449 Patent?

A. That's correct. They're very clearly defined. We have them in the picture on the left, slide 38. Highlighted in red, you've got the driver subassembly, and highlighted in blue, you've got the trim subassembly.

When the whole lighting device is assembled, these two subassemblies are put together. But I guess I'll make the important point. When you add bits onto the trim element, which is very clearly defined in the specification, what you then have is a trim subassembly.

When you add pieces onto the driver casing, you then -- you have a driver subassembly, and you put these parts together to get the lighting device.

Q. In the '449 Patent, is there any driver component that is part of the trim subassembly?

A. None whatsoever.

Q. Can you turn your attention to the following slide.

Dr. Katona pointed to column 11, lines 17 to 32 as supporting his opinion.

Do you agree that this opinion -- this passage supports his opinion to the driver housing can be part of the trim element?

A. No. It doesn't.

And the reason is because this is not the preferred embodiment. All it says is that the trim element can comprise a chamber to accommodate driver modules. It doesn't say it does, and it doesn't show -- no pictures are shown where there's a chamber accommodating driver modules.

So it's just called out as an option, and it's not the preferred embodiment at all. And this is the only mention of that possibility in the whole patent.

So it's just an obscure option which is called out as being possible.

Q. So in your opinion, what would be the correct way of applying the construction of trim element to RAB's accused products?

A. In the picture on the right here, we have got a CAD drawing, which has been marked up, and on the left, you've got the definitions of trim element and trim element space.

So with the trim element, you've got to have the structure forming a flange and defining an outward-facing surface, which is the flat part at the bottom.

I personally use that definition in conjunction with a totally consistent definition shown in the drawings of the patent, which shows the exact same shape structure.

So with that in mind, then the thing that's highlighted in blue on the right side, that is the trim element. Then you have a definition of the trim element space down at the bottom left there.

That's basically the space inside the hollow trim element. So that space has been highlighted in pink.

So you can see if you were to try to fill it up, then that's the space that gets filled up.

Q. Your figures here shown on slide 40 refer to RAB's performance downlight. Is your analysis the same for RAB's retrofit downlight?

A. Yes, it's just the same set of concepts.

Q. For the record, I meant to say RAB's recessed retrofit product.

A. I knew what you meant.

Q. Are the driver components for these two products inside or outside of the trim element space?

A. Well, you can see the driver housing is sitting on top of the trim element. So there's no driver

components inside the trim element space.

Q. I want to next discuss with you in the context of your infringement or non-infringement analysis a reference we were discussing earlier today, US Patent Number 7,614,769, the Sell reference. That's RX-0721.

Do you recognize the Sell reference?

A. I recognize the Sell reference.

Q. The Sell reference was cited in the prosecution history of the '449 Patent.

Does the Sell reference show the driver being outside of the trim element space?

A. The Sell reference shows a driver assembly, which is outside the trim element space. In this figure, we have here on the left, the trim element is highlighted in that same bluey-purple color, and the driver assembly, or its components are highlighted in red.

And you can see that the driver assembly is mounted on top of the trim element item.

Q. The driver -- and the driver in Sell is referred to as the power supply 66; is that right?

A. That's correct. Yes.

Q. And in the context of the configuration of the driver components and the trim element space, is the apparatus in Sell distinguishable from the RAB accused products?

A. Not in my opinion. The RAB accused products on the right and Sell on the left are, in my opinion, topologically identical.

That means they're not actually physically identical, but they're identical inasmuch as in each case, you have the driver housing sitting on top of the trim element. They have the same topology. They are topologically identical.

Q. I now want to talk for a brief moment regarding the Cree Lighting retrofit downlight products.

Do you recognize what's shown in slide 44?

A. Yes. That's one of the Cree downlights, CAD drawings marked up by Dr. Katona.

Q. Dr. Katona has opined that these Cree Lighting products have the first driver component in the trim element space.

Do you agree with this opinion?

A. I disagree quite strongly, and the reason being that just as with the RAB products, you have the driver components in that upper section above where the three legs stick out, and the trim element is down below the joint between the driver compartment and where the legs come out.

So the drivers are not in the trim element space, on top of it.

Q. Are Dr. Katona's opinions concerning the first

driver component in the trim element space of the Cree Lighting products materially different from his analysis for RAB's products?

A. No. He used the same concept for both.

Q. I next want to briefly talk about some invalidity issues.

Claim 10 recites the lighting device weighing less than 750 grams.

Does the '449 Patent disclose a lower boundary for this limitation?

A. No, there's no lower boundary at all.

Q. Does the '449 Patent teach how to make a downlight with weights approaching zero kilograms.

A. No, it does not. And this -- to make an extremely light downlight is a challenging task. It would involve very careful choice of materials, and you would have to tell people exactly what material to use, and what thickness of materials to use, and so on. The specification of the '449 doesn't give you any of these details.

Q. Claim 10 also recites, "Wherein if not more than about 15 watts is supplied to the electrical connector, the at least one solid-state light emitter will illuminate so that the lighting device will emit white light of at least 500 lumens."

Does the '449 Patent disclose an upper boundary for this lumen output limitation?

A. No, there's no upper boundary described or called out, which is a problem because there are theoretical limits to how many lumens per watt can be produced by any LED.

Q. Does the '449 Patent teach how to make a downlight with a lumen output approaching the theoretical limits?

A. No, it does not. And if it were going to give any such kinds, then you would expect to see information about the nature of the P injunctions that we use. You would expect to see information about the light extraction techniques for the LED. You would expect to see information about a super high efficiency power converter for the driver, and what sort of transformers or otherwise were used inside it.

None of that information is present. So it categorically gives you no guidance on how to get to these very high levels of light output.

MR. ROUSH: Thank you, Dr. Shackle.

I will pass the witness.

JUDGE CHENEY: Okay. Is there cross-examination for Dr. Shackle?

MR. HAMSTRA: Yes, there is, Your Honor.

JUDGE CHENEY: Please proceed when you are ready, Mr. Hamstra.

MR. HAMSTRA: Thank you.

CROSS-EXAMINATION

BY MR. HAMSTRA:

Q. Dr. Shackle, nice to talk to you again.

JUDGE CHENEY: Mr. Hamstra, can you adjust the boom on your mic?

MR. HAMSTRA: Yes. Thank you, Your Honor.

THE WITNESS: That's a little bit better.

BY MR. HAMSTRA:

Q. Nice to see you again, Dr. Shackle.

A. Nice to see you.

Q. First of all, you started with the FALCOR, so I'll start there as well.

Mr. Jay, could you pull up CX-478C.0009?

So, Dr. Shackle, do you recognize this to be an excerpt from a CAD drawing of the FALCOR product?

A. I recognize it.

Q. And just to be clear, in the FALCOR products, I can draw a straight line from the LED module to the chamber in the FALCOR products; correct?

A. Yes. On paper.

Q. Okay. And your testimony today spoke of, I think, a hypothetical device with an LED module on one side

of the country and a driver on the other.

Do you recall that testimony?

A. I do.

Q. But the claim requires -- the claim preamble recites a light fixture; correct, Dr. Shackle?

A. It doesn't say how big the light fixture is, but that's correct.

Q. So your hypothetical earlier today was describing a light fixture that is hundreds of thousands of miles large?

A. I was trying to explain that unless you applied a constraint, that just as in the '270 Patent, the components were inside a housing, a fixture with a housing, that the whole thing did not make sense.

I was trying to make that point, saying, look, if you didn't have a housing there, you could have the components hundreds of thousands of miles apart, and it would still meet the requirements.

Q. But just to be clear, what's shown on CX-478C.0008 is the FALCOR light fixture; correct?

A. That's correct.

Q. I want to next turn to your opinions regarding COBs.

You recall those opinions, Dr. Shackle; correct?

A. I gave opinions about the nature of COBs a

little earlier.

Q. The electrical contacts on COBs are connected to the driver through something called a COB holder; correct?

A. That's correct.

Q. The output wires from the driver can be run to the COB holder, which then passes that circuit to contacts on the COB; correct?

A. That's correct.

Q. Now, I want to ask you a few questions about what's discussed in the '270 Patent regarding this subject matter.

So, Dr. Shackle, the word "die" does not appear in the '270 Patent; correct?

A. That's correct.

Q. The word "package" also doesn't appear in the '270 Patent?

A. That is correct.

Q. The '270 Patent makes no reference to encapsulation or encapsulating LEDs; correct?

A. That's correct.

Q. The '270 Patent doesn't talk about substrates; correct?

A. That is correct.

Q. And it doesn't talk about circuit boards; correct?

A. That's correct.

Q. The '270 Patent does refer to an LED array, as an example of an LED module, though; correct?

A. Yes. As I explained, these days, the words "array" and "module" are used synonymously.

Q. I want to talk about some of the evidence you relied on earlier today in your testimony.

So you relied on catalog websites from Samsung and Digi-Key today; is that right?

A. That's right. I did.

Q. Were those websites collected in this year, 2021?

A. The Digi-Key one definitely was. I think, yes, they both were.

Q. You understand that when interpreting claims of a patent, they must be given their plain and ordinary meaning as of the filing date of that patent; right?

A. Yes. We have a problem there with that understanding, though. Because the very first LED COBs were only sold at about the same year that the '270 Patent was being written.

So although they definitely existed at that time, they were a rare and uncommon creature.

Q. Then I think you mentioned that you're a card-carrying member of the -- is it the Illuminating

Engineering Society?

A. Yes, that's correct.

Q. Mr. Jay, could you pull up RDX-4.014?

In your demonstratives you relied on a definition from a 2011 edition of the IES lighting handbook; correct?

A. Yes. I explained, at the time, it takes a long time to put these handbooks together.

So this would have been the operative definition at the time that the '270 Patent was being written, even though this was actually published a couple of years later, but it takes so long to put the handbook together that this would have been the operative definition on LED array or module at the time the patent was being written.

Q. Understood, Dr. Shackle.

You say this is a definition of LED array or module; correct?

A. That's correct.

Q. The text here is actually just the definition of LED module from that handbook, though; right?

A. It says, "LED array or module."

Q. Do you see the cite on the bottom left-hand corner, RX-0114, Dr. Shackle?

A. Yes.

Q. Mr. Jay, could you switch to RX-01114, and can

you blow up that definition of LED module on the left?

A. Yeah. This definition shows that, in recent years, people in the IES have been considering a modified definition of LED array or module.

I personally happen to disagree with it, and will try to get an opportunity in the committees to make sure that this does not come out in the next edition of the handbook.

But this is something that was written approximately nine years after the '270 Patent was published.

Q. Mr. Jay, can you go to the front page of RX-114 briefly?

This is the 10th edition IES handbook we're looking at together right now; correct?

A. Yes. I'm not -- I was referring in my testimony to the, I think, 11th edition. It looks extremely similar, but the one that came from 2011, which is -- I'm not sure of the difference.

Q. Let's just go back to your slide.

RDX-4.014, Mr. Jay.

You see it's the 10th edition, 2011, on the top there, Dr. Shackle?

A. Yes. Must be correct.

Q. Sorry.

Mr. Jay, can you go back to RX-114, then? And the first page.

RX-114 is the 10th edition, Dr. Shackle?

A. Right.

Q. Mr. Jay, can you go to the next page and see if we can find a 2011 date on this or maybe one more?

Yeah. Do you see a copyright date there, Dr. Shackle, 2011?

A. 2011, yep.

Q. Okay. All right. Can you go to the next page, Mr. Jay?

A. I would just make the comment that I've already explain it takes a long, long time to put these handbooks together. So that thing which came out in 2011 was reflecting opinions of the committees that would have been operative in the 2009 time frame, which is relevant for the patent.

Q. Understood, Dr. Shackle, and if you have some additional testimony to provide, your counsel will have that opportunity.

Mr. Jay, could you blow up the definition of LED module?

So, Dr. Shackle, from RX-114, the definition you included in your slide deck is not of LED array or module, but rather, just of LED module; correct?

A. Yeah. As I already said, this appears to be a new definition which is being floated for inclusion in the next generation of the IES handbook. This is not the current definition. This is something new that's being floated, and reflects a change on the 2011 definition.

Q. Mr. Jay, can you -- sorry, Dr. Shackle. Are you done?

A. Yes.

Q. Mr. Jay, can you put up RX-114, and then can you blow up the definition of LED module in 114, and can you get these next to each other? Sorry, Mr. Jay.

Dr. Shackle, can you just confirm that you included in RDX-4.014 the definition of LED module from RX-114?

A. The extract on the right is from my testimony; it seems to be RDX-014. And the text on the left is an extract from the IES website, which I think was put there about two years ago.

Q. Dr. Shackle, I'm going to represent to you that the text on the left is from RX-114, the 10th Edition, 2011, of the IES Lighting Handbook.

Okay. Can you confirm that you text that you are seeing on the two sides here, RX-11 and RDX-0004.014 is, in fact, accurate -- in fact, identical?

A. That's correct. You had me confused there for a

moment. I thought you were referring to something else.

Q. I'll get there, Dr. Shackle.

So, Mr. Jay, can we just stick with RX-114.

So, Dr. Shackle, RX-114 begins, "A component part of a LED light source that includes one or more LEDs connected to the load side of an LED power source or LED driver."

And then continues.

You agree that this definition of LED module encompasses one or more LEDs; correct?

A. That's correct.

Q. I believe you testified earlier that you are interpreting the word LEDs and one or more LEDs to refer to LED packages; is that right?

A. That's correct.

Q. Now, Mr. Jay, could you put this definition and the one immediately above it -- highlight both of those.

Dr. Shackle, in RX-114, immediately above the definition of LED module that you relied on, there's a definition of LED array; correct?

A. I'm just reading it.

Yes. That's correct.

Q. This definition of LED array, when it refers to LED packages, it spells out LED packages; correct?

A. That's correct.

Q. Now, one basis for your explanation that LEDs and the definition of LED module below means LED packages was that the intended audience of this book is -- I'll use the term you used at your deposition.

The intended audience is illumination engineers; is that right?

A. That's correct.

Q. I'm sorry. Is it illumination engineers or illuminating engineers?

A. For the moment, I'm slightly vague -- let's call it illuminating engineers.

Q. Okay. I believe you mentioned earlier today, illuminating engineers can't connect wires to LED dies because they're too small; correct?

A. That's correct. These are people who build light fixtures.

Q. Okay. But people who build light fixtures can join wires to COBs through a COB holder; correct?

A. That is correct.

Q. And, in fact, that's how RAB connects their drivers to their COBs in the products you looked at today; correct?

A. That is correct.

Q. All right. Dr. Shackle, now I'll jump forward to where you were getting ahead of me a little bit.

The IES has a new definition of, this time, LED array or module on its website; correct?

A. Yes, which was introduced two or three years ago.

Q. All right. Mr. Jay, could you turn -- pull up CX-1694.

This definition begins, "An assembly of light emitting" -- well, let me step back a moment.

Dr. Shackle, do you recognize this definition to appear on the IES.org website?

A. I do. Mm-hmm.

Q. IES.org, that's the website for the Illuminating Engineering Society?

A. That's correct. This is where they have added in the option of dies on a printed circuit board.

Q. So there's a definition here, LED array or module that begins, "An assembly of light-emitting diode (LED) packages (components), or dies on a printed circuit board or substrate."

Do you see that, Dr. Shackle?

A. Right. This is a new definition, which appears nine years after the '270 Patent was published.

Q. And several years before the Samsung and Digi-Key catalogs on which you relied on today?

A. That's correct. I don't think you would have

found anything different in those catalogs back in 2018, though.

Q. Dr. Shackle, you agree that this definition in CX-1892 does cover COBs as an LED array or module; correct?

A. It would allow that possibility. As I said, this is new thinking that's apparently going through committees at the moment. I would attempt to influence those committees that -- explain to them, that, hey, this is a problem.

But I do not see that it applies to the time frame of the '270 Patent.

Q. Dr. Shackle, this definition would read on COBs; correct?

A. That is correct. Yeah.

Q. I want to talk briefly to you about the '449 Patent for a moment.

You understand that Claim 10 of the '449 Patent recites -- I hope I wrote this down right -- at least one driver component?

A. That's correct.

Q. Actually, I did write that down wrong, I think. Bear with me for a moment.

JUDGE CHENEY: We have it here on the screen, Mr. Hamstra.

BY MR. HAMSTRA:

Q. Thank you.

So Claim 10 of the '449 Patent recites at least a first driver component, correct, Dr. Shackle?

A. Yes.

Q. According to RDX-004.032, your demonstratives, that was construed by the Court as, "Any component that is part of the driver, and is involved with performing the functions of the driver."

Correct?

A. That's correct.

Q. You discuss a Sell reference in connection with the '449 Patent today; right?

A. Sell was discussed, yes.

Q. In your expert report, you offered some invalidity opinions based on Sell; right?

A. That's correct.

Q. You opine that Sell discloses a driver component because it discloses the component that converts AC current to DC current having the proper voltage to power LEDs; right?

A. I'm not sure if those were the exact words I used. I said that Sell shows a driver element. I'm not sure in that context I mention the AC current part.

Q. No problem.

Mr. Jay, could you pull up CX-1053 for

identification purposes, Dr. Shackle's opening report, and go to Paragraph 327.

Yeah. I don't know the page number, but Paragraph 327. Okay.

Mr. Jay, could you go to the page immediately preceding, just so we can orient ourselves a little bit.

So beginning with Paragraph 326, Dr. Shackle, you're opining on at least the first driver component; is that right?

A. Right. I see the word AC is mentioned there.

Q. Okay. In Paragraph 327, you wrote, "Sell discloses 'a power supply 166' that is adapted to convert AC current from the electrical source 30, to DC current having the proper voltage to power the LEDs 138.

"In my opinion, the 'power supply 166' of Sell therefore meets the claimed at least the first driver component."

That was an opinion you offered in this case, Dr. Shackle?

A. Right. I stand by that.

Q. Dr. Shackle, a driver is typically something that takes in AC power on one side, and produces a constant current DC output, based on that AC input; correct?

A. The normal definition also include taking in DC power at the input; still a driver.

Q. But typically, a driver takes in AC power, and outputs constant current DC output; right?

A. Often, but the ones that take into DC power also exist, and are a standard item of commerce.

Q. Mr. Jay, could you pull up for identification CX-1892, Dr. Shackle's deposition transcript at, I believe, page 53.

If you could go to the prior page and get the question there.

So, Dr. Shackle, I asked you, "What does it mean for a light engine to be driverless?"

A. Yeah.

Q. You answered, "The documents that I've seen, any formal definition of that term, I can use a lot of words to explain it, though. A driver typically is something that takes in -- it's a module that takes in AC light power on one side, does power conversion, normally involving high-frequency switching, produces a -- usually a source of" -- it says, "retrofied power, which is still in a large capacitor, and then does another conversion to produce a constant current output from that.

"So typically, there's two stages, input stage, which produced the DC source of power, and then a second stage, which produces a current source, which acts upon the LED.

"So this is a function of the driver, these two elements.

"And I recently, in fact, gave testimony in a court case where somebody was making out that the product did not have a driver, and I described all of those things, and said yes, 'it does have a driver.' Does that answer your question?"

You gave that testimony under oath when I deposed you, Dr. Shackle?

A. Yes. I stand by that today.

Q. Mr. Jay, could you turn to Dr. Shackle's demonstratives, RDX-004, slide 20.

Dr. Shackle, I think you said that power connector 112 receives a 24-volt DC input.

Did I understand your testimony correctly today?

A. That is correct. We were talking a few moments ago about the definition of a driver, and you noticed the words -- or some words like "typically" or "commonly."

The point being that drivers can have DC input, and you will see -- the important thing is the conversion of constant voltage at the input to constant current at the output.

MR. HAMSTRA: Your Honor, this may be a good spot for a lunch break, if I have my schedule right here.

JUDGE CHENEY: Okay. Let me just ask, Doctor,

are you testifying to us from a far away time zone?

THE WITNESS: I'm in Washington, D.C.

JUDGE CHENEY: Okay. I just wanted to make sure we were accommodating a normal circadian rhythm for a human being if we take a lunch break now.

So let's take one hour, and we will be back at 1:30.

Doctor, please do not discuss your testimony with anyone during the break.

We're off the record.

(Whereupon, the lunch break was taken at 12:31 p.m. - 1:30 p.m.)

A F T E R N O O N S E S S I O N

(1:29 p.m.)

JUDGE CHENEY: We're back on the record now in the 1213 Investigation after taking a lunch break.

Before our lunch, we were listening to Mr. Hamstra in cross-examination of Dr. Shackle, who is RAB's technical expert for the '270 and '449 Patents.

Dr. Shackle, I remind you, you are still under oath.

Mr. Hamstra, please proceed when you are ready.

MR. HAMSTRA: Thank you, Your Honor.

CONTINUED CROSS-EXAMINATION

BY MR. HAMSTRA:

Q. Dr. Shackle, during your earlier testimony, you referred to what I think you called 24-volt drivers; correct?

A. Yes. I was making the point that it's standardized in commerce to have a 24-volt LED driver, DC LED driver of the kind that's used in the '270 Patent.

Q. The 24-volt LED driver is one that outputs 24 volts DC; correct?

A. No. It takes in 24-volt DC, which is the standard voltage that's available in lighting installations, and puts out a constant current as required by an LED.

Q. You said that's available in catalogs --
A. Oh, yes.
Q. -- earlier in your testimony today?
A. In fact, I was so intrigued by it, I went and rummaged through the catalogs and found a driver with the exact shape, size, input voltage, output current as would be appropriate for the -- what's described in the '270 Patent.

Now whether it was that one that was used, I don't know, but certainly, the item described in the patent is still available today.

Q. But whatever catalog you found, you did not discuss that evidence in particular today, did you?
A. Not until this moment, no.
Q. So let's turn to the '449 Patent.

Mr. Jay, could you pull up RDX-4.32?

And RDX-4.32 includes the Court's '449 Patent claim constructions; correct?
A. That's correct.
Q. There's a construction for trim element space; right?
A. Yes. Shall we -- I won't read it out, but yes.
Q. The construction of trim element space refers back to the trim element; right?
A. That's correct.

Q. There's a separate construction for trim element; right?

A. That's correct.

Q. When I deposed you earlier in this case, you weren't aware that the Court had construed trim element; correct?

A. I forget the exact words we exchanged, but I think that I either had momentarily forgotten or I misunderstood you. I mean, this existing construction of trim element is a -- has been around in this case since I have been around.

Q. You thought, at your deposition, that the Court had construed trim element as limited to trim element, 109, in the '449 Patent; correct?

A. I apologize if I gave you that impression. What I would have been trying to say was that the Court's construction of trim element was the exact -- exactly represented element 109 in the patent.

Q. Mr. Jay, could you pull up Dr. Shackle's deposition testimony at page 45? This is CX-1892.

Starting at line 18, Dr. Shackle, I asked you, "Did you apply for your rebuttal to Dr. Katona's analysis, were you looking for something like element 109 in the accused products or were you applying the Court's claim construction of trim element?"

You responded, "I don't see what the difference is. The ALJ gave a description of how to or what trim element space means. Did he actually give another description of the trim element itself? If he did, I believe it was the same as element 109."

You gave that testimony under oath, Dr. Shackle?

A. Yes, that's correct, and I would basically stand by that today. I --

Q. And it --

A. I had at that moment seem to have got stuck in my head the definition of a trim element, and I had for a moment forgotten the exact details of what the Court's definition was, but I came out with what I still believe to be the truth, that the Court's definition is essentially the same as element 109 in the patent. It describes element 109 in the patent.

Q. Because the Court's construction is essentially the same as element 109, you interpreted the Court's construction of trim element to require a unitary structure; correct?

A. It's the case that both 109 is basically a unitary structure, and the Court's construction describes 109.

Q. Is the answer to my question yes, Dr. Shackle?

A. I'm worried -- if you pull up the figure from

the patent in which 109 exists, you'll see that there's some little bits and pieces stuck on the back side of the trim element, and you could say that, well, because of the existence of those bits and pieces, that this is not a unitary structure.

So that's why I was hesitant to wholeheartedly say yes to this unitary structure.

Q. Dr. Shackle, trim element has to be something that looks like element 109 in Figure 5 of the '449 Patent, which is a unitary structure; correct?

A. It's basically a unitary structure; it's not composed of two big pieces put together.

But if you could pull up that figure from the patent, we can look at it together and I can explain to you what I was talking about.

Q. Well, I would like to pull up your deposition testimony.

Mr. Jay, could you pull up CX-1892, at page 45, lines 12 through 17.

I asked you, "So that the trim element has to be a single structure, and when you add other things to it, it's no longer the trim element; correct?"

Your response, "Trim element has to be something that looks like element 109 in Figure 5 of the '449 Patent, which does happen to be a unitary structure."

You gave that answer under oath, Dr. Shackle?

A. I did give that answer under oath, and when I stared and stared at the pictures, I saw there were some tiny structures appear to be affixed to the back of that 109, and some people might say, well, that means it's not a unitary element.

But the basic piece itself is a unitary element, it's either pressed or spun aluminum.

Q. In your direct examination today, you testified that if you take something that's a trim element and add something to it, it's no longer a trim element, it's a trim subassembly; correct?

A. Yes. There's something in question being LEDs, and nuts and bolts, as illustrated in the patent.

Q. Mr. Jay, could you turn to RDX-0004.045?

Now, Dr. Shackle, regarding the '449 Patent today, you didn't offer any anticipation or obviousness opinions on that patent today; correct?

A. I'm just thinking back to what I said about that patent.

I was asked that -- did it do anything which taught you how to achieve the low weight. That's all I opined upon.

Q. Okay. Yeah. I apologize. I probably got a little bit ahead of myself by showing you this slide.

The invalidity opinions you offered, some of those opinions relate to the slide 45 that we're seeing here, though; correct?

A. Yes.

Q. You recognize that it's impossible for a recessed downlight to have no weight; right?

A. I believe that to be the case.

Q. And one of skill in the art would, in fact, have understood that there is a theoretical lower limit to weight for the claimed downlight; correct?

A. That is the first time I've heard about a theoretical lower limit to the weight of a downlight. And I -- in that may be a true statement, I've -- the obvious next question is, what is that lower limit, and I don't have an opinion on that.

Q. Mr. Jay, can you pull up CX-1053, at page 96, Dr. Shackle's opening expert report? Paragraph 289.

Dr. Shackle, in your opening report, you wrote, "Moreover, even downlights made with these lightweight materials will still have some weight. It is simply impossible for a downlight to have no weight. Thus, in my opinion, there must be some theoretical lower limit for the weight of the claimed downlight; however, the '449 Patent fails to explain what this minimum weight is."

Did I read that correctly, Dr. Shackle?

A. Yes. I stand by that statement.

Possibly, I was misunderstanding your question because I thought you were asking me to opine on what the theoretical lower limit weight for a downlight would be.

Q. The IES publishes standards for downlight sizing; correct?

A. I expect they do, but I have not ever reviewed them.

Q. Okay. But you agree that the '449 Patent contains detailed drawings of the embodiment of that '449 Patent; correct?

A. It contains drawings, which are outline drawings, and I would not call them detailed drawings, no.

Q. But one of skill in the art could take the drawings of the '449 Patent and create a CAD model that looks like those embodiments; correct?

A. The trouble is that things like the thickness of the materials used and the choice of the materials used, and therefore, the density, are not contained in those drawings.

Q. But once someone has the CAD drawing, CAD software allows a designer to simply identify a material and the CAD software will itself calculate the weight?

A. Yes. We discussed that the last time we spoke.

Q. Can you turn to RDX-0004.46, Mr. Jay.

On this slide, Dr. Shackle, you offer some opinions about there not being an upper limit on the amount of light emitted by the claimed lighting device; correct?

A. I'm just reading that. Yes. That's all correct.

Q. But you agree that one of skill in the art at the time would have been able to create a downlight that output over 600 watts at an input power less than 6 watts at the time of the filing of the '449 Patent; correct?

A. I suspect you misspoke. Would you like me to repeat back what I just heard you say?

Q. Did I say "watts" twice, Dr. Shackle?

A. You said a fixture that could output 600 watts with an input of 6 watts.

Q. Thank you, Dr. Shackle. Let me try again.

You agree that one of ordinary skill in the art at the time of the filing of the '449 Patent would be able to construct a downlight that emit over 600 lumens that had an input power of less than 6 watts; correct?

A. Yes. That represented approximately the record achievement in the time frame the patent was filed.

Q. You came to that opinion in your expert report because a US Patent Number 8,403,531 to Negley taught how to do that; correct?

A. That is correct.

Q. I want to talk a little bit about the prosecution of the '449 Patent. Let's pull up -- I apologize. Give me a moment here.

Mr. Jay, can you pull up RDX-0004.43.

Do you see in your depiction of Sell on the left there is something labeled numeral 40?

A. The trim element is colored in a bluish color.

Q. So for this -- for this diagram in your demonstrative, you colored in shell 34, flange 40, side wall 42, and top plate 36 in the blue of the trim element; correct?

A. That's correct.

Q. Now, in prosecution of the '449 Patent, the examiner identified something a little different as the trim element; right?

A. Okay. I did not recollect what it was that the examiner identified. Looking very carefully at the diagram now while you're speaking, element 40 appears to be the blue thing. It's just one piece, goes up and across and down again near the side, and it has another plate, 34, put on top of it, and then the driver structures, 66, were placed on top of that.

I thought let's clarify what I think I'm seeing here.

But I do not recollect if I ever saw what the

examiner's construction was.

Q. Sure. No problem.

Mr. Jay, can you pull up JX-0008 at page 547.

Do you recognize this to be a rejection -- well, first of all, I will represent that this is the prosecution history of the '449 Patent.

Dr. Shackle, do you recognize this to be a rejection of the claims of the '449 Patent over Sell US Patent Number 7,614,769?

A. Yes. Shall we go back for a moment to the previous picture, and see which of those elements I mentioned was element 40?

Q. Sure, but let's just clarify one piece here.

In this rejection, at least, the examiner was identifying as the trim element numeral 40; correct?

A. Right.

Q. Okay. Mr. Jay, can you go to the prior demonstrative, if you can recall where that is. I believe it's .43.

A. Here we go. Yes. So 40 is the piece that's colored in blue -- bluish -- bluish-purple.

Q. Now, during prosecution, in addition to making arguments regarding trim element space, the applicant also argued that the claims were allowable based on the lumens power output and weight limitations; correct?

Strike that.

A. Those arguments definitely appeared, yes.

Q. Okay. You are not offering any opinions in this case about why the examiner allowed the claims of the '449 Patent; correct?

A. That is correct.

Q. Finally, Mr. Jay, if you could pull up RDX-0004.043 once more.

Dr. Shackle, the heading of your slide here is "Sell compared to RAB's products."

Do you see that?

A. Yes.

Q. You understand that an infringement analysis requires a comparison of the claims as construed to the products; right?

A. Yes.

Q. Infringement analysis is not a comparison of the products to the prior art; right?

A. That is correct.

MR. HAMSTRA: Your Honor, no further questions from me.

JUDGE CHENEY: Okay.

Dr. Shackle, I just have a couple of questions for you.

Do you recall in your direct testimony with

Mr. Roush that you testified that the '449 Patent does not expressly discuss the theoretical limits of lumen output?

THE WITNESS: That's correct. It's not mentioned.

JUDGE CHENEY: Okay. Would a person of ordinary skill in the art at the time of the invention disclosed in the '449 Patent understand there to be such limits?

THE WITNESS: The definition of person of ordinary skill in the art that we used was probably not of a high enough level of education to be aware of the correlation of energy between watts of energy in light and the lumens present in light.

So even though a physicist working in optics would have been perfectly aware of those numbers, I don't think the POSITA in the way we defined him or her would have had that information in his head, no.

JUDGE CHENEY: Okay. When you say "POSITA," you're using an acronym for person of ordinary skill in the art?

THE WITNESS: Yes. Right.

JUDGE CHENEY: Okay.

Can we have RX-0114 put on the screen, and the page of that exhibit that shows the definition of LED module and LED array.

Just to orient you, Dr. Shackle, we're looking

at the 10th Edition of this handbook that was published in 2011.

Do you have any --

THE WITNESS: Right.

JUDGE CHENEY: -- questions about what we're looking at?

THE WITNESS: No, I do understand that.

JUDGE CHENEY: Okay. So we're looking at these two definitions, appearing on Bates Number RAB_0164623.

What is the difference in the definitions given here in the handbook?

THE WITNESS: I'm looking at the definition from the handbook. What was the one you said here, I understand?

JUDGE CHENEY: So we have a definition of LED array on this page; is that right?

THE WITNESS: Yes.

JUDGE CHENEY: And we have a definition of LED module on this page; is that right?

THE WITNESS: Yes.

JUDGE CHENEY: According to this handbook, what is the difference between those two items?

THE WITNESS: I'm thinking about it. I'm not ignoring you.

The LED array definition is explicit about not

including an ANSI standardized base, so it can't be screwed into something like an Edison socket, for example.

The LED array definition explicitly mentions packages, even though in that time frame this was all written, the word "LED" under module would also have been implying packages.

So this would appear to be only the bit about the standardized base that's really significantly different.

But there is -- the word "packages" appears in array. It doesn't appear in module; however, in that time frame, it would have been taken for granted that the word "LED" wasn't talking about LED packages.

JUDGE CHENEY: Do you agree with the difference between these two terms as defined by this handbook on this page?

THE WITNESS: That's a snapshot in time back from 2011, and that was -- a more elaborate definition would have been possible. I think they were trying to make a very general-purpose definition to cover all possibilities.

So yes, I agree with it, taken in the context in which it was written.

JUDGE CHENEY: Okay. That's all the questions I have for Dr. Shackle.

Is there any redirect?

MR. ROUSH: No redirect, Your Honor.

Could we just have a minute or two to switch out our witness chair and adjust the nameplates?

JUDGE CHENEY: Yes.

Thank you, Dr. Shackle, for being with us today. Your testimony helped me understand the case.

THE WITNESS: Thank you for having me.

JUDGE CHENEY: It's been our pleasure.

Let's now go off the record for just a moment while we prepare for the next witness.

(Off the record.)

JUDGE CHENEY: We're back on the record now in the 1213 Investigation.

Before we went off the record, we had just finished the examination of Dr. Shackle, who is RAB's expert on the '270 and '449 Patents, and now will RAB please call the next witness.

MR. MOSKIN: RAB calls as its next witness Dr. Jianzhong Jiao.

JUDGE CHENEY: Dr. Jiao, please raise your right hand, and I will administer the oath.

JIANZHONG JIAO, PhD,

a witness, having been first duly sworn, was examined and testified as follows:

THE WITNESS: Yes, I do.

JUDGE CHENEY: Thank you.

Please proceed with your examination, Mr. Moskin.

MR. MOSKIN: Thank you, Your Honor.

DIRECT EXAMINATION

BY MR. MOSKIN:

Q. Dr. Jiao, you've been engaged as a technical expert on behalf of the Respondent RAB; is that correct?

A. Yes.

Q. I'd like to call up Exhibit RX-853, and ask if you can identify this.

A. Yes. This is my current CV.

Q. Can you provide just a high-level summary of your background?

A. Yes. I received bachelor of science Degree in electric -- in mechanical engineering in 2000 -- I'm sorry -- 1980 from Beijing Polytechnic University.

After that I received master of science in -- degree in applied physics from Beijing University of Posts and Telecommunications in 1983.

After that, I received my PhD in electrical engineering from Northwestern University in 1989.

Right after that, I joined the industry. And the last 32 years of my career, oh, I'm engaged in

lighting, and specifically with LED and other light sources, and for technology development, product design, testing, and standards, and regulation compliances.

In particular, the last --

Q. Go ahead. I'm sorry.

A. Yeah. In particular, in the last 14 to 15 years, I was actively engaged in the collaborations with industry, academia and government for LED lighting technology application and standardizations.

JUDGE CHENEY: Can we go off the record for just a moment?

MR. MOSKIN: Yes.

(Off the record.)

JUDGE CHENEY: We're back on the record now after having taken a short break to make some audio adjustments.

Please continue, Mr. Moskin.

BY MR. MOSKIN:

Q. Dr. Jiao, does your curriculum vitae, Exhibit 853, accurately summarize your background, experience and qualifications?

A. It does.

MR. MOSKIN: Your Honor, pursuant to the parties' stipulation, without further introduction, I'd like to offer Dr. Jiao as an expert on LED lighting

devices.

JUDGE CHENEY: As there is a stipulation and no objection, Dr. Jiao will be accepted as an expert in the fields tendered.

BY MR. MOSKIN:

Q. Dr. Jiao, have you prepared a set of demonstrative exhibits to help illustrate some of your testimony today?

A. Yes, I did. I worked with the counsel and the team to make the preparation.

Q. Are these shown in Exhibit -- are these shown in Exhibit RDX-0002?

A. Yes.

Q. Were you -- let's go to slide 2, I believe it is, of the demonstrative.

Were you asked to provide any technical opinions regarding the '819 and '531 Patents?

A. Yes.

Q. Do you understand that the asserted claims are summarized on slide 2 of your demonstrative exhibit?

A. That is correct.

Q. Do you understand -- let's go to the slide 3 -- that there's certain -- the -- certain claims of the patent have been -- these patents have been construed?

A. Yes.

Q. Does slide 3 accurately summarize your understanding of what the claim constructions have been?

A. Yes.

Q. If we -- did you apply these claim constructions in rendering your opinions?

A. Yes, I did.

Q. In considering your opinions, did you assess the level of ordinary skill necessary in the art -- necessary -- the skill in the art necessary?

A. Yes, I did.

Q. If we go to slide 4, does that summarize your understanding of what is the level of skill in the art necessary to understand the asserted claims of the '819 and '531 Patents?

A. Yes, it does.

Q. Did you apply this understanding of the level of ordinary skill in considering your opinions of these two patents?

A. Yes.

Q. In developing your opinions regarding the validity of the two -- of the asserted claims of the two patents, did you understand that claims of an issued patent are presumed to be valid, and must be shown invalid by clear and convincing evidence?

A. That's what the counsel informed me.

Q. Let's turn to the -- some general level of background as to the '819 Patent, and go to slide 5 of your demonstrative. If you look -- why don't we turn to slide -- page 6, a little more informative?

Can you provide a brief summary of your understanding of the subject matter of the '819 Patent?

A. Yes.

This patent is a disclosed -- a lighting device with the LED as light source that produces 6 lumen per watts of efficacy or wall plug efficiency with other performance characteristics described.

Q. Do you understand -- well, let's go to the next slide and see if this -- I want to ask you if you understand what claims of the '819 Patent have been asserted in this case?

A. Yes. The limitations for asserted claims describes efficacy level or wall plug efficiency level in different range. In Claim 24, the limitation is the light output is perceived as white light, warm white.

Q. In your view, do the asserted claims listed here specific any particular structure or components to achieve the recited wall plug efficiency numbers?

A. No.

Q. Now, I think you've heard Dr. Wetzel and Mr. Negley suggest that a feature of the '819 Patent is the

balancing of electrical, thermal, optical considerations to achieved improved efficacy.

Do you recall that?

A. I do recall.

Q. Do you agree with Dr. Wetzel?

A. No, I do not agree.

Q. Do you believe that the '819 Patent reflects a balancing of these different elements?

A. No. The claims only disclose the results without disclosing any balance principles.

Q. The claims of the '819 Patent refer to a lighting device having at least one LED.

Prior to the '819 Patent, is it your understanding that whether -- was it known in the field to use at least one LED in lighting devices?

A. Yes, it was known.

Q. You mentioned that -- I think we were discussing white light. Let's turn to white light.

Is that the type of light used for general lighting applications?

A. Yes.

Q. How is that produced, white light produced in an LED lighting device?

A. The white light is the light with the broad spectrum that the human eye is to be detected. With the

perceived white, you can -- as the patent also described, you can combine the two or more single-colored content of LEDs to form white, and usually we do something called RGB, right? Green-blue to form white. Or you can use blue or UV LED die to excite the phosphor, which you need a broader spectrum to be the white.

Typically, there's two way. Combine single wavelengths of two or three or more, or using phosphor to have a broader spectrum to achieve the white light.

Q. Did the asserted claims of the '819 Patent recite any specific structures or components to emit white light?

A. No.

Q. Are you aware that Claim 24 of the '819 Patent refers to output light emitted as warm white? And perhaps let's pull up --

A. Yes.

Q. Let's just pull up Claim 24 of the '819 Patent.

Again, is that your understanding of Claim 24?

A. Yes.

Q. Do you see in Claim 24 anywhere where it specifies a particular structure or components by which the lighting device emits warm white light, or achieves an efficacy of 60 lumens per watt or higher?

A. It does not.

Q. Let's discuss the specification of the '819 Patent.

Do you recall that it -- whether it discloses any embodiments?

A. Yes. '819 Patent discloses the first embodiment and the second embodiment.

Q. Let's go to slide 8 of your demonstrative exhibits.

And does this slide reflect the -- either the first or second embodiment?

A. This one discloses the first embodiment, which consists of two type of LED or emitters, namely 16. In the description, you can see 16a and b. They use the term "package the LED." And together with other components to form this first embodiment.

Q. So the first embodiment discloses two types of LEDs?

A. Correct. And if you look at the illustration number 16, yet the text, you will see 16a and b.

Q. Okay. Let's turn to slide 9, and I'd like to ask if the '819 Patent provides a description of the greenish-yellowish emitters in one of the two types of die or emitters referenced in the first embodiment?

A. The first embodiment discloses this 16b as greenish-yellowish emitters that use the -- a specific die,

namely Cree XT LED, with the model number C460XT290, which is the die produced by Cree.

The characteristics include the wavelength range, and also optical output power level of 24 milliwatts.

Q. The embodiment references Cree. Do you know whether the patentee, LLF, was the manufacturer of the blue LED dies mentioned in the first embodiment?

A. No, it is not.

Q. Do you know what -- what entity is the Cree that's referenced here or what relationship it had with LLF at the time?

A. A Cree XT LED, again, is a kind of LED blue die which was produced by Cree, Inc. If I recall at the time the patent was filed, there's two separate companies.

Q. Okay. Now, would a person of ordinary skill know what type of blue Cree C460XT290 LED die is being used in the first embodiment?

A. Yes, because Cree published its data sheets for all their products sold publicly.

Q. Mentioning a Cree data sheet, can we pull up Exhibit JX-159?

Is this the Cree data sheet for the -- referencing the C460XT290 LED die?

A. Yes, it is.

Q. How do you know from the Cree data sheet that the C460XT290 LED die is an XT-24 die?

A. The CX and -- XT, and typically is referring to the so-called XThin LED die technology.

460, the first of three digits, according to the nomenclature on the data sheet, disclose the wavelength. The peak wavelength of 460 nanometers.

290 describes the dimensions of the die. It's relatively 300 micron by 300 micron. A little less than 300 micron.

Furthermore, the data sheets prescribed two more critical parameters. One is operating current. Later we'll talk about it.

More importantly is the data sheets disclose what the light put -- the optical output produced by this die, binned it in five different bins. The highest, being namely XT-24, produced 24 milliwatts. The lower bins, the wider bins, produced much lower range in 224.

So binning means that if you have a wider bin, you have variation of light output, yet the highest one is 24 milliwatts.

Q. Let's go back to the demonstrative exhibit in slide 10, and you see there's a reference to red LEDs.

Can you describe what red LEDs are mentioned in the '819 Patent?

A. The '819 Patent first embodiment discloses the red LED die is from Epistar, made by Epistar, which is a Taiwanese die manufacturer, and there's other packaging characteristics illustrated in Figure 6.

Q. Okay. Let's go ahead to slide 11 of your demonstrative exhibits.

Does the first embodiment describe how many LEDs were used?

A. It does. The first embodiment also described the configurations, how these two type of emitters being configurated into three strings.

The cascade are a series connected to each string with a number of LEDs or emitters. They specifically numbered each of the strings, and with a total number of 47 red LED, and 123 BSY emitters. Together is 170 total, with all of the strings or LED individually are operating at 20 milliamps.

Q. Does the '819 Patent identify the wall plug efficiency of the first embodiment?

A. No.

Q. You may have answered it.

Does it identify the operating current for the LED?

A. Yes. Yes. The specification describes -- says on the screen, you can see the current passing, each string

is 20 milliamps.

Q. Does the first embodiment describe any way to balance electrical, thermal and optical components to achieve a wall plug efficiency of over 60 lumens per watt?

A. No, it does not.

Q. Do you believe it would be necessary to provide the efficiency and performance levels of the components in order to achieve 60 lumens per watt?

A. Yes, I do.

Q. What -- can you be a little bit more specific about what you would need, a person of ordinary skill?

A. Well, in order to achieve the claimed wall plug efficiency, or efficacy, the light source, namely, LED or emitter, must be specified what minimum performance needed. And for achieving the claimed efficacy number, more importantly, you're using two types of emitters, namely, BSY emitter and red LEDs.

The efficacy for each not only needs to describe it, but also color content of each so that you would be able to achieve the white light. Because none of them is white. One is bluish-greenish yellowish. One is red.

Q. Well, let's turn to the second embodiment of the '819 Patent, and if we can advance to the next slide, 12.

Can you describe what is your understanding of what is shown or depicted by the second embodiment?

A. The second embodiment described, again, is like recessed downlight configuration with the LED and other components, with the example the prescribed -- described the, again, number of greenish-yellowish emitters that is combined with the red LEDs to form this embodiment.

Q. At what level does the -- would you say the LED components used in the second embodiment are disclosed?

A. Other than they're disclosing these are two types of emitters, and also as example how these number of emitters being connected, that's what it discloses in the second embodiment.

Q. Does the second -- okay. I didn't mean to cut you off.

Was there more that you wanted to say?

A. Yeah. There is a number associated with each string, yet it is shown as example.

Q. Well, let me come back to some of the other more specific questions about some of these specific components, but does -- let me just ask if the '819 Patent identifies the wall plug efficiency of the second embodiment?

A. No. It does not.

Q. As you understand the concept of BSY+R, which we've heard substantial testimony about, including from Mr. Negley, are the first and second embodiments examples of this approach, the BSY+R developed by LLF?

A. Yes.
Q. Why do you say that?
A. They both disclose the two types of emitters, namely, BSY plus red LEDs are needed in these two embodiments.
Q. Does the '819 Patent discuss any approach other than the BSY+R approach to produce white light?
A. In the background section, the patent described the conventional approach to produce white light.
Q. Okay. Well, let's turn to slide 13.
Does this describe some of the in the background, what conventional approaches you were referring to?
A. It is.
Q. What is your understanding of what is disclosed in the background of the conventional approaches?
A. The background discloses the conventional white light approach -- white light approach to generate -- I'm sorry.
The conventional approach to generate white light that includes RGB in single color, combining single color emitters, and using the blue LED to excite phosphor. Here it uses the word luminous in the material, or lumina, to generate a white light. And the background also described these two are not good enough in terms of

efficacy.

Q. All right. Well, let's turn to slide 14, and I'd like to ask if the '819 Patent describes any problems with the conventional so-called RGB approach?

A. Yes.

The background information discloses the RGB approach is not efficient based on the green LEDs being -- at that time being very less efficient. Furthermore, they also described the color quality is not good, namely, with the lower CRI.

Q. Why were green LEDs less efficient?

A. Well, green LEDs take some challenges, especially in the semiconductor material. The property itself as well as processing the material, it has been very challenging to generate -- efficiently generate a green light using LEDs.

Q. Let's turn to slide 15 of your demonstrative, and I'd like to ask if the '819 Patent identified any problems using the phosphor conversion LED method?

A. It did.

Q. What did it say -- what did it identify, and -- in short?

A. Well, while using the blue die to excite the phosphor, and which we call the secondary emission, the phosphor absorbed the light, and the majority the lights

emitted from the die, with the short wavelength, and reemitted in the longer or broader wavelengths, specifically the shifted longer wavelengths, they involved several fundamental losses, and Stokes shift that everybody is talking about, the re-emission itself also fundamentally involved the backscattering, the lights not going to the direction that you wished to, as well as absorption itself.

So as a result, the background information disclosed these phosphor-converted white LEDs are less efficient.

Q. Just turn to slide 16.

Does this further describe problems with the PC, phosphor-converted LED approach?

A. It is. It described the warm white, which in this particular case -- and use the example from 2700 kelvin to 3500 kelvin, it correlated color temperature was CCT, or higher color rendering index of average of 95.

These type of light, using phosphor-converted approach tend to have much less efficacy compared to a cool white with a much higher color temperature or CC -- correlated color temperature.

Q. Does the '819 Patent describe any other method -- method other than the conventional RGB or the phosphor-conversion approaches to achieve higher efficacies?

A. No. Other than BSY+R, there's --

Q. Okay. Well, does the '819 Patent encourage use of the red -- the RGB or phosphor-conversion approach to achieve higher efficiencies?

A. No. The '819 Patent discourages these two conventional approaches due to the description of these two approaches were less efficient at the time.

Q. Did you review any parts of the prosecution history of the '819 Patent in forming your opinions in this case?

A. Yes, I did.

Q. Let me ask you in particular, did you review a declaration submitted by the inventor, Mr. Negley?

A. Yes, I did review.

Q. Let's -- did you find that relevant in any way?

A. Yes.

Q. Let's call up Exhibit JX-14. Do you recognize this?

A. Yes.

Q. If I can direct your attention to Paragraph 6 on page 3.

Does the Negley declaration refer to any test data?

A. It does. It did refer to test data.

Q. That is just summarized here on the screen?

A. Yes. This screen shows -- I mean, this section shows there was tests done in April 2006 at CSA International.

Q. Do you understand whether the Figures 8 and 9 referenced by Mr. Negley here in Appendix A to his declaration refer to the second embodiment of the '819 Patent?

A. Yes.

Q. Okay. Let's move forward to page -- Bates Number on the same document, 3401, ending in 3401.

Are you there -- are you with me, Dr. Jiao?

A. Yes.

Q. Can you describe what's shown on this page?

A. This page shows the test report done at CSA International in April 2006, with the prototype samples being tested at two different -- well, input voltages, namely, 110 volts versus 115 volts.

Q. What were the respective efficacy levels this device conducted, the two different voltage levels?

A. In the lower voltage, 110 volts, the efficacy is 79.79 lumens per watt. In 114 voltage input, the efficacy was 72.7 lumens per watt.

Q. Now, based on Mr. Negley's declaration, and even his testimony yesterday, do you have an understanding why the efficacy levels differed in these two tests on the same

device?

A. Yes, I do.

Q. What's that?

A. I do understand the -- the general understanding is LEDs are more efficient at a lower operating current, and these -- this prototype, per Mr. Negley's testimony, was using the driver that was not regulated.

For that reason, at lower input voltage, the current that is operating LEDs being reduced at a lower current. LED is more efficient. As a result, the lighting device appears to have a higher efficacy.

Q. If you look at page 3 of the Negley declaration ending in Bates Number 3395, particularly Paragraphs 8 and 9, did Mr. Negley refer to any test reports other than those done by CSA?

A. Yes. It also refers to the CALiPER report, or the product samples tested at CALiPER of US DOE programs.

Q. What were the efficacy values of the CALiPER reports referenced as being part of Exhibit C to Mr. Negley's declaration?

A. The exhibit -- this Appendix C reports to the wall plug efficiency or efficacy 59.9 lumen per watts, and there's also other numbers, 62.4 lumen per watts.

Q. In Paragraph 9, what were the efficacy numbers Mr. Negley attested to as shown in Exhibit D to his

declaration?

A. 61.3 lumen per watts and 62.4 lumen per watts.

Q. Going to page -- the page ending in Bates Number 3413, what products were tested by CALiPER or the Department of Energy?

A. That was a Cree downlight model LR6.

Q. When you say "Cree," was it LLF at the time?

A. I don't know. I have to look at the report. It was -- the time frame -- yeah, I don't know if Cree have -- Cree, Inc. has bought --

Q. Well --

A. Yeah, let me --

Q. If you back out a second, I'll just refer you to the product description.

Does that help you identify what -- whose product this was?

A. Oh, it's LLF. I'm sorry.

Q. That's fine.

A. It's LLF. LR6 is from LLF.

Q. Okay. When were these tests conducted?

A. September 2007.

Q. Do any of the efficacy values reported in the tests referenced in Mr. Negley's declaration reach or exceed 80 lumens per watt?

A. No.

Q. Do any of the efficacy values reported in the tests referenced by Mr. Negley in his declaration suggest that, to your understanding, LLF knew how to make an LED lighting device with a wall plug efficiency meeting or exceeding 80 lumens per watt as of September 2007?

A. No.

Q. Okay. Let's go back to your demonstrative exhibits, in particular, slide 17. And 18, that's more informative.

Can you describe what's shown in -- or the summary of the -- let me strike that. A different question.

Can you provide a brief summary of what your understanding is the subject matter of the '531 Patent?

A. This patent also described lighting devices that -- with certain performance characteristics, including the wall plug efficiency at least about 85 lumen per watts, together with other characteristics.

Q. Let's go to slide 19.

Do you understand this is -- summarizes the relative limitations of the claims at issue?

A. Yes. These claims limitations are different wall plug efficiency range.

Q. I'm glad you phrased it that way.

How do the -- or do the asserted claims of the

'531 Patent differ from those of the '819 Patent?

A. Well, there are two differences. One is the '819 Patent is at least -- the limitation stated at least 6 lumen per watts, where the '531 Patent stated at least 85 lumen per watts, and other increments above that.

The second difference is that the '819 Patent discloses of using light-emitting diodes or LEDs. The '531 Patent, instead of it stating LEDs, the patent claims solid-state light emitters.

Q. Do you understand whether the '531 Patent discloses any embodiments?

A. Yes.

Q. Let's turn to slide 20 of your demonstrative exhibits.

What is shown here?

A. It shows the only embodiment disclosed in '531 Patent, again, is a downlight lighting configurations with an LED sort of emitters, components, and other components associated with this lighting device.

Q. Does it describe the LEDs used in the embodiment?

A. Well, it described LED -- blue LED die, and -- made from Cree. And it also described the lens components used in Cree LED package. And it described a red LED as OSRAM Golden DRAGON.

Q. The specification of the embodiment description refers to Cree XLamps.

Are those the type of die, LED die?

A. Yes. Cree XLamp is the trademark of LED blue die.

Q. It refers to Cree XRE parts.

What are those?

A. XRE is Cree's model for an LED package that includes die and lens and other components to package the die into an LED package.

Q. It references use of an optical adhesive.

Do you see that?

A. Yes.

Q. Do you understand what is referred to or why is there a reference to an optical adhesive being used?

A. This embodiment disclose -- it uses lens -- lenses from the Cree XRE package, and the lens is adhesively connected to this particular package using optical adhesive materials.

Q. Okay. Does the '531 Patent identify what is needed for the non-saturated phosphor -- by the way, just to go back, the fact that there was an optical adhesive used, does that suggest that this was not an off-the-shelf part?

A. It doesn't describe any off-the-shelf. It

describes two different parts from two different types of products, and then together with adhesive, and making them connected to each other.

Q. Does the '531 Patent identify what is needed for the non-saturated phosphor-converted LEDs to achieve lighting device level wall plug efficiencies of any number?

A. No, it does not.

Q. Does the '531 Patent identify a specific saturated LED that can be used?

A. Well, the way they use the word saturated is -- has to refer to single-color LEDs. In this particular case, they use the OSRAM Golden DRAGON parts.

Q. As of November 2007, did OSRAM make more than one type of Golden DRAGON LED?

A. Yes. Golden DRAGON is tradename for OSRAM for a type of LED package configurations. And Golden DRAGON is a family of many products.

Q. It's many products, you said, did I hear you correctly?

A. Golden DRAGON is a family of products.

Q. Right. I thought you -- I was just trying to -- I didn't hear you correctly, you said many products, or I think that's what you said.

A. Well, family means more than one; right?

Q. No, that's fine.

Does the '531 Patent identify a wall plug efficiency associated with the disclosed embodiment?

A. No.

Q. Well, but it does reference --

A. I'm sorry.

Q. -- the 113.5?

A. Okay.

Would you mind repeating the question before I answer to know if I --

Q. Sure.

Does the '531 Patent identify any wall plug efficiency associated with the disclosed embodiment?

A. Yes. It discloses 11. -- 113.5 lumen per watts.

Q. Does the '531 Patent identify how many of the phosphor-converted emitters and red LEDs were used to achieve that wall plug efficiency?

A. It does not disclose the number of LEDs that are used.

Q. Let's go to slide 21.

First of all, what's shown here?

Dr. Jiao, I was just asking if you know what's shown on slide 21.

A. Oh, this is the description in the embodiment for the LED driver that was used.

Q. Does it --

A. Including -- I'm sorry.
Q. Go ahead.
A. Including a schematic.
Q. Does the '531 Patent teach any improvements in the power supply or LED driver used?
A. No, it doesn't.
Q. What LED driver is disclosed in Figure 2?
A. It discloses a commercially available LED driver in this description with a model number and the manufacture.
Q. Let's go to the next slide, 22.
I think you said this earlier, but just to be clear, this is the only embodiment disclosed in the '531 Patent; correct?
A. Correct.
Q. It identifies the -- the correlated color temperature is 2760 kelvin.
Do you see that?
A. Yes, I do.
Q. Is that white light?
A. It is white.
Q. Okay. Is there anything -- at a high level, is there anything not disclosed in the '531 Patent that a person of ordinary skill would need to build a device such as the one tested at NIST?

A. The critical part is the LED light source level of efficacy, and that is not disclosed, what is needed for the light source to achieve the lighting device level of wall plug efficiency.

In addition, because you're -- it discloses it uses two type of emitters, non-saturated, saturated. It is necessary to disclose the content, the color contribution from each type of emitter to achieve such wall plug efficiency with the desired light, especially warm light -- warm white.

Q. So a person of ordinary skill would need to know the color content ratio; is that what you're saying?

A. Yes, they do.

Q. Let's pull up the '435 provisional, RX-0090.

I'll just ask if you recognize this document?

A. Yes, I do.

Q. What do you recognize it to be?

A. This is the presentation provided by the inventors, Tony Van de Ven and Gerry Negley, November 2007.

Q. Do you understand that this presentation is also shown in the '435 provisional application that became part of the '531 Patent?

A. Yes.

Q. Okay. Let's look at slide -- your demonstrative slide 23.

Do you understand this is some of the same material out of the provisional application?

A. Yes.

Q. Okay. This -- what does this slide show regarding conventional LED warm white light?

A. The slide shows two approaches to generate LED warm white light, and namely blue converted -- blue using phosphor-converted white light, or using RGB, three single-color combined to produce warm white light.

Q. So those are what the inventors described as conventional type needs; correct?

A. It is. It further described in each approach the disadvantage, they both have a lower efficacy and are --

Q. Yeah. Go ahead. I was going to ask you, what did they describe -- say about the RGB LED approach?

A. Well, the RGB, according to this slide, has the lower CRI, the color rendering index, which means poorer color quality.

The highlight for this slide is indicating that both approaches, low efficacy or poor CRI.

Q. What did the inventors say about phosphor-converted -- the phosphor-converted LED approach?

A. Phosphor-converted LED approach, for warm white, they couldn't achieve a higher CRI, yet the efficacy is too

low -- very low.

Q. What efficacy was reported here?

A. On the slide, it shows 15 to 35 lumens per watt.

Q. Okay. Having reviewed the conventional approaches, let's turn to slide 24 of your demonstratives, and I'd like to ask you, how did the inventors describe their BSY+R approach?

A. The inventors proposed a different approach and instead of using the phosphor to convert the blue light into a white light, the inventors proposed to use the phosphor to convert the blue emission from LED die into this color called a greenish-yellowish light, not white, and in conjunction by using R, which is LED -- single-color LEDs combining this bluish-yellowish light with the red LED red light, and to achieve high efficacy, and high CRI.

Q. So this approach requires use of two emitters; correct?

A. Minimally.

Q. Yes, minimally.

You said -- you used the term "not white." What do you mean -- what did you mean by that?

A. Well, the white light, although is a human eye's perceived concept or more physiological concept rather than physics concept.

Yet throughout the years, the industry has

established the definition of the white, especially United States. And we have LED lighting, other lighting, too. We have LED lighting or solid-state lighting chromaticity specification, defining in the chromaticity space what is white or white space, and this BSY is not in the white space.

Q. So are you saying that the BSY emitter described here would not be within the standardized definition of white light?

A. It is not. It is not in white space. It's not white light.

Q. Let's call up Exhibit RX-765, which is a patent -- the US Patent 7,213,940.

Do you recognize this patent?

A. Yes, I do.

Q. Are you aware whether this, I'll call it the '940 patent was incorporated by reference in the '531 Patent and '819 Patents in this case?

A. That is correct.

Q. Let's look at Figure 9 of the '940 patent, which is I think on page 9 or sheet 9 of the -- here we go.

Can you explain to us what is shown here?

A. This figure shows the inventors for this patent created this color space, namely, BSY, which is bordered by five lines on the chromaticity chart X, Y, which is the

1931 chromaticity chart.

If you look at element 50, that is the space defined by this patent with pentagonal shape of -- there's five sides of -- yes, that is the color space defined in this patent.

Q. That pentagonal space, is that -- according to standard definitions, is that white or not?

A. No. That is greenish-yellow. That's outside of white space.

Q. Can we, Mr. Hall, call up RX-90, which I believe is a provisional application that we were just discussing, but this is the actual provisional application.

And I think what this shows is RX-90 together with the Figure 9 that we were just looking at from the '940 patent.

Can you tell us what is shown in -- in the diagram on the left?

A. The diagram on the left is -- uses the CIE1931 coordinates as X, Y coordinates, as you can see on the screen, to describe or to define what is white space border.

In other words, again, from human eye perception, although we see white from the different end of issues, and industry standardized -- actually, besides the industry, the government, the United States, and European,

and the entire world will have the same consistently -- it used to be inconsistent, but now it's consistently defined the definition of white space.

If you can somewhat see, there's two different lines along the black-body curve, which is the curve starting on the right upper corner of this around 600, I think, and curves to the left. That's what is called the black-body locus.

That is the black-body radiation curve correlated to something called thermal emission, which means as light is emitted, the temperature increases the light color changes. It's called the black-body emission or thermal emission.

LED and other lights are not black-body radiation curve.

So for that reason, and -- you cannot directly and produce light on that black-body locus as a result, and you needed to have some way to connect it to that black-body curve.

The industry defines something called correlated color temperature, which is in the line -- not in this diagram, but CIE1971 diagram is perpendicular to the black-body line --

Q. Okay.

A. -- based on the black body.

Q. What is the black-body curve shown in -- on the left, what does that reveal in contrast to what is shown in Figure 9 from the '940 patent?

A. Well, if you look at it carefully, there's solid line. The dark line, that is white color space defined by ANSI chromaticity standards, and, namely, ANSI C78377.

The little bit of greenish line -- there's multiple angles -- that is SAE standard to define the white.

So the ANSI defines white for general illumination purposes in the United States, and SAE defined the white for automotive headlamps white definition or other lights white definition in the United States.

Interestingly enough, in Europe, others, they're consistent for automotive.

The white light is defined by US first, and then the rest of the world were pretty much adopted.

Q. Mr. Hall, can you pull up -- I know we have been looking at part of RX-09 of the provisional application, but can you pull up the actual patent application -- the provisional application. Go to page 3.

Dr. Jiao, what does this show you as to the nature of the light emitted by the BSY emitter -- emitters developed by LLF?

A. I'm assuming you're not referring to this slide.

This is --

Q. On the left.

A. Okay.

Q. On page -- should be --

A. Well, the one before this one. One before. Here you go. Yes.

Q. Right.

A. If you can see from the right hand of the screen --

JUDGE CHENEY: I'm sorry. Before you continue, Dr. Jiao, tell us where we are for the record.

MR. MOSKIN: This is -- if, Your Honor, would like -- would you like me to address that?

JUDGE CHENEY: Someone.

MR. MOSKIN: Okay. This is part of RX-90, which is the provisional application that became part of the '531 Patent.

JUDGE CHENEY: We're looking at slide 4 from RX-09?

MR. MOSKIN: Yes.

JUDGE CHENEY: Okay.

Please proceed, Counsel.

BY MR. MOSKIN:

Q. Yes. I would just ask you to, again, describe what this reveals about the BSY emitters developed by LLF.

A. As you can see -- first of all, if you can see from the right-hand screen, element 50, that is that bluish-yellowish color space on the left-hand side of the screen.

And this concept shows if you pick up a spot from that space -- you can see -- right, there's a little cross right there.

If you use that light in conjunction or combining with another light, if you see in the right lower corner in the right region, which, namely, the red LED lights -- if you can combine these two lights together, and combined properly, the combined color may lay right near the black-body curve.

Again, it could be anywhere along that line or even away from that line. Because if you look at the color -- if you look at a color space defined in the right side of the screen, that is pretty big of color space.

On the left-hand screen, and ideally you pick up one from that space, and you pick up red -- red is well defined. Combining those two, you may line it up somewhere, and it could be on the black-body curve.

Q. Let's go to -- back to your demonstrative exhibit in slide 25.

Does Figure 5 help explain the differences between the BSY+R approach and the conventional approaches,

RGB and phosphor conversion?

A. It does.

Q. And how so?

A. The far right, you will see the Figure Y -- Figure 5 that demonstrates BS+R [sic] and the embodiment specifically describe 16A and B.

A means all of the red, and B means all of the greenish-yellowish emitter. So you can see these two emitters mixed, which is the warm white in the claim.

The two on the left -- the far left is the RGB, three different LED combined. You can -- symbolically, in putting the three colors depends upon the color -- the output level, you can determine how many of each needed.

The middle one is conventional PC converted white, which is using either blue or UV LED die, using the phosphor to convert light into a white, broader spectrum.

Q. Now, does the -- do the '819 or the '531 Patents teach how to make the BSY components, a -- kind of a recipe of how to put them all together?

A. Other than disclosing the concept of two emitters and some elements of these emitters, no.

There's no description how to combine them to achieve the wall plug efficiency of the lighting device level.

JUDGE CHENEY: Okay. It's now 3:00. Let's take

our afternoon break.

Dr. Jiao, please don't discuss your testimony with anyone during the break.

We're off the record for 15 minutes.

(RECESS, 3:01 p.m. - 3:17 p.m.)

JUDGE CHENEY: We're back on the record in the 1213 Investigation.

Before the afternoon break, we were hearing the direct examination of RAB's technical expert on the '819 and '531 Patents, Dr. Jiao.

Please continue with your examination, Mr. Moskin.

MR. MOSKIN: Thank you.

CONTINUED DIRECT EXAMINATION

BY MR. MOSKIN:

Q. I think the last question I asked you before we broke was whether the '819 or '531 Patents teach you how to combine the components into achieving the desired result or the claimed efficiencies use of the BSY component.

Do you have any opinion -- to move on from that, do you have any opinion whether there are any drawbacks to using the BSY+R approach developed by LLF?

A. Yes, I do.

Q. What is your understanding?

A. This BSY+R approach presents a level of

difficulty, introduce the to variables, and you have -- not only the BSY itself is a pretty wider color space, but also the controlling the color content contributed by BSY+R has to be independent, meaning that you have to have a separate control circuitry to operate these emitters to produce the amount of light.

On top of that, you needed to have combined efficacy, and that added -- to achieve the claimed efficacy level, so that added a degree of difficulty.

Q. Are you referring to the two control circuits, did you hear Mr. Negley testify about the challenges of having two control circuits?

A. Yes, I did.

Q. Is that what you are referring to?

A. Yes.

Q. Okay. Did the lighting industry, as far as you know, actually adopt the BSY+R approach as developed by LLF?

A. Not as far as I know.

Q. What approach is most commonly used today, to your knowledge, for LED lighting applications?

A. The majority of general lighting LED applications today are using phosphor-converted LEDs either using blue die or UV die to convert it through phosphor into white light.

Q. Have the -- these currently available products been able to achieve high efficacies without using the BSY+R approach?

A. Correct. Yes.

Q. What enabled the industry to develop lighting devices with improved efficacies?

A. That enablement come from the LED light source level improvement, including the die efficacy, or external quantum efficiency improvement, including the phosphor efficiency improvement.

Also, on LED package level, there's improvement made over the years. LED, the light source itself, became brighter and more efficient.

Q. If we can pull up slide 26.

I think I may have asked you this before, but is it possible to practice the BSY+R method using only one LED die?

A. BSY+R approach fundamentally described to have a two emitter, and that means two separate LED packages. Even up to today, there's no single LED die junction can produce more than one color of light. And this BSY+R approach, minimally, you need two emitter, and you can't use one to produce lighting -- to be used for lighting device.

Q. Let's look back, and to take a slightly wider

view from the specific claims of the two patents, were advances in efficacy of lighting devices predicted by -- within the industry before the '819 and '531 Patents were filed?

A. The industry has been working on the LED, the light source improvement for long period of time, collaboratively between government and industry, long before these patents were filed. There's been significant improvements made.

Q. Did the government, in fact, publish a roadmap of anticipated improvements?

A. Yes.

Q. Why don't we --

A. That page --

Q. -- bring up -- excuse me. I'm sorry. Bring up slide 27.

A. The industry -- the government collaborations started as early as early 2000. And the government work is really collaborating with industry.

Yes, they did publish a roadmap in both LED emitter level as well as the lighting device level of projected efficacy.

Q. Can you pull up the full Exhibit RX-726?

Can you identify this?

A. Yes. This is a document dated 2002 for the

roadmap.

Q. Can you summarize the overall scope of what was contemplated by the roadmap?

A. With that time frame, knowing the LED technology was developing very rapidly, it presented the potential to have the LED generate white light for the general illumination application, with a higher energy saving potential as well as color quality potential.

So the roadmap is the collaboration effort, again, between US DOE and industry parties to establish what could be projected technology improvement over the years.

Q. Let me bring up -- sorry. Slide 29.

And can you explain what is shown by slide 29?

A. This slide is a summary of LED, the die level or LED source level, improvement over the years. The slide clearly demonstrates two milestones.

One of them is late 1990s where the red LED has a significant improve over a few years that leads to very high efficacy as well as lumen output produced by red LEDs. That leads to the first lighting applications using LEDs in the beginning of 1990s, namely for automotive lighting.

The second noticeable milestone is the blue LED die became so bright, enough to convert into white light through phosphor. That portion of this chart shows the

growth of the blue LED light could be substantially good enough in terms of lumen efficacy for general illumination purposes, namely white light.

Q. Can you pull up slide 30?

Does this further illuminate the trajectory of increasing efficacies of lighting devices?

A. Yes. This is the concept of the time of the duly established roadmap is to take the LEDs, put it into the lighting devices, and to see the potentials, possibilities of replacing existing light sources, lighting devices using incandescent, tungsten halogen and metal halide, to other light sources.

So over the years, the belief at the time was with LED development, that LED white light and -- to be used for lighting devices can surpass other traditional lighting devices to be more energy efficient.

Q. Can we pull up document RX-752?

Do you recognize this document, Dr. Jiao?

A. Yes.

Q. Following on what you have just been describing about, the projections of anticipated improvements in efficacy, what does RX-752 show?

A. This shows the -- actually, it shows the capability for LED light source development that leaded to the lighting applications, and using LEDs being very

efficient, and this gives you the number of LEDs being implemented in the overall illumination.

Q. Can we go to page 4 of this report?

I've highlighted the passage for you, but does this summarize your understanding of the state of the level of LED lighting efficacy in the world today?

A. Yes. In this report, it demonstrates in the residential lighting, 110 to 130 lumen per watts has become available. And for the commercial lighting space, it could be better. And further projected, there's further improvement or increase will continue to occur.

Q. In your view, are the improvements in LED lighting efficiencies since 2007 improvements that are taught by the '819 and '531 Patents?

A. No.

Q. I'd like to go back to reviewing some of the tests. We covered several of these yesterday with Mr. Negley, so I can be a little bit quicker.

But let's go to slide 31, which I believe references a January 2006 CSA test, and ask if you see this in front of you now?

A. Yes.

Q. What do you understand this document shows?

A. My understanding is, in January 2006, the inventors used BSY+R approach, and -- who achieved 33.7

lumen per watts efficacy on the right.

On the left, by listening to Mr. Negley's testimony, I understand the 47.36 lumen per watts, the sample test, it was not a BSY+R, it was using cool white the inventors built.

Q. Okay. Let's go to slide 32 -- oh, excuse me. Let's skip slide 30 -- let's go to slide 33.

Do you recognize what testing data is shown on slide 33?

A. Yes.

Q. Can you tell us what wall plug efficiency -- what were the wall plug efficiency -- or what was the wall plug efficiency of this prototype?

A. 53.5 lumen per watts at February 2006.

Q. Let's go to slide 35.

Can you tell us -- we looked at this previously, but just to summarize, what wall plug efficiencies were shown in the April CSA test?

A. It shows in the lower voltage, it received 79.79 lumen per watts. With a higher voltage, the efficacy was 72.7 lumen per watts.

Q. Let's, then, go to slide 43, and I'll ask if this is, in your mind, a fair summary of the test results shown in the record before the ITC now of the testing conducted by LLF?

A. Yes, these are their test results. And shows during this investigation each prototype samples or product samples being tested at different test laboratories, what they can achieve -- what they could achieve.

Q. And as of May 31, 2006, when the '819 provisional application was filed, what was LLF's record for wall plug efficiency?

A. 79.79 lumen per watts.

Q. And as of November 27, 2007, when the provisional application for the '531 Patent was filed, what was LLF's record for wall plug efficiency?

A. 113.5 lumen per watts.

Q. Let's pull up Exhibit RX-743.

Do you recall having seen this before, this e-mail exchange between Mr. Negley and Cynthia Merrell?

A. Yes. Yes.

Q. Does this e-mail exchange provide any insight to you why the April 2006 testing numbers differed?

A. This shows the e-mail address -- I'm sorry, the e-mail indicates the same thing, that 79.79 lumen per watts was measured at the CSA, and that this e-mail is a month after that test.

Q. Go ahead.

A. Well, the improvement also shows they use a specific part number highlighted underneath of that, which

is XT-33 and XT-31.

Q. Okay. Does that help explain why there was improvement in efficacy in the -- excuse me -- as of the date of these tests?

A. What this indicated what parts they're using for achieving 79.79 lumen per watts. We now confirmed we use these parts.

Q. I'll call your attention to the comment from Ms. Merrell in the middle of the page. Do you see her -- does her comment help explain -- do you form any opinion from her comment that "it must be the new Cree die" in explaining how the 77 lumen per watt number was achieved?

A. Yes. And this indicated what part they're using. The die, specifically.

Q. Let's go to -- back to the demonstrative, which is taken from this e-mail exchange, slide 39.

And do you see any other indication here as to how LLF itself recognized it was able to achieve the 79.9 or almost 80 lumens per watt number?

A. The e-mail indicates some trick in -- to be used to get a higher lumens per watt or efficacy.

Q. Do you know what trick that -- do you have any understanding what that trick would have been?

A. Well, I have my understanding, and I also listened to Mr. Negley's testimony, and it is known that if

LEDs are operating at the lower current, it will be more efficient and will have a higher efficacy.

The trick could be, if you operate the LED lighting devices at lower current, you have a higher efficacy, yet at the lower current, LED produces less light.

So as one lighting device needed to have enough light, you have to add lots of LEDs.

So the trick, again, is to achieve a high-efficacy number with a lot of LEDs to maintain the certain lumen output that is not realistic, but on the report it looks better because higher efficacy looks better.

Q. Do you have any understanding whether the new die mentioned by Ms. Merrell on Exhibit 743 is disclosed in the patent?

A. No. That -- that model number was not disclosed.

Q. Let's move on to your consideration of the so-called Wand factors to address enablement of the '531 Patent '819 and '531 Patents.

We can just bring up slide 45.

Okay. Without going through all of them, is this -- Dr. Jiao, does this slide set forth the so-called Wand factors, as you understand them?

A. Yes.

Q. Did you consider these factors in forming your opinions as to the validity of the '819 and the '531 Patents, or the asserted claims of the '819 and '531 Patents?

A. Yes, I did.

Q. Let me ask you a few questions about the breadth of the claims, and would you characterize the asserted claims of the '531 Patent as being limited to any type of lighting device?

A. No. The breadth of the claim for these two asserted patents are very broad and covers all lighting applications.

Q. Are they limited to any particular type of lighting device, the '819 Patent?

A. It does not. Covers all lighting devices.

Q. Just as long as it has one LED; correct?

A. As long as it's using LED or solid-state emitter.

Q. In the '531 Patent?

A. Correct.

Q. Correct.

Okay. And moving on, the '819 Patent recites a wall plug efficiency of 60 lumens per watt; correct?

A. Yes.

Q. Would one of ordinary skill reading that claim understand that is limited to any particular upper range of wall plug efficiency?

A. No.

Q. The Claim 1 of the '531 Patent similarly recites wall plug efficiency of up to -- of at least 85 lumens per watt; correct?

A. Right.

Q. Would a person of ordinary skill reading Claim 1 of the '531 Patent understand that it is limited to any particular upper range of wall plug efficiency?

A. No.

Q. Are the asserted claims in the '819 and '531 Patents limited to lighting devices emitting a particular color temperature?

A. No, other than Claim 24 of the '819 Patent, and overall covers any kind of light or white light.

Q. Do any of the asserted claims of the '819 and '531 Patent specify a particular arrangement or type of LED components by which to achieve wall plug efficiency ranges as stated or as claimed in the patents?

A. No, the claims are very broad for any kind of light-emitting device -- emitters, not --

Q. The claimed --

A. Not particularly -- not limited to LEDs in

the --

Q. Okay.

A. -- in the terms, using a solid-state emitter.

Q. So are the claims limited to using the BSY+R approach specifically disclosed in the specifications of the patents?

A. No. It covers all approaches to generate the light or white light.

Q. With respect to the nature of LED devices, what components are typically used?

A. Well, the LED lighting devices must have a light source, namely, using LED as the light source. The light source is integrated with the other components, electronic electrical components, such as driver optical -- optical components, such as the secondary optics, if necessary, and the mechanical thermal components and -- for assembly and to manage the heat.

Q. To achieve wall plug efficiency, which component or components are most important?

A. The LED light source level of efficacy is the most important part.

Q. Why is that?

A. Because the lighting devices can never be higher than light source efficacy, yet when you have other components being assembled or integrated into one lighting

device, and you need it to have the description, what the contribution of the loss is introduced by other components.

So in -- without very efficient or high-efficacy light sources, you can't achieve the wall plug efficiency numbers disclosed in the claims.

Q. As of 2008, what challenges existed or faced the industry in order to make LED light sources more efficient?

A. Well, the main challenge is, again, the light source level of the improvement, including the die and the phosphor improvement.

Q. Have you heard the term "green gap"?

A. Yes.

Q. What does that refer to?

A. That refers to the semiconductor emission property. In the green region, the -- due to the semiconductor property itself, and the process of making the LED die, and it's very challenging to emit the green light in the semiconductor devices.

Q. As of 2006 to 2008, were there clear or established standards for measuring and testing LED lighting devices?

A. Not yet. The industry was pretty aggressively working on the standardization for measuring LEDs and LED lighting devices during that time frame. The first standards we published was 2008.

Q. In your opinion, would it be important to -- that there be established testing standards to determine efficacy?

A. Very important, because the LED lighting test conditions, and -- has to be clearly defined, and otherwise, the test result will be inconsistent, unreliable, non-reproducible.

Q. Starting with the '819 Patent, how much direction does it -- does the specification provide as to how to make a lighting device within any of the specific claimed efficacy ranges?

A. There's no directions.

Q. Any -- what information is missing from the '819 specification that would be needed for a person of ordinary skill to make and use a lighting device with, say, 60 lumens per watt, as of May 2007?

A. The key part -- the key piece is the LED source level requirements. In order to achieve the lighting device level, wall plug efficiency, what is the light source needed or specified.

Q. I think you also mentioned the color content?

A. Yes. Because the '819 Patent, and specifically described approach of using BSY+R, and it is also very essential to describe the color content contributed by each emitter in order to achieve the desired white light,

specifically warm white.

Q. The '819 Patent discloses a red LED made by Epistar and a blue LED die manufactured by Cree, the C460XT290. Why doesn't that provide sufficient information about the LED components?

A. Well, that's only the description of the part itself without describing the performance necessary to achieve such efficacy level.

Q. Let's go to slide 46. What is shown on slide 46?

A. Well, on the left is the -- first embodiment that described what die is used, more specifically the model disclosed is C460XT290.

As I testified earlier, that is commercially available Cree LED die with the performance characteristics disclosed in this embodiment, and light of -- the optical output is 24 milliwatts.

Where on the top, it indicates -- of the slides indicate the April 2006 prototype tested, namely, the project number D3-1, that is using XT-31 die. In my opinion, that's a different part.

Q. Do you believe that --

A. That's from --

Q. I'm sorry.

Do you believe that's the different part that

was referenced in the e-mail we looked at previously between Ms. Merrell and Mr. Negley?

A. Yes, I do, just by looking at the model number, and also the operating current, and that indicates XT-31 is not XT-24, or the C460XT290 die.

Q. Let's go to slide 47.

What is shown here?

A. This is the commercial product of the data sheet described how much light, optical output for this product even with the binning, the highest bin, this product produced 24 milliwatts optical output in the nearest, highest bin.

The rest of the bins are mixed with a much lower output.

Q. Are you able -- I'm sorry. Go ahead.

A. The die manufacturers has almost the responsibility, the obligations to tell users, and for each product what its performance associated with the product, especially for LEDs, and what performance is associated with each bin.

In the LED industry, the binning tolerance is pretty well known. You could vary another 10 percent-ish.

Whatever the binning change, you must provide the corresponding characteristics defined the code. And XT-24 is the highest bin for this product, 24 milliwatts.

Q. So are you able simply to look up the efficacy of the identified C460XT290 from its data sheet?

A. No. Blue LEDs, the output is only measured with the optical power, not photometric flux. Not a luminous flux.

The blue LEDs or the blue light is being very less sensitive to human eyes.

So the blue light measurements typically do not use a luminous flux. Instead it's using radiated flux. The quantity of the blue light is using milliwatts or watts instead of lumens of white lights or other colors of light.

Q. Let's pull up RX-750.

Do you understand what is shown on RX-750?

A. Yes. That was the same as previous slide. That shows D3-1 is the project number that used these two parts, XT-31 and Epistar, and they have different numbers, from the first embodiment. They do have three strings, and they tested in 700 lumen output with the 10 watts input, achieved 73 lumen per watts at a CRI of 92, that matches exactly the CSA report which they also marked as yes for CSA.

Q. Does the April 2006 CSA prototype refer to a particular internal project name at LLF?

A. My understanding is the DS1 -- the D3-1.

Q. Let's go back to the -- to slide 48.

What type of LED components are listed for the April 2006 CSA prototype in the project list?

A. At least the blue die is XT-31, and red die is Epistar die, with the defined wavelength 660 nanometer, and with output of 600 millicandela. And they also described the strings and total number of LEDs on this project sheet.

And that matches the April 2006 CSA test report of 72.7 lumen per watts.

Q. Let's go to slide 49.

What is shown here? First of all, do you recognize -- can I just -- I think we'll bring up RPX-001 so that you can identify it for the record.

Do you recognize RPX-001?

A. Yes.

Q. Then let's -- if I can, let's go back to the slide RDX-49, and can I ask you if you can identify the spreadsheet shown here?

A. Yes. The spreadsheet shows internal record for a model LLF-T3. That was built -- or the project was issued the dates on the sheet is February 16, 2006.

The sheets indicate what kind of die or chip they're using, and this one uses XT-24. That is the first embodiment description in this particular case. They specified how many XT-24 it uses. Also, the operating current is 20 milliamps, that's exactly the data sheets

described.

In addition, they also have other dies, XT-27. By altering from 24 to 27, which is no longer in the data sheets, and this spreadsheet shows the operating current is different, and instead of 20 milliamps, these 27s could -- XT-27s could be operating 40 milliamps.

In my opinion, an XT-27 is not the same die as XT-24, and for that reason, based on nomenclature, anything -- not anything above XT-24, it's not the same die.

Q. Meaning this spreadsheet does reference the C460XT290 blue dies, does it?

A. It did. It shows several of the XT-24 were used in this prototype.

Q. What were the -- what was the greatest efficacy level that was achieved using this prototype as shown by this spreadsheet?

A. Well, this spreadsheet shows using XT-24 die, with the phosphor, the blue-shift yellow phosphor approach, in the die and the LED package level in the -- they received 69.1 lumen per watts, if I read it correctly. That's the highest one for XT-24 die operated, converted bluish-yellowish lights efficacy.

Q. Could the wall plug efficiency of an LED lighting device using the components listed here be used to

build a lighting device with a wall plug efficiency of at least 60 lumens per watt?

A. No.

Q. Why is that?

A. It shows the report, 53.5.

Q. Okay. Simple enough.

Let's turn to the '531 Patent.

How much direction does it provide in the specification how to make or use a lighting device with the claimed efficacy ranges?

A. There's no direction provided in the patent.

Q. The '531 Patent does disclose a wall plug efficiency of 113.5, doesn't it, for the prototype shown, does it not?

A. It does.

Q. But what is missing, then?

A. What is missing is the light source level of efficacy. The light source level performance was not described.

Q. Anything else?

A. Furthermore, because '531 also uses two types of emitters, saturated, non-saturated. To achieve a specific color temperature or warm white, you needed to specify what color content; otherwise, the POSA would not be able to come out with whatever number, or you have to conduct

substantial amounts of experimentation.

Q. Well, how much -- if you can estimate, how much work would a person of ordinary skill have needed to engage in to practice the claimed inventions of '819 and '531 Patents?

A. Well, my understanding is that can be very substantial amounts, and I -- as I testified earlier, if you use the LED as emitter source, first of all, in order to achieve the lighting level efficacy, minimally, you needed to know what emitters level, light source level of efficacy is.

In this particular approach, the BSY+R approach, the BSY is very wide color space, and it's not white light. It's this greenish-yellowish light. And red is defined rather narrowly, yet how much the contributions from the wide space BSY in terms of number of emitters, in terms of total amount of light contributions, in terms of where the contribution comes from, which color specific the content is, that requires tons of experimentation to really get to this combined color into this wide space and described. On top of that, in each type of emitter and what type of efficacy needed in order to combine those.

For that reason, the experimentation is very substantial amount.

Q. Now, to take one example, the '819 Patent

references as a claim reciting an efficacy level of 80 to 85 lumens per watt, is there anything in this patent specification that, to your mind, indicates the inventors were able to build a device with a wall plug efficiency of 80 lumens per watt?

A. Well, the '531 Patent disclosed one example, 113.5 lumen per watts, right?

Q. Right.

A. So if I may ask you to repeat your question.

Q. You recall there was testimony about record levels reached in the testing done by LLF. And with those in mind, was there anything in the '819 Patent specification that, to your mind, indicated that the inventors were able to build devices with wall plug efficiencies of greater than 80 lumens per watt, as of the date of the application?

A. I'm sorry. You're referring to the '819 Patent?

Q. Yes.

A. No, no. The highest that they got was 79.79.

Q. Right. You testified that the '819 and '531 Patents don't teach a new method of producing white light other than the BSY+R; is that right?

A. Correct.

Q. Could the BSY+R approach be applied to the so-called RBG LED approach?

A. No, RBG is using single-color emitter.
Q. A series of single-color emitters; correct?
A. Yes.
Q. Right.
A. Emitters.
Q. Could the BSY+R approach be applied to effectuate the PC conversion LED approach that you described?
A. No, because PC conversion is using the blue or UV LED die to excite the phosphor with the wider spectrum, including red content. And BSY+R is the concept to add red LED.
Q. Is there anything in the '819 or '531 Patents indicating the inventors thought their invention involved using any approach producing white light other than BSY+R?
A. No.
Q. Is there anything in the -- excuse me. Did I -- I didn't mean to cut you off?
A. Actually, they discouraged the conventional approach.
Q. Okay.
Do you -- let's pull up Exhibit JX-80.
Do you recall listening yesterday to Dr. Wetzel's testimony on priority issues?
A. Yes.

Q. Okay. What embodiments are disclosed in this provisional application?

A. First embodiment.

Q. Okay. Have you seen any evidence the first embodiment could practice any of the asserted claims?

A. No, instead, I have seen that April 2006 test was not first embodiment.

Q. Okay. And let's -- I won't go back over your testimony as to why you -- I think we have covered that well enough.

Let's turn to the '531 Patent.

Do you agree with Dr. Wetzel that the '819 Patent provides enablement in written description support for Claims 1 and 25 of the patent?

A. No, I disagree.

Q. Does the '819 Patent enable any claim of the wall plug efficiency of at least 85 lumens per watt?

A. No, it doesn't.

Q. Let's go to slide 50, discussing prior art.

Do you -- well, first, let me back up.

I think we need to identify JX-150, and can you identify JX-150?

A. Yes.

Q. What is it?

A. This is a report submitted by Paul Fini and

Shuji Nakamura to DOE on July 30, 2005, for LED Lighting Fixture performance achievement.

Q. Did Mr. Nakamura's work on LEDs garner him any recognition in the wider world?

A. Yes, he was a Nobel Prize winner for physics based on his work for the blue LED development.

Q. Now, this article, JX-150, does it describe work that Dr. Nakamura and Fini conducted together with a Dr. Narendran?

A. That is correct.

Q. Do you have a general understanding of what that work was they did together?

A. Yes. Dr. Narendran and his team did improvements on the LED package level, and Fini/Nakamura's report is collaboratively using that technology to put the LED package into the lighting fixture to obtain very high luminous efficacy for the lighting fixture, a lighting device.

Q. Are you familiar with the term "scattered photon extraction"?

A. Yes, I am.

Q. Is that the advance that Dr. Narendran had achieved?

A. It is.

Q. Can you just give us a high-level understanding

of what a scattered photon extraction or SPE means?

A. Yes. I believe I have a demonstrative of Dr. Narendran's work.

Q. Just at a very high level, if you could.

A. Well, the higher level -- I was hoping that I could demonstrate -- is his concept is here, is in a conventional LED, phosphor-converted LED die, and the phosphor is often very close to the die or often mixed with an encapsulant. Dr. Narendran and his team's work is to remotely put the phosphor away from the die by properly designed optics, especially in conjunction with encapsulant, these phosphor back-scattered photons, and can be redirected using properly designed optics toward a direction that is desired, and in turn, the LED package level, the efficacy was improved significantly.

Q. Okay. I will come back to show you.

I think I know what you want to look at, but first, just to move forward, let's look at slide 51 of your demonstrative exhibits.

I'd like to ask you what slide 51 illustrates.

A. This illustrated the LED -- the package level was using the SPE technology, or invention from Dr. Narendran being integrated into a lighting fixture, and with a few components listed in the illustration, including the optical elements, and the driver, and other mechanical

elements to form a lighting fixture or lighting device.

Q. As shown in -- does Figure 64 show a complete light fixture, or just a package?

A. No, it's a lighting fixture -- light fixture.

Q. Okay. What do you mean by a complete light fixture?

A. Well, in the lighting industry, we typically don't use the word "fixture." We use two terminologies to describe the final product, namely, lamp and luminaire.

And lump and luminaire are lighting product or lighting device that's being used directly with the users that it can be connected to the wall plug.

This figure demonstrates a luminaire.

Q. Okay. Let's go to the next slide, 52, and I'd like to ask you about whether Fini and Nakamura included test results for the light fixture or lamp illustrated in Figure 64?

A. It demonstrates at an operating current of -- LED operating current of 50 milliamps that this light fixture achieved 78 lumens per watt efficacy.

Q. In your view, does the reported lumens per watt efficacy figure satisfy the requirements of the '819 Patent having an efficacy of greater than 60 lumens per watt?

A. Correct.

Q. Does the reported 78 lumens per watt efficacy

meet the elements of Claims '819, that wall plug efficiency achieved of -- between 70 and 80 lumens per watt?

A. Yes. 70 and 80 -- it's about 80, yes.

Q. Does the reported 78 lumens per watt efficacy figure meet the elements of the asserted claims of the '819 Patent requiring wall plug efficiency between 60 and 70 lumens per watt?

A. Yes.

Q. In your view, does the reported efficacy level of 78 lumens per watt meet the elements of the claims of the '819 Patent requiring the wall plug efficiency of about 80 to 85 lumens per watt?

A. Yes. In my view, this is only demonstrating example of 50 milliamps LED level operating current, and the report also demonstrated data shows the trend, and the lower current, higher lumens per watt values can be achieved.

Q. Well, let's go to -- let's look at slide 53 of the demonstrative exhibits, and ask if there's any other information in the report that discloses a fixture with a wall plug efficiency of between 80 and 85 lumens per watt?

A. Well, if you look at the graph in the middle, and they demonstrate the efficacy, lumens per watt value, the right curve, each point is selectively testing the current in terms of milliamps for the LED package level.

And yes, you have selectively test a few points, and the important part is between test point is the trend. And as you can see from this curve, the trend goes up rather sharply. If you further reduce the operating current less than 50 milliamps, it's pretty obvious. You can go up higher than 85 lumens per watt.

Q. Does the Fini/Nakamura report reveal the use of at least one light-emitting diode?

A. Yes.

Q. Claims 52 and I believe 60 of the '819 Patent recite AC electricity.

Does the Fini/Nakamura report reveal use of AC electricity?

A. Yes, this is the light fixture or luminaire is default. It connected to the wall plug.

Q. Can you summarize the optical components you revealed in the Fini/Nakamura report?

A. The LED die was packaged into that SPE package. It looks like with the primary optics on the die, on the package level. Then you have the reflective -- the highly reflective reflector, and you also have a diffuser on the diagram, yet the diffuser appears to be optional.

Q. The Fini/Nakamura report mentions that the high-reflective paint has an efficiency of 7 -- 97 percent and a machine reflector -- an efficiency of 94 percent.

Does this mean that the efficiency of the device should be subtracted out, 3 and 6 percent to determine the ultimate wall plug efficiency respectively?

A. No.

Q. Why is that?

A. Well, the reflector efficiency is only indicating that with the lights that hit on the reflector, that are being reflected, and as you can see -- and this LED was primary optics.

The majority of lights are projecting in the beam pattern without hitting the reflector. Whatever the lights in the larger spread angle hitting the reflector being redirected will be highly reflected, but this very small portion of the light beam will hit the reflector.

Q. Okay. So to summarize, if I understand what you're saying, that most of the light will go directly into the illumination area, and only a small percent will even need to be reflected off of the paint or other -- or other reflector?

A. Correct.

Q. Okay. I think you said also that the diffuser is not -- you don't need to use the diffuser to practice the invention or show or make the device shown in the Fini/Nakamura technical report?

A. The diffuser is typically used to enhance light

appearance, avoid a glare, uniformity or sometimes a decorative purpose.

I can see in the figure -- the lower portion of the figure, the diffuser doesn't have to be used.

Q. What is shown in Figure 65 of the Fini/Nakamura report?

A. Again, the Figure 65 shows the current dependency of the fixture, and meaning if you operate the LED current in lower current, and the overall efficacy, and also the lower efficacy -- overall efficacy is increasing.

And the way to look at the -- how much increase is demonstrated this figure is the solid red line.

Q. So with the -- running this device at lower than 50 milliamps, do you believe, or would a person of ordinary skill understand that an efficacy level of over 78 lumens per watt could be achieved?

A. Correct.

Q. Let's pull up JX-150, and go to page 66.

Is the drawing in Figure -- I think I have to go back to Figure 64.

Is a driver shown in the Fini/Nakamura device?

A. A driver doesn't have to be shown. This shows the driver is part of the integration with the heat sink. And by the way, when you mentioned the word light fixture, and driver is default.

All of the LEDs need a driver, and without driver, LED lighting devices cannot be operating.

Q. Let's pull up Exhibit RX-40.

Can you identify what this is?

A. This report I previously testified is from Narendran and his team.

Q. Does this report describe the photon extraction method?

A. Yes.

Q. Sorry. Extraction method.

I -- let's go to slide 57. And perhaps this -- was this the diagram you wanted to refer to earlier to explain scattered photon extraction?

A. Yes.

Q. Okay. Can you perhaps, then, with this in front of us, can you explain a little more clearly what is the concept?

A. The concept is, looking at the illustration, the die, which in this case is gallium nitride die. The phosphor layer is placed away from the die.

By placing the phosphor layer away from the die, yet there's back-scattered light. And the one important part is that -- the arrow on the right. You see the optics.

If you design the optics correctly, and these

back-scattered light can be recollected into the direction in the illumination -- desired illumination direction.

So generally speaking is you don't waste the photons by using. Better way to collect the back-scattered photon to be used for illumination -- for the desired direction of the illumination.

Q. Does the Narendran article disclose testing of an SPE package or scattered photon extraction package?

A. Yes.

Q. Let's go to slide 58.

Can you tell us what test results are reported in the Narendran article?

A. The test report in his article shows the comparison between two sets of samples, with SPE approach, and with the typical without the SPE approach.

That demonstrated the total lumen output has significant improvements. If I recall, 6 percent. Using the total lumen output, without changing the input of power, the efficacy is improved equally.

Q. Let's turn to slide 59, which is Figure 6 of the Narendran article.

What does Figure 6 reveal?

A. That's the same figure that's used by Fini and Nakamura's report.

Q. Okay.

A. Again, it's the current dependency. Having a lower current, you can further improve. This particular figure shows the package level how much you can improve.

As you can see, the current level, 50 milliamps, the test result is lumen -- 80 lumens per watt, but the trend shows rather significant increase in -- quick increase, if you further reduce current.

So the package level in this LED package can have a much higher than 80 lumens per watts if you are running a lower current.

Q. Can you pull up RX-0039.

Can you identify RX-0039, Dr. Jiao?

A. Yes. That was using that --

Q. I'm sorry. I didn't mean to cut you off.

Is this a press release discussing the -- from April 2005 discussing the SPE technology?

A. Correct.

Q. Let's pull up JX-151.

Can you identify what's been marked as JX-151?

A. That is a report submitted to DOE by James Ibbetson.

Q. Okay.

A. Ibbetson.

Q. It's getting late in the day.

Let's go to slide 62, which I think summarizes

some of the finds in the Ibbetson report.

And first of all, I think it was cited in the previous paper.

When was the Ibbetson report issued? If you want, we can pull back up JX-151. I apologize.

A. Well, that was the submission date, right? It's April 2007.

Q. That's fine. Yeah, that's fine.

Let's now -- I apologize. Let's go back to slide 62.

Can you provide an overview of this -- of the publication?

A. Well, Ibbetson's report also demonstrates LED lighting device, in this case, it's a lamp, equivalent to PAR38 lamp, using LED to achieve high efficacy.

Q. Does the Ibbetson report discuss a package or an actual lamp prototype?

A. That is lamp. This is, you know, part of the DOE/SSL project is --

Q. Is that -- go ahead. I'm sorry. I didn't mean to speak over you.

A. The integration of using LED into lamp, luminaire or light fixture, including the Fini/Nakamura report, and this report is really similar to the same track of DOE/SSL program, this is for lighting fixture -- or

light fixture, lighting device level of technology improvement.

Q. Why is the prototype lamp tested by Mr. Ibbetson relevant to your opinions?

A. Because this shows LED lighting device in this art can achieve the wall plug efficiency in the asserted claims.

Q. Let's go to slide 63 of the demonstrative.

And can you summarize what's shown here?

A. This lamp demonstrated in this prior art, or this report, shows when the LEDs are operating in the current density of 50 milli -- 50 amps per centimeter squared, at the lamp level, you can achieve 87 lumen per watts of efficacy.

Q. If you reduce the -- does the Ibbetson report -- where is that -- does the Ibbetson report indicate any way that, to a person of ordinary skill in the art, it would be able to achieve even higher levels of efficacy?

A. Yes. If you look at the current dependency projections or trends on the right-hand side, and you can see at 50 amp per centimeter squared, you obtain 87, but the curve didn't stop. So if you further reduce the current density less than 50 amps per centimeter squared, much higher efficacy can be achieved on the lamp level. It can be much higher, 113.5.

Q. How high -- as you read the table or chart shown --

A. When I read --

Q. -- in 116 -- how high was Mr. Ibbetson -- or Dr. Ibbetson projecting he could achieve?

A. Well, the graphic shows, you know, certainly higher than 115, or 110 or 115. It's close to 120 lumen per watts.

Q. So I think we touched on this earlier, but can you explain perhaps a little more clearly how current density affects efficacy?

A. Well, similar to the lower current achieving higher LED level of efficacy, the current density is actually more precise description of how the LED die is being operating.

The current density is using the current -- amount of current divided by die size. So if the die is smaller and same current, would certainly have a higher current density.

So in this way, it's a more objective way to measure the LED die or package level current dependency, is using current density, because apparently, if you are using only current, you don't know what the die size, it's not as accurate as current density.

Q. Does the Ibbetson report show that his device

was able to meet the limitations of Claim 1 of the '531 Patent?

A. Yes.

Q. Does Claim 1 of the -- Claim 1 recites, "At least one solid-state light emitter."

Does the Ibbetson report meet that limitation?

A. Yes, it does.

Q. Claim 1 also recites a solid lighting device, when supplied with electricity of a first wattage, emitting output light having a wall plug efficiency of at least 85 lumens per watt of said electricity.

Does the Ibbetson report meet this limitation?

A. Yes.

Q. Does the Ibbetson report meet claims, let's see, 10, 11, 12, 25 and 26 of the '531 Patent?

A. Yes.

JUDGE CHENEY: Mr. Moskin, is that a natural place to wrap for the day?

MR. MOSKIN: Sure.

JUDGE CHENEY: Okay.

Dr. Jiao, I understand you're going to be returning to the stand tomorrow to give us some additional testimony. In the hours between now and then, please don't discuss your testimony with anyone. We'll see you tomorrow morning. You are excused while I talk with the attorneys

about some housekeeping matters.

THE WITNESS: Thank you.

JUDGE CHENEY: Okay. Anything that you want to raise housekeeping-wise, Mr. Moskin, as you're here on the screen?

MR. MOSKIN: Nothing that I'm -- nothing from RAB.

JUDGE CHENEY: Okay.

What about Cree; anything Cree wants to raise?

MR. ERWINE: Yes, Your Honor. I was just going to mention, we do intend to send some updated time estimates for tomorrow and Friday. And I think we still need to confer with RAB about this, but our best guess, as we can tell now, is we're going to be able to finish on Friday with sufficient time to spare.

JUDGE CHENEY: Happy to hear that.

Trial abhors a vacuum. It tends to expand to fill the time allotted, but let's do try to keep things moving along efficiently, because if we let our guard down, we'll suddenly find ourselves out of time.

MR. MOSKIN: Indeed.

JUDGE CHENEY: So nothing else to talk about?

MR. ERWINE: Not from Cree Lighting, Your Honor.

JUDGE CHENEY: Okay.

Well, here is your Wednesday night pep talk:

You're more than halfway there. Good job, everyone, in making it this far. It's going well. I'm learning a lot. And I look forward to tomorrow. Do take care and we will see you in morning.

We're off the record.

MR. MOSKIN: Thank you.

(Whereupon, the proceedings were recessed at 4:32 p.m.)

I N D E X

Confidential Sessions: (None)

E X H I B I T S

EXHIBIT NO:	RECEIVED
LISTS PROVIDED BY COUNSEL TO BE RECEIVED IN EVIDENCE	
RAB	
Dr. Lebby	
RDX-0012	
CDX-0002C	
Mr. Negley	
RX-0737	
JX-0016	
RX-0738	
RX-0050	

RX-0051
RX-0743C
RX-0658
RX-077C
RX-0180C
RX-0750C
RX-0740C
JX-0159
RPX-0001
JX-0066C
Mr. Edmond
RX-0658
Dr. Wetzel
RX-0658
Cree Lighting:
Dr. Lebby
CPX-0035
CPX-1893C
CPX-1894C
CPX-1895C
CX-0342C
CX-0343C
CX-0345C
CX-0606
CX-0646

CX-0647C
CX-0648C
CX-0649C
CX-0655C
CX-0656
CX-0661C
CX-0662C
CX-0664C
CX-0666
CX-0668
CX-0672
CX-0673
CX-0674
CX-0676
CX-0677
CX-0680
CX-0683
CX-0965
CX-1893C
CX-1894C
CX-1895C
JX-0005
JX-0077C
JX-0084
JX-0085

JX-0086
Mr. Negley
JX-1
JX-2
JX-14
JX-17
JX-45
JPX-70
CPX-144
Mr. Edmond
JX-1
JX-45
JPX-70
Mr. Wetzel
CX-0056
CX-0342C
CX-0345C
CX-0352C
CX-0353C
CX-0465C
CX-0473C
CX-0474C
CX-0712
CX-1887C
JX-0001

JX-0002
JX-0018
JX-0072
JX-0077C
JX-0080
JX-0081
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JX-0118C
JX-0119C
JX-0141C

CERTIFICATE OF REPORTER

TITLE: Certain Light-Emitting Diode Products, Fixtures, and Components Thereof

INVESTIGATION NO: 337-TA-1213

HEARING DATE: May 5, 2021

LOCATION: Washington, D.C. - Remote

NATURE OF HEARING: Evidentiary Hearing

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