

1 UNITED STATES PATENT AND TRADEMARK OFFICE 2 BEFORE THE PATENT TRIAL AND APPEAL BOARD 3 4 5 APPLE INC., 6 Petitioner 7 v. 8 RJ TECHNOLOGY LLC, 9 Patent Owner 10 11 Case IPR2023-01350 12 Patent 7,749,641 13 14 15 16 17 DEPOSITION OF LOUIS HRUSKA 18 TAKEN REMOTELY BY VIDEOCONFERENCE 19 Tuesday, June 4, 2024 20 21 22 23 24 Reported by: Mary Ann Payonk 25 Job No. 1461	Page 1 1 APPEARANCES: 2 ON BEHALF OF PETITIONER: 3 FISH & RICHARDSON PC 4 HYUN JIN IN, ESQ. 5 1000 Maine Ave SW, Suite 1000 6 Washington, DC 20024 7 GRETCHEN DEVRIES, ESQ. 8 60 South Sixth Street 9 Minneapolis, MN 55402 10 11 ON BEHALF OF PATENT OWNER: 12 GEORGE STAMATOPOULOS, ESQ. 13 ROBERT ZHOU, ESQ. 14 KOBRE & KIM 15 800 Third Avenue 16 New York, New York 10022 17 18 MINGHUI YANG, ESQ. 19 CARMICHAEL IP, PLLC 20 8607 Westwood Center Drive, Suite 270 21 Tysons, VA 22182 22 23 ALSO PRESENT: 24 Deric Shults, Videographer, BlueBear Law 25 Annliese Coleman, BlueBear Law
Page 2 1 2 3 4 June 4, 2024 5 7:00 a.m. Pacific 6 7 DEPOSITION OF LOUIS HRUSKA taken remotely by 8 videoconference pursuant to Notice and agreement of 9 counsel, stenographically reported by Mary Ann Payonk, 10 Shorthand Reporter and Notary Public, CA CSR No. 13431. 11 All attorneys participating in this deposition 12 acknowledge that the reporter is not physically present 13 in the deposition room and there is no objection to the 14 oath being administered remotely. 15 16 17 18 19 20 21 22 23 24 25	Page 4 1 THE VIDEOGRAPHER: We are now on the record. 2 The time is 7:03 AM Pacific Standard Time. Today's date 3 is June 4, 2024. This begins the remote video-recorded 4 deposition of Louis Hruska in the matter of Apple, Inc. 5 versus RJ Technology LLC. 6 I'll be recording this deposition remotely, 7 and the reporter will swear in the witness remotely 8 pursuant to Federal Rules of Civil Procedure and the 9 stipulated deposition protocol in this case. 10 My name is Deric Shults, and I'm with BlueBear 11 Solutions. Our court reporter is Mary Ann Payonk. 12 Counsel, please identify yourselves and state 13 whom you represent. 14 ATTORNEY STAMATOPOULOS: George Stamatopoulos 15 for patent owner. With me here today is Robert Zhou, 16 also for patent owner. We're from the law firm of 17 Kobre & Kim. And Mitch Yang from Carmichael, the 18 Carmichael firm, also for patent owner. 19 ATTORNEY IN: Hyun Jin In of Fish & Richardson 20 on behalf of petitioner Apple. I'm joined by Gretchen 21 DeVries also for Apple. 22 THE VIDEOGRAPHER: Are there any stipulations 23 or announcements from either party? 24 ATTORNEY STAMATOPOULOS: No. 25 ATTORNEY IN: No.

1 THE VIDEOGRAPHER: Would the court reporter 2 please swear in the witness. 3 THE REPORTER: Yes. I'll first give you my 4 California license number, which is 13431. And now I'll 5 swear the witness. 6 LOUIS HRUSKA, 7 called as a witness, having been duly 8 sworn, was examined and testified as 9 follows: 10 EXAMINATION 11 BY ATTORNEY STAMATOPOULOS: 12 Q. Good morning, Mr. Hruska. How are you? 13 A. I'm good, thank you. Good morning. 14 Q. Have you ever been deposed before, sir? 15 A. Yes, I have. 16 Q. Approximately how many times? 17 A. At least a dozen, maybe 15. 18 Q. You said maybe 50? 19 A. Maybe 15. 20 Q. Okay. And have you ever been deposed in 21 proceedings before the PTAB? 22 A. Yes, I have. 23 Q. Approximately how many times? 24 A. Once. 25 Q. So the remainder of your testimony has been in	Page 5 1 A. I certainly will. 2 Q. And your lawyer may at times object to a 3 question that I've asked. But even if your lawyer 4 objects, you understand that you should still answer my 5 question unless, of course, your lawyer instructs you 6 not to answer. 7 Is that fair? 8 A. That is. 9 Q. And if you think of something after you've 10 answered one of my questions that would complete your 11 answer to that question, you'll let me know and we can 12 go back to that topic. 13 Fair? 14 A. Yes. 15 Q. Now, sir, other than your laptop -- let me 16 actually withdraw that. 17 Do you have any electronic devices with you in 18 the room today other than the device, of course, through 19 which you're connecting to this deposition? 20 A. I have an iPad on my desk. 21 Q. And is that the same device through which 22 you're connected to the deposition? 23 A. No, it's not. 24 Q. Is the iPad on? 25 A. Not right now, no. Page 7
1 District Court proceedings? 2 A. Or for the ITC. 3 Q. Now, you understand that your testimony here 4 today is under oath just like it would be in court? 5 A. Yes, I do. 6 Q. And is there any reason why you can't give 7 accurate and complete testimony here today? 8 A. No, there isn't. 9 Q. So one thing I'll ask -- you're familiar with 10 the deposition process -- is that you phrase your 11 answers with words as opposed to gestures or nonwords. 12 That's for the benefit of the record as well as the 13 court reporter. 14 Is that fair, sir? 15 A. Certainly. 16 Q. And I'll do my best not to speak over you and 17 let you complete your answers to my questions. At times 18 that might be hard, given that this is a Zoom 19 deposition, but I'll do my best. And you'll let me 20 finish my questions as well. 21 Is that fair? 22 A. That is. 23 Q. And if I ask you an unclear question or a 24 question that you don't understand, you'll let me know, 25 sir, so that I can maybe try to ask a better question? Page 6	Page 8 1 Q. Okay. Do you have a cellphone or any other 2 electronic device with you? 3 A. No, I -- my phone's not here. 4 Q. Do you have any notes with you in the room 5 today? 6 A. I have a binder with copies of my report and 7 the relevant patents, but no personal notes, no. 8 Q. Okay. Do you have access to any personal 9 notes from where you're sitting? 10 A. No, no. 11 Q. All right. Mr. Hruska, you mentioned a copy 12 of your report. So you prepared a report in this case. 13 Correct? 14 A. That's correct. 15 Q. And sometimes we'll refer to this report as 16 your declaration. 17 Is that fair? 18 A. It is. 19 Q. You'll understand what I'm talking about? 20 A. Yes, I will. 21 Q. Great. 22 Now, setting aside the declaration, did you do 23 anything to prepare for your testimony here today? 24 ATTORNEY IN: Let me just caution the witness 25 not to reveal substance of any communications you may

1 have had with your counsel. But insofar as you can 2 generally answer the process, please do so. 3 A. Yes, I met with Ms. DeVries and my attorney, 4 HJ, by Zoom call twice. 5 BY ATTORNEY STAMATOPOULOS: 6 Q. And when were those calls? 7 A. Yesterday and Friday. 8 Q. Okay. And approximately how long did those 9 calls last? 10 A. Total of four hours, four to five hours. 11 Q. Each? 12 A. No, total. 13 Q. And other than your attorneys did you speak 14 with anybody else? 15 A. Yes. I mentioned Ms. DeVries, who I believe 16 is on this call. 17 Q. And do you know what Ms. DeVries' role is? 18 A. Yes. She works for Fish & Richardson, 19 supports, in this case, Apple's position. I don't know 20 her exact title at the moment. 21 ATTORNEY STAMATOPOULOS: Counsel, is it okay 22 if I ask what Ms. DeVries' title is, briefly? 23 ATTORNEY IN: Yeah, it's a senior patent 24 agent, and she's of record in these proceedings. 25 ATTORNEY STAMATOPOULOS: Okay.	Page 9 1 your report? 2 A. Well, it was almost a year ago, so I'm trying 3 to remember. I think it was more than 40 hours. 4 Q. Can you walk me through the process at a high 5 level? 6 ATTORNEY IN: Again, I caution the witness not 7 to reveal the substance of any discussions you may have 8 had with counsel, but you may answer. 9 THE WITNESS: Perhaps you could be more 10 specific. Process? What process you're asking about. 11 BY ATTORNEY STAMATOPOULOS: 12 Q. So you mentioned you prepared your declaration 13 in this case. Correct? 14 A. That's correct. 15 Q. And your declaration is in support of Apple's 16 positions against a patent that is at issue in these 17 proceedings. Correct? 18 A. That's correct. 19 Q. And in particular, Apple's position is that 20 many of the claims in that patent are invalid. Correct? 21 A. I -- 22 ATTORNEY IN: Objection. Form. 23 A. I didn't offer an opinion as to what Apple's 24 position is. That was not part of the process, as you 25 put it, of developing my declaration.
1 BY ATTORNEY STAMATOPOULOS: 2 Q. Mr. Hruska, did you review any documents in 3 preparing for your deposition? 4 A. Yes, the documents that I mentioned that I 5 have before me now. My report. The response from RJ, 6 and all of the patents that are part of that binder. 7 Q. Any documents that were not part of the 8 record -- let me withdraw that. 9 Did you review any documents that were not 10 part of the record insofar as you know in preparing for 11 your deposition? 12 ATTORNEY IN: Objection. Form. Scope. 13 A. I -- to be honest, I'm not sure I've got a -- 14 other than the documents listed here, which are made 15 part of the record, I'm not sure I have a complete list 16 of what's part of the record. But no, I did not. 17 BY ATTORNEY STAMATOPOULOS: 18 Q. Now, you mentioned you submitted a declaration 19 in this case. Correct? 20 A. Correct. 21 Q. And who prepared your declaration? 22 A. I did. I mean, of course, I didn't physically 23 type in many of the details, but it's my report. I 24 wrote it. 25 Q. Okay. And how much time did you spend writing	Page 10 1 BY ATTORNEY STAMATOPOULOS: 2 Q. You've offered opinions in your declaration 3 that many of the claims in this patent are invalid. 4 Correct? 5 ATTORNEY IN: Objection. Form. 6 A. Yes. My declaration, of course, is a matter 7 of record, and I do offer positions that combinations of 8 prior art make claims in this patent obvious. 9 BY ATTORNEY STAMATOPOULOS: 10 Q. So you reviewed -- in connection with forming 11 your opinions, you reviewed the patent. Correct? 12 A. Yes. I studied the patent. 13 Q. And how much time would you say you spent 14 studying the patent? 15 A. Probably at least four hours. 16 Q. And then there are a number of prior art 17 references that you offered opinions about. Correct? 18 A. That's correct. 19 Q. And in particular, some of your opinions are 20 that combinations of these prior art references render 21 claims in the patent obvious. Correct? 22 A. That's correct. 23 Q. So you studied the prior art references? 24 A. Yes, I did. 25 Q. And how much time would you say you spent
	Page 11

1 studying the prior art references? 2 A. Well, it varies. Yamaki, for example, I 3 probably spent at least two or three hours just studying 4 the patent. Same for Sakamoto. Some of the -- what I 5 would call a secondary reference, I think Abraham, 6 Richardson, probably an hour, hour and a half each. 7 Q. And that's just studying those references. 8 Correct? 9 A. I may have taken notes. Certainly on some of 10 them I took notes when I studied them. 11 Q. And in addition to those references, there are 12 a number of other exhibits that are cited in your 13 declaration. Correct? 14 A. That's correct. 15 Q. And how much time would you say you spent 16 studying those documents? 17 A. Well, some of those additional references were 18 references that I suggested or located and proposed. So 19 if I include the time I spent thinking about what other 20 references would be relevant, finding them, proposing 21 them, and studying them, at least five hours. 22 Q. So the time you spent finding, studying, and 23 proposing these references in total was approximately 24 five hours? 25 ATTORNEY IN: Objection. Form.	Page 13 1 A. I do. 2 Q. And then in the following sentence, you say: 3 I have also reviewed the following references. 4 Do you see that? 5 A. I do. 6 Q. Then you list a number of these references, 7 and your list goes on through page 5. 8 Do you see that? 9 A. I do. 10 Q. Are these the references that you located and 11 identified for counsel? 12 A. Well, I think I represented that I located, 13 proposed some of them. Most, in fact, were probably 14 proposed by counsel. 15 Q. So some of these references were references 16 proposed by you. Fair? 17 A. I believe so, yes. 18 Q. And some of them were proposed by counsel? 19 A. I think I said the majority of them were 20 proposed by counsel. 21 Q. Okay. And the ones that you located and 22 identified for counsel and studied, that whole process 23 took you about five hours? 24 A. The ones that I located, proposed, and studied 25 took less than five hours. I also studied, of course,
Page 14 1 A. I'm sorry, finding, studying, and proposing 2 them? Yes, it's at least five hours. 3 BY ATTORNEY STAMATOPOULOS: 4 Q. Do you have your declaration in front of you? 5 A. I do. I have a hard copy in this. 6 Q. Let's go to page 3 of your declaration, and on 7 page 3, paragraph 3. 8 A. Okay. 9 (Exhibit No. Apple 1003, previously marked, was 10 referenced and indexed.) 11 BY ATTORNEY STAMATOPOULOS: 12 Q. And to be clear, just for the record, your 13 declaration is Apple 1003. Correct? The exhibit 14 number. 15 A. Oh, I don't have that as an exhibit number. 16 Q. That's fine. I'll represent to you that it's 17 Apple Exhibit Number 1003. 18 Are you on page 3 -- 19 A. I am. 20 Q. -- of your declaration? 21 A. I am. 22 Q. And in that paragraph, second sentence, you 23 state: I have reviewed the '641 patent and relevant 24 excerpts of the prosecution history of the '641 patent. 25 Do you see that?	Page 16 1 the other references that counsel provided or proposed. 2 Q. How long did that process take you? 3 A. Again, this was a year ago. Another -- at 4 least another three or four hours. 5 Q. So just to recap a little bit, we talked about 6 how you studied the patent and how you located and 7 identified certain references and studied them, and then 8 how you studied certain references that were identified 9 by counsel. 10 Good so far? 11 A. That's correct. 12 Q. And that was part of the process that you used 13 to prepare your declaration. Correct? 14 A. That was part of the process, yes. 15 Q. So what did you do after reviewing all of 16 these references? 17 A. Well, I started to write opinions and propose 18 them to counsel and to Ms. DeVries. It was clear to me 19 after reading the '641 patent and some of the references 20 that there was prior art that described many of these 21 concepts earlier than the '641 patent, and I wrote 22 opinions regarding how those references compared to the 23 '641. 24 Q. And how did these references compare to the 25 '641?

1 ATTORNEY IN: Objection. Form. Page 17 2 A. Well, as I concluded in this declaration, the 3 key concepts in the '641 patent were disclosed in 4 earlier prior art. 5 BY ATTORNEY STAMATOPOULOS: 6 Q. And what, in your view, are the key concepts 7 of the '641 patent? 8 A. The claims focus on the combination of a high 9 voltage charge limit and on understanding the relative 10 balance between the positive and negative electrodes, 11 and in particular, ensuring that there is a higher ratio 12 than one so that the negative electrode has more 13 capacity than the positive. 14 Q. And you mentioned earlier, I believe, that you 15 did not type every word in your declaration. Correct? 16 A. That's correct. 17 Q. Tell me a little bit about the process of 18 actually writing the declaration. 19 How much of your declaration did you write 20 yourself? 21 A. I wrote the majority of the technical 22 opinions. Certainly, things like legal concepts and a 23 great deal of editorial or support work, you know, for 24 instance, getting the citations right for all the 25 references and pages and numbers, was provided by	1 Q. Why not? Page 19 2 A. I wasn't asked to. As I said, these were 3 presented as relevant excerpts and I presume that the 4 ones that I wasn't asked to study were irrelevant. 5 Q. When you conducted your -- so withdrawn. Let 6 me ask a different question. 7 So you conducted a search for literature that 8 might be relevant to the subject matter of the '641 9 patent. Correct? 10 A. The phrase you used, I conducted a search, 11 perhaps implies a more complete process than I conducted 12 at the time. 13 I searched for relevant documents. I was 14 aware and had extensive experience doing exactly what 15 the '641 patent describes, that is, designing batteries 16 and looking to improve them. 17 So I looked for patents in the literature that 18 were relevant. But I think "conducted a search" has 19 sort of an academic phrase, meaning, that maybe goes 20 beyond what I contributed here. 21 Q. So you identified some documents, but your 22 process of document identification wasn't thorough 23 enough that it would make it a search, in your view. 24 Is that fair? 25 ATTORNEY IN: Objection. Form.
1 counsel's staff. Page 18 2 But I think all of the key technical opinions 3 were things that I originated through discussion or 4 separate study and then proposed in writing. I sent 5 quite a few emails which proposed my understanding of 6 how these patents should be compared. In particular, 7 the Yamaki and Sakamoto references and how they compared 8 to the '641 patent. 9 Q. Now going back to paragraph 3 of your 10 declaration, is this a comprehensive list of all the 11 materials that you considered, apart, of course, from 12 your own personal professional experience, in connection 13 with forming your opinions? 14 A. I believe it is, yes. 15 Q. Now, in paragraph 3, you state that you have 16 reviewed the '641 patent and relevant excerpts of the 17 prosecution history of the '641 patent. 18 Do you see that? 19 A. I do. 20 Q. What do you mean by "relevant excerpts"? 21 A. I was provided with excerpts of the 22 prosecution history, or that's what these documents were 23 described to me as, by counsel. And I studied and 24 discussed those excerpts. I didn't study the entire 25 prosecution history of the '641 patent.	1 A. My process identified some documents that I Page 20 2 felt were relevant and were useful, but I wouldn't call 3 it an exhaustive search. 4 BY ATTORNEY STAMATOPOULOS: 5 Q. Useful in what respect? 6 A. Well, they presented the same exact concepts 7 as are presented in the '641, and they were prior art, 8 so that to me was useful in forming a comparison of the 9 '641 to existing technology at the time. 10 Q. Now I'd like to draw your attention 11 momentarily to page 2 of your declaration, the Table of 12 Contents. Do you see that? 13 A. I do. 14 Q. And under section 5, there are some headings 15 that relate to your prior art analysis. 16 Is that fair? 17 A. I see that. 18 Q. And each and every one of your opinions, 19 labeled Grounds, is an obviousness ground. Correct? 20 A. That's correct. 21 Q. So is it fair to say that you were not able to 22 identify a prior art reference that anticipated any of 23 the claims in the '641 patent? 24 ATTORNEY IN: Objection. Form. Scope. 25 A. No, that's not fair. I -- it is -- again, as

1 part of this process, when I studied Yamaki, I offered 2 the original thought that all of the concepts presented 3 in the claims were in Yamaki and could have been 4 considered as anticipatory. 5 But in studying additional references, and in 6 discussion with counsel, it became clear that Yamaki, 7 when combined with Sakamoto, was certainly a clear case 8 of presenting obviousness. And that was a combination I 9 chose to present. 10 But my original opinion, frankly, while we 11 discussed this, was that Yamaki presented all of the key 12 concepts. 13 BY ATTORNEY STAMATOPOULOS: 14 Q. The opinions that ultimately -- well, let me 15 ask you a different question. 16 Who chose what opinions to include in your 17 declaration, you or counsel? 18 A. I chose them, obviously in consultation with 19 counsel. 20 Q. Ultimately, the decision was yours? 21 A. Yes. Some things, and particularly the way 22 that they were presented and written and which ones 23 might have been reason number 1, for example, as opposed 24 to reason number 3, no, those were my decisions. 25 Q. And your final decision was only to include	Page 21 1 had seen that term, "secondary considerations." And I 2 have. But I avoid offering any opinion of what legal 3 definitions are. And I generally refer to -- I think in 4 my declaration, there's a section, in fact, called Legal 5 Standards and Terminology. And so I typically would 6 refer to that for any definition. 7 BY ATTORNEY STAMATOPOULOS: 8 Q. Let me ask you this. Is it fair to say that 9 the documents listed in your Materials Considered 10 section fall into one of two categories, either 11 documents identified by yourself or documents identified 12 by counsel? 13 A. Yes. I would add that I don't know the origin 14 of that. Counsel may have obtained them through some 15 other process, but they were presented to me or offered 16 for consideration by counsel. Or in some cases I found 17 them and suggested that we consider them in our 18 discussions. 19 Q. And the majority of the documents in your 20 Materials Considered list was actually provided to you 21 from counsel. Correct? 22 A. That's correct. 23 Q. And did you undertake to look into whether 24 there were documents or references in the literature 25 that might cut against your obviousness opinions?
1 obviousness grounds in your declaration. Correct? 2 A. That's correct. 3 Q. Are you familiar with the term "secondary 4 considerations"? 5 A. I am. 6 ATTORNEY IN: Form. 7 BY ATTORNEY STAMATOPOULOS: 8 Q. What's your understanding of the term 9 "secondary considerations," with the understanding that 10 you're not a lawyer? 11 ATTORNEY IN: Objection. Form. Scope. 12 Relevance. 13 ATTORNEY STAMATOPOULOS: Let me ask what the 14 basis for the scope objection is here. 15 ATTORNEY IN: Well, he's not a legal expert; 16 he's a technical expert. And he was not -- he did not 17 opine upon anything related to secondary consideration 18 in his report. 19 ATTORNEY STAMATOPOULOS: Let me ask you, 20 counsel, on the record to limit your objections to form 21 and not scope. And let me have the court reporter to 22 repeat the question, please. 23 (The reporter read from the record.) 24 ATTORNEY IN: Objection. Form. 25 A. I believe you asked if I was familiar, if I	Page 22 1 ATTORNEY IN: Objection. Form. Relevance. 2 A. Yeah, that's a -- that would be a subset. I 3 think my process of looking for relevant documents 4 wasn't specifically looking for documents that would 5 make these claims obvious, it was looking for documents 6 that were relative and relevant to the '641 patent. So 7 it's my opinion that I would have come across documents 8 that went both ways. 9 BY ATTORNEY STAMATOPOULOS: 10 Q. So describe to me your search for documents 11 that were relevant. What criteria did you use to 12 identify them? 13 A. Well, I used key terms and used search 14 functions. Frankly, one of my favorites is Google 15 Patent Search using key terms that I think describe the 16 '641 patent's claims. Again, this was a year ago, but 17 that's the memory of how I did that. 18 And I also used my experience and knowledge. 19 For example, I think there's a reference in there that's 20 the Handbook of Batteries. That's a document that I'm 21 familiar with for many years. I knew the author, the 22 original author, who's passed away. And it's often a 23 good reference source for fundamental comparisons or 24 finding data on things that might otherwise be singular 25 references.
BlueBear Reporting LLC	Page 23 Page 24 RJ Technology Exhibit 2008 Apple Inc. v. RJ Technology LLC IPR2023-01350, Page 6 of 99

Page 25 1 So some things I just knew where to go and 2 what to look for; some things I searched the open 3 literature. Some, I should say, I believe I identified 4 and used counsel's, what's called a library function to 5 produce those documents and I then studied them. So 6 there were a variety of techniques in the process. 7 Q. And you mentioned a handbook. Is that Apple 8 1015, identified on page 4 of your declaration the 9 Linden Handbook of Batteries? 10 A. Yes, that's correct. 11 (Exhibit No. Apple 1015, previously marked, was 12 referenced and indexed.) 13 BY ATTORNEY STAMATOPOULOS: 14 Q. And why is it that you specifically referred 15 to this handbook as an example in your previous answer? 16 A. Well, you asked about the process for 17 identifying documents. And that one, I didn't need to 18 identify. It's right on my bookshelf, so I was able 19 to -- and I believed that it would contain relevant 20 information about questions of cell balance and voltage 21 so I immediately looked in it for that. Didn't have to 22 search. 23 Q. Is it a seminal text in battery design? 24 A. No, I wouldn't describe it as a seminal text. 25 That might go back to Volta a couple hundred years ago.	Page 27 1 away. So a secondary system is a system that can be 2 recharged. 3 A lithium-ion secondary system is one where 4 the internal flow of charge is carried by lithium ions 5 which are missing one electron and move from one 6 electrode to the other during the course of charge and 7 discharge. 8 Q. And the answer you just gave me, that would be 9 consistent with the understanding of a person of 10 ordinary skill in the art with respect to the term 11 "secondary lithium-ion battery" as of the time of the 12 priority date of the '641 patent? 13 A. Yes. It would be entirely consistent. 14 Q. Would it be fair if, over the course of this 15 deposition, just to keep things a little bit shorter, 16 when I ask you about the meaning of a certain term, if 17 we understand that to mean the understanding of a person 18 of ordinary skill in the art? 19 A. I'm not sure what you're asking. 20 Q. If I ask, you know, what does this term or 21 that term mean, would it be fair if we could assume that 22 that question is with respect to a person of ordinary 23 skill in the art's understanding as opposed to just 24 putting "person of ordinary skill in the art" in every 25 single question?
Page 26 1 It's a compilation of industrial and academic learning 2 that tries to give a wide variety of systems and put 3 them in some sort of encyclopedic position. 4 So it's certainly not the earliest or a way to 5 describe -- it's not a fundamental electrochemistry 6 text, but it is a good source of a wide variety of 7 particularly commercial systems and publications that 8 have been offered on those systems. 9 Q. And it's something that a person of ordinary 10 skill in the art would have been aware of as of the 11 priority date of the '641 patent? 12 A. Yes. I think, in fact, we particularly 13 focused on the '95 version. I know there are newer 14 versions, so the '95 version, edition, would have been 15 available and commonly referred to by a person of skill 16 doing battery design at the time of the patent filing. 17 Q. You yourself have experience with the design 18 of secondary lithium-ion batteries. Correct? 19 A. That's correct. 20 Q. What is a secondary lithium-ion battery? 21 A. Well, a secondary battery is a battery that 22 can be charged and recharged. It's distinguished in the 23 industry from primary systems, which are assemblies of 24 chemicals that produce power. And when those chemicals 25 have reacted and are exhausted, they're generally thrown	Page 28 1 Is that fair? 2 A. Yes. I'll try to remember that. And if I'm 3 answering in a different context, I'll make that clear. 4 Q. Absolutely. And I'll try to make it clear if 5 I'm asking in a different context. 6 Now, you mentioned, I believe, that secondary 7 as opposed to primary means that a secondary battery is 8 rechargeable. 9 Did I get that right? 10 A. That's correct. 11 Q. Does that mean that it would be physically 12 impossible to recharge a primary battery? 13 A. Well, it's -- of course, many things are 14 physically possible to do once or to do in a dangerous 15 fashion. 16 Many people try to make primary batteries into 17 secondary batteries by recharging them. But in broad 18 terms, to a person of skill in the art again, they know 19 that a primary battery is never recharged and would be 20 unlikely to produce good results if it was. 21 Q. Let's unpack that a little bit. 22 What do you mean by "good results"? 23 A. To successfully produce a battery that could 24 then be discharged again. So once you've completely 25 discharged a primary cell, you can't draw more energy

Page 29 1 from it. There's certainly nothing significant. And a 2 successful recharging would then allow you to withdraw 3 or to discharge it. So it's unlikely to be successful 4 if you start with a typical primary system. 5 Q. So what would happen if I tried to recharge a 6 primary system? 7 A. Typically, you produce gas. You know, there's 8 some level of -- a primary system, let's say the one 9 you're most familiar with is an alkaline cell like 10 Duracell, Copper Top, many brands. But basically, 11 they're relying on the zinc and MnO₂. And the zinc has 12 become an oxide and the MnO₂ has moved to a different 13 valent state and it's not possible to recharge them back 14 to their original states. So you would probably, if 15 applied enough voltage, produce gas and pop the seal on 16 the cell. 17 Q. When you say "pop the seal on the cell," does 18 that mean that the cell would explode? 19 A. No. They're designed to discharge gas safely. 20 It would not explode, but it wouldn't be of much use 21 after that process. 22 Q. What is it about a primary cell that -- I want 23 to actually withdraw that. I want to go back to my 24 original question. 25 Is it physically impossible to recharge a	Page 31 1 that cell. It's just not useful. 2 Q. So is it fair to say that what distinguishes 3 from a performance standpoint a primary cell from a 4 secondary cell is that the secondary cell achieves much 5 better performance results when it's actually recharged 6 than a primary cell? 7 ATTORNEY IN: Objection. Form. 8 A. A primary cell often contains more energy per 9 unit volume or weight than a secondary cell. It can't 10 be recharged. So your specific question may need to 11 consider that. 12 The secondary cell can be charged and reused 13 many times, typically. Each discharge may contain less 14 than a similarly sized primary cell, but the point of a 15 secondary system is that you can use it to store energy 16 repeatedly. 17 BY ATTORNEY STAMATOPOULOS: 18 Q. Right. But you said that the primary cell 19 still contains some amount of energy than if discharged. 20 Correct? 21 A. Yeah. It's virtually impossible to completely 22 react every bit of the reactance in a primary cell. 23 Q. And would it be possible to increase that 24 residual amount of energy if I applied a voltage after 25 the primary cell is discharged?
Page 30 1 primary cell? 2 A. It's physically possible to apply a charge 3 voltage to a primary cell. But, as I described, you 4 would not get acceptable results. There's nothing 5 useful about applying a voltage to try to recharge a 6 primary cell. If it was, if you could, it would be a 7 secondary cell. 8 Q. What happens when I apply a voltage to a 9 discharged secondary cell? 10 A. Well, if it's designed to be a secondary cell, 11 and the voltage is in the correct recharge level that 12 the cell's designed to accept, it will reverse the 13 chemical reactions that took place during discharge and 14 it will store energy. Ions move within the cell and 15 electrons move external to the cell. 16 Q. So if I were to apply a voltage to a primary 17 cell, would it store zero energy? 18 ATTORNEY IN: Objection to form. 19 A. No. As I described, you could have some -- 20 there's no zero. I mean, you could -- in point of fact, 21 a primary cell, it's almost impossible to discharge to 22 the point where it has zero energy. There's always some 23 microamp level of energy that's left in a primary cell. 24 And the same thing. If you reversed that, you 25 would have some very small level of energy stored in	Page 32 1 A. Not to any measurable or significant value. 2 Certainly, there would be no value in applying a charge 3 voltage. And it may be dangerous and most likely would 4 be destructive to the chemicals in the cell. 5 So the electrolyte, in the case of most 6 primary systems, is water based. And applying a charge 7 voltage, water breaks down at 1.23 volts, and so in 8 trying to charge a primary cell, you're most likely 9 going to create gases, which will then vent. 10 So it's not at all becoming a secondary 11 system. It doesn't store any measurable energy. But 12 you could try it. 13 Q. What do you mean by "measurable"? 14 A. Well, anybody doing battery research will use 15 methods of measuring current in or out. And it would be 16 very difficult to determine the difference between a 17 discharge cell energy content which, as I said, probably 18 never goes to zero, and that of a cell which has had a 19 voltage higher than its discharge voltage, which could 20 be considered trying to charge it. So it would be 21 difficult to make that distinction. 22 Q. And the secondary cell, in contrast, is one 23 that can be charged and discharged safely over a number 24 of cycles? 25 A. Yes. That's what it's designed to do. That's

1 why you would call it a secondary system. 2 Q. And would a system that can only be charged 3 and discharged safely, say, twice, would that be 4 considered a secondary system? 5 A. Most secondary systems have a specification, 6 and the application that they are designed for would 7 determine whether it's twice or 2,000 times. 8 So there's a wide variety of secondary battery 9 systems, and some are designed for tens of thousands of 10 cycles; some are designed for far, far fewer. So I 11 don't think it's easy to generalize the way that you 12 described it. 13 Q. I'm not trying to describe it, I'm just trying 14 to get your views on this, to be clear. 15 A. Okay. 16 Q. So is it your opinion that batteries that are 17 designed to be charged and discharged 2,000 times are 18 secondary batteries? 19 A. Yes, that's how they would be described. 20 Q. And it's also your opinion that batteries that 21 are designed to be charged and discharged 200 times are 22 secondary batteries. Correct? 23 A. Typically, yes, if they're -- 24 Q. And they -- 25 A. If they're charged. I'm sorry. If they're	Page 33 1 A. Yes, I am. 2 Q. What is the meaning of the term "cycle life"? 3 A. Again referring to a person of skill at the 4 time of these patents, they would refer to cycle life as 5 the number of charge and discharge cycles that a battery 6 could undergo, typically with a great deal of 7 description on the conditions at which it was cycled and 8 the results or the capacity of each cycle as that 9 testing went on. 10 Q. Just to make sure that I understand your 11 answer correctly, is it fair to say that cycle life is 12 not just the number of cycles over which a battery is 13 charged and discharged but, rather, it's the number of 14 those cycles over which certain performance 15 characteristics can be retained, based on a 16 specification? 17 Is that a fair description of what you just 18 said? 19 A. I think in addition to emphasizing the 20 results, I'm emphasizing the conditions. So you would 21 never talk about cycle life without saying 1C cycling, 22 for example, which would be the rate at which it's 23 charged and discharged, or the temperature, or whether 24 it's pulse charging. 25 So there are -- outside of the popular press
1 charged and -- 2 Q. No, no, no, you -- 3 A. -- they're a secondary system. 4 (Reporter clarification.) 5 THE REPORTER: I'm sorry, I need the witness 6 to repeat the entire sentence of your answer. 7 THE WITNESS: I think I said if they are 8 charged and discharged, they are a secondary system. 9 THE REPORTER: Thank you. 10 BY ATTORNEY STAMATOPOULOS: 11 Q. So we have talked about 2,000 cycles and 200 12 cycles. Would your answer change if I asked you whether 13 a battery that's designed to be charged and discharged 14 20 times would be considered a secondary battery? 15 A. No, it would not. 16 Q. What about two times? 17 Would your answer change then? 18 A. No, if it's designed to be charged and 19 discharged. I'm, in fact, aware of systems that are 20 designed to be charged and discharged very few times. 21 Military systems. But they're secondary systems. It's 22 important that they accept charge and that they be 23 available for discharge. 24 Q. Are you familiar with a term called "cycle 25 life"?	Page 34 1 or something like that, a person of skill would talk 2 about cycle life under certain conditions. 3 Q. And what are the conditions that a person of 4 ordinary skill in the art would specify in connection 5 with describing the cycle life of a secondary 6 lithium-ion battery? 7 A. Are you asking for what typical conditions 8 would be, or what the categories of conditions are? 9 Q. The categories of conditions. 10 A. Well, certainly, the characteristics of the 11 charge and discharge. It can be a constant current. It 12 can be a constant voltage. It can be constant power. 13 It can be pulse discharge. And then within those 14 categories, there would be the rate. 15 1C refers to the practice of discharging a 16 battery at approximately the one hour rate, meaning that 17 its entirety capacity's discharged in an hour if it 18 maintains that current. 19 And then there are conditions like 20 temperature. There are, you know, many conditions that 21 need to be specified to understand or compare cycle life 22 data. 23 Q. Is one way to define cycle life to say that 24 the battery retains a certain level of capacity or a 25 certain percentage of its capacity over a number of

1 cycles? 2 A. It is one way to describe a cycle life. It's 3 sort of a point in a collection of data that one would 4 generally supplement with more information. So one 5 point provides some information, as you described it. 6 Retained a certain amount of its capacity at a certain 7 number of cycles would be one point on that, typically a 8 curve. 9 Q. And different operating conditions might bear 10 upon the cycle life of a particular battery. Correct? 11 A. They definitely would. 12 Q. So temperature, for example, might increase or 13 decrease the cycle life. Correct? 14 A. That's correct. 15 Q. And when I mentioned cycle life in my previous 16 question, I'm talking about the percentage of capacity 17 that a battery can retain over a given number of cycles. 18 Do you understand that? 19 A. I understand that's the way you're using it, 20 yes. Again, in the industry, one would provide more 21 information. Is it the percentage of the energy of 22 each -- delivered on each cycle, or is it measured as 23 the current milliamp hours, coulombs? 24 So again, I'm accustomed to applying a bit 25 more specificity when even describing cycle life.	Page 37 1 a cell may have a significant amount of energy left but 2 it's unable to deliver high pulse. It's something that 3 takes place in modern phones, for example. 4 So the exact form of the current and voltage 5 during charge and discharge are important to make a 6 comparison between cycle life claims. 7 Q. How would a person of ordinary skill in the 8 art go about determining the cycle life of a battery, 9 given certain operating conditions? 10 A. If one specifies all the conditions that I 11 said are important, then a person of ordinary skill 12 would cycle the battery and consider the results, 13 typically using some piece of equipment that applies the 14 charge current that you've specified, whether it's pulse 15 or continuous. And, in fact, there's a whole industry 16 of commercial equipment available for battery cycling. 17 Q. Is it necessary to cycle the battery in order 18 to determine its cycle life? 19 A. It's necessary to cycle a battery to present 20 data that says this is its cycle life. It's certainly 21 not necessary to cycle it in all of the conditions that 22 I've described, or to the end of cycling. 23 Nobody cycles every cell until its capacity is 24 virtually nothing left. Typically, cycling takes place 25 under a set of conditions that are enough to predict
Page 38 1 Q. What are some of the factors that affect cycle 2 life? 3 A. The way that the cell is charged and 4 discharged. I think I described three or four methods. 5 A constant current charge -- and all these can be 6 applied during discharge, of course -- constant voltage 7 or constant power are three very different methods of 8 applying charge and discharge currents. And they would 9 give different results in terms of the capacity that's 10 remaining. 11 So if one were to charge constant current and 12 then stop at some cutoff voltage of charge -- and, of 13 course, there has to be a cutoff voltage for discharge 14 too. And you can vary those. Discharge it to -- if you 15 want to talk about a lithium system, you can discharge 16 it to 3 volts or you can discharge it to 2 and a half 17 volts, or you can discharge it to zero volts and destroy 18 the cell very quickly. 19 So all of these are key factors in determining 20 the results that you get in a cycle life testing. And 21 you need to specify how it was charged, how it was 22 discharged, and, of course, whether that's a continuous 23 process. 24 Pulse discharges are very important for 25 applications that use pulse power because a battery --	Page 40 1 results at a wider variety of conditions. 2 Q. You mentioned every battery in your previous 3 response. What did you mean by "every battery"? 4 A. I'm sorry, could I hear the context that I 5 used that phrase? 6 Q. Maybe I misheard you. Well, let me ask you a 7 different question. I may have misheard you. 8 If a person of ordinary skill in the art were 9 presented with a new battery for which there were no 10 cycle life data, would it be necessary for that person 11 of ordinary skill in the art to cycle the battery and 12 obtain life cycle data, or would it be possible to 13 ascertain the life cycle of the battery or the cycle 14 life of the battery without such experimentation? 15 ATTORNEY IN: Objection. Form. 16 A. So when you say "a new battery," there's 17 nothing new under the sun, there's only variations. So 18 how new? I mean, elements that have never been 19 described before? A variation? I'm finding it hard to 20 understand what a new battery would be. 21 BY ATTORNEY STAMATOPOULOS: 22 Q. Well, you said there's only variations. What 23 did you mean by that? 24 A. Well, the periodic table of useful elements is 25 a fixed set and scientists have been examining it for

1 electrochemical properties for centuries, many 2 centuries, so it's difficult for me to think of a 3 system, a new battery, that hasn't been explored in some 4 regard before. And therefore -- 5 Q. And what -- 6 A. -- I do have some background, sorry, some 7 background for knowing. If somebody started talking 8 about a lithium system, the world becomes much smaller 9 and you can apply all that's been known about lithium 10 systems. So I'm trying to understand what you mean by a 11 new battery. 12 Q. Sure. Let's limit ourselves to the universe 13 of secondary lithium-ion batteries for starters. 14 Do you follow? 15 A. Okay. 16 Q. And then different secondary lithium-ion 17 batteries can use, for example, different cathodes, 18 right? 19 A. They can. 20 Q. And they can use different anodes. Correct? 21 A. Yeah. I assume by that you're referring to 22 the positive and the negative as different. They switch 23 identity during the course of charging and discharging 24 so I like to refer to them as the positive and the 25 negative because those identities don't change.	Page 41 1 There's a lot of different ways in which a 2 person of ordinary skill in the art could construct a 3 battery, given a number of different building blocks, 4 including the cathode, the anode or the positive and 5 negative electrode materials, and the electrolyte 6 correct? 7 A. Yes. 8 Q. So there's different variations of batteries 9 that a person of ordinary skill in the art could build. 10 Correct? 11 A. Yes. 12 Q. And so now taking these different variations 13 into account, would all different variations have the 14 same life cycle? Or, sorry. Cycle life? 15 A. The same cycle life characteristics. Perhaps 16 you'll let me use that phrase, because cycle life is a 17 single number. It doesn't make much sense to me. Yes, 18 they would have different cycle life characteristics. 19 Q. And if I wanted to ascertain their cycle life 20 characteristics, one way to do so would be to actually 21 test batteries with a particular composition. Correct? 22 A. That's correct. 23 Q. And would it be necessary for a person of 24 ordinary skill in the art to actually test cycle a 25 battery in order to ascertain its cycle life Page 43
1 Q. So the composition of the positive electrode 2 can be different as between different secondary 3 lithium-ion batteries. Correct? 4 A. Yes, it can. 5 Q. And is it okay if I refer to that as the 6 cathode material? 7 A. Well, it can be confusing, frankly. 8 Q. The positive electrode material? 9 A. Positive electrode material is -- never 10 changes, so I like to use those absolute terms. 11 Q. And the negative electrode material likewise 12 can differ from battery to battery. Correct? 13 A. Yes, it can. 14 Q. And even between batteries that have the same 15 positive electrode and the same negative electrode 16 materials, the ratios of those materials can change. 17 Correct? 18 A. Yes, that's true. 19 Q. And the electrolytes between different 20 batteries that have the same positive electrode, same 21 negative electrode, and same ratio positive to negative 22 electrode materials can also be different. Correct? 23 A. That's correct. 24 Q. So there's a lot of different ways in which I 25 can construct the same -- withdrawn.	Page 42 1 characteristics? 2 A. Not necessarily, no. 3 Q. How else could a person of ordinary skill in 4 the art ascertain the cycle life characteristics of a 5 battery that presents significant variations from other 6 batteries for which that person of ordinary skill in the 7 art may already have data for? 8 A. Cycle life characteristics are determined by 9 what a battery engineer would call failure modes. And 10 there are maybe a dozen or more failure modes, and they 11 vary widely. So one failure mode that's discussed in 12 the patent and the prior art would be lithium metal 13 plating. It's a failure mode. It's just one. And 14 there are many other failure modes. 15 So if one were to design a series of batteries 16 where the failure mode is known and to study 17 characteristics of something else, like the electrolyte, 18 which is not affecting that failure mode, it would be 19 perfectly reasonable to predict there'd be no effect on 20 cycle life. 21 So whatever information you had could be 22 applied to this new system because the known failure 23 mode is not being affected by the variations that you're 24 proposing. 25 Q. Okay. Now let's say I were to charge the Page 44

1 ratio of cathode -- withdrawn. 2 Let's say I were to change the ratio of the 3 positive to the negative electrode for a secondary 4 lithium-ion battery. All else being equal, would the 5 cycle life characteristics for that battery change? 6 A. They could. 7 Q. Do you know one way or the other for sure 8 whether they would change without testing the battery? 9 A. Well, you could predict. And again, cycle 10 life is not a single number. There are a wide variety 11 of characteristics. Some cells decrease in cycle life 12 rapidly and then stay at that intermediate level for 13 many, many cycles. And so if you were to define end of 14 life as 90 percent of original capacity, they might have 15 a very short cycle life, and if you defined it as 16 80 percent, they would have an extremely long cycle 17 life. 18 So I'm suggesting that that information, 19 it's -- you wouldn't have that complete picture without 20 testing. But just like the patent gives one variable, 21 it's a very incomplete picture of cycle life. 22 And one point can be used to predict other 23 characteristics, but it's not the full cycle life 24 picture. It's not -- it's only one point in that 25 characterization.	Page 45 1 Q. How many years did you work at Duracell? 2 A. Almost 11. 3 Q. And what did you do at Duracell? 4 A. I was -- at the end, I was director of 5 rechargeable battery engineering. 6 Q. And folks at Duracell designed rechargeable 7 batteries? 8 A. Yes, we did. Built factories for it. 9 Q. And was one of the performance characteristics 10 that Duracell strove for capacity retention after a 11 certain number of cycles? 12 A. Yes, in general terms, it was. 13 Q. And an easy way to market batteries to 14 consumers is to say -- rechargeable batteries to 15 consumers is to say this battery will retain 80 percent 16 or 90 percent of its capacity after a certain number of 17 cycles. Correct? 18 A. Usually you would define the conditions. 19 Under normal use, or in this application, or in phone 20 use, or something like that. 21 Q. So you might say to a consumer in normal 22 operating conditions, this battery will retain 23 80 percent of its capacity after 300 cycles. Fair? 24 A. You could use that as an advertising claim, 25 yes.
Page 46 1 Q. If I give you a new variation of a battery 2 that has a particular positive to negative electrode 3 capacity ratio, can you predict with certainty how much 4 capacity that battery will retain after, say, 300 cycles 5 without testing it? 6 A. Without any testing at all? 7 Q. Yes. 8 A. Well, I think the prediction would be a lot 9 less valuable than if you had done some testing. 10 Q. Well, let me just add a parameter to my 11 question. I'm not asking if you could issue some 12 prediction that has no value. 13 I'm asking you whether you could reliably 14 predict the capacity retention of a battery after, say, 15 200 or 300 cycles without testing. 16 A. Well, you can't reliably predict the capacity 17 of a system from one data point no matter what that 18 point is. It's a much more complex surface of the 19 failure modes and capacity loss over time and cycles and 20 conditions. 21 So you're asking if you could reliably 22 predict. I would say that you can't rely bring predict 23 from a single test point no matter where the point is. 24 Q. You worked at Duracell. Fair? 25 A. Yes.	Page 48 1 Q. In order to ascertain whether a particular 2 battery could, in fact, retain 80 percent of its 3 capacity after 300 cycles, what was Duracell's practice 4 for doing so? 5 A. You're going to have to be more specific. 6 Practice for developing a system that met that 7 requirement? There are legal standards before you can 8 advertise things. You have to develop proof. So what 9 would its practice be in what regard? 10 Q. Let me ask it a different way. 11 Let's say Duracell sold a battery to its 12 customers that was supposed to retain a certain level of 13 capacity after a certain level of cycles. 14 Would Duracell test that battery? 15 A. Yes. 16 Q. Was that Duracell's common -- 17 A. Extensively. 18 Q. -- practice? 19 A. I'm sorry. 20 Q. Was that Duracell's standard operating 21 procedure, to test its batteries? 22 A. Yes. 23 Q. And the reason it was Duracell's standard 24 operating procedure was because it wanted to make sure 25 that it could reliably make that representation to

1 consumers. Correct? 2 A. Well, that was one reason for a finished 3 system. Testing -- most of the testing that takes place 4 is in developmental efforts, so -- 5 Q. We'll get to that. But in terms of finished 6 systems, Duracell tested its batteries to make sure that 7 the performance characteristics that it advertised were 8 actually advertised accurately. Correct? 9 A. They typically would not test exhaustively 10 under the conditions, even those that are advertised, 11 because cycle life testing is long, difficult, 12 expensive. And so we typically, when we're talking 13 about production cells now, typically, we would have 14 abbreviated testing, which was useful in predicting the 15 performance and identifying if anything had gone wrong 16 in production much faster to get results and none the 17 less valuable in predicting the quality and the 18 performance of systems that were offered for sale. 19 Q. So Duracell would not test its batteries over, 20 say, a couple hundred cycles if it represented to its 21 customers that its batteries could retain a certain 22 amount of capacity after a couple hundred cycles? 23 A. No, I don't think that's what I said. I said 24 typically, as a point of production and in quality 25 check, once that system was being sold and you had	Page 49 1 prototypes to the end of their cycle life? 2 A. I think it's likely that some version of that 3 system had been tested to understand the cycle life 4 characteristics. Again, we might have tested an 5 accelerated test. If you test the system at high 6 temperature or at high current, you will shorten the 7 life, but it's still useful data, so it's -- you test it 8 and you can then predict cycle life characteristics 9 under other conditions. 10 But it's not common to -- for example, a phone 11 application for a rechargeable battery, it's almost 12 impossible to get cycle life conditions as a phone user 13 because the condition is so varied and so stochastic. 14 It's not possible to -- 15 Q. I'm talking about the testing that's conducted 16 in the development phase. Do you follow? 17 A. Yes. And that's -- 18 Q. I'm not -- 19 A. -- what I'm trying to describe. 20 Q. Okay. So a company might define -- a battery 21 manufacturer might define certain operating conditions. 22 Correct? 23 A. Again, in what? In advertising or in -- 24 Q. In its internal testing. 25 A. A company would define -- I'm sorry, repeat
1 identified through development the characteristics of 2 that system, we would do much abbreviated testing. 3 Every cell was checked for voltage, okay? 4 Very few were checked for initial capacity. They might 5 be sorted. And far fewer than that were checked for 6 capacity under a variety of conditions. And far, far 7 fewer than that would actually be cycled for any set of 8 time. 9 And they typically wouldn't be cycled until 10 the end of life. They would be cycled maybe for a few 11 cycles, or for 10 or for 100 cycles, something much less 12 than the expected life because otherwise, you'd have 13 millions of -- we made, I mean, millions of cells a day, 14 so you would have factories full of test equipment to 15 conduct those tests. Once in production, you would use 16 abbreviated testing to predict the results of systems 17 that were being sold. 18 Q. But in development, you developed prototypes 19 for the batteries that you eventually sold. Correct? 20 A. Yes. 21 Q. And you tested some of those prototypes until 22 the end of their cycle life. Correct? 23 A. Probably, yeah. I'm trying to think exactly. 24 Q. Do you think it's likely that Duracell sold 25 batteries on the market for which it did not test	Page 50 1 the question. 2 Q. When a company sells a battery to consumers, 3 it usually develops a prototype for that battery. Fair? 4 A. Okay, fair. 5 Q. Well, I'm asking you. Is it -- 6 A. Well, I, you know -- 7 Q. -- a fair statement? 8 A. That sounds like you develop one thing and say 9 this is a prototype for a system. Development process 10 would involve hundreds and hundreds of experiments and 11 design decisions and then pilot plant manufacturing so 12 they don't use the word "prototype" typically. They 13 describe maybe three or four levels of development from 14 a basic chemist's lab all the way up to full production. 15 But each of those involves testing, yes. 16 Q. So you said that the development process would 17 involve hundreds and hundreds of experiments and design 18 decisions and then pilot plant manufacturing. 19 What do you mean by that? 20 A. Well, one -- a company that's in the business 21 of providing rechargeable cells is always looking to 22 improve those and so they, as a matter of course, test 23 variations, new materials, you know, improvements in the 24 design and test those for improvement that they're 25 looking to achieve.
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1 And if successful, they'll then take that 2 improvement and take it to the next stage of 3 manufacturing, which might be -- as I said, there are 4 many stages, at least four. But let's simplify it and 5 say you go from the lab to some sort of pilot plant. Or 6 you could call it a prototype, but the cell is not 7 what's changing. It's the manufacturing process. 8 Speed, equipment, conditions that are changing as the 9 cell development is finished. 10 Q. You said the cell is not changing, so -- 11 A. Well, typically -- no, if you develop an 12 improved cell and you confirm that at least in the 13 laboratory it can provide improved results, you don't 14 then scale up some different cell. You scale up that 15 improvement. 16 Q. Let's say I'm trying to improve the capacity 17 retention for a particular secondary lithium-ion battery 18 after 200 cycles, and I make some tweak to my 19 compensating battery. How would I know, if I'm a person 20 of ordinary skill in the art, whether my tweak has 21 actually led to an improvement in terms of capacity 22 retention? 23 A. Through testing. 24 Q. Is there any other way? 25 A. There are -- well, I think you presented a	Page 53 1 trying to impact when you design a battery, dozens and 2 dozens of things, so you can't modify one of those, for 3 example, the cycle life characteristics, or the high 4 temperature performance, or many other things. You 5 can't change those in a vacuum. So testing is always 6 important to understand the full impact of a new design. 7 And you do it in the most time-efficient and 8 resource-efficient method possible. 9 Q. And I asked you if testing was important in 10 terms of determining the capacity retention of a battery 11 after a certain number of cycles. Let me change that 12 question a little bit. 13 If I'm designing a new battery, is testing 14 important to make sure that it has the performance 15 characteristics that I want it to have? 16 A. Yes. Testing is the only way to make sure 17 that you've got all of the performance characteristics 18 that you're looking for. 19 But you can't ever test -- the example I said 20 was let's say you're trying to improve the high 21 temperature performance. There may be a point where 22 that high temperature performance has improved, but 23 there may be a level of temperature at which it's 24 disastrously bad so you look for ways to predict it. 25 You know, the phrase that I used to always
1 scenario that I'm somewhat reluctant to accept. Nobody 2 decides to, you know, change a cell's performance at 200 3 cycles if that same system, for example, caused disaster 4 at 210 cycles. And so one would never look to test a 5 very specific development like that. 6 Typically, let's say you're considering a new 7 material and you say that this material might have an 8 impact on the cycle life characteristics. I would start 9 by quick cycling. What is the -- what's the initial 10 capacity? What's the capacity in the first few days of 11 testing? And it might be disastrous, or it might be 12 equivalent to the original design, in which case you 13 might then expand the testing. 14 Eventually, on any system, you would test it 15 out to full failure and you would not stop at 100 or 10 16 or 200 or 400. You would test it completely. 17 But that's after, you know, sort of the 18 predictive testing that you do in a new system. 19 Q. But back to my question. Is testing important 20 in terms of determining the capacity retention of a 21 battery after a certain number of cycles? 22 A. Yes, testing is important. 23 Q. Why? 24 A. Because it's the only way to obtain specific 25 information. There's far too many things that you're	Page 54 1 teach engineers was be bold in the testing. You know, 2 use some key tests to predict values so that you don't 3 have to test every single temperature, every single 4 current, every single set of pulse conditions. You need 5 to minimize that to do development in a reasonable time. 6 ATTORNEY STAMATOPOULOS: Counsel, okay to go 7 briefly off the record? 8 ATTORNEY IN: Yes. 9 THE VIDEOGRAPHER: Time is 8:26 AM. We are 10 off the record. 11 (Recess taken.) 12 THE VIDEOGRAPHER: We are back on the record. 13 The time is 8:39 AM. 14 BY ATTORNEY STAMATOPOULOS: 15 Q. Welcome back, Mr. Hruska. 16 A. Thank you. 17 Q. Are you familiar with -- well, let me ask you 18 this first. Did you speak with counsel at all during 19 the break? 20 A. No. I was fully occupied with the dogs. 21 Q. Okay. So, Mr. Hruska, what is the meaning of 22 the term "battery capacity"? 23 A. I'll say this probably more than once, but in 24 the battery industry, there are many terms that have 25 different meanings colloquially, in popular press, and

1 among engineers. So again referring to our person of 2 skill, they would typically use the phrase "battery 3 capacity" to mean the milliamp hours or amp hours that 4 can be charged and discharged from a secondary system. 5 Q. What about the term "average operating 6 voltage"? 7 A. Well, that one is less defined, but there are 8 ways to calculate the average, you know, an arithmetic 9 average taken over a period of time. But it obviously 10 at its core refers to the voltage that is produced by 11 the battery during a discharge implied by operating. 12 There would also be an average charge voltage, but 13 typically, operating would mean discharge. 14 Q. And are you familiar with the term "specific 15 energy" in connection with a secondary lithium-ion cell? 16 A. Yes, I am. 17 Q. What's the meaning of that term? 18 A. Well, there are two uses of that. Specific 19 energy can refer to the amount of energy in watts or 20 milliwatts contained in a cell and divided by either the 21 mass or the volume. So it's commonly used, particularly 22 in the automotive battery industry to describe both 23 gravimetric, they call it, and volumetric specific 24 energy. 25 Q. And are you familiar with the term "specific	Page 57 1 A. It's a fair question, but it's a lot less 2 clear. The negative electrode in a lithium-ion battery 3 is usually a -- you know, often is a carbon material. 4 And that doesn't participate in the reactions so it's 5 not the same type of calculation. And people designing 6 a lithium system that uses carbon as the negative 7 electrode, certainly when I was actively involved in 8 doing that, we wouldn't use the same sort of terms or 9 calculation because the carbon doesn't participate in 10 the reaction and it's sort of not really an active 11 material. 12 Q. Well, in the context of the '641 patent, what 13 would be the understanding of a person of ordinary skill 14 in the art of the negative electrode's specific 15 capacity? 16 A. In the context of the '641? So a person of 17 ordinary skill, you're asking them to adopt the 18 terminology used in the '641, if I understand correctly. 19 Q. Yes. 20 A. Well, the way I understand the '641, they are 21 really using measured capacity of some sort, because 22 it's very difficult to calculate the specific capacity 23 for material that doesn't participate in the reactions. 24 It's common for graphitic systems to assume 25 there's a certain ratio of carbon to lithium that's Page 59
1 capacity" with respect to the battery cathode or 2 positive electrode? 3 A. I'm familiar with it because of this case and 4 this patent. It's not a term that I would consider 5 commonly used by a person of skill in this industry. 6 Q. Well, what would be the understanding of a 7 person of ordinary skill in the art with respect to the 8 term "specific capacity" of the positive electrode? 9 A. Well, one might talk about the capacity per 10 gram that's obtained at a given voltage under certain 11 conditions, or there's also a theoretical capacity, 12 which is generally not energy but it's only amp hours or 13 coulombs per gram. So those two concepts are pretty 14 well understood and used, the theoretical being 15 calculated just from the number of electrons that are 16 transferred and what a mole of that material weighs, and 17 the actual or measured, which would be a capacity either 18 in current or could be in energy of a particular 19 material under particular conditions. 20 Q. And like the cathode, the -- let me withdraw 21 that. I'm trying to respect your preference for 22 positive and negative electrodes. 23 A. It's just clarity. 24 Q. Like the positive electrode, the negative 25 electrode also has a specific capacity. Fair? Page 58	1 intercalated, but even that's inexact. And many 2 lithium-ion carbon systems don't use pure graphite and 3 therefore have no specific ratio. So it's a practical 4 measure as used in the '641. That's the only way to 5 understand it. 6 Q. Do you have the '641 patent in front of you? 7 A. I do. I can turn to it. 8 Q. Yes, please do. And that's Apple, for the 9 record, Apple 1001. 10 A. Okay, I've got it. 11 (Exhibit No. Apple 1001, previously marked, was 12 referenced and indexed.) 13 BY ATTORNEY STAMATOPOULOS: 14 Q. Let me invite your attention to Claim 5. 15 A. Yes. 16 Q. Do you see the phrase "calculated by a 17 theoretic capacity with a charge cutoff voltage set at 18 4.2 volts"? 19 A. I do. 20 Q. What would a person of ordinary skill in the 21 art understand this phrase to mean? 22 A. A person of ordinary skill would probably 23 ignore the word "theoretic," because, well, as one of 24 experience and skill in this, I'd consider it to be sort 25 of nonsense to say a theoretic capacity with a charge Page 60

1 cutoff voltage set at 4.2. 2 You can understand that perfectly well without 3 considering the word "theoretic." I'm not sure that 4 "theoretic" is an English word anyway. 5 Q. What about the word "theoretical"? That's an 6 English word, right? 7 A. I think so. And again, I would ignore it, 8 because it is in somewhat conflict with the finishing 9 phrase, "a charge cutoff voltage of 4.2." That's a 10 practical, an empirical measurement then, so that's how 11 I would understand this. And I think any person of 12 skill would understand this. 13 Q. Did you ignore the word "theoretic" or 14 "theoretical" in your analysis? 15 A. I didn't ignore it, no. I considered it and I 16 tried to understand what was being described in this 17 claim. 18 Q. And you conducted your analysis from the lens 19 of a person of ordinary skill in the art. Correct? 20 A. I did. 21 Q. So in that context, what is the meaning of 22 "theoretic" as it appears in Claim 5? 23 A. Well, at the time I conducted my comparison, I 24 was told that these terms should be given their plain 25 and ordinary meaning. I've become aware that there are	Page 61 1 Q. So in the context of the '641 patent, a person 2 of ordinary skill in the art would understand that there 3 are different theoretic capacities at different charge 4 cutoff voltages. Correct? 5 A. Again, a person of ordinary skill would, first 6 of all, be forced to understand by the word "theoretic" 7 what was intended. If we assume it's theoretical, 8 they're left with this conflict between a theoretical 9 capacity, which does not change, and the statement that 10 it's limited to 4.2 volts. And I, as I did in my 11 analysis, assume that what's meant by that phrase is the 12 capacity at 4.2 volts and that the word "theoretic" was 13 possibly misused in this claim. 14 Q. Do you know if "theoretic" is a word in the 15 English language? 16 A. I don't know that, but I've never come across 17 it before this claim. 18 Q. Did you look to see if the word "theoretic" 19 actually exists in the -- 20 A. I saw that -- 21 Q. -- English language? 22 A. -- it was corrected to "theoretical" in some 23 document, so I assume that confirmed my understanding 24 that it was not a word. But even assuming it's 25 "theoretical," I do know what that means. That means
Page 62 1 some other decisions that have been handed down. I was 2 made aware yesterday that there was a court ruling on 3 some of these. But again, my analysis was based on 4 plain and ordinary meaning of all the terms. 5 And when there's a potential conflict like 6 this, I try to understand the most sensible plain and 7 ordinary meaning. And the key phrase there, "a charge 8 cutoff voltage set at 4.2," that's something that a 9 person of ordinary skill would immediately understand 10 and understand that it means the amount of lithium 11 that's stored when the voltage reaches 4.2 and no more 12 than that. 13 Q. So the amount of lithium that's stored changes 14 depending on the charge cutoff voltage. Correct? 15 A. That's correct. 16 Q. And at the very least, in the context of 17 Claim 5 of the '641 patent, the theoretic capacity 18 depends in part on the charge cutoff voltage. Correct? 19 A. Again, I would -- as a person of skill would 20 interpret this, the amount of lithium stored depends on 21 the charge cutoff voltage. 22 Q. The '641 patent in Claim 5 says: As 23 calculated by a theoretic capacity with a charge cutoff 24 voltage set at 4.2 volts. Right? 25 A. That's what it says.	Page 64 1 according to theory. And the theory means that you 2 could calculate the capacity or the number of coulombs 3 of electrons stored with no experiments, just do it 4 purely by a chemistry book and a calculator. So that's 5 what a theoretical capacity would mean. 6 This is an experimental value limited by the 7 4.2 volts, and that conflict has to be resolved somehow. 8 And I believe, as most persons of skill would resolve 9 that conflict by assuming the important phrase is that 10 the cutoff voltage is 4.2 volts. It's an experiment. 11 It's empirical value. 12 Q. Do you have a definition for "theoretical 13 capacity"? 14 A. I'm sorry, do I have a definition? 15 Q. Yeah. 16 A. Well, a person of skill -- again, you're 17 asking to interpret all your questions in this form -- 18 would know what theoretical capacity meant because 19 there's a common electrochemical principle that says a 20 mole of a certain chemical, you know, to change the 21 valent state by one electron needs one -- essentially, a 22 mole of electrons. That's what the theory would lead 23 one to believe. 24 So it's a common calculation. And the fact 25 that it's called theoretical to me says that it's purely

1 based on the 100 percent conversion of one form, for 2 example, lithium plus to lithium zero. One electron, 3 one ion, what's the molecular weight of lithium, etc., 4 and you come up with a theoretical capacity. It's a 5 very clear term, but that doesn't happen in a real cell. 6 You don't get 100 percent conversion. 7 So it's useful for a battery engineer to say, 8 well, the theoretical capacity is so many amp hours or 9 coulombs per gram. I'm achieving in my laboratory 10 testing some fraction of that. And that ratio, what 11 you're achieving, tells you to some extent the 12 efficiency of that system. But this claim uses them 13 together in a way that you have to choose one or the 14 other. 15 Q. Aside from voltage, what other -- withdrawn. 16 So it's your testimony, if I understand it 17 correctly, that theoretical capacity is not affected by 18 the charge cutoff voltage. Correct? 19 A. Theoretical capacity, as I used it throughout 20 my career, and as any person of skill would use it, 21 would not be affected by the charge cutoff voltage. But 22 as used here, it clearly is. 23 And again, I'm not a lawyer. I'm not going to 24 offer opinions on how one would use something other than 25 the common and ordinary meaning of a phrase. But as one	Page 65 1 be 4.4, could be 3.9. But empirical data, which is a 2 measure of how much charge that electrode is accepting, 3 is very much dependent on the cutoff voltage. 4 So I think I clarified here that it was 5 conventional to specify a charge cutoff voltage, and 4.2 6 was a common cutoff voltage for some lithium-ion 7 systems. And it's that cutoff voltage more than 8 anything else that's going to determine the capacity of 9 the electrode. 10 There are other things that affect it. And 11 you could have systems with identical cutoff voltages, 12 but if their formulation was very different -- much more 13 conductive additives in the positive electrode, for 14 example -- you could get different results. But the key 15 variable is the cutoff voltage. 16 More current is stored as reacted chemicals, 17 lithium becoming lithium zero at higher voltages. So 18 it's important to specify just what voltage you're 19 referring to when you talk about a capacity. 20 Q. So it was commonly known that capacity would 21 be measured at the charge cutoff voltage for a 22 particular battery. Correct? 23 A. It was common to specify it at a voltage, yes. 24 Q. To specify it, meaning to specify the 25 capacity. Correct? Page 67
1 doing this type of engineering for nearly 50 years, I 2 know what it means to the industry and I see that it's 3 different here. So the answer depends on which one 4 you're referring to. 5 Q. Can we go to paragraph 81 of your declaration. 6 A. Certainly. Okay. 7 Q. And if you go to page 488, still on paragraph 8 81 of your declaration, you state: It was also 9 conventional for capacity values to be determined and/or 10 provided with respect to a 4.2-volt charge cutoff 11 voltage, for example, because it is at the charge cutoff 12 voltage of the battery that the capacity is relevant. 13 Do you see that? 14 A. I do. 15 Q. What do you mean by that? 16 A. I think it's very clear. As of the critical 17 date, so referring back to near the turn of the century, 18 batteries were operated with a 4.2 charge cutoff 19 voltage. It was conventional for capacity values to be 20 determined or provided, in other words, measured or 21 offered as data with respect to a 4.2-volt charge cutoff 22 voltage. 23 So as the discussion we've just been having 24 indicates, practical empirical data only makes sense 25 with a specific cutoff voltage. It could be 4.2, could Page 66	1 A. Specify the capacity in, for example, milliamp 2 hours per gram of material. 3 Q. At the voltage at which the battery was 4 operating. Sorry. Withdrawn. 5 It was common to specify the capacity at a 6 voltage at which the battery was operating. Let me 7 withdraw it again, and I apologize. 8 It was common to specify the capacity at the 9 battery's charge cutoff voltage. Correct? 10 A. No, that's not quite correct. As I think 11 we've seen in the '641, you can specify the capacity at 12 a cutoff voltage and then operate the battery at a 13 different cutoff voltage. 14 Q. I'm talking about paragraph 81 of your 15 declaration where you state: It was also conventional 16 for capacity values to be determined and/or provided 17 with respect to a 4.2-volt charge cutoff voltage, for 18 example, because it is at the charge cutoff voltage of 19 the battery that the capacity is relevant. 20 Do you disagree that it is at the charge 21 cutoff voltage of the battery that the capacity is 22 relevant? 23 A. Oh, no. That's directly from my statement. 24 In fact, it points out one of the anomalies in the '641 25 that I found interesting at the very least. They Page 68

1 specify capacity at 4.2 but talk about operation at 2 other voltages. 3 So as my declaration says, it's at the charge 4 cutoff voltage that the capacity is relevant. So if 5 you're applying a different cutoff voltage, you would 6 have a different capacity and perhaps one would be 7 interested in determining the capacity of that electrode 8 at that voltage. 9 So it raises the problem of trying to 10 understand how the '641 could have learned anything from 11 the experiments they did because for one thing, they're 12 charging to a different cutoff voltage than they've 13 stated capacity for and so the ratios will change -- 14 Q. I'm asking a slightly different -- 15 A. -- so -- 16 Q. -- a much more simple question. 17 So just to be clear, you agree that capacity 18 values are provided or determined with respect to a 19 battery's charge cutoff voltage. Correct? 20 A. No. Capacity values are provided or 21 determined at a cutoff voltage. It's not always the 22 battery's cutoff voltage, though. 23 Q. Okay. How do you reconcile what you just said 24 with the statement in your declaration "because it is at 25 the charge cutoff voltage of the battery that the	Page 69 1 A. I don't believe that's what I said here. It 2 was conventional for values, capacity values to be 3 determined with respect to that cutoff voltage. I 4 wouldn't call the 4.2 cutoff voltage a conventional 5 cutoff voltage, though. 6 Q. Well, why was it conventional for capacity 7 values to be determined and/or provided with respect to 8 a 4.2-volt cutoff voltage? 9 A. It was a common cutoff voltage, so to compare 10 materials, if one was to consider different positive 11 electrode materials, different cobalt oxides, and to 12 compare them for capacity, the crystal structure, the 13 density, you have to compare them at a -- at the same 14 voltage. So because at 4.2 was a common voltage, then 15 it would be conventional to compare capacity values of a 16 material at a voltage that was common. 17 Q. What other voltages were common? 18 A. 4.1, 4.25. Certainly, I'm familiar with 19 commercial systems that used -- they didn't vary wildly. 20 I didn't know of any 5-volt systems or 3-volt systems, 21 but certainly they varied some within the range of low 22 4s. 23 Q. Was it conventional for capacity values to be 24 determined and/or provided with respect to a 4.4 charge 25 cutoff voltage?
1 capacity is relevant"? 2 A. Oh, I think that statement is the source of my 3 concern over the '641. I'm saying that the charge 4 cutoff voltage of 4.2 volts in this case, it is at that 5 voltage that the capacity is relevant. So if one tries 6 to calculate or estimate a ratio when they don't know 7 what the capacity is because they're using one from a 8 different cutoff voltage, they're calculating the wrong 9 ratio. This is a problem with the '641. 10 Q. In page 47 of your declaration, you state: 11 A person of ordinary skill in the art designing a 12 battery to have a certain ratio positive to negative 13 electrode material will be interested in that ratio at 14 the charge cutoff voltage of the battery. 15 Do you see that? 16 A. Precisely. 17 Q. Do you agree? 18 A. Yes. 19 Q. Okay. Now, as of the priority date, it was 20 conventional for capacity values to be determined and/or 21 provided with respect to a 4.2-volt charge cutoff 22 voltage. Correct? 23 A. That was a common cutoff voltage, yes. 24 Q. It was the conventional cutoff voltage. 25 Correct?	Page 70 1 A. That was much less common because it was a 2 much less common cutoff voltage. 3 Q. Why was it much less common? 4 A. Because commercial developers of lithium-ion 5 batteries had determined that the results they obtained 6 with a 4.2 cutoff voltage were what they wanted for the 7 combination of safety, capacity, lifetime performance. 8 One of the issues in determining cutoff 9 voltage is it's a closed system. You don't charge 10 lithium-ion batteries with just any charger. It's a 11 closed system. All lithium-ion batteries typically were 12 always provided with a charge system. So if you cut it 13 off at 4.2 volts and you had a high rate charger, you 14 might lose some capacity or leave some ungained. 15 At a high rate system you might go to 16 4.3 volts because there's IR losses in the system. At a 17 very low rate system, if you're charging for days, you 18 might limit that to 4.15. 19 So every system was unique, but the 4.2 was a 20 common -- I think Sony may have produced the first 21 large-scale commercial systems with lithium-ion that 22 used 4.2, and it was widely adopted as a conventional 23 place to consider. 24 Q. Was it conventional for capacity values to be 25 determined and/or provided with respect to a 3.9-volt
Page 71	Page 72

1 charge cutoff voltage? 2 A. No, not to my knowledge. 3 Q. Why not? 4 A. Because if your system was designed to operate 5 at a charge cutoff voltage of 4.2, which I described as 6 common, then why would you be interested in the much 7 lower capacity that you would achieve at 3.9? It 8 wouldn't be useful. 9 Q. So all else being equal, battery designers 10 tried to raise the charge cutoff voltage for their 11 respective batteries. Correct? 12 A. No. Battery designers had a goal always, 13 still do, of increasing the capacity. Charge cutoff 14 voltage is one of the key control parameters you have. 15 You got the formulation, then you've got the charge 16 cutoff voltage. Those are the simple things, the knobs 17 to fiddle with when you're designing a new system. 18 So I would say no, they didn't start off by 19 saying their goal was to increase. In fact, if you 20 could get more capacity at lower voltage, that would be 21 great. 22 Q. Why? 23 A. Well, because that indicates that you're 24 charging at a lower condition, less energy used. 25 Q. Why is it good to charge at a lower voltage?	Page 73 1 retain a certain percentage of its initial capacity 2 after, say, 300 cycles. 3 Do you follow me so far? 4 A. Now you're constructing a theoretical, I -- I 5 guess. Okay. 6 Q. Right. So my question is, with the 7 information given, can you tell me what impact, if any, 8 there would be on this battery's ability to retain 9 capacity after 300 cycles from decreasing the charge 10 cutoff voltage from 4.2 volts to, say, 4.1 volts? 11 Would it increase, decrease, or leave equal 12 the cycle life? 13 A. Well, there are too many unspecified 14 variables. If you decrease the voltage, you would 15 immediately obtain a lower capacity. So how do you 16 define the cycle life? You've got much less capacity 17 right from the start, very first cycle, and you would 18 recognize that in the very first cycle. 19 Q. Right. But the ability to retain capacity 20 with respect to that initial capacity, that's unaffected 21 by the initial capacity. Correct? 22 A. Well, it's affected by the many of -- the 23 initial capacity -- no, no, that's not true. The 24 initial capacity -- there are -- your hypothetical is 25 left with more questions than I can analyze. Is it the
Page 74 1 A. Well, if you can achieve the same energy 2 output with a lower charge voltage, it means you've got 3 a very flat charge curve, which is a valuable thing. 4 Lithium-ion cells do not have a flat discharge 5 or charge curve. It varies as the cell is charged or as 6 it's discharged, so something that would flatten it out 7 a little bit would be a desirable thing. 8 Q. Are there any other benefits to having a lower 9 charge cutoff voltage? 10 A. Not independent of other things, no. I mean, 11 you could say, well, you save a little energy. But the 12 key is that battery designers aren't looking to change 13 voltage; they're looking to increase the capacity of 14 their system. 15 Q. If I were to decrease the charge cutoff 16 voltage for a particular battery, what would the impact 17 be with respect to the cycle life of that battery? 18 A. Apropos of nothing, it's difficult to say what 19 effect. It's not an independent variable that you can 20 change. So if you had a conventional system and you 21 decreased the voltage, I'm trying to understand what -- 22 what the proposal is. 23 Q. Let's say I have a battery, a secondary 24 lithium-ion battery that is specified for a 4.2-volt 25 charge cutoff voltage, and it is also specified to	Page 75 1 same material, the same -- 2 Q. All else being equal. All else being equal 3 was my hypothetical. 4 A. You simply take a system designed for 5 4.2 volts and now charge it to a lower voltage? 6 Q. Correct. 7 A. You would get lower capacity. 8 Q. What would happen to the battery's ability to 9 retain capacity with respect to the initial capacity in 10 each of the two hypothetical batteries? 11 A. You mean as a percentage -- 12 Q. Correct. 13 A. -- of its initial capacity? 14 Q. Yes. 15 A. Well, based on my experience, I would predict 16 that it would have a longer cycle life. 17 Q. So the battery -- just to sum up what you just 18 said, the battery with the lower charge cutoff voltage 19 would have a longer cycle life? 20 A. If it was designed for a higher battery 21 that -- it would have a longer cycle life than the same 22 battery probably would at 4.2 volts. Again, the problem 23 with cycle life comparisons is that there are dozens of 24 failure modes. And when you change a variable like 25 that, you may switch from one failure mode to another,

Page 77 1 even all things being equal, as you stated, just by 2 virtue of the changed conditions, so -- but again, based 3 on my experience, I would expect that it would have a 4 longer cycle life. 5 Q. But it's still hard to predict exactly, even 6 all else being equal. Correct? 7 A. What's hard to predict? 8 Q. Well, I asked you to tell me if you could 9 which of the two batteries would have a longer cycle 10 life, and you said that even all else being equal, it's 11 just hard to predict exactly which of the two batteries 12 will have a longer cycle life. Correct? 13 A. Because other failure modes might come into 14 play. But I did offer an expectation. I wouldn't call 15 it here a prediction. I haven't seen any data. But I 16 would offer an expectation that the lower charge voltage 17 would have a longer cycle life. 18 Q. Why is that? 19 A. It's based on my experience. 20 Q. And what have you observed in your experience? 21 A. Well, I'll give you a perfect example. My 22 wife recently bought a new car, and they clearly stated 23 in the operating instructions -- it's a Mercedes EV -- 24 that if you charge it to a lower value, you can expect 25 longer cycle life. So there's a real-world example.	Page 79 1 technical officer of a startup company that focused on 2 lithium battery control systems. 3 Q. These were important positions. Yes? 4 A. To the company, they were. 5 Q. And they were technical positions, right? 6 A. They were. 7 Q. And the charge cutoff voltage is one of 8 several important battery operation parameters. 9 Correct? 10 A. Yes. 11 Q. Did you ever become curious and try to see why 12 4.2 volts had become a common value with respect to the 13 charge cutoff voltage in the industry at the time? 14 A. Well, as I said, we were developing control 15 systems and working with the cell manufacturers to 16 implement those systems so we -- in fact, we used at 17 times what were called dynamic cutoff voltages, which 18 measured things like temperature and charge rate and 19 modified the cutoff voltage as a function of those 20 things. 21 So while I described 4.2 as common, it 22 certainly wasn't ubiquitous. It's not something that 23 was always used. In fact, I was part of an industry 24 trend to complicate things by providing different charge 25 voltages for different conditions. It was an area of
Page 78 1 If you charge it to the highest voltage 2 possible every single time, it tells you that you'll get 3 lower cycle life than if you charge it to a lower value. 4 And it's a lithium system. 5 Q. Now, why was it common -- withdrawn. 6 Why was 4.2 volts a common charge cutoff 7 voltage as of the priority date of the '641 patent? 8 A. Why was it common? You know, that's an 9 observation of the state of the industry at the time. I 10 was, you know, actively working in the middle of the 11 lithium battery industry, and it was -- I was -- by 12 2000, I had spun off a company to develop 13 battery-controlling electronics because it was such an 14 important field. And I was aware of what was being done 15 in cell suppliers, the recommended charge voltages, and 16 I -- it was just an observation. I'm not sure I know 17 all the reasons why. 18 Q. So you were heavily immersed in this industry. 19 Fair? 20 A. Yes. I was working in it throughout the late 21 '90s and throughout 2000s. 22 Q. And you served in important positions at 23 various companies in this industry. Fair? 24 A. Well, I was director of engineering for 25 rechargeable batteries for Duracell. I was chief	Page 80 1 active research. 2 Q. Back to my question, though. 3 What was it about 4.2 volts that was 4 significant enough that that value had become common? 5 A. It was the point where the cell manufacturers 6 clearly found the combination of characteristics that 7 they felt were the best for their system. 8 It wasn't a single point of failure, success, 9 or like -- there are many, many things that are used to 10 evaluate a cell. If a computer manufacturer, for 11 example, was going to choose a cell supplier, he would 12 consider dozens of performance characteristics at many 13 different conditions. And the cell supplier would 14 typically recommend charge -- both charge cutoff voltage 15 and charge technique, for example, constant current up 16 to a voltage and then switch to constant voltage. That 17 was common. There were other systems too. 18 So it's -- while I described it as common, it 19 certainly wasn't the only one. And even then, it was 20 complicated by the actual operating systems. 21 Q. Would you say that identifying the correct 22 voltage ranges for lithium-ion batteries is particularly 23 important? 24 A. I'm sorry, I don't -- I'm not sure what you 25 mean by identifying the correct voltage ranges. Could

1 you be more specific? 2 Q. For example, identifying the maximum cell 3 voltage limit on charging. Is that important? 4 A. Yes. 5 Q. Why? 6 A. Because you typically rely on the cell 7 manufacturer's experience in developing that cell, and 8 he or they have determined that this maximum limit 9 produces the best results. And it's usually a 10 combination of many, many things. 11 Q. What are those things? 12 A. Well, safety is one of them. Cycle life is 13 one. Performance at a wide range of conditions is 14 another. Calendar life is another. You know, there's a 15 difference between cycle life and calendar life. 16 Holding a cell at a high voltage, even if it's never 17 charged and discharged, can impact its life. You can 18 destroy a cell in a couple of cycles if it's incorrectly 19 held at the wrong voltage. So it's important to adopt 20 the recommendation of the manufacturing organization 21 that has conducted all those tests. 22 Q. So you mentioned safety, cycle life, holding 23 life or calendar life, right? 24 A. I did. 25 Q. And you also mentioned performance at a wide	Page 81 1 A. The number of amps that are being withdrawn 2 from the battery or discharged at any given time. 3 Q. What else? 4 A. Well, you could then measure all those things 5 at different conditions of temperature. 6 Q. So there's a lot of different parameters -- 7 that -- 8 (Reporter clarification.) 9 BY ATTORNEY STAMATOPOULOS: 10 Q. So it's fair to say, Mr. Hruska, that there 11 are a lot of different battery performance 12 characteristics that are affected by the charge cutoff 13 voltage. Correct? 14 A. I think you just added charge cutoff voltage 15 to this line of questioning. It was a while ago, but I 16 don't remember that being the reference for the -- so 17 I'll answer that specifically. 18 The charge cutoff voltage typically would not 19 affect some of those characteristics. For example, the 20 performance at different temperatures I wouldn't expect 21 would be immediately affected directly by the charge 22 cutoff voltage, but -- so help me understand what it is 23 that you're asking. 24 Q. I believe before we were disconnected we were 25 talking about why 4.2 volts was a common charge cutoff
1 range of conditions. 2 A. That's correct. 3 ATTORNEY IN: Did we lose George? 4 THE VIDEOGRAPHER: Time is 9:26 AM. We are 5 off the record. 6 (Recess taken.) 7 THE VIDEOGRAPHER: We are back on the record. 8 The time is 9:33 AM. 9 ATTORNEY STAMATOPOULOS: So apologies for that 10 interruption due to the connectivity issues. So before 11 we were disconnected, could the court reporter actually 12 repeat my last question? 13 (The reporter read from the record.) 14 BY ATTORNEY STAMATOPOULOS: 15 Q. What do you mean by "performance"? 16 A. The values that one would measure when 17 discharging the cell, typically. Voltage, current 18 capacity measured in milliamp hours, performance at 19 different rates of discharge, different temperatures, 20 all contribute to what one would call performance 21 measurements. 22 Q. You mentioned voltage. You mentioned 23 temperature. What else? 24 A. Rate. 25 Q. What do you mean by rate?	Page 82 1 voltage. 2 Do you recall that? 3 A. I do. 4 Q. And I'd asked you about why it had become a 5 common charge cutoff voltage value. 6 Do you recall that? 7 A. I do. 8 Q. And you had listed a number of different 9 performance characteristics that contributed to 4.2 10 volts becoming a common value for charge cutoff voltage. 11 Do you recall that? 12 A. I think I described it as there were a wide 13 variety of conditions that would be tested to make the 14 decision for a charge cutoff voltage recommendation by 15 the manufacturer. 16 Q. And cycle life was one of those, right? 17 A. Yes. 18 Q. And the operating voltage was another one. 19 Correct? 20 A. That's correct. 21 Q. And what are the other performance 22 characteristics that are affected by the charge cutoff 23 voltage? 24 A. The cycle life again is a characterization 25 that would have many, many different values. The
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1 capacity, you know, on the first cycle, the capacity 2 after 10 cycles, after 100, all different values all 3 might be affected in different ways by the charge cutoff 4 voltage. 5 The capacity as measured by amp hours 6 initially is a key variable, and that is clearly 7 affected by the charge cutoff voltage. Safety is 8 another -- it's not as easily quantifiable, but safety 9 is a key question when considering charge cutoff 10 voltages. How close are you to a voltage that might 11 cause some sort of issue, not just lifetime, as in the 12 cell doesn't perform, but actually venting or even fires 13 at very high voltages. So there are many. Those are 14 some of them. 15 Q. Any other ones you can think of? 16 A. I don't think anything else would be as 17 important as those. 18 Q. Would you say safety is a principal driver in 19 connection with determining an appropriate charge cutoff 20 voltage for a battery? 21 A. No. A principal driver is an odd way to 22 describe it, I would think. It's a -- it's an important 23 consideration. Typically, it doesn't come into play 24 because one develops cells that are known to be safe and 25 a long way from conditions that would cause safety	Page 85 1 priority date of the '641 patent. Correct? 2 A. 4.2 volts was far below the cutoff voltages 3 that would still be considered safe, but it was in the 4 safe range, yes. 5 Q. Is safety at all related to cycle life? 6 A. Everything is related in a complex chemical 7 system like this, but not directly, no. I -- one 8 typically doesn't look for cycle life as an indicator of 9 safety issues, and vice versa, no. 10 Q. Do the failure modes that affect cycle life 11 also come into play with respect to safety? 12 A. There are failures modes that can result in 13 safety issues, the classic one being lithium plating, of 14 course. It's a failure mode initially when present in 15 very small levels. You can indicate it by seeing 16 reduced capacity and by voltage fluctuation during 17 charge. And if allowed to continue at low rate and over 18 a long time, it can result in a short-circuit of a 19 lithium dendrite directly contacting the positive 20 electrode. 21 So there's a relationship in that particular 22 failure mode. Most failure modes are not connected to 23 safety issues, though. 24 Q. Are the failure modes that are relevant safety 25 issues related to the charge cutoff voltage of a
1 problems. 2 So it's a consideration, but it's not 3 something one would measure very frequently because 4 typically, we design cells that are in a very safe 5 region. 6 Q. Could it be potentially unsafe to charge a 7 battery to a very low charge cutoff voltage? 8 A. If you mean a voltage that's -- so a charge 9 cutoff voltage implies that it's higher than the open 10 circuit voltage of the cell, so very low still has to be 11 above the open circuit voltage of the cell. So no, 12 there's no safety aspect of very low charge rates or low 13 cutoff voltages, no. 14 Q. When does safety come into play as a factor or 15 an element to be considered in connection with a 16 battery's charge cutoff? 17 A. Typically at very high cutoff voltages, one 18 would raise issues of safety. 19 Q. And battery designers want to make sure that 20 they adopt charge cutoff voltages that are safe. 21 Correct? 22 A. Yes. They want their systems to be safe, yes. 23 Q. And with safety as a consideration in mind, 24 4.2 volts was a common value for the charge cutoff 25 voltage of secondary lithium-ion batteries as of the	Page 86 1 secondary lithium-ion battery? 2 A. Yes. The one I just described, lithium 3 plating, typically occurs at higher voltages. 4 Obviously, the active material ratios are very important 5 there, which is the subject of this whole discussion. 6 But yes, high voltages, a failure mode, and the 7 resultant safety issues are related in that case. 8 Q. Aside from safety, what are the reasons for 9 which a person of ordinary skill in the art might want 10 to keep the charge cutoff voltage low? 11 A. Well, certainly the understanding of capacity 12 and the change in capacity under different conditions 13 and over time is important. 14 Q. What do you mean by that? 15 A. Well, at very high charge voltages, one would 16 expect to have a shortened cycle life. 17 Q. And why would high voltages cause a shortened 18 cycle life from an electrochemical perspective? 19 A. Well, I can offer some reasons. I'm not sure 20 that it's an exhaustive list. But changes in the 21 positive electrode material where internal crystal 22 changes, a battery engineer might describe it as 23 over-discharging and overcharging the positive 24 electrode, would change the conductivity and the ability 25 of that particular chemical to store lithium, so it will
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1 affect the capacity over time. 2 Q. What other reasons? 3 A. To avoid high voltage? Electrolyte breakdown 4 is a well-known one. These cells all contain nonaqueous 5 electrolytes and lithium salts. And lithium salt is the 6 source of the lithium ions that carry the current 7 internal to the cell. The organic solvents that carry 8 those electrolyte salts are subject to breakdown at high 9 voltage. And typically, the result of breakdown is 10 either the formation of films on electrodes, which are 11 not conductive, and the breakdown into gas like CO₂. 12 Q. Could those issues also result in safety 13 hazards? 14 A. They could. Venting is, broad terms, 15 considered to be a safety issue. Most cells are 16 designed to vent safely, but what they're venting is a 17 flammable material, so it's considered a -- there's no 18 explosion, there's not necessarily a fire, but venting a 19 flammable gas is a safety issue. So yes, electrolyte 20 breakdown and the formation of gases is related to 21 safety considerations. 22 Q. And at what voltages would those issues begin 23 to become a concern for a battery designer? 24 A. Depends on the electrolyte, the salts, the 25 electrodes, the metals, the positive electrode, the	Page 89 1 experiments? 2 A. By limiting the system you're testing to 3 reasonable electrolytes materials that you know won't 4 break down. You know, some of them go up to 5 volts 5 without breaking down. 6 Q. You're talking about the electrolytes? 7 A. Yes, as a specific example of a failure 8 mechanism that's not lithium plating, yes. 9 Q. Fair to say that the charge cutoff voltage of 10 a secondary lithium-ion battery is different than the 11 externally applied voltage that is used to charge the 12 battery? 13 A. I'm not sure I understand that question. 14 The -- could you repeat it? 15 Q. Well, let me try to break it down. 16 So we've talked about this term, "charge 17 cutoff voltage," right? 18 A. Yes. 19 Q. And you -- I believe you testified earlier 20 that the externally applied voltage needs to be higher 21 than the open circuit voltage. Correct? 22 A. That's correct. 23 Q. Circuit voltage is the potential between a 24 positive and a negative electrode of a secondary 25 lithium-ion battery. Is that fair?
1 carbons used in the negative. There's a wide range of 2 design considerations that will impact where, for 3 example, the electrolyte breakdown decides to occur. 4 Q. So there's a host of factors that might affect 5 the particular charge cutoff voltage at which all of 6 these issues might start to arise. Correct? 7 A. There is a host of factors that affects that, 8 yes. 9 Q. And deciding what the appropriate charge 10 cutoff voltage is for a battery is a complex problem. 11 Fair? 12 A. Well, it becomes a complex problem when you 13 open up all of those considerations. Of course, battery 14 designers typically limit their experimentation to a 15 manageable set of factors, trying to make it a 16 reasonable problem to solve. What are electrolytes that 17 are available, commonly used, not particularly toxic, 18 etc., and then you limit the world to a smaller set of 19 opportunity. And that's how you end up with a set of 20 conditions that is acceptable for all of the design 21 considerations. The chemicals used, the materials, the 22 substrates, the tabs, everything in there impacts 23 whether or not the electrolyte's going to break down and 24 form gas so you try to simplify that set of experiments. 25 Q. And how do you try to simplify that set of	Page 90 1 A. When zero current is flowing. 2 Q. Right. So I guess my question to you is, is 3 the charge cutoff voltage a particular value of open 4 circuit voltage, or is it a voltage measured at a time 5 when current is flowing through the electrodes? 6 A. It depends very much on the system. As I 7 described earlier, lithium-ion systems, perhaps until 8 very recently, were never sold without charge control 9 equipment, construction, or even assemblies. Sony, it 10 took them 10 years before they would sell a system that 11 didn't have charge control protection built into the 12 battery pack. 13 So every system that was sold, and to this 14 day, at least in recommendations, has a specific set of 15 charge recommendations or acceptances. And you can 16 specify the charge cutoff voltage to be under conditions 17 of charge. That's why it's called a charge cutoff 18 voltage. But that is different than the open circuit 19 voltage. 20 So if it's an open circuit voltage, there's no 21 current flowing, the system is not charging. If it's a 22 charge voltage, then you need to know how much current 23 is flowing. And as somebody who designed systems like 24 this, I can tell you there are many ways of defining 25 what that charge cutoff voltage -- how it's measured and
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Page 93 1 when the current -- and, in fact, often it is not cut 2 off in terms of going to zero, it's often switched 3 simply to a volt or potentiostatic or voltage constant 4 where the current decreases over time but, in fact, is 5 not zero and is never zero. 6 So it's a long way of saying that there's no 7 simple answer to what -- how it responds without knowing 8 the system design. 9 Q. Are you familiar with a term called 10 "equilibrium voltage" or "equilibrium potential"? 11 A. I am familiar with it as a sort of a 12 fundamental electrochemical principle, so perhaps you're 13 thinking of something specific. Maybe you could tell me 14 what -- 15 Q. Well, tell me what your understanding is of 16 this term. 17 A. "Equilibrium" means that there's no reaction 18 taking place, so I would liken it to an open circuit 19 voltage. 20 Q. So the external voltage that is applied to a 21 battery needs to be greater than the open circuit 22 voltage for charging to take place. Fair? 23 A. Yes. 24 Q. And once that externally applied voltage is 25 removed, will the open circuit voltage be equal to the	Page 95 1 initially, it's probably lower. 2 Q. Well, let me try to make it a little bit 3 clearer so we understand what we're talking about. 4 So let's assume constant current charging 5 conditions, okay? 6 A. Okay. 7 Q. And there's an externally applied voltage. 8 Good so far? 9 A. In constant current, you would -- I guess an 10 engineer would say you apply the current, because you're 11 controlling the current, not the voltage. 12 Q. Okay. But there's also an externally applied 13 voltage as a result of that current. Or, rather, 14 there's an externally applied voltage that causes that 15 current to occur, right? 16 A. That's correct, yeah. 17 Q. Okay. And that externally applied voltage 18 during the entire charging phase will be greater than 19 the open circuit voltage at the end of charging. 20 Correct? 21 A. No, that's not correct. 22 Q. Why? 23 A. Because the voltage of a discharged battery is 24 significantly lower than the voltage of a charged 25 battery. So during charge, the voltage rises from its
Page 94 1 value of the externally applied voltage that was last 2 applied to the battery? 3 A. That depends on the rate at which it was being 4 charged. 5 Q. And there are different charging conditions 6 that may use different charging rates. Correct? 7 A. Yes. As I described, you can taper off the 8 charge where the voltage is held at a constant and the 9 current drifts down towards zero but essentially never 10 reaches zero. 11 Q. You're familiar with the term "constant 12 current charging"? 13 A. Yes, I am. 14 Q. You're familiar with the term "constant 15 voltage charging"? 16 A. Yes, I am. 17 Q. And you're familiar with the term "constant 18 current/constant voltage charging," right? 19 A. As -- well, you're describing, I think, the 20 system I just described where you switch from one to the 21 other upon reaching a specific voltage. 22 Q. Right. And so under constant current 23 charging, will the externally applied voltage be greater 24 than the open circuit voltage at the end of charging? 25 A. No. The voltage rises during charge, so	Page 96 1 discharged state to its charged state. So even the open 2 circuit voltage at the end is likely to be higher than 3 the voltage that's observed during the charge process 4 because it started off at a lower voltage. 5 Q. I'm talking about the externally applied 6 voltage, though. 7 Isn't it true, sir, that for as long as 8 current is flowing through the battery, the externally 9 applied voltage is greater than the open circuit 10 voltage? 11 A. The open circuit voltage has to be defined at 12 a specific state of charge. So your question was is the 13 voltage during the charge process higher than the open 14 circuit voltage at the end of charge, and the answer is 15 no. If your question was something different, I might 16 have a different answer. 17 ATTORNEY STAMATOPOULOS: I think it was 18 something different, and I think we're talking past each 19 other. Maybe this is a good time for a break and we 20 can -- maybe we can go off the record briefly. 21 ATTORNEY IN: Yeah. 22 THE VIDEOGRAPHER: Time is 9:59 AM. We are 23 off the record. 24 (Recess taken.) 25 THE VIDEOGRAPHER: We are back on the record.

Page 97 1 The time is 10:23 AM. 2 BY ATTORNEY STAMATOPOULOS: 3 Q. Welcome back, Mr. Hruska. 4 A. Thank you. You too. 5 Q. Now I'd like to invite your attention to the 6 '641 patent, Claim 11. Claim 11 you'll see recites a 7 secondary lithium-ion cell or battery according to 8 Claim 5 wherein the secondary lithium-ion cell or 9 battery maintains at least 75 percent of capacity after 10 400 cycles. 11 There's a typo there, but 7500 refers to 12 75 percent. Do you understand that? 13 A. I do. 14 Q. What is a person of ordinary skill in the 15 art's understanding of this phrase here, "maintains at 16 least 75 percent of capacity after 400 cycles"? 17 A. Well, we've discussed cycle life at length, so 18 I think it's fair to say that this is an example of a 19 single-point cycle life determination. They may have 20 done a series of tests and have more data, or maybe they 21 just cycled it 400 times at some conditions. We don't 22 know what those conditions are. And presumably, they 23 obtained a capacity in milliamp hours that was at least 24 75 percent of its original capacity. 25 Q. What is the initial capacity?	Page 99 1 want to ship the cells. They typically don't ship them 2 in 100 percent state of charge so sometimes there's a 3 partial discharge, but it's not a, what I -- I wouldn't 4 call it a cycling event. 5 Q. And in any event, whatever the formation 6 period might be, it's with respect to that initial 7 capacity that capacity retention is defined. 8 Is that fair? 9 A. Yes. 10 Q. Would capacity retention be measured against a 11 capacity that is other than a capacity measured at the 12 end of a formation period? 13 A. Well, it depends on the testing. You -- I've 14 been part of cycle testing where one was interested in 15 understanding how the cell performs at very high rate or 16 at pulse conditions, and in which case you might obtain 17 significantly less capacity at a very high rate. And 18 comparing that to the formation capacity might show that 19 the capacity is always less than high rate. Might be 20 70 percent or 50 percent of that initial capacity. So 21 it depends on the test and what it is you're trying to 22 determine. 23 Q. In the context of Claim 11, what is the 24 initial capacity against which capacity retention is 25 then measured?
Page 98 1 A. That would be the capacity measured during -- 2 there's a process called formation for lithium-ion 3 cells, and during that process, you can determine -- you 4 can estimate -- measure the capacity, essentially. But 5 it's the first charging of the electrodes because, of 6 course, the carbon is applied without any lithium in it. 7 So during formation, you can measure the initial 8 capacity of the cell. 9 Q. And what is the formation period? 10 A. Well, it's typically quite slow. Hours. 11 Q. Does it consist of a single charge/discharge 12 cycle? 13 A. No, not always, no. Formation only requires 14 really charging. 15 Q. Is it just a single charge that's required to 16 complete the formation period? 17 A. It can be. It can be followed by a discharge, 18 but the formation itself is charging. A low rate, 19 typically. 20 Q. And is it just one charge? 21 A. It can be. 22 Q. Can it be several charges? 23 A. Well, it could be. It could be. Again, it 24 depends on the process and the type of cell and the 25 application and what the intended use is and how they	Page 100 1 A. Well, it's not stated so you need to assume 2 that there's some -- 75 percent is 75 percent of 3 something. So there was some initial capacity that they 4 presumably called 100 percent, and then after 400 5 cycles, they were looking for something that was -- 6 maintained 75 percent of that value. But I -- it's not 7 clear how they measured that initial capacity and 8 whether it was at the same conditions. So there's very 9 little information here. 10 Q. What would a person of ordinary skill in the 11 art understand with respect to the initial capacity of 12 the battery claimed in Claim 11? 13 A. They would expect that there had been some 14 measurement, perhaps at formation, or maybe it was even 15 a nominal capacity. That's another way of doing it, 16 where cells are designed and manufactured in large 17 volume. And they say this is a 5-amp hour cell and then 18 cycle life might be measured against that five hours 19 even though there's a distribution curve of capacities 20 for every manufacturing. 21 So I've seen that as a way of determining 22 cycle life measuring against a nominal capacity. It 23 saves -- or you could carefully measure each and every 24 cycle, but they don't -- they don't describe that here. 25 Q. What initial capacity did you use in

1 connection with your analysis of Claim 11? 2 A. I'm not sure I understand the question. 3 Q. You analyzed Claim 11, right? 4 A. I did. 5 Q. You looked to see if one of the prior art 6 combinations described a battery that retained 7 75 percent of capacity after 400 cycles. Correct? 8 A. That's correct. 9 Q. What was the initial capacity of that prior 10 art combination, according to your analysis? 11 A. Well, these are relative numbers. There's no 12 need to know what the initial capacity was. The point 13 is that there's -- there's some techniques. In this 14 case, it's the combination of voltage and material 15 balance that leads to a cycle life measurement of 16 75 percent. You don't need to know what the absolute 17 value was. 18 My analysis of this claim, I think it's 19 described in my report around 1 -- around Claim -- or 20 paragraph 100. And if I could refer to some of that 21 discussion here, you asked what the combination -- the 22 combination describes the exact same two factors, higher 23 voltage and higher negative electrode cell balance, that 24 Claim 11 says led to a cycle life. 25 So my analysis would tell me that by bringing	Page 101 1 A. That's correct. 2 Q. Is it possible to evaluate capacity retention 3 after 400 cycles based on capacity retention after 10 4 cycles without conducting further testing? 5 A. It's possible to predict it, yes. Values of 6 up -- in this case, up to 98 percent capacity retention 7 would indicate to me a good long-life cell. 8 And again, the key features are contained in 9 both the '641 and in the combination of the two patents, 10 so I would expect that the performance would also be 11 carried along. 12 Q. What are the key features that you're 13 referring to? 14 A. The claim that a higher voltage produces 15 increased capacity, and that the ratio of the negative 16 electrode capacity, putting aside the question of how 17 that's measured, to the positive is in a certain range 18 all above one. 19 Q. So as long as you meet those two requirements, 20 it's your expectation that capacity retention would be 21 high after 400 cycles? 22 A. Well, again, all other things being equal. 23 The '641 patent does not describe in any kind of detail 24 how to make these cells, what the formulations are, what 25 the materials are, how they're processed, coded, rolled,
Page 102 1 those same two key factors in, one would achieve a 2 similar cycle life if all things were equal. 3 Q. Is it possible for the formation period to 4 last 10 cycles? 5 A. No, I don't think so. That's not a formation 6 period. 7 Q. What's the maximum number of cycles that a 8 formation period may last? 9 A. Well, they're not cycles because it's not 10 being charged and discharged, necessarily. As I said, 11 it may be charged to a less than 100 percent state of 12 charge. It's often discharged to a less than full 13 discharge, so they're not cycles. 14 Q. Is it possible to have a formation period that 15 includes 10 cycles? 16 A. No, I don't think anybody would ever do that 17 and call it a formation period, no. 18 Q. Paragraph 97 of your declaration, you list 19 some experimental results that are contained in the 20 Yamaki prior art reference. 21 Do you see that? 22 A. I do on page 58, yes. The table? 23 Q. Yes. 24 And Yamaki discloses capacity retention after 25 10 cycles, right?	Page 104 1 compacted, separated. All of the things that actually 2 determine performance are left undescribed. 3 So they describe results that include a 4 400-cycle single point. And if all of those undescribed 5 values were identical for the combination 6 Yamaki/Sakamoto device, and it included those two key 7 features, then yes, I would expect it. 8 And, in fact, there's nothing in the data 9 that's given that would suggest anything else. 98, 97, 10 95 percent indication at 10 cycles is an excellent 11 start, and I think it's on track to perform well at 400 12 cycles. 13 Q. Let's forget about the '641 patent for a 14 second. Let's just look at Yamaki itself. 15 Just looking at Yamaki and the disclosure here 16 of a capacity retention after 10 cycles, would it be 17 possible for a person of ordinary skill in the art, 18 looking just at Yamaki's disclosure of capacity 19 retention after 10 cycles, to predict that Yamaki would 20 also retain 75 percent of capacity after 400 cycles? 21 A. Yamaki doesn't describe, of course, one of the 22 key features, so it's missing that aspect. So the 23 reason I brought up the '641 is it's the kind of data 24 that a person of skill would use to say, is this a 25 reasonable expectation?

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1 But barring that, I think it's still a very 2 reasonable expectation based on the high 90s that are 3 observed after 10 cycles. That's a very good retention 4 rate. Typically, there is a drop in the first few 5 cycles. And if they're retaining high 90s, again, 6 assuming that the failure mechanisms are known and are 7 not going to cause precipitous failure, then yes, I 8 think it's a very reasonable prediction to say it would 9 go 400 cycles and stay above 75 percent capacity. 10 Q. So 400 cycles is about 40 times 10 cycles. 11 Correct? 12 A. It's exactly 40 times 10 cycles. 13 Q. And in 10 cycles, the best performing of 14 Yamaki's batteries is example 3, which loses 2 percent 15 of its initial capacity after 10 cycles. Correct? 16 A. That's correct. 17 Q. And do you know how Yamaki's battery -- well, 18 let me withdraw that question. 19 Does Yamaki disclose the curve of its capacity 20 retention over the number of cycles whether, for 21 example, capacity retention is linear, geometric, or 22 other? 23 A. Well, neither Yamaki nor the '641 patent 24 disclose a curve. But I know from thousands, tens of 25 thousands of cell results obtaining cycle life that a	1 directed the testing of, observed, and used those 2 results to make decisions on battery designs and 3 manufacturing. 4 Q. Aside from your own -- fair to characterize 5 that as your own experience? 6 A. Yes. 7 Q. Aside from your own experience, on what other 8 basis is it your opinion as you sit here today that 9 Yamaki would retain 85 percent or thereabouts of 10 capacity after 200 cycles? 11 A. Well, data presented in hundreds and hundreds, 12 I believe, that the -- earlier, we talked about the 13 Handbook of Batteries, and I think there was some data 14 presented in a table there. And I'm pretty sure it 15 shows the characteristic S curve that I just described. 16 So you could say this system, based on, you 17 know, 3 -- 2 to 5 percent loss in the first 10 cycles, 18 yes, it's early. I certainly would be happier if Yamaki 19 had provided later data. But it's a single point, just 20 like the '641 patent is a single point, and I think it's 21 instructive and leads me to say it's a reasonable 22 prediction that it would meet about 200 cycle, 85 to 23 90 percent life, and 400 cycles above 75 percent. 24 Q. And again, the basis for your opinion is data 25 that you have observed over the course of your career.
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1 lithium-ion system like this will always exhibit an 2 S-shaped curve, that is, it declines more steeply in the 3 first few cycles, and then there's a period of time 4 where it's relatively flat, sometimes even slightly 5 increasing. And then as it begins to decline, there's a 6 broader dropoff resulting eventually in a very steep 7 drop. 8 So all lithium-ion systems exhibit that unless 9 there's something precipitous, so vents or something 10 that causes rapid change. But basically, if you're 11 testing cycle life, you'll see an S-shaped curve. 12 And typically, that first dropoff is up to 13 5 percent in a few cycles, and I would expect anything 14 that doesn't show some dropoff is questionable data. 15 But I would expect a long period of relatively flat 16 performance after that. And this is based on observing 17 literally tens of thousands of cycle life tests in 18 lithium-ion development. 19 Q. What would be your expectation with respect to 20 Yamaki's capacity retention after 200 cycles? 21 A. I would expect it would be a significant, 22 measurable dropoff from the 95 to 98 percent but still 23 in the range of 85 or 90 percent. 24 Q. On what basis? 25 A. Again, of tens of thousands of cells that I've	1 Correct? 2 A. Data that I've observed directly from doing 3 the tests and data from other published results in 4 conferences and other presentations of data from other 5 people. 6 Q. And the data, to be clear, is not listed in 7 your report. Correct? 8 A. I'm trying to remember exactly what the 9 Handbook of Batteries -- I think it does reference cycle 10 life, that particular reference, yeah. 11 Q. You're talking about the Linden reference? 12 A. Yes. 13 Q. Linden doesn't talk about charge cutoff 14 voltage of 4.5 volts. Correct? 15 A. No, I don't believe so. 16 Q. Yamaki talks about a charge cutoff voltage of 17 4.5 volts. Correct? 18 A. Yamaki talks about 4.4 to 4.8, if I remember 19 right. 20 Q. In this table right here with respect to 21 example 3 that we were just discussing, Yamaki gives 22 4.5. Correct? 23 A. That's correct. 24 Q. And it also gives an initial battery capacity 25 of 4.17, right?

1 A. That's correct. 2 Q. And have you ever published on the maximum 3 cell voltage limits for charge cutoff voltage? 4 A. No. I was doing this work at Duracell, a 5 commercial competitive company, not as an academic. We 6 didn't publish any data. 7 Q. Do you recall the capacity retention after 100 8 cycles of lithium-ion batteries that you personally 9 worked on during the course of your career? 10 ATTORNEY IN: Objection. Form. 11 A. I was directing a development and 12 manufacturing effort. There's a wide, wide range of 13 results that I could probably refer to, so you'll have 14 to be more specific. 15 BY ATTORNEY STAMATOPOULOS: 16 Q. So fair to say that the capacity retention of 17 batteries that you worked on varied widely? 18 A. Because it was a developmental effort. The 19 capacity retention of batteries that were produced in a 20 high-volume commercial manufacturing facility did not 21 vary widely. 22 Q. So what was the capacity retention of 23 batteries that were produced in a high-volume commercial 24 manufacturing facility that you're aware of? 25 A. We made claims of over 500 at the C rate and	Page 109 1 A. We would do extensive testing during 2 development and then, once in production, do a very 3 limited set of tests as part of quality control, 4 essentially. 5 Q. But at some point in time, you would actually 6 test the batteries at several hundred cycles to make 7 sure that they actually retained approximately 8 80 percent after -- or more after 500 cycles. Correct? 9 A. I don't remember that being a regular test, 10 but I'm sure it was conducted during development and 11 probably some sample of production. I don't recall that 12 being part of the quality test, but we used predictions, 13 like the initial capacity, as the key element in 14 determining whether our process remained in control and 15 what the performance of the cells -- and whether or not 16 to release batches or production volumes from given 17 dates for sale. It would primarily be the initial 18 capacities. 19 Q. What do you mean by that? 20 A. Well, you make a decision on whether cells 21 should be -- could be shipped to customers on the basis 22 of tests that were conducted, and the initial capacity 23 was the key determiner whether those cells were 24 acceptable for production. 25 Q. You're talking about the cells that you
1 25 degrees C. 2 Q. And when you say you made claims of over 500 3 at the C rate and 25 degrees C, what was the actual 4 capacity retention as a percentage of the initial 5 capacity after 500 cycles for those batteries? 6 A. Well, like all real data, of course, there's a 7 wide range of results, but it -- the center of that 8 curve would have been above 80 percent. 9 Q. And how did you ascertain the 80 percent 10 capacity retention for those batteries? 11 A. Well, during development by measuring cycle 12 life and capacity at that rate. 13 But we did not do that regularly for 14 commercial high-volume cells. It would be ridiculous to 15 conduct cycle life tests on the millions of cells that 16 might be made, let alone a reasonable fraction of them. 17 Typically, characteristic tests were conducted 18 and the formation and initial capacity were actually 19 very good indicators of the long-term performance of 20 that battery. 21 Q. And so after 500 cycles, you might get an 22 80 percent capacity retention. Fair? 23 A. Or above, yes. 24 Q. And you would do what you referred to as 25 characteristic testing, right?	Page 110 1 actually sold. Correct? 2 A. That's correct. 3 Q. The cells that you actually sold were not 4 tested for 500 cycles, right? 5 A. Not regularly. 6 Q. Okay. But the cells that you actually sold 7 were identical to other cells that you used for testing, 8 correct, but that you did not sell? 9 A. Well, if they were identical, we wouldn't need 10 to test them. No, they were other examples of the same 11 formulation, the same design specification, so they were 12 intended to be the same cell, yes. 13 Q. And those cells would be tested to 500 cycles. 14 Correct? 15 A. During development, yes. 16 Q. And it was on the basis of those results that 17 you ascertained the capacity retention after 500 cycles. 18 Correct? 19 A. Well, those results and others. 20 Q. Right. But you didn't just test a battery for 21 10 cycles and then determine that every battery 22 identical to that battery, later on sold to consumers, 23 had 80 percent capacity retention or above for 500 24 cycles. Correct? 25 A. Let me explain our process. We tested
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1 extensively during development, including far beyond 400 2 or 500 cycles. It would make no sense to sell a cell 3 that maybe met 500 cycles in some test but never met 4 550, so that would be a -- so we would test them 5 extensively to failure, thousands of cycles, until they 6 had virtually, you know, a small fraction, less than 7 10 percent of the initial capacity. 8 And you -- and that distribution of data you 9 use to make decisions about what formulations, what 10 materials, what process, what temperature. And 11 hopefully during that process you can find shorthands 12 for determining what are the key drivers. And one of 13 those is initial capacity, the formation process I 14 described. Better than that would be short cycle 15 testing, like 10 cycles. And, of course, better than 16 that would be longer cycle testing. But with each step 17 it gets more expensive and more difficult. 18 So typically, we relied the most on the 19 initial capacity, no cycling. But short cycling was 20 still sometimes done to determine whether there was some 21 unexpected failure mode. So we relied on none of those 22 singularly, but all of them at different times for 23 different information. 24 Q. Why did you use longer cycle testing if it was 25 expensive to do so?	Page 113 1 Q. Now, secondary lithium metal batteries are 2 different from secondary lithium-ion batteries. 3 Correct? 4 A. Right now, I don't know of any secondary 5 lithium metal batteries. 6 Q. You're familiar with the concept of a 7 secondary lithium metal battery. Correct? 8 A. I can imagine -- yes. And I know people that 9 tried to develop it. But I don't know of any commercial 10 examples of secondary lithium metal batteries. 11 Q. Is there a difference between a secondary 12 lithium metal battery and a secondary lithium-ion 13 battery? 14 A. I'll interpret secondary lithium metal 15 battery, your phrase, as a battery that has a pure 16 lithium negative electrode. So in other words, 17 extruded, wound, but pure lithium. 18 I built a factory that built lithium metal -- 19 metal oxide lithium batteries, but they were not 20 secondary because it's very difficult to put the lithium 21 back in that form. 22 So I'm -- I know the concept. People have 23 tried. But I don't know of any successful examples of a 24 pure lithium metal negative electrode. 25 Q. Well, let me try -- when I say "lithium metal
Page 114 1 A. Well, 10-cycle testing isn't very expensive. 2 Q. Well, I'm asking you about longer cycle 3 testing. 4 Why did you rely specifically on longer cycle 5 testing in addition to shorter cycle testing? 6 A. Well, as I said, I don't think we relied on 7 it. It was part of the mix that told us what to expect 8 and what to essentially tell our customers to expect. 9 They wouldn't look for a single data point. 10 They would want to see capacity fade over time, and so 11 we would sometimes provide that data out to the complete 12 failure of the cell. And that, of course, is more data 13 than a single point where you have 100-cycle or 14 400-cycle or 10-cycle. Those are all single points. 15 So we would conduct those tests to have a more 16 complete picture of the failure. We would also conduct 17 them at different rates. The cycle life at .1C, which 18 is sort of like a 10-hour charge, is very -- discharge 19 is very different than the 1C cycle life. 20 So again, we would have to conduct those 21 tests. And those are very slow because now, you're 22 taking many hours to cycle and -- charge and discharge 23 the battery. And as a result, we would be even less 24 likely to take those out to very high cycle life 25 measurements, so --	Page 116 1 battery," I mean a lithium secondary battery. Does 2 that -- are those terms different to you? 3 A. Yes. I'd say you're creating new terms that 4 are not widely used in the industry. 5 People talk about lithium-ion batteries 6 because the key feature is the lithium-ion acts as the 7 current carrier within the cell. And that's true for a 8 wide variety of systems. 9 A lithium metal battery implies that the 10 lithium exists in a solid form as opposed to the 11 lithium-ion cells that have that lithium in zero valent 12 state form, but it's contained in atomic-level lattices. 13 So, you know, these terms have meaning in the industry, 14 and it's not possible to just make up new terms and 15 expect them to have meaning. 16 Q. Well, I'm not trying to make up a new term 17 here, I'm just asking you, are you familiar with the 18 term "lithium secondary battery"? 19 A. I would say I don't think I've ever heard 20 that. People always say lithium-ion. 21 Q. Have you ever heard the term "lithium metal 22 cell"? 23 A. Lithium metal cell? Oh, yes, yes. I built a 24 factory that made 20 million a year. They were primary 25 cells, though, not rechargeable.

1 Q. Are there no rechargeable lithium metal cells? Page 117 2 A. Certainly not commercially. I mean, what 3 people do in laboratories, you can't find an end to the 4 possible systems that are being experimented on. But 5 commercially available, successful, no, I don't believe 6 there are any lithium metal secondary systems. 7 Q. Why are lithium metal cells not rechargeable? 8 A. Well, they discharge perfectly well. The 9 lithium is available. They discharge better than a 10 lithium-ion cell because there's no little lattice for 11 the lithium to move out of. 12 But on charging, the lithium ions move across 13 the separator to the negative electrode, where they 14 collect an electron, become lithium metal. But it's in 15 the process of that that they become attached to another 16 atom of lithium, and that process does not produce a 17 beautiful smooth sheet of lithium like is originally 18 inserted into a lithium metal battery. It produces a 19 very rough dendritic surface where the lithium builds 20 little pyramids and the electromotive forces are 21 encouraging it to move in the direction of the positive 22 electrode. And the net result is you get lithium metal 23 producing very uncompact, mossy they call it in the 24 industry, and dendritic, where the lithium is not very 25 conductive. It's not a compact, cohesive slab of	1 eventually safety, if -- when you tried to commercialize Page 119 2 it. 3 Q. Let's go back to the patent and let's go to 4 Claim 5. 5 A. Okay. 6 Q. You earlier referred to, I believe, the key 7 features of the '641 battery as the charge cutoff 8 voltage and the capacity ratio range recited in Claim 5. 9 Is that fair? Is that a fair summary of your 10 testimony? 11 A. Yes. 12 Q. So is it your view that as long as a battery 13 meets the key features of Claim 5, then it will also 14 have the capacity retention recited in Claims 11 through 15 14? 16 A. Well, there are many assumptions behind that. 17 As I said, this patent and this claim gives no further 18 evidence, no further description of what you need to do 19 to achieve the cycle life. So it appears to me that 20 this patent only offers those two features as the basis 21 for achieving cycle life. 22 Now, I know that there are many things that 23 have to be done right to achieve an operating cell with 24 a long cycle life. They apparently did those things 25 right, so the comparison one makes to a competing system
1 lithium. It's this fuzzy lithium formation that Page 118 2 eventually goes through the separator and forms a 3 short-circuit to the positive. 4 So that's the net result of almost every 5 lithium metal rechargeable system that I'm familiar 6 with. And people have worked on solving those problems 7 for more than 40 years. 8 Q. So is it fair to say that it is unsafe to use 9 lithium metal as the negative electrode of a 10 rechargeable battery? 11 A. Well, your question implies some -- there is 12 no commercial system. So safety is an issue in 13 commercial systems; it's not an issue in laboratories. 14 We would build and construct things in what are called 15 bomb rooms where doesn't matter what happens -- fires, 16 explosions -- the experimenter was protected. 17 So it's perfectly safe to do it under the 18 right conditions, but there is no commercial lithium 19 metal system, so that -- the idea of a safe system has 20 never been breached. 21 Q. Right. So one of the reasons that lithium 22 metal cells have not become widely used, if at all used, 23 commercially is because of issues with using pure 24 lithium as the negative electrode. Correct? 25 A. Yes. Performance, first of all, and I guess	1 would be let's do those things right again. Page 120 2 So no, of course it's not the only two things 3 one needs to do. There are many, many things that you 4 need to do that are not described in this patent. 5 Q. Putting that to the side for one second, my 6 question's a little bit different. Not varied, but a 7 little bit different. 8 If a battery that meets Claim 5 because it has 9 a charge cutoff voltage greater than 4.2 volts but less 10 than 5.8 volts and a capacity ratio that falls within 11 the claimed range of 1 over 1 to 1 over 2.5, would that 12 battery necessarily also satisfy Claims 11 through 14, 13 in your view? 14 A. Not without the other key aspects of battery 15 manufacturing, no. 16 Q. Well, let's say it had all the -- when you say 17 "other key aspects," you mean outside of the charge 18 cutoff voltage and outside of the range. Correct? 19 A. That's correct. 20 Q. Let's say that it had all of those aspects. 21 Would every single battery that has all of those other 22 aspects and a charge cutoff voltage above 4.2 volts but 23 below 5.8 volts necessarily meet Claims 11 through 14 so 24 long as its capacity ratio fell within the claimed 25 range?

1 A. No, I don't think so. Not necessarily. There 2 are many things that could be done wrong. You could say 3 it has these key features, but it could have others. It 4 could be contaminated. You know, the electrolyte could 5 have contaminants that don't -- so no, it -- it's -- 6 it's not possible to say that it would necessarily meet 7 those. 8 I think the patent describes a system where 9 they apparently have some data that includes 400 cycles. 10 So for that system, they achieved that cycle life, but 11 you can't say more than that. You can't say these two 12 features would guarantee that you would reach that cycle 13 life in all cases, no. 14 Q. Is it possible that I have two -- that I have 15 one battery that satisfies both Claims 5 and Claims -- 16 let me withdraw that question. 17 Is it possible to have a battery that 18 satisfies Claim 5 as well as Claim, let's say, 14, and 19 then by changing its capacity ratio such that it still 20 falls within the range claimed in Claim 5, it will not 21 meet Claim 14? 22 ATTORNEY IN: Objection. Form. 23 BY ATTORNEY STAMATOPOULOS: 24 Q. Do you understand my question? 25 A. You asked -- repeat it carefully, please.	Page 121 1 of that range. 2 Q. I just want to be very clear. I'm talking 3 about changing the ratio of the battery such that it 4 still falls within the range but it's different than the 5 first battery. 6 Do you understand that? 7 Do you follow that aspect of my hypothetical? 8 A. Yes. 9 Q. So I'm saying you've got two batteries. Both 10 meet Claim 5. One of them also meets Claim 14, but the 11 second one has a slightly different ratio than the first 12 one. 13 Based on the information that I just gave you, 14 can you tell me if the second battery will also meet 15 Claim 14? 16 A. The first battery doesn't meet Claim 14? 17 Q. Let me start over. 18 We have a first battery that meets both 19 Claims 5 and 14. 20 A. Uh-huh. 21 Q. And then we have a second battery that meets 22 Claim 5 only but has a slightly different ratio than the 23 first battery. 24 Based on the information provided, can you 25 tell me if that second battery will also necessarily
Page 122 1 Q. I will repeat it very slowly. And if you want 2 me to go faster, I'm happy to go faster. I'm happy to 3 go at your pace. 4 A. Okay. 5 Q. Is it possible to have a battery that 6 satisfies Claim 5 as well as Claim 14 and then, by 7 changing its capacity ratio such that it still falls 8 within the range claimed in Claim 5, it will not meet 9 Claim 14? 10 A. It is possible. This patent describes those 11 as the key features and gives no additional information 12 as to what you have to do to achieve that 400 cycles. 13 So per this patent, one would expect that 14 staying in that range would give you a good cycle life. 15 But these aren't guarantees, even in a patent. This is 16 a point in time. And, in fact, the data in this patent 17 is some of the worst experimentation I've ever seen in a 18 patent. It changes -- it never repeats something with a 19 simple change where you could compare two different 20 ratios. It changes the voltage and the ratio. 21 So certainly, the data is not in this patent 22 to make that prediction. But the evidence that they 23 present, you know, shows at least one example where 24 systems in that range met that claim, and then changes 25 to both the voltage and the ratio eventually got you out	Page 124 1 meet Claim 14? 2 A. Based on the information provided in the 3 patent, you can't guarantee that, no. 4 Q. I hesitate. I'm a little bit curious. Why do 5 you say "based on the information provided in the 6 patent"? 7 A. Well, because your question said "based on the 8 information," and I'm trying to clarify. 9 Q. I'm thinking about the information in my 10 hypothetical. I'm giving -- here's the information I'm 11 giving you. You have a first battery, and I want to 12 make it a little bit more concrete. You have a battery, 13 battery number 1. 14 A. Uh-huh. 15 Q. And it meets Claim 5, and it has a charge 16 cutoff voltage of 4.3 volts. It has a capacity ratio of 17 1 over 2.3. And it also meets Claim 14. 18 Do you follow me? 19 A. Yes. 20 Q. And then you have a second battery which is 21 identical in every single respect to that first battery 22 except that its capacity ratio is 1 over 2.2. 23 Can you tell me if that second battery will 24 also meet Claim 14? 25 A. I can't tell you that because you can't change

1 the capacity ratio without changing the content of the 2 positive electrode, for example. So now we've got 3 different capacity, most likely. So no, I can't tell 4 you that it would be identical. 5 Q. The voltage level applied to a secondary 6 lithium-ion battery increases the amount of lithium ions 7 extracted from the positive electrode. Correct? 8 A. I'm sorry, did you mean to say increase the 9 voltage? 10 Q. Let me try to repeat the question. 11 A. Okay. 12 Q. Yes, increasing the voltage applied to a 13 secondary lithium-ion battery also increases the amount 14 of lithium ions extracted from the cathode. Correct? 15 A. Yes. I assume you're talking about increasing 16 the charge cutoff voltage, for example. 17 Q. For example. 18 A. Yes. 19 Q. And decreasing the charge cutoff voltage will 20 decrease the amount of lithium ions extracted. Correct? 21 A. That's correct. 22 Q. That was known to a person of ordinary skill 23 in the art as of the priority date of the '641 patent. 24 Correct? 25 A. Yes.	Page 125 Page 127 1 A. You can't -- 2 Q. Sorry. Go ahead. 3 A. I'll just again reiterate that you can't 4 affect one electrode independently. They have to 5 operate in tandem. For every lithium ion that's 6 extracted, there's one that's sequestered. 7 Q. Okay. In what circumstances would a person of 8 ordinary skill in the art look to decrease the capacity 9 of the battery? 10 A. Well, independent of everything else, doesn't 11 make sense to decrease the capacity. But there's 12 nothing done independent of everything else. 13 So certainly, there could be a combination of 14 features which includes a reduction in capacity that 15 could be desirable due to things like safety or high 16 temperature performance or high rate performance, high 17 rate cells. And just to bring the example home, power 18 tools use high rate cells; phone use low rate cells. 19 And high rate cells have lower capacity. So depending 20 on the application, it might be the right combination 21 that includes a lower capacity. 22 Q. Is it possible that the crystal structure of 23 the positive electrode may become unstable if too much 24 lithium is extracted from the positive electrode? 25 A. Yes. The crystal structure would change if
Page 126 1 Q. If a person of ordinary skill in the art 2 wanted for some reason to increase or decrease the 3 amount of lithium ions extracted from the positive 4 electrode, one of the toggles that they might consider 5 using would be -- let me withdraw that question. It was 6 poorly phrased. 7 So a person of ordinary skill in the art 8 looking to change the amount of lithium ions extracted 9 from the positive electrode would consider increasing or 10 decreasing the charge cutoff voltage of the battery. 11 Correct? 12 A. Yes. It's -- if I could respond to your 13 phrasing, a person of skill doesn't look to increase the 14 amount of lithium ion extracted. They look to increase 15 the capacity, because there is no lithium ion extracted 16 without lithium ion being stored, so it's not -- you 17 can't focus on one electrode in a secondary system like 18 this. They would look to increase the capacity of the 19 battery and therefore say let me look at increasing the 20 voltage. 21 Q. Well, they might also try to decrease the 22 amount of lithium ions extracted. Correct? 23 A. Well, that's, in essence, decreasing the 24 capacity. 25 Q. So a person of ordinary --	Page 128 1 too much lithium is extracted from the positive 2 electrode. That's correct. 3 Q. And that's one circumstance in which a person 4 of ordinary skill in the art might try to decrease 5 battery capacity to prevent that from happening. 6 Correct? 7 A. No, I would not phrase it that way. I think 8 it implies a logic, you know, if this, then that, and 9 that's not -- again, a person designing -- a person of 10 ordinary skill wouldn't consider the limitation to 11 lithium extraction from the positive. That's in that 12 calculation of the -- what we talked about before, the 13 theoretical capacity versus an empirical measured 14 capacity. And they know don't go beyond this capacity 15 because now, the crystal structure changes, it's not as 16 conductive, you can't store the lithium. So yeah, there 17 are limits, but those are preexisting limits in the 18 material capacity. So your question frankly didn't make 19 sense. 20 Q. I think I -- I think I understand where we 21 might be talking past each other a little bit. 22 So is it fair to refer to complete lithium 23 extraction from the positive electrode as delithiation 24 of the positive electrode? 25 A. Yes, I've heard that phrase and seen that

1 term, yes. 2 Q. And it's fair to say that delithiation as a 3 phenomenon imposes an upper limit on the charge cutoff 4 voltage of a battery. Is that fair? 5 A. No. No, I don't agree with that. 6 Q. Is delithiation a negative consequence in the 7 operation of a lithium-ion battery that a person of 8 ordinary skill in the art might consider in connection 9 with deciding upon the charge cutoff voltage of the 10 battery? 11 A. They would consider delithiation as part of 12 the overall specification, and charge cutoff voltage 13 would be one of those factors. But there are many 14 others that determine how much lithium you can extract, 15 most notably the exact positive material and any 16 additives, as Yamaki describes, that change that ability 17 to extract lithium without affecting the crystal 18 structure. 19 Q. All else being equal, doesn't delithiation 20 impose an upper limit on the charge cutoff voltage? 21 Like, if I'm not concerned about any other 22 failure mode, doesn't delithiation itself impose an 23 upper limit? 24 A. No. It's not the charge cutoff voltage that 25 you're limiting, again, because it depends on the	Page 129 Page 131 1 about the difference between measured energy content or 2 theoretical capacity per gram and the actual. But 3 either way, that's the key consideration is how much 4 theoretical and practical. And the practical is, of 5 course, measured under certain conditions. 6 So when Yamaki described a new material, he 7 was addressing that very issue, how to obtain more 8 lithium removal from the positive without affecting the 9 crystal structure. So the key feature is understanding 10 the material and how it reacts to lithium removal. 11 Q. You said Yamaki was describing a new material? 12 A. Yeah. Well, of course, no element is new in 13 that sense, but he was modifying cobaltite positives 14 with other metals, largely, and obtaining changes to the 15 crystal structure that allowed -- he described it as a 16 higher capacity positive, so more capacity per gram. 17 Q. In what sense was Yamaki's material new? 18 A. That particular combination of additives to 19 the cobaltite was described as new, and he obtained a 20 patent on it. 21 Q. And fair to say that Yamaki -- fair to say 22 that Yamaki discloses that it is possible to obtain more 23 lithium removal from the positive electrode by raising 24 the charge cutoff voltage? 25 A. He was able to obtain -- he raised the charge
1 balance. These concepts are inextricably linked. And 2 that's one of the amazing things when I read -- first 3 read the '641 was how somebody could attempt to patent 4 two concepts that are always present in every single 5 battery design. You can't consider delithiation as an 6 issue without considering the balance of the two 7 electrodes, how much positive material have you got. 8 And then knowing the amp hours that you're going to 9 extract, you'll determine whether you're taking too much 10 lithium or delithiating the positive electrode. But -- 11 and what voltage it takes is a completely different 12 issue. So no, I don't link them as you described. 13 Q. Nevertheless, delithiation is a potential 14 negative phenomenon -- let me withdraw. 15 Delithiation is one danger that was known to 16 persons of ordinary skill in the art to affect the 17 positive electrode of a secondary lithium-ion battery. 18 Correct? 19 A. I would stay away from the word "danger." 20 It's a performance issue. It's not likely to be a 21 safety explosion issue, but it's a performance issue. 22 One of concern? Yeah. 23 Q. And what were the factors that would 24 contribute to the occurrence of delithiation? 25 A. Well, the primary one is the -- we talked	Page 130 Page 132 1 cutoff voltage, which had the effect of removing (ph) -- 2 lithium removal without destroying the crystal 3 structure, yes. 4 Q. Why is that significant, if at all? 5 A. Well, it's very significant to increase the 6 capacity of a material because now, Yamaki was able to 7 achieve the same capacity, amp hours, per gram and, as a 8 result, per volume, with less material. So he, of 9 course, immediately had the opportunity to have a cell 10 which, per gram or per cubic centimeter, would have more 11 energy. 12 This, of course, leads to the need to 13 rebalance the cell because now you've got less space 14 taken up by the positive. If you fill it with negative, 15 you've changed that ratio, which is why Yamaki leads 16 directly to the question of what the negative/positive 17 ratios are. 18 But at the heart of it, he was describing a 19 material which could be charged to a higher voltage, 20 thereby extracting more lithium and retain its crystal 21 structure. 22 Q. Are you familiar with the concept of a 23 reference electrode? 24 A. Yes, I am. 25 Q. What is a reference electrode?

1 A. Well, it's often described as a third 2 electrode in an electrochemical system. When you study 3 electrochemical systems, as a necessity, you've got a 4 positive and a negative. And during either charge or 5 discharge, one's the anode, one's the cathode. And it's 6 not possible to learn everything about that system by 7 measuring the two voltages, or the voltage at the two 8 electrodes. It's interesting and instructive to insert 9 an additional electrode, which provides sort of an 10 intermediate voltage. It is an analogy. Let me say 11 that let's say it was 100 degrees outside and 70 degrees 12 inside. It might be interesting to know what the 13 temperature is in the middle of your wall. Is all that 14 heat being lost right at the surface, or is it being 15 lost out at the external? So you put in a third 16 measurement, and that's what a reference electrode is. 17 It's usually a standard that's sort of a 18 guidepost or a, you know, a signpost that -- that's 19 absolute and gives you a reference. And then you 20 measure the two other voltages in reference to that 21 third electrode. 22 Q. Is a reference electrode typically used to 23 establish the capacity of a positive and negative 24 electrode in the secondary lithium-ion battery? 25 A. It's not necessary. Reference electrodes are	Page 133 1 understand is that the electrodes where current is being 2 passed are perturbed, or they're not at their open 3 circuit voltage. And the degree of perturbation depends 4 on how much current is being passed through them. 5 So in that case, you could have two identical 6 electrodes, one being used, one passing current and the 7 other one not passing current, and they'll have 8 different voltages. 9 But at rest at open circuit voltage the two 10 should have the exact same voltage, and any reference 11 comparing to those two would give the same measurement. 12 Q. Isn't it true that a negative electrode may 13 have a potential versus a lithium reference electrode 14 that is roughly 0.1 volts? 15 A. Well again, that could only be answered in 16 terms of is the lithium electrode that you described 17 active as a passing current; otherwise, it would have 18 0.00 difference. There's no difference if it's at rest 19 or open circuit. 20 The more current that's passing through it, 21 the more different it will become because the other 22 electrode is essentially at zero. But for the purposes 23 of most measurements, the two electrodes are going to 24 have the same reference. I think I saw it described as, 25 you know, a negligible or insignificant difference. And Page 135
1 more typically used in very basic academic or 2 fundamental studies of electrochemical systems, but 3 they -- but you can refer to them. I've used reference 4 electrodes in understanding battery systems even in 5 factories, so yeah, they can be used. 6 Q. Just to be clear, are they used in secondary 7 lithium-ion batteries or not? 8 A. Well again, secondary lithium-ion batteries 9 range from an academic producing one to a factory 10 producing millions. So are they used? Certainly more 11 commonly in the development and experimental side. A 12 commercial lithium-ion cell does not contain a reference 13 electrode in it. So in between those extremes, there's 14 a whole range of answers to your question. 15 Q. Okay. So fair to say that reference 16 electrodes are used in the development of secondary 17 lithium-ion batteries? 18 A. They definitely are used in the development of 19 secondary lithium-ion batteries, yes. 20 Q. Now, a positive electrode may have a 21 particular potential versus a lithium electrode and a 22 different potential versus the actual negative electrode 23 of a secondary lithium-ion battery. Correct? 24 A. If the negative electrode is lithium, then no. 25 Of course, there's another concept that's important to Page 134	1 I think for most real measurements at the current 2 densities that are carried out in these batteries, 3 they're very high surface area systems. The electrodes 4 are very, very long. 5 And so the current density actually at the 6 actual surface is quite low. And as a result, a lithium 7 metal inserted as a reference electrode would be nearly 8 identical to the negative electrode, which is also 9 basically lithium. 10 Q. What do you mean by "nearly identical"? 11 A. Well, I just describe the differences only 12 being caused by current. And you haven't defined how 13 much current's going on. So at rest, open circuit, they 14 are precisely identical. 15 Q. Well, what about not at rest? 16 A. Depends on how much they're not at rest. 17 Q. Depends on how much current is flowing. 18 Correct? 19 A. Right. You could find some differences if you 20 forced very high currents, but I'm saying that a 21 lithium-ion battery, if discharged, for example, at the 22 rates it's designed for, I would expect to find 23 negligible difference between the lithium-ion electrode 24 and the lithium inserted as a reference electrode. 25 Q. When you were at Duracell, what was the Page 136

1 maximum charge cutoff voltage that you recall using in a 2 secondary lithium-ion battery cell? 3 A. It was a dynamic charge cutoff voltage which 4 measured the current and the temperature and reacted to 5 that, so there wasn't a single voltage. 6 I think certainly, I remember values of 425 7 under some conditions, possibly lower than 4.2, that 8 very low rate and cold temperatures. But it was a 9 dynamic measurement. It wasn't a single value. I mean, 10 I was responsible for developing the electronics that 11 controlled the charging process in a sense and so I was 12 pretty familiar with that aspect of it. 13 And I did testing to determine the optimum 14 charge, looking to optimize performance, lifetime, 15 safety. And dynamic applied voltage gave the most 16 opportunity to maximize those features. 17 Q. Do you recall the capacity ratios that you 18 used at Duracell? 19 A. Only in the most general terms. Obvious -- 20 it's a general rule, known long before even these exact 21 systems were published, that you needed more negative to 22 avoid the failure modes associated with lithium plating. 23 So one of the problems in particularly the 24 time frame of this patent was uncertainty as to the 25 capacity of the carbon materials. There was a great	Page 137 1 proposed experimenting with values where the negative 2 had less capacity than the positive. So it was 3 certainly a common accepted practice within Duracell and 4 I believe within the industry as a whole. 5 Q. Are you aware of examples in which batteries 6 were designed with negative electrode greater than 7 positive electrode capacity? 8 A. All of them. I just described that that is -- 9 that's the -- 10 Q. Are you aware of examples in which batteries 11 were designed with positive electrode capacity greater 12 than negative electrode capacity? 13 A. Certainly not within the development 14 activities I directed at Duracell, no. 15 Q. I'm not talking about Duracell now. Just more 16 broadly, are you aware of examples in which batteries 17 were designed with positive electrode capacity greater 18 than negative electrode capacity? 19 A. I can't think of any, no. Certainly not 20 lithium-ion systems. I mean, if you open it up to other 21 secondary batteries, of course, that's a completely 22 different case. 23 Q. Let's limit ourselves to just secondary 24 lithium-ion batteries. 25 A. Okay.
1 deal of work going on in carbonaceous materials. Formed 2 graphite, that's one, but there are many that have 3 higher capacity per gram that are from other materials, 4 but they don't have the regular structure of graphite 5 and therefore have an unknown capacity. 6 So to be safe, because of this uncertainty and 7 variation, it was common to find variation. These are 8 natural materials. They coke natural materials, which 9 is burn it without the presence of oxygen, producing 10 these carbon structures. So it's a natural material. 11 Sometimes it's started from, you know, plant materials. 12 And the result was that there was variation in the 13 lithium adsorption or intercalation in the carbon. And 14 the result was that everybody knew to keep the lithium 15 ratio higher than one or more lithium capacity than was 16 contained in the positive. 17 Q. What do you mean, it was a general rule that 18 you needed more negative electrode to avoid the failure 19 modes associated with lithium plating? 20 Specifically, what do you mean by it was a 21 general rule? 22 A. Well, I -- I managed a large development 23 group, and the people responsible for the detailed 24 battery design -- in other words, the formulation, the 25 coding, the materials -- they, to my knowledge, never	Page 140 1 Q. Are you aware of any literature or patents or 2 any other publications in which it is disclosed that 3 batteries be designed with greater positive than 4 negative electrode capacity? 5 A. I can't recall that, no. I can't think of any 6 examples of that. 7 Q. Do you recall testifying earlier that there 8 was a great deal of uncertainty about anode capacity? 9 A. I do. I think I just described it again and 10 some of the reasons for it. 11 Q. Can you explain to me what you mean by 12 uncertainty about anode capacity? 13 A. Well, the negative electrode, I assume you're 14 talking about, the anode during discharge, has a wide 15 variety of carbons that are used, and those are 16 described as the negative electrode. But, in fact, of 17 course, they don't participate in any reactions. 18 They're just there to conduct electrons to the lithium 19 ions. 20 And in the lithium-ion cell, a common design 21 is to use those carbon structures as cages or 22 intercalation points to hold lithium atoms separately 23 from each other so they don't form continuous metal. 24 But the way in which the lithium is associated with the 25 carbon varies tremendously.

Page 141 1 In graphite, the simplest system, there are 2 ring structures that form sort of platelets and almost a 3 laminar structure in graphite. That's why it flakes 4 apart and why it's lubricant. But it has these ring 5 structures that allow lithium to form sort of regular 6 associations. And the commonly accepted number is that 7 there are six carbon atoms associated with one lithium 8 when it's being stored. But natural carbon materials 9 formed by coking different natural materials have very, 10 very different structures and don't have an associated 11 number of carbon atoms. 12 So it's only an empirical measurement that 13 tells you what the capacity as measured by the lithium 14 storage and given voltage is going to be for that 15 material. So it's uncertainty both when you're 16 designing a cell, when you're purchasing materials and 17 you need to assure that you've got a regular quality 18 process that measures that lithiation rate per gram to 19 know that your cell balance is going to be correct. 20 Q. Let's turn to your declaration, paragraph 41. 21 A. Okay, if I could take a moment to review that. 22 Q. Yes, you can take a moment. I have specific 23 questions that don't relate -- you list a number of 24 different references there, so I can point you to the 25 spot where -- that I'm interested in. But if you want	Page 143 1 references, and I know it's -- I don't have Ijiri in 2 front of me, no. I have the main references. So no, I 3 don't. 4 ATTORNEY STAMATOPOULOS: Let's pull up the 5 Ijiri reference, which is Apple 1022. And it should be 6 mark in the folder as Exhibit 1022. 7 THE WITNESS: Okay. 8 (Exhibit No. Apple 1022, previously marked, was 9 referenced and indexed.) 10 BY ATTORNEY STAMATOPOULOS: 11 Q. This is a translation, I believe, of a 12 Japanese reference. Are you familiar with the Ijiri 13 reference? 14 A. I've seen it, used it in writing this opinion, 15 but I don't happen to have it right here. 16 Q. Let's turn to paragraph 17. 17 ATTORNEY IN: Counsel, I don't think 18 Mr. Hruska has a version of it. Are you able to share 19 it with him so he can scroll through it? 20 ATTORNEY STAMATOPOULOS: He should be able to 21 access it. But I don't know what link you've received, 22 Mr. Hruska. There, I think it's been shared in the 23 chat. 24 THE WITNESS: I see it, yes. All right, I've 25 got it.
Page 142 1 to take a moment, feel free. 2 A. Yeah, I'm just trying to get the context here. 3 Okay. 4 Q. So on page 25 also paragraph 41, you -- 5 actually, page 24, close to the end of paragraph 41, you 6 say: More generally, it was well known that batteries 7 having more capacity in the negative electrode than in 8 the positive electrode were safer. 9 Do you see that? 10 A. I do. 11 (Exhibit No. Apple 1022, previously marked, was 12 referenced and indexed.) 13 BY ATTORNEY STAMATOPOULOS: 14 Q. And then one of the references that you cite 15 is the Ijiri reference, which is Apple 1022. Do you see 16 that? That's in the same paragraph. 17 A. Yeah. On page 25? 18 Q. Yeah. 19 A. Similarly, Ijiri describes that a battery 20 where the effective capacity of the negative electrode 21 active material layer is 100 to 110 with respect to the 22 effective capacity of 100. So they're giving a ratio. 23 Q. Yeah. So if you go to -- do you have Ijiri in 24 front of you? 25 A. I can turn to it. It's -- I have a binder of	Page 144 1 BY ATTORNEY STAMATOPOULOS: 2 Q. So paragraph 17 of Ijiri says: If the 3 effective capacity of the negative electrode active 4 material is too large relative to the effective capacity 5 of the positive electrode active material, the object of 6 the present invention cannot be achieved. 7 Do you see that? 8 A. I do. 9 Q. What's your understanding of that statement? 10 A. Well, Ijiri is stating that there's a ratio of 11 the negative to the positive, and he's putting some 12 limits on that ratio for his purposes. 13 Q. Why? 14 A. Well, I'd have to refer to the complete patent 15 to understand what he's referring to as the object of 16 his present invention. I'm not sure what his object is. 17 I don't remember the details of the patent to that 18 extent. 19 Q. Well, you've cited this reference in support 20 of your view that it was generally well known that the 21 negative electrode's capacity should exceed that of the 22 positive electrode, right? 23 A. And that's what Ijiri states here. More than 24 100, yeah. 100 to 110 is his preferred ratio. So that 25 is, in fact, a case where the negative is shown to be

1 more than the positive. 2 Q. But Ijiri also says in that same paragraph 17 3 that the effective capacity of the negative electrode 4 active material is set to 80 to 120. Correct? 5 A. I see that. 6 Q. And so clearly, Ijiri contemplates scenarios 7 where the capacity of the negative electrode is less 8 than the capacity of the positive electrode, right? 9 A. Well, he contemplated them but he makes it 10 clear that he's recommending preferably 100 to 110, so 11 more negative than positive. 12 Q. Nevertheless, he does disclose here a wide 13 range that is -- in which the negative electrode 14 capacity is below that of the positive electrode. 15 Correct? 16 A. He discloses a range where it goes from 80 to 17 120, yes. 18 Q. What's your explanation of that? 19 A. He considered a wide range. It's clear he 20 focused on the widely accepted advantage of having more 21 negative than positive by describing in the same 22 sentence "preferably, 100 to 110." 23 Q. I guess my question to you is this. It seems 24 that in your declaration, you're stating that there was 25 a conventional wisdom of sorts that the negative	Page 145 1 invention." Why doesn't he go beyond, you know, 110 in 2 general? Because we know from other references that 110 3 to 120 works perfectly well and brings some advantages. 4 I just -- this tiny extraction from that 5 reference supports the contention that I made in my 6 declaration, which is that Ijiri -- and it's quoted in 7 my declaration -- is the effective capacity of the 8 negative electrode active material layer is 100 to -- 9 with respect to the effective capacity. So he's -- I 10 appreciate the fact that he's talking about effective 11 capacity -- that's a good phrase -- as opposed to these 12 theoretics. So he's talking about practical, measured 13 capacity and he's recommending values that are more 14 negative than positive. 15 And the details are how wide the limits are. 16 I've seen enough patents to know that people often 17 describe widely ranging variables that aren't 18 necessarily the recommended, trying to get increased 19 coverage for something. So there could be a lot of 20 reasons why he's doing it. And you seem to be focusing 21 on the fact that he's mentioned a wide range that goes 22 below one, but I focus on the fact that he's 23 recommending preferably more negative than positive. 24 Q. Would you agree that, at least based on Ijiri, 25 there are exceptions to your general rule that --
Page 146 1 electrode always have greater capacity than the positive 2 electrode, yet here in Ijiri we're seeing a scenario 3 where, notwithstanding this recommendation, as you put 4 it, there is a disclosure of a range of negative 5 electrode capacity that is lower than the positive 6 electrode. 7 And how do you square that with your view that 8 there was a general rule that the negative electrode 9 always have greater capacity than the positive? 10 A. Well, I describe that general rule as within 11 the development activities that I directed. What 12 somebody discloses in a Japanese patent, of course, can 13 be wide, wide -- widely outside of what are safe or 14 reasonable limits. I mean, I'm satisfied that he's 15 recommending more negative than positive. 16 Q. Is it -- I'm sorry, you mentioned -- you said 17 a Japanese patent. How does the fact that it's a 18 Japanese patent bear on your views, if at all? 19 A. I just -- I'm trying to bring the 20 recommendation home to this specific case. This one 21 indication, first of all, it confirms that he's 22 recommending more negative than positive. That's a good 23 sign. 24 Again, I'd have to study this patent to 25 understand what he means by "the object of the present	Page 148 1 assuming it's even a rule, that is, that the negative 2 electrode always have greater capacity than the positive 3 electrode? 4 A. Well, no. It's not an exception, because I 5 described my general rule as practiced in the 6 development laboratory that I directed. So I know what 7 went on there. I know what we believed, went to 8 conferences, read a lot of papers, and concluded that 9 our development activities would focus on electrodes 10 that had more negative than positive. 11 So the fact that somewhere there was somebody 12 who claimed a range that exceeded that would have very 13 little impact on what I would have directed. What the 14 rest of the world did, I can't answer for every single 15 experiment done in a developmental lab. 16 Q. So your reference to a general rule and your 17 testimony about a general rule has to do with what was 18 going on in the laboratories of Duracell, not the rest 19 of the world. Correct? 20 A. As a rule, yes. But commonly accepted 21 practice I think also supports that same observation. 22 So I don't ever remember seeing -- and believe me, we 23 analyzed many, many commercially available lithium-ion 24 systems, every one we could get ahold of, and I never 25 saw a commercially available system with less negative

1 than positive. So I -- whether it was a rule in 2 development labs, certainly not in patent applications. 3 But I would say it was common practice and it was a rule 4 in my lab. 5 Q. Do you know as you sit here today any of the 6 reasons for which a person of ordinary skill in the art 7 might design a battery in which the capacity of the 8 cathode might exceed the capacity of the anode? And 9 when I say "cathode" and "anode," I mean positive and 10 negative electrode, to be clear. 11 A. Do I know a reason why they might design a 12 battery like that? 13 Q. Yes. Are you aware of any reasons why a 14 person of ordinary skill in the art might go against 15 your rule and design a battery in which the capacity of 16 the cathode would exceed that of the anode? 17 A. Well, certainly a developmental lab might do 18 that to determine the ratios at which safety issues, 19 short-circuiting and explosion, became common. It's 20 always good to know that -- how far away you are from 21 those issues. But commercially I cannot think of a 22 reason, no. 23 Q. You can't explain why Ijiri here teaches that 24 it's possible to set the negative electrode active 25 material layer to 80 percent of the capacity of the	Page 149 1 A. Thank you. You too. 2 Q. So you have cited in your declaration Apple 3 1015, the Linden handbook. 4 A. Yes, I did. 5 Q. Now, do you have that in front of you? 6 A. I don't, but I could get it. 7 Q. Do you have it in your binder? 8 A. No, I don't. 9 ATTORNEY STAMATOPOULOS: All right. Can we 10 pull it up and also share it on the chat? Let me know 11 when you have it open, Mr. Hruska. 12 THE WITNESS: Okay, I believe I do. 13 BY ATTORNEY STAMATOPOULOS: 14 Q. So if we go to page 2310, there's a table that 15 gives characteristics of the major secondary battery 16 systems. Do you see that? 17 A. You know, it's a little slow. 18 Q. Yeah, take your time. 19 A. For some reason, it's not responding. Oh, 20 here it is. It's just a little slow. All right, 2310, 21 got it. 22 Q. So you see the table reads Characteristics of 23 the Major Secondary Battery Systems? 24 A. I do. 25 Q. And if you go to the leftmost column, it says
1 positive electrode? 2 A. I don't know all the reasons Ijiri did this. 3 Certainly not why he mentioned that range, no. I can't 4 explain his disclosure. 5 Q. Okay. 6 ATTORNEY IN: Counsel, I think we've gone 7 maybe an hour and a half since the last break. If 8 there's a natural breaking point, can we take a break 9 and let Mr. Hruska grab some lunch? 10 ATTORNEY STAMATOPOULOS: It's up to you 11 Mr. Hruska. What would you like to do? 12 THE WITNESS: Yeah, if this is a good time, 13 yeah. I'll be happy to take what you described before, 14 a 30-minute break. 15 ATTORNEY STAMATOPOULOS: Let's do a little bit 16 longer to also give the court reporter and others a 17 chance to -- I realized I was being a little -- let's go 18 off the record, first of all. 19 THE VIDEOGRAPHER: Time is 11:57 AM. We are 20 off the record. 21 (Recess taken.) 22 THE VIDEOGRAPHER: We are back on the record. 23 The time is 12:43 PM. 24 BY ATTORNEY STAMATOPOULOS: 25 Q. Welcome back, Mr. Hruska.	Page 150 1 Common Name. Do you see where it says "nominal open 2 circuit operating end" under Cell Voltage? 3 A. Yes. 4 Q. What is the meaning of that? 5 A. Well, nominal means sort of a generic number 6 which represents a typical common value, not necessarily 7 exact, but it's a cell volt. For example, the first 8 one, lead acid battery, you know, 2 volts. The lead 9 acid battery in your car is almost never 2 volts. It 10 charges to 14 volts when your car's running, and it 11 discharges down below 10 volts when you're cranking. 12 And when it's normally sitting there, it's about 12.6. 13 So that would be, you know, for example, 2.06. So it's 14 a nominal value, meaning it's not a very precise value, 15 but I do see them. 16 Q. And if you go to the next page, 2311 -- 17 A. Yes. 18 Q. -- the last column has lithium systems, 19 lithium-ion systems. 20 A. Yes. 21 Q. And there's a description of a battery that 22 has lithium cobalt dioxide as the cathode. 23 A. Yes. 24 Q. And at the second row, the open circuit 25 voltage, which you can't see on this page but you can
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Page 153 1 see on the previous page that we just discussed, that's 2 listed as 4.2 volts. Yes? 3 A. It's a little hard for me to read. What's the 4 top value? Is it -- 5 Q. Lithium cobalt dioxide, organic -- 6 A. I'm sorry. I'm sorry, there's four numbers 7 there, yeah. 4.0, okay. 8 Q. The 4.2 is in reference to the open circuit 9 voltage, right? And feel free to look back at page -- 10 A. Yeah, okay, okay. 11 Q. So just for the record, fair to say that 4.2 12 is a reference to the open circuit voltage? 13 A. Yeah, that's what the row designator says. I 14 don't remember what they said over at the left. But 15 what's the 4.0? 16 Q. Typical cell voltage, it seems like. 17 A. Okay. 18 Q. Is that your understanding? And feel free to 19 flip through the pages. 20 A. No, I'm just trying to remember it. Typical 21 cell voltage is listed at 4. Nominal, open circuit, and 22 operating. Okay, end. All right, good. I see those. 23 Q. So Linden here is teaching that for this 24 particular battery, which has lithium cobalt dioxide as 25 the cathode, carbon as the anode, an organic solvent is	Page 155 1 temperature, state of charge, whether it's operating. 2 And it's the same thing for lithium-ion. This edition 3 of Linden came out in '95, so lithium-ion was very new, 4 and he was giving some nominal data to place it among 5 the systems that vary from, you know, 1-volt systems up 6 to here, a full 4-volt system. 7 Q. Nevertheless, Linden picks 4.2 volts as the 8 listed value here. What's the basis for that listing, 9 in your view? 10 A. Well, he's listed it as -- that's the open 11 circuit voltage he's provided. So regardless of the 12 charge voltage or the material balance, the open circuit 13 is determined by the chemistry of the components no 14 matter how much of each there is. You could have a 15 10-to-1 ratio and you'd still get the same open circuit. 16 Q. Why? 17 A. Why? It's electrochemistry. It has nothing 18 to do with, you know, the amount of material. 19 Q. Well, why is the 4.2 volts the voltage that 20 corresponds to this particular cathode and anode and 21 electrolyte configuration? 22 A. Because that's approximately the open circuit 23 voltage you'll get with lithium cobalt type versus 24 lithium. 25 Q. And why is that the open circuit voltage
Page 154 1 the electrolyte, the open circuit voltage is 4.2 volts. 2 Yes? 3 A. That's what it says, yes. 4 Q. It doesn't -- Linden doesn't teach that a 5 person of ordinary skill in the art should charge this 6 battery to a higher voltage, right? 7 A. Well, he doesn't list this as a end-of-charge 8 voltage, he just describes it as either nominal or open 9 circuit, yeah, so -- 10 Q. Is that the -- 11 A. -- these are the -- 12 Q. -- maximum -- is that the maximum open circuit 13 voltage that's prescribed for this battery? 14 A. There's only one open circuit voltage listed. 15 And, of course, it's a nominal number. As I was just 16 talking about lead acid, there's a wide range, depending 17 on the state of charge, that that open circuit voltage 18 would range through. But it's a, you know, it's a sort 19 of seat-of-the-pants rough number to compare to 2 volts 20 or 3 volts or -- these aren't precise data. 21 Q. Well, why is it that Linden is giving this 22 value at all? 23 A. Well, as a comparison. He listed lead acid as 24 2 volts, and I just described the actual voltages of a 25 single lead acid cell vary a lot, depending on	Page 156 1 you'll get? 2 A. Well, that's electrochemistry. You could look 3 up any pair. You could say what is lithium versus a 4 hydrogen electrode, or lithium versus something else. 5 And if you specify the conditions and the chemistry, 6 you'll know what the open circuit voltage is. 7 Q. There's no teaching here in Linden that you 8 can charge this particular combination of materials put 9 together in a secondary battery to a voltage higher than 10 4.2 volts. Correct? 11 A. No, that's not true. If you took this at its 12 word, 4.2 volts, being an open circuit, we had an 13 extensive discussion earlier about how during charge, 14 the voltage has to be higher than the open circuit. 15 And, in fact, if you took that at face value, you would 16 say that you, in fact, have to charge it above 4.2 if 17 that's the open circuit. There's no charging going on 18 at 4.2. 19 Q. That's the volt -- you would have to apply a 20 voltage greater than 4.2 in order to get a battery 21 voltage of 4.2. Correct? 22 A. No. If the open circuit was 4.2 volts, 23 regardless of whether any charge was being applied or 24 not, that would be the voltage you measure at 25 equilibrium. That's the open circuit voltage that he's

1 listed. If you want to charge it, you got to apply a 2 voltage that's higher than that. 3 Q. Right. So you would -- that was my question. 4 In order to obtain an open circuit voltage 5 equal to 4.2 volts, you would have to apply a voltage 6 greater than 4.2 volts. Correct? 7 A. No. You could obtain an open circuit voltage 8 just by assembling the chemicals involved. You don't 9 actually need to -- if you had a lithium electrode that 10 had intercalated lithium and you had this particular 11 cobalt type cathode, according to Linden, you've got 12 a -- pardon me. Sorry. You've got a 4.2-volt open 13 circuit and you haven't charged it at all. That's a -- 14 it's a measurement based on the electrochemical 15 chemistry, not on the state of charge or what's being 16 applied. 17 Q. So your testimony is that the battery voltage 18 is always going to be 4.2 volts whether it's charged, 19 discharged, regardless of whether the battery's charged 20 or discharged. Is that fair? Am I understanding that 21 correctly? 22 A. No. That's the open circuit voltage that's 23 listed here. If I could explain this by describing the 24 electrochemistry as a function of the concentrations of 25 chemicals. For example, in lead acid, the voltage that	Page 157 1 let's assume that it's a charged battery, 4.2, and I 2 could understand the system to make sense there. 3 The other data he gives is the operating 4 voltage and the end voltage. So I would read this as 5 probably a charged voltage, but it doesn't say. 6 Q. Okay. So you would read this 4.2 volts as a 7 charged open circuit voltage. Correct? 8 A. That's correct. 9 Q. And to obtain a charged open circuit voltage 10 equal to 4.2 volts, you would need to apply an external 11 voltage greater than 4.2 volts. Correct? 12 A. That's correct. 13 Q. Is it your view that the charge cutoff voltage 14 recited in the claims of the '641 patent refers to the 15 open circuit voltage or to the applied -- externally 16 applied voltage during charging? 17 A. Well, by definition, a cutoff voltage is the 18 voltage that the battery is at because it's being 19 charged. It's not the open circuit voltage. 20 Q. What do you mean, "the voltage that the 21 battery is at"? 22 A. Well, it's being charged. It's a charge 23 cutoff voltage so you haven't cut off the charge yet. 24 Q. So in your view, it's the -- the charge cutoff 25 voltage is the externally applied voltage.
Page 158 1 you measure, whether it's 2 volts per cell or 1.9 or 2 2.1, is a measure of the strength of the sulfuric acid 3 that's in the battery. So you could get very different 4 open circuit voltages depending on, for example, the 5 strength or the concentration of chemistry. 6 Q. Linden -- 7 A. Linden has given a generic nominal value of 8 4.2 for an open circuit. That is a good description for 9 some systems. I wouldn't say it covers everything, and 10 it's certainly not precise. 11 Q. What's the open circuit voltage of a battery 12 when it's fully discharged? 13 A. Well, if you discharge it to the point of 14 having no lithium in the positive electrode, it would be 15 very low, like close to 2, if that, if it's fully 16 discharged. There's no lithium left in the positive 17 electrode, in which case the battery's probably 18 incapable of being recharged. 19 Q. For a battery such as the one that's described 20 here at a high level in Linden where the open circuit 21 voltage is 4.2 volts, is that for a charged battery or a 22 discharged battery? 23 A. Well, he doesn't say, of course. And that's 24 one of the reasons I call it a nominal value. Just like 25 he doesn't say how charged the lead acid system is. So	Page 160 1 Did I get that correctly? 2 A. Well, keep in mind that that can be current 3 anywhere from high rates, you know, 10C, down to 4 astronomically small rates, which is what you see when 5 you float it at that charge voltage. 6 Q. I'm asking a very, very simple question. 7 A. But there's -- 8 Q. There's charge cutoff voltage that is recited 9 in the '641 patent claims. Are you familiar with that 10 term? 11 A. I'm familiar with charge cutoff voltage, of 12 course. 13 Q. And you're aware that that term is recited in 14 the '641 patent claims. Correct? 15 A. Correct. 16 Q. And you analyzed that term, right? 17 A. That's correct. 18 Q. And when you analyzed that term, did you take 19 it to mean the externally applied voltage during 20 charging? 21 A. Yes. 22 Q. And that's different than the open circuit 23 voltage. Correct? 24 A. Well, it asymptotically approaches the open 25 circuit voltage as the charge current goes to zero.

Page 161 1 Q. Essentially, these are two different things, 2 right? 3 A. No. 4 Q. The open circuit voltage is not different than 5 the externally applied voltage? 6 A. Not when the charge current goes to zero, no. 7 Q. Let's start with before the charge current 8 goes to zero. 9 Before the charge current goes to zero, the 10 externally applied voltage is different than the open 11 circuit voltage. Correct? 12 A. If there is significant current being used to 13 charge the cell, yes. 14 Q. What if there is a very, very small current 15 that is going through the battery? 16 Isn't the externally applied voltage greater 17 than the open circuit voltage in that scenario? 18 A. Well, when you say "very, very small," I would 19 say then there's a very, very small difference, perhaps 20 immeasurable. 21 Q. Okay. If there's a measurable current going 22 through the battery, then there ought to be a measurable 23 difference between the open circuit voltage and the 24 externally applied voltage. Correct? 25 A. Correct.	Page 163 1 Q. My question was a little bit different. 2 The difference between the open circuit 3 voltage and the externally applied voltage during 4 charging will be affected by the manner in which the 5 battery is charged. By "manner," I mean constant 6 current, constant voltage, or a combination of the two. 7 Is that fair? 8 A. No. The difference, it's an instantaneous 9 measurement. And when you're talking about the manner 10 in which it's charged, these are things that change over 11 time. So at any moment in time, the difference is 12 simply a function of the current that's being applied. 13 It doesn't know what happened before or necessarily 14 whether you're going to stop or pulse charge. It's 15 simply an instantaneous reflection of how much current 16 is being applied. 17 Q. Well, let me ask you this. If I'm fast 18 charging at 4.5 volts and I want to charge the battery 19 up to 4.2 volts vis-a-vis its open circuit voltage -- 20 let me withdraw that and try to ask you a better 21 question. 22 If I'm charging a battery to an open circuit 23 voltage of 4.2 volts, do you follow? 24 A. That's the end result you want when you have 25 an open circuit, that it will sit at 4.2 volts?
Page 162 1 Q. And measurable difference between the open 2 circuit voltage and the externally applied voltage ought 3 to be proportional to the difference between -- let me 4 withdraw that question. 5 The measurable difference between the open 6 circuit voltage and the externally applied voltage ought 7 to be proportional to the current flowing through the 8 battery. Correct? 9 A. Yeah. And I assume you don't mean directly or 10 linearly. In some way, more current, higher voltage. 11 Higher difference. 12 Q. Yes. I just said proportional. 13 A. Directional, yes. 14 Q. And as we discussed earlier, there are 15 different ways to charge a battery. Correct? 16 A. Yes, there are. 17 Q. And the difference between the open circuit 18 voltage and the externally applied voltage during 19 charging will be affected by the manner in which the 20 battery is charged. Correct? 21 A. Yes. I think you're -- let me restate that to 22 be -- to make sure I've got the same understanding. The 23 difference between the open circuit voltage and the 24 externally applied voltage is again proportional to the 25 current that's being applied to the battery.	Page 164 1 Q. Correct. 2 A. Okay. 3 Q. One way to do that is to fast charge it at a 4 voltage, an externally applied voltage of, say, 5 4.5 volts. Fair? 6 A. Starting from where? You know, if it's 7 already charged, why would you apply 4.5? I'm not -- 8 it's not clear to me what you're -- 9 Q. There's a discharge battery, okay? 10 A. Okay. 11 Q. Do you follow? 12 A. And what -- 13 Q. And I want to -- 14 A. And what open circuit voltage is it at? 15 Q. 2 volts. 16 A. Then it won't take any charge. It's 17 destroyed. 18 Q. 3 volts. 19 A. Okay. 20 Q. Okay? 21 A. Okay. 22 Q. So I have a discharge battery, 3 volts, open 23 circuit voltage. 24 A. Okay. 25 Q. And I want to charge that battery up to an

1 open circuit voltage of 4.2 volts. Do you follow? 2 A. I follow. 3 Q. And I apply an external voltage of 4.5 volts. 4 Do you still follow? 5 A. I do. 6 Q. At the end of the charge, there will be a 7 0.3-volt difference between the externally applied 8 voltage and the open circuit voltage that I've attained. 9 Correct? 10 A. No, no. The 4.5 is a charge cutoff, is a 11 conceptual value. You couldn't actually measure 4.5 12 anywhere during the charge process until it was fully 13 charged and the voltage of the battery rose to 4.5. 14 While you're charging it, the voltage of the 15 battery would be 3 -- it would rise through 3.1, 3.2, 16 eventually reaching some value where you stopped it. 17 But during that, you're not applying a 4.5-volt voltage, 18 charging voltage. You're applying some level of power 19 that causes the battery to start charging. But the 20 voltage of the battery doesn't immediately go to 4.5. 21 It's going to rise from this lower level up towards -- 22 Q. I'm not talking -- I'm sorry, I'm not talking 23 about the voltage of the battery being 4.5. I'm talking 24 about an externally applied voltage. 25 You said, I think, that you could apply an	Page 165 1 the battery through these levels of charge, and the 2 voltage increases as the charge, state of charge 3 increases. You can reach the point where the battery is 4 at 4.5 and your voltage being applied is controlled to 5 4.5. And if that's the case, well, there's no more 6 current being applied because you sort of reach stasis. 7 That's the description of a voltage -- 8 constant voltage end of charge where you charge it up, 9 you reach the voltage, and then you just hold it there 10 at the desired voltage. 11 Q. You said "you hold it there." You hold what 12 there? 13 A. You hold the voltage. 14 Q. The voltage of what? 15 A. The voltage of the -- both the cell and the 16 circuit, if it's still attached. You know, there could 17 be tiny changes in temperature or something else which 18 it may respond to, but it's basically holding it there 19 at decreasingly level -- levels until it reaches 20 essentially zero current. 21 Q. So I'd like to take you to your declaration, 22 paragraph 182. And in particular, your citation of 23 Apple 1025. 24 A. Paragraph 182? 25 Q. Yeah.
1 externally applied voltage of 4.5 volts. Correct? 2 A. Well, you could, and you'd get an 3 extraordinarily high -- and then the battery voltage 4 would be 4.5 immediately. 5 Q. Immediately. 6 A. Immediately. And the current -- of course, 7 most of that would be IR and the current would be huge 8 and you'd probably be destroying the battery. That's 9 not a good description of how batteries are charged. 10 Q. Explain to me the difference between, in your 11 view, an externally applied voltage and an open circuit 12 voltage at the end of charging. 13 A. Well, they can come to be the same thing, but 14 it's a -- it's a process of raising the charge level of 15 the cell, the battery, as it goes from a discharge state 16 up toward a charged state. 17 So you may be applying essentially a circuit 18 of power that has a cutoff limit or you're going to cut 19 it off, but during charge there's no 4.5-volt anywhere. 20 If you measured the voltage at the battery, it's going 21 to start at 3 and it's going to rise. And even though 22 you intended to increase it to 4.5, you can't do that 23 immediately without, you know, huge amounts of power 24 and -- or overcoming -- it's -- it's not practical. 25 So it's a process that takes the voltage of	Page 166 1 A. Okay, if I could take just a short moment to 2 review that. Okay. 3 Q. Do you have Exhibit 1025 with you? 4 A. No, I don't. 5 ATTORNEY STAMATOPOULOS: Can we share that 6 with Mr. Hruska, please? 7 (Exhibit No. Apple 1025, previously marked, was 8 referenced and indexed.) 9 BY ATTORNEY STAMATOPOULOS: 10 Q. In your declaration, you state right at the 11 top of page 101: Moreover, it was also well known in 12 the art to operate secondary lithium-ion batteries with 13 a charge cutoff voltage of greater than 4.2 volts. 14 Do you see that? 15 A. I do. 16 Q. And one of the references you cite in support 17 of that is the Amatucci reference, Apple 1025, column 2, 18 line 63 to column 3, line 3. 19 Do you see that? 20 A. I do. 21 Q. And I'd like to invite your attention to 22 Amatucci. 23 A. Oh, yes. Amatucci and Tarascom, yes. 24 Q. So if you could go to column 2, line 63. 25 THE VIDEOGRAPHER: Do you have a page number

1 for that? 2 ATTORNEY STAMATOPOULOS: There are columns in 3 the actual exhibit, but it's page 12. 4 BY ATTORNEY STAMATOPOULOS: 5 Q. Mr. Hruska, you have the exhibit in front of 6 you, right? 7 A. I do on the screen now. 8 Q. Yeah. Are you -- 9 A. Can I -- let me -- 10 Q. Feel free to -- feel free to look through it 11 yourself. I don't know that it's necessary that you 12 just look at what's being shared, but we can do it 13 whichever way's easier for you. 14 But in any event, at column 2, line 63, that's 15 where the passage starts that you cited in your 16 declaration, right? 17 A. Okay. I'll take a moment to review that. 18 Could you actually reduce the size of that because it's 19 overlaying my -- yeah, that's good, by the pictures. 20 Q. So you've seen that part of the passage. 21 Let's look also at maybe the rest of what 22 you've cited, which is column 3, lines 1 through 3. 23 A. I see that. 24 Q. So here, Amatucci is discussing how a lithium 25 metal cell utilizing a lithium cobalt dioxide positive	Page 169 1 native English speaker, may have used a different phrase 2 here. So I -- I'm not -- I'm not sure that it's a 3 primary cell. In fact, I think it's a secondary cell. 4 Q. You mentioned that no commercial rechargeable 5 lithium metal battery exists, to your knowledge, 6 earlier, did you not? 7 A. No secondary cell that uses lithium metal as 8 the negative electrode was available commercially. I 9 still think that's true. 10 Q. This is what Amatucci's describing here, 11 right? 12 A. He's describing a cell where lithium is one of 13 the electrodes. I'm not convinced that he means a cell 14 where lithium metal, like a ribbon of pure lithium, is 15 used as the electrode. I don't think that's the case. 16 Q. This is what you've cited, though, in your 17 declaration, right? 18 A. Well, I've cited it because he clearly charges 19 it to high voltages. 20 Q. Well, the "it" in what he charges is a lithium 21 metal cell, not a lithium-ion cell. Correct? 22 A. I'm not willing to agree that this is a 23 lithium metal cell as I described lithium primary 24 systems. 25 Q. In your view, is there a difference between --
1 electrode may be reasonably expected to achieve 2 nominal -- normal, sorry, operating ranges of about 4.3 3 to 5.1 volts, right? 4 A. That's correct. 5 Q. Amatucci's discussing a lithium metal cell, 6 not a lithium-ion battery. Correct? 7 A. That's the way he describes it here. 8 Q. Is there a reason why you cited this in 9 support of your position that it was well known in the 10 art to operate secondary lithium-ion batteries with a 11 charge cutoff voltage of greater than 4.2 volts? 12 A. Well, he describes higher operating voltages, 13 so that's why I referenced it. 14 Q. But this is not for a secondary lithium-ion 15 battery, is it? 16 A. I'd have to review the patent again, but I 17 think he was talking about secondary systems. I 18 don't -- I don't believe this is a primary system. 19 Q. Yeah, but secondary or not, this is a lithium 20 metal cell, it's not a secondary lithium-ion cell. 21 Correct? 22 A. Again, I would have to review the completeness 23 of this to understand how -- as is often the case, 24 patents use phrases outside of the normal meaning. And 25 Mr. Tarascom -- I remember him giving papers -- not a	Page 170 1 well, let me ask you a different question. 2 Is there such a thing as a secondary lithium 3 metal cell? Yes or no. 4 A. It's not a yes-or-no answer, I'm sorry. There 5 are lithium metal cells that have lithium ribbons 6 extruded from a chunk of lithium used as the electrode. 7 I don't know of any that are secondary. 8 Certainly, it's possible to think that a 9 person working in the industry in Bell Labs, not a 10 commercial battery producer, would describe a secondary 11 cell as a lithium metal cell even if it didn't meet my 12 definition of a lithium metal cell. 13 Q. Did you take care to review this reference in 14 its totality when you cited it in your declaration in 15 support of your opinions? 16 A. I reviewed this reference in its totality a 17 year ago as a minor secondary reference. I didn't spend 18 the time that I spent, for example, on Yamaki or some of 19 the other key references, though. 20 Q. But you're putting it in as an example that it 21 was well known in the art to operate secondary 22 lithium-ion batteries with a charge cutoff voltage of 23 greater than 4.2 volts. And this reference here in the 24 passage that you've cited in your declaration in support 25 of that opinion does not mention secondary lithium-ion
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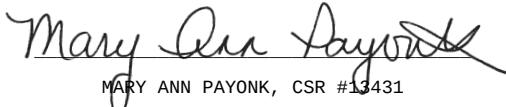
1 batteries. Correct? 2 A. Well, it's obvious from this section that's 3 even shown excised at this time that it's a secondary 4 system. Lithium intercalations implies that there is 5 some structure that's holding the lithium. It's not a 6 lithium metal ribbon. 7 So my explanation of this, after -- 8 understanding I knew Tarascom, I knew the work that Bell 9 Labs was doing, I don't believe that he's used the 10 phrase "lithium metal cell" the way that I have 11 explained to you. He's using it somewhat sloppily, I 12 would say, because he's got a secondary system and he's 13 not using an extruded ribbon of pure lithium as the 14 negative. 15 Q. So let's assume that you're correct and that 16 this lithium metal cell is consistent with your 17 understanding as you've put it today in your testimony. 18 Let's make that assumption. 19 A. Well, I -- 20 Q. Here's my question. 21 A. Your -- your -- I'm sorry, your statement of 22 my assumption isn't clear to me. 23 Q. Let's assume that your reading of Amatucci 24 right now, the portion that you've cited as you sit here 25 today, is correct. Let's make that assumption. And I	Page 173 1 write things in a patent, and he may have -- I don't -- 2 I'm not prepared to discuss his reasoning I guess is 3 what I'm saying. 4 Q. Yet you chose to include this reference in 5 your declaration. Correct? 6 A. It's a secondary system. He charges it to a 7 high voltage. It's worthy of being included, yes. The 8 fact that he described it, I think incorrectly, as 9 lithium metal, it's no different than saying -- 10 overlooking the fact that the '641 patent uses 7500 to 11 describe something. You interpret it the way that you 12 think it should be. Or that something that's theoretic 13 when it really can't be. So there are -- you have to 14 interpret these patents in particular, and I'm 15 interpreting this to be a secondary system with some 16 sort of intercalated lithium structure. It states that. 17 And I'm ignoring what his reasoning may have been for 18 including the phrase "lithium metal." 19 Q. Have you ever -- well, withdrawn. 20 As of the time -- withdrawn. 21 As of the priority date of the '641 patent, 22 had you ever designed a battery that qualified as a 23 secondary lithium-ion battery -- 24 A. Yes. 25 Q. -- that -- sorry, I'm not finished with my
1 have a question for you. 2 A. Okay. 3 Q. Is a lithium metal cell as described here in 4 Amatucci equivalent to a secondary lithium-ion cell? 5 A. As I understand Amatucci's system, it's a 6 secondary system. It's clear that he uses the phrase 7 "lithium metal cell," so what else he means, how else to 8 interpret that, I can't say. But he uses it differently 9 than I've used it in our earlier discussion. 10 Q. Let's forget about -- 11 A. It's talking -- 12 Q. Let's forget about our earlier discussion. 13 I just want you to focus on the question that I'm 14 asking. 15 Is a lithium metal cell as described here in 16 Amatucci equivalent to a secondary lithium-ion cell? 17 A. I don't think Amatucci describes a lithium 18 metal cell, so your question doesn't make sense to me. 19 He uses the phrase, but he doesn't describe a lithium 20 metal cell. 21 Q. Why do you think he's using that phrase? 22 A. I -- I can't fathom his reasons for a 23 particular phrasing. It could have been because he was 24 unfamiliar with most of the American industry's US 25 patent phrasing. It's an individual choice how you	Page 174 1 question. 2 A. Oh, sorry. 3 Q. As of the priority date of the '641 patent, 4 had you ever designed a battery that qualified as a 5 secondary lithium-ion battery to a voltage of 5.1 volts? 6 A. I'm not sure how to answer that because you 7 don't design a battery to a voltage. You design a 8 battery, including the process, the materials, the 9 structure, and you test it, but you don't design it to a 10 voltage. So I certainly designed systems that were 11 tested at a wide range of voltages. 12 Q. Did you design a secondary lithium-ion battery 13 as of that -- withdrawn. 14 Had you designed a secondary lithium-ion 15 battery as of that time that was specified to a charge 16 cutoff voltage of 5.1 volts? 17 A. No. 18 Q. What about 5 volts? 19 A. No. 20 Q. What about 4.8 volts? 21 A. I don't think so, but you're getting close. 22 Q. Well, what was the maximum charge cutoff 23 voltage for which a battery that you had designed as of 24 the priority date of the '641 patent was specified? 25 A. I definitely -- and again, speaking broadly as

1 somebody directing a department of cell designers and 2 engineers -- participated designing a cell that was 3 meant to be charged to 4.5. 4 Q. And what time frame was that? 5 A. Would have been late '90s. 6 Q. Do you recall the context in which you 7 specified -- you designed that battery? 8 A. Well, again, I was responsible for a group 9 that was doing cell design and for a group that was 10 doing charge circuits and safety circuits, battery 11 control, battery management, fuel gauging. And it's in 12 that context that I remember having charge voltage 13 control of 4.5 because that's what we wanted to apply to 14 the battery. 15 I'm not claiming that this was a commercial 16 system that was sold, but certainly we did design 17 batteries that were charged at 4.5 volts, because I 18 designed -- specified the circuits to do that. 19 Q. You're saying you're not claiming this was a 20 commercial system that was sold. 21 Why was it not sold? 22 A. Well, there were many, many reasons, the 23 largest of which is that Duracell's entry into 24 large-scale cell production changed after they were 25 acquired by Gillette. So it was a business decision	Page 177 1 Q. Do you know what the anode is in this 2 secondary system? 3 A. Do you mean the anode during charge? The 4 negative electrode? 5 Q. Yes. 6 A. Oh, it's clearly something that intercalates 7 lithium. Again, I'd have to review the details of this 8 patent, but at this time, I would expect it to be some 9 carbon material. But there are other things that 10 intercalate lithium. 11 Q. What's the difference between a commercially 12 viable secondary lithium-ion battery and an experimental 13 secondary lithium-ion battery? 14 A. Commercial viability. That means that it can 15 somehow survive and succeed in a marketplace. So 16 there's no predetermined difference. By definition, 17 it's what succeeds. 18 Q. Well, let me ask it slightly different. 19 What's the difference between a secondary 20 lithium-ion battery that is marketable versus a 21 secondary lithium-ion battery that is at experimental 22 stages of development? 23 A. Well, that depends to a great extent on the 24 organization that is considering to market it. An 25 organization like Duracell would not market something
1 more than many projects where they simplified it. So 2 instead of a wider range of rechargeable products, 3 Gillette had a different business strategy so the 4 business changed dramatically for that reason. 5 Q. Have you cited any references from that time 6 frame describing your work that you just discussed in 7 your declaration? 8 A. Well, we definitely didn't publish anything. 9 This was experimental, confidential company -- this was 10 a competitive business, so no, we never would have 11 published anything. 12 Q. Do you know if Amatucci describes any examples 13 of secondary lithium-ion batteries with charge cutoff 14 voltages higher than 4.2 volts? 15 A. The way I understand your question, that's 16 exactly what he describes in this section that's been 17 referenced. 18 Q. So your view is that what's being described in 19 this passage here that's being highlighted that you've 20 cited in your declaration is that this refers to a 21 secondary lithium-ion battery. Correct? 22 A. That's very clear to me, because he talks 23 about in this paragraph the reversible -- "reversible" 24 means secondary -- lithium intercalations. That's a 25 secondary system.	Page 178 1 without extensive development, testing, understanding 2 the marketplace. Small startup companies would bring 3 things to market all the time that are potentially 4 unsafe, certainly not competitive. So there's a wide 5 range of responses to what happens in the market. 6 Q. Is it fair to say that not all secondary 7 lithium-ion batteries are safe? 8 A. Well, none of them are safe under every single 9 conceivable condition. So I would look as an answer to 10 say that every single lithium-ion battery can be made to 11 burn if it's incorrectly charged, if it's crushed, if 12 it's -- so it's not a question of safe or unsafe. It's 13 a question of under what conditions will this battery 14 respond without fire, flame, overheating, venting. And 15 that -- 16 Q. Are there -- oh, sorry. I didn't mean to cut 17 you off. 18 A. No, I was simply going to say and that 19 determines whether it might be described as safe or not. 20 Q. Are there certain conditions that were known 21 in the art to be normal operating conditions for 22 lithium-ion batteries? 23 A. Well, there are independent organizations, 24 like UL and CE, that specify tests in the US. 25 Underwriters Lab was the most well known. And there are
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1 tests you can look up, UL3053. And they specify a test 2 that could be conducted on a battery. And there are 3 tests specifically for lithium-ion batteries. And to 4 describe something as safe, typically an organization 5 would look to results from those UL tests to say we meet 6 these tests; therefore, it is safe. 7 Q. And so a person of ordinary skill in the art 8 would understand that some secondary lithium-ion 9 batteries satisfy safety requirements. Correct? 10 A. Most commercial lithium-ion batteries, those 11 sold not for experimental but described as available for 12 application, particularly consumer applications, will 13 have a listing of the tests that they pass. I don't 14 think anybody has ever sold lithium-ion cells without 15 describing the safety tests that they pass. 16 Q. What happens if you sell secondary lithium-ion 17 batteries that don't pass certain mandated safety tests? 18 A. Well, there are many tests that go beyond the 19 minimum. And certainly, people have sold batteries that 20 might pass some tests but not others. And you could 21 restrict the applications that those are sold for, or 22 describe the results so that it -- it all comes down to 23 liability. So it could be done, but certainly a large 24 commercial organization, the ones that had the resources 25 to develop lithium-ion cells, Sony, Sanyo, all of the	Page 181 1 safe to charge a secondary lithium-ion battery to 2 6 volts in the context of normal operating conditions? 3 A. I don't know of any system where I would call 4 that safe for normal lithium-ion cells as we've talked 5 about today, no, I -- I would not. 6 Q. Why do you say that you would not call that 7 safe? 8 THE WITNESS: I'm sorry, I'm tiny bit 9 distracted. Let me see if I can shut a door here. 10 Sorry. It's hard to contain the excitement of a 11 delivery truck. 12 ATTORNEY STAMATOPOULOS: No, it's perfectly 13 all right. Thank you for that. 14 THE WITNESS: Yes. 15 BY ATTORNEY STAMATOPOULOS: 16 Q. So why would you say that it's not safe to 17 charge a secondary lithium-ion battery operating in 18 normal operating conditions to a charge cutoff voltage 19 of 6 volts? 20 A. All of the electrolytes that I'm familiar with 21 would decompose at those voltages, resulting in 22 overpressure, venting. And the venting is a flammable 23 solvent, so it's not safe. 24 Q. Apart from the electrolyte, are there any 25 other issues that might occur as a result of charging a
Page 182 1 original Japanese manufacturers, and some US, had enough 2 at stake that they would describe the exact tests that 3 they passed and may even describe tests that -- or 4 applications that the cells are not suitable for. 5 Q. And with respect to experimental lithium-ion 6 batteries, there's no requirement that they meet any 7 safety conditions. Correct? 8 A. That's correct. 9 Q. And a person of ordinary skill in the art 10 would understand that there's a lot more latitude to 11 experiment with parameters like charge cutoff voltage or 12 capacity ratios or the materials used in the battery in 13 experiments as opposed to actually marketing a battery. 14 Correct? 15 A. I think I described earlier doing experiments 16 in bomb rooms where we expected what's known in the 17 industry as a rapid disassembly of the cell, and -- but 18 in an experimental context where the people are trained, 19 yeah, that's perfectly acceptable. 20 Q. As of the priority date, were you aware of any 21 batteries that were safe to use in normal operating 22 conditions that could be charged to a cutoff voltage of 23 6 volts? 24 A. No. 25 Q. Do you have a view as to whether it would be	Page 184 1 battery to that high a charge cutoff voltage? 2 A. I can't imagine other issues. Just the 3 current that passes at higher voltage could heat up 4 electrodes, you know, resulting in, again, hotspots, 5 potentially fire. So the system is not designed 6 generally to accept voltages that high. The breakdown 7 voltages for the electrolyte, although you said ignore 8 that, and other components are not meant to accept 9 voltages of 6 volts. 10 Q. You mentioned that you had studied the Yamaki 11 reference extensively. 12 A. I think so. I think it was thoroughly, yes. 13 Q. It's one of the primary references in your 14 declaration. 15 A. That's correct. 16 Q. Do you know what happens to lithium cobalt 17 dioxide when a battery is charged to a -- withdraw that 18 question. 19 Do you know what happens to a positive 20 electrode made of lithium cobalt dioxide when the 21 battery is charged to 4.8 volts? 22 ATTORNEY IN: Objection. Form. 23 A. Well, the lithium ions leave the lithium 24 cobaltite and move into the negative electrode, 25 delithiating to some extent, not harmfully, but removing

1 lithium from the positive electrode. 2 BY ATTORNEY STAMATOPOULOS: 3 Q. Do you have Yamaki in front of you? 4 A. I can turn to it, yes. 5 Q. Can you turn to paragraph 7 of Yamaki. 6 A. Yes, I have that. 7 Q. And paragraph 7 of Yamaki reads that 8 theoretically, all of the lithium in the lithium cobalt 9 dioxide is released and the theoretical capacity reaches 10 about 274 milliamp per hours per gram when charging to 11 about 4.8 volts in terms of metallic lithium. 12 Do you see that? 13 A. I do. 14 Q. Does that mean that all of the lithium is 15 extracted at that charge cutoff voltage of 4.8 volts 16 according to Yamaki? 17 A. Well, he prefaces that by "theoretically," so 18 yes, it means it's all removed, theoretically. 19 Q. Is it your view that that is different in 20 practice? 21 A. It is. You never remove 100 percent. It's a 22 rate process. So to say "all" would imply every last 23 atom, and that's practically not possible, but 24 significant. The majority, perhaps most of the lithium 25 is released.	Page 185 1 Q. And in paragraph 155, you state: In the 2 context of the capacity of the negative electrode active 3 material, Yasunami places no particular restrictions on 4 the use ratio for the positive electrode active material 5 and the negative electrode active material but states 6 that the ratio is preferably set so that the effective 7 equivalents of each are equal. An effective equivalent 8 is the equivalent that can substantially maintain cycle 9 performance. 10 Do you see that? 11 A. I do. 12 Q. And then in the same paragraph of your 13 declaration, you say: Yasunami also indicates that 14 either the positive electrode active material or the 15 negative electrode active material can be increased, 16 right? 17 A. Yes, I see that. 18 Q. Do you have Yasunami in front of you? 19 A. I can turn to it. 20 Q. Of course. That's Apple 1006. 21 A. Yes. Okay. 22 (Exhibit No. Apple 1006, previously marked, was 23 referenced and indexed.) 24 BY ATTORNEY STAMATOPOULOS: 25 Q. Effectively, in paragraph 19, is it fair to
Page 186 1 Q. And would a person of ordinary skill in the 2 art want to remove almost all of the lithium from the 3 lithium cobalt dioxide cathode or positive electrode? 4 A. Not this pure cobaltite formulation, no, 5 because the crystal structure is affected, which limits 6 future recharging. The lithium doesn't insert 7 successfully if it's been 100 percent removed. 8 ATTORNEY STAMATOPOULOS: Let's take a brief 9 break. I just want to -- actually, let's go off the 10 record briefly if that's okay with you, counsel? 11 ATTORNEY IN: Yeah. 12 THE VIDEOGRAPHER: Time is 1:46 PM. We are 13 off the record. 14 (Recess taken.) 15 THE VIDEOGRAPHER: We are back on the record. 16 The time is 1:59 PM. 17 BY ATTORNEY STAMATOPOULOS: 18 Q. I just have a few more questions for you, 19 Mr. Hruska. So turning to your declaration, paragraph 20 155. 21 A. Okay. 22 Q. You're discussing the Yasunami reference. 23 A. All right, let me turn to that. 24 Q. Yeah. 25 A. 155, page 87, yes.	Page 188 1 say that Yasunami is saying that any positive to 2 negative electrode capacity ratio could work for a 3 secondary lithium-ion battery? 4 A. Let me review that paragraph. 19, you said? 5 Q. Yes. 6 A. Okay, let me review then. Okay, I see it. 7 Q. Effectively, paragraph 19 says that any 8 capacity ratio could work. Correct? 9 A. I don't think it says "could work." It said 10 there are no particular restrictions on the use ratio of 11 the positive and negative materials. 12 Q. And then it says: But the ratio's preferably 13 set so that effective equivalents of each are equal, 14 right? 15 A. That's correct. 16 Q. So Yasunami is not teaching that a person of 17 ordinary skill in the art should set the capacity ratio 18 such that the negative electrode capacity is greater 19 than the positive electrode capacity. Correct? 20 A. He does not state that. He's referring -- 21 instead of the issue of excess capacity, which is the 22 reason for larger effective negative electrode, they're 23 talking about the effective capacity, which he's 24 describing as the equivalent that can substantially 25 maintain cycle performance.

1 So this is sort of again an empirical 2 measurement, how much of the negative and positive can 3 be charged and discharged. And he's recommending to set 4 that ratio at a level that will be reversible, but not 5 as to how much excess is needed or what the ratio should 6 be, no. 7 Q. What do you mean, "at a level that will be 8 reversible"? 9 A. Reversible, as in charge and discharge. I 10 think he's -- in effect, that can substantially maintain 11 cycle performance. So that's charge and discharge. 12 That's a reversible insertion and delithiation. 13 Q. Has it been brought to your attention that the 14 patent owner submitted a translated version of Yasunami 15 in these proceedings? 16 A. Yes, it has. 17 Q. Have you reviewed that translation submitted 18 by the patent owner? 19 A. I've -- my attention was drawn to a particular 20 difference between that version. I haven't reviewed the 21 entire patent version that they provided in detail, just 22 the part that was drawn to my attention. 23 Q. Do you have that translation in front of you, 24 by any chance? 25 A. I do. I believe it's conveniently listed as	Page 189 1 to be combined"? 2 A. It's my reading of this that the original 3 patent in Japanese is trying to present the idea that 4 the ratios can be changed based on the active materials, 5 that there's not a preconceived limit on what those 6 ratios are. 7 The use of the word "arbitrarily," which the 8 other translator chose to translate differently, may 9 imply that there's no fixed or preconceived ratio that's 10 necessary so it's set without regard to that. 11 They chose the word "arbitrarily." To me, 12 it's got a pejorative context that is probably not 13 intended in a patent document. But nonetheless, it's 14 certainly fine. It means that there's not a fixed 15 ratio. 16 Q. Doesn't that imply to a person of ordinary 17 skill in the art that the charge cutoff voltage is not a 18 factor that bears upon the capacity ratio of a secondary 19 lithium-ion battery? 20 A. No, I don't think the inclusion of the word 21 "arbitrarily" would override a person of skill's deep 22 understanding of the connection between charge voltages 23 and capacities of active materials. 24 As we've seen throughout the day, those 25 capacities are defined at a specific voltage, and I
1 Patent Owner's Translation of Yasunami, yes. 2 Q. Very imaginative title. 3 A. Correct, at least. Okay, I've got it. 4 Q. So let me invite your attention to 5 paragraph 32 of that translation. Let me note for the 6 record that's Exhibit 2001 in these proceedings. 7 A. Paragraph 32? Okay. Now this is -- I've got 8 it. 9 (Exhibit No. 2001, previously marked, was 10 referenced and indexed.) 11 BY ATTORNEY STAMATOPOULOS: 12 Q. And I'll just read for the record what it says 13 in paragraph 32. It says: The ratio of the positive 14 electrode active material to the negative electrode 15 active material used in the nonaqueous secondary battery 16 of the present invention can be set arbitrarily 17 according to the type of active materials to be 18 combined. 19 Did I read that correctly? 20 A. Yes, you did. 21 Q. Is that the section that was brought to your 22 attention? 23 A. Yes, it is. 24 Q. What's your understanding of the phrase 25 "arbitrarily according to the type of active materials	Page 190 1 think a person of ordinary skill would maintain that 2 deep understanding and not be concerned about whether or 3 not it was sort of arbitrary or whether it was simply 4 open to choice or whether it was something that was 5 chosen according to the type of active material. So 6 there's the limitation that I could read into this 7 statement also, which kind of counteracts the 8 arbitrariness of it. But it's certainly open to 9 changing. 10 Q. What do you mean, it sort of counteracts the 11 arbitrariness but it's certainly open to changing? 12 A. Well, I find some conflict, some tension 13 between the words "arbitrarily" and "according to the 14 type of active materials." If it's -- if you're paying 15 attention to the type of active materials, you're not 16 choosing entirely arbitrarily, you're choosing within 17 that correct and understanding the type of active 18 material. So I would say that those two concepts have 19 to be brought together somehow, and "according to the 20 type of active materials to be combined" is the key part 21 of that phrase. 22 Q. And so Yasunami's very careful to tell a 23 person of ordinary skill in the art that notwithstanding 24 the disclosure that the capacity ratio can be set 25 arbitrarily, you still have to pay attention to the type
BlueBear Reporting LLC	Page 191 RJ Technology Exhibit 2008 Apple Inc. v. RJ Technology LLC IPR2023-01350, Page 48 of 99

1 of active materials to be combined? Is that a fair 2 summary of your understanding of that passage? 3 A. No. I think you reversed the way I would 4 phrase it. A person of skill would choose the active 5 material ratio certainly according to the type of active 6 material but have choice within that definition. So we 7 don't know what other considerations he's implying by 8 saying "according to the type." 9 But I would read into it the most important 10 things in cell balance issues, things like safety and 11 cyclability and all those. So I would deemphasize what 12 "arbitrary" means, but it's -- it certainly is a range 13 of possibilities. He's saying that you can choose 14 different ratios as long as you pay attention to the 15 type of materials you're using. 16 Q. So Yasunami's careful to include that caveat 17 as to the types of active materials that are being used 18 in the definition. Fair? 19 A. That's fair. 20 Q. It's also fair that Yasunami doesn't mention 21 the charge cutoff voltage in his paragraph 32. Correct? 22 A. In this paragraph, that's correct. 23 ATTORNEY STAMATOPOULOS: I don't have any 24 further questions. Thank you very much for your time. 25 I pass the witness for the time being.	Page 193 1 REPORTER'S CERTIFICATE Page 195 2 I, MARY ANN PAYONK, shorthand reporter and 3 Notary Public, CA CSR No. 13431, do hereby certify that 4 the witness whose deposition is hereinbefore set forth 5 was sworn by agreement of all parties, that the 6 proceedings were reported stenographically by me, and 7 that this transcript is a true, correct, and full record 8 of the testimony given. 9 I further certify that I am not related to 10 any of the parties to this action by blood or by 11 marriage, and that I am in no way interested in the 12 outcome of this matter. 13 IN WITNESS WHEREOF, I have hereunto set my 14 hand this 5th day of June, 2024. 15  16 MARY ANN PAYONK, CSR #13431 17 18 19 20 21 22 23 24 25
1 THE WITNESS: Thank you. Page 194 2 ATTORNEY IN: Can we go off the record? Can 3 we take 10 minutes on our end? 4 THE VIDEOGRAPHER: Time is 2:11 PM. We are 5 off the record. 6 (Recess taken.) 7 THE VIDEOGRAPHER: We are back on the record. 8 The time is 2:24 PM. 9 ATTORNEY IN: Great. We don't have any 10 further questions for the witness. So thank you, 11 Mr. Hruska. Thank you, everyone. 12 ATTORNEY STAMATOPOULOS: Thank you. 13 THE VIDEOGRAPHER: Time is 2:24 PM. We are 14 off the record. 15 16 (Deposition adjourned at 2:24 p.m.) 17 18 19 20 21 22 23 24 25	Page 196 1 INDEX TO WITNESSES 2 WITNESS PAGE 3 LOUIS HRUSKA 4 Examination by Attorney Stamatopoulos 5 5 6 INDEX TO REFERENCED EXHIBITS 7 Exhibit No. Apple 1001 60 8 Exhibit No. Apple 1003 14 9 Exhibit No. Apple 1006 187 10 Exhibit No. Apple 1015 25 11 Exhibit No. Apple 1022 142 12 Exhibit No. Apple 1022 143 13 Exhibit No. Apple 1025 168 14 Exhibit No. 2001 190 15 16 INDEX TO NEWLY MARKED EXHIBITS 17 (None.) 18 19 20 21 22 23 24 25

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1 I,

2 LOUIS HRUSKA,

3 state that I have read the foregoing deposition and

4 declare under penalty of perjury:

5 That the foregoing is my deposition under

6 oath;

7 That I have read same and have made the

8 necessary corrections, additions or changes to my

9 answers that I deem necessary;

10 That my answers as indicated are true and

11 correct.

12

13 Executed at _____

14 this _____ day of _____, 2024.

15

16 _____

17 LOUIS HRUSKA

18

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