Deposition Testimony of:

Nigel Richardson

Date: July 10, 2013

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Page 6:25 to 7:03

00006:25 Q. No. Do you understand that you're under
00007:01 oath just as though you were testifying in a
02 Court of Law?
03 A. Yes.

Page 7:10 to 9:09

00007:10 Q. Okay. If you don't understand a
11 question, please let me know, and I'll rephrase.
12 A. Yes.
13 Q. And if you answer, is it fair for me to
14 assume that you understood my question?
15 A. Yes.
16 Q. Is there any reason why you wouldn't be
17 able to give complete and accurate answers to my
18 questions today?
19 A. No.
20 Q. Okay. What's your educational
21 background, Dr. Richardson?
22 A. I have a Ph.D. from Florida A&M, Florida
23 State University. I did Structural Engineering
24 during that Ph.D. My Minor was Composites, Major
25 being Organic-Based Composites. I have a
00008:01 Master's Degree from the same institution,
02 Structural Engineering again, and in this -- this
03 iteration probably more along the civil lateral
04 structure side.
05 And, of course, I have a Bachelor's
06 Degree from the same institution, and it's across
07 several disciplines, Civil Mechanical and
08 Structural Mechanics.
09 Q. When did you receive your Ph.D.?
10 A. I believe it's December 2000.
11 Q. 2000. And you mentioned your Ph.D. was
12 in organic-based composites. Is that --
13 A. Yes.
14 Q. -- correct?
15 A. Yes.
16 Q. Did that include finite element analysis?
17 A. Yes.
18 Q. And are organic-based composites metals?
19 A. No.
20 Q. Did your Ph.D. include modeling --
21 structural modeling of metals?
22 A. There was some studies done on metals,
23 that's correct.
24 Q. Was your primary focus on nonmetals in
25 your Ph.D.?
00009:01 A. Yes.
02 Q. Have you ever modeled a blowout preventer
03 using finite element analysis before,
04 Dr. Richardson?
05 A. No.

Q. So you wouldn't have previously modeled blind shear rams using finite element analysis, either. Is that correct?
A. Yes.

Page 9:11 to 9:13

So BP first asked you to provide an Expert opinion in this case. Is that correct?
A. Yes.

Page 10:16 to 10:22

Q. (By Ms. King) What -- what subject ar -- matter area were you asked to examine?
A. The cutting capacity of the blind shear ram for two conditions, a centered pipe and a potentially buckled pipe, which would be an off-centered pipe in the configuration of the BSR.

Page 11:05 to 11:11

Q. Okay. Did you reach any conclusions that were not included in your Final Report, meaning Appendix F to Dr. Nesic's Report?
A. No.
Q. How long did it take you to reach an opinion in this case?
A. To my recollection, several months.

Page 12:10 to 13:04

Q. How did your colleague assist you with this Report, Appendix F to the Nesic Report?
A. If I could explain the process --
Q. M-h'm.
A. -- and then get into the Report.
Q. Sure.
A. There's a modeling stage, there's an analytical stage --
Q. M-h'm.
A. -- and then, of course, there's the Report writing and conclusion.
So the modeling stage, the analyst would have helped -- helped with it.
Q. Okay.
A. And on the direction and -- and leadership from me, based on experience, and we both ran analyses.
Q. M-h'm.
A. And the final drafting of the Report and approval of the Report was done by myself.

Page 13:09 to 13:12

00013:09 Q. Okay. So you issued one Report in this
10 litigation, correct, as we've discussed, which is
11 Appendix F to Dr. Nesic's Report? Correct?
12 A. That's correct.

Page 14:03 to 14:07

00014:03 Q. Well, turning to Appendix F, which would
04 be your Report, can you look at that and
05 determine whether it's a true and correct copy of
06 your Report?
07 A. Sure.

Page 14:17 to 14:20

00014:17 Q. Does -- does your Report, Appendix F of
18 the Nesic Report, contain a complete statement of
19 all opinions that you will express in this case?
20 A. Yes.

Page 16:23 to 17:01

00016:23 Q. Does your Report, Appendix F to the Nesic
24 Report, contain all of the reasons supporting
25 your opinion in this case?
00017:01 A. Yes.

Page 17:10 to 17:12

00017:10 Does Appendix F contain a complete
11 statement of all of the bases for your opinions
12 in this case, Dr. Richardson?

Page 17:14 to 17:22

00017:14 A. The Report contains everything that we
15 looked at and all -- it summarizes all the
16 assumptions and analyses that were completed to
17 come to the conclusion.
18 Q. (By Ms. King) And you're aware that
19 Dr. Nesic relied on your work for -- for -- in
20 coming to his Expert opinion in this case,
21 Dr. Richardson?
22 A. Yes.

Page 18:22 to 19:22

00018:22 Q. Did BP attorneys provide you with any
23 documents that you relied upon in forming your

opinion in this matter, Dr. Richardson?
A. We got some information from the initial portion of the -- our project, but that -- that data was not necessarily used to come to any conclusions.
Q. Okay.
A. Our analyses were done based on the information on the boundary conditions that we assumed and -- and we were told to examine, and our analyses and conclusions are based purely on those.
Q. You said that you got some information from the initial portion of your project, but that data was not necessarily used to come to any conclusions.
What information are you referring to?
A. Well, we discussed -- we were provided the intent of the analyses, and we were given some supplementary data regarding the -- the blind shear ram, in particular a 3D CAD file that defines the geometry that we were supposed to model, and if my recollection serves me, we were told where the pipe was restrained, which served as the boundary conditions for our analyses.

Page 20:09 to 20:10

Q. (By Ms. King) You mentioned that you were provided with an intent of your analysis.

Page 20:12 to 20:19

A. Let me rephrase "intent."
Basically, two conditions were examined; a pipe that was aligned directly in the center of the blind shear ram, and one that was off-centered, or in a buckled state. So that -- that is the information we have. Plus the -- the information regarding where the restraints were in the upper annular and upper VBR.

Page 21:01 to 23:21

Q. Did BP attorneys provide you with any other documents that you relied upon in reaching your conclusion?
A. In addition to the information that we got from BP, namely, the CAD file and the -- the boundary conditions, we did some literature searches on our end to try to classify information with regards to the stack and potential pipe geometry for the cutting with the blind shear ram, and I think there was additional information with some Reports. I don't recall

exactly which Reports that we -- we saw.
Q. When you mentioned doing literature searches, are you referring to publicly available literature, or are you referring to information that's been exchanged in this litigation?
A. Our expertise, as Consultants, are primarily -- we're -- we're -- we're Experts at the finite element approach, and it's -- it's general when -- when we do these types of analyses that we'll do a little literature research to gain an understanding of the particular components that we are going to analyze.
Q. M-h'm.
A. In question here, the blind -- the blind shear ram, and -- and this is just a -- a validation check, such that any information that was provided by the client could be seconded, prior to starting the analysis.
So we just did general literature search, to make sure we understood what defined the restraints and the general position of the blind shear ram.
Q. Can you remember specifically any documents that turned up in that literasure -- literature search that you relied upon in forming your opinion?
A. Well, those documents were not used to form --
Q. Okay.
A. -- our opinion. Those documents were just used as validation to understand what we were analyzing, namely, the blind shear ram, and -- and -- and that information was taken from Internet sources, but that -- again, that was just for familiarity, not necessarily to overstate or utilize anything outside of what we were provided.
Q. Can you describe generally the types of Internet information that you were looking at to gain familiarity with the blind shear ram?
A. The major would be how the blind shear ram operates. That would be the -- the major point we sought, trying to understand how the cutting procedure was completed.
Q. And what sources were you looking at, to try to understand that?
A. Videos online.
Q. Online videos?
A. Yes.
Q. And do you know who produced those videos?
A. If I recall, it could have been Cameron. Cameron might have shown one in a wellbore, if I recall.
Q. Okay. Did you talk to Dr. Nesic without

attorneys present in the course of preparing your Report, Dr. Richardson?
A. I've -- I've never met him or spoken to him.

Page 24:07 to 24:16

Q. What are your personal areas of expertise, Dr. Richardson?
A. Finite element analysis is -- is the prime expertise for myself.
I've been doing finite element simulation for roughly 18 to 20 years. I -- I've used just about every commercially available finite element package, and I've done several simulations, probably in excess of 200, and continue to do so in my current role.

Page 25:09 to 25:19

Q. Okay. Do you -- does your expertise in finite element analysis have a focus in any particular structure or item that you might focus on modeling?
A. No. The -- the majority of work we've done in the past have been metallic-based structures, isotropic elastic, plastic-type material models, so it's -- it's a wider -- a wide array.
Q. Okay. So you're not an Expert in blind shear rams; is that correct?

Page 25:21 to 25:22

A. I'm not an Expert in the design of blind shear rams, that -- that is correct.

Page 28:18 to 29:18

Q. I'd like to turn now back to you your Report, Appendix F of the Nesic Report, which we've marked as Exhibit 11529.
In your Report, you describe that you conducted a validation model in which you calculated the maximum shear pressure observed in your model of the BSR closing on a centered drill pipe. Is that correct?
A. That is correct.
Q. And so you compared this sheer pressure from your model of the centered drill pipe to a Cameron calculation for BSR shear pressure. Is that correct?
A. Cameron provided shear number. I -- I'm

not sure how they -- they arrived at it; but, yes, they provide -- there was a number provided by Cameron.
Q. Cameron provided you with a shear number?
A. Not directly. It was cited in a -- a Report. Sorry.
Q. Okay.
A. That number was derived from, I think, an actual physical test, which is why we're -- we're suggesting that it was a val -- validation of the centered pipe cutting.
Q. Did you ever see the Report --

Page 29:20 to 31:14

Q. (By Ms. King) -- in which this number from Cameron for the BSR shear pressure was located?
A. I may have seen the document. The details, no. The -- the -- the number, I saw in a table, yes. So it was a -- a section of -- of the Report.
Q. If we could turn to Page 5 of your Report, Dr. Richardson.
A. Yes.
Q. In the small table labeled "Comparison of Calculated Max BSR Pressure" --
A. M-h'm.
Q. -- you have there a "Calculated Shear Pressure" from Cameron of 3,008 psi; is that correct?
A. Yes.
Q. Is this the pressure that you were just discussing, a pressure that was cited in a Report --
A. Yes.
Q. -- that you relied upon to validate your model for the centered drill pipe buckling test?
A. Yes.
Q. And you have a Footnote here to Cameron ED-702 and a Bates number, Page 5, Table 2.
A. Yes.
Q. Was this the source for this calculated shear pressure --
A. I believe --
Q. -- that's --
A. -- that it was --
Q. -- 3,008 psi.
A. -- it --
Q. Excuse me.
A. -- that -- that reference was cited in another document. Yeah, that reference was cited in a -- another document in -- I think it was a DNV document.
Q. It was a DNV document?

A. Yes. I think it was a DNV document, tabulated. And they referenced that -- that number as being extracted from ED-702.
Q. So you, yourself, never looked at Cameron ED-702, Dr. Richardson?

Page 31:16 to 31:24

A. Not that I can recall of in -- in -- in any detail. Actually, I'm not sure I've actually seen it. I think I've seen the -- the DNV Report.
Q. (By Ms. King) So this number that you used to validate your model, then -- 3,008 psi -- came from the DNV Report, correct?
And you're not aware, in fact, whether it was in Cameron ED-702; is that correct?

Page 32:01 to 32:06

A. That's -- that is correct, I cannot validate that it was in that -- that Report.
Q. (By Ms. King) Why, then, did you put Cameron ED-702 as the Footnote to this table in your Report, Dr. Richardson, if you had never looked at this document?

Page 32:08 to 32:13

A. Again, the -- the ED-702 Report that was cited in the DNV Report, I could have seen the document, I just don't recall the content of the -- the document as is the ED-702.
Q. (By Ms. King) Well, let's take a look at it, turning to Tab 6.

Page 33:02 to 33:03

Q. (By Ms. King) So this document was previously marked as Exhibit 3185.

Page 33:12 to 33:25

Q. Take a moment to review this document, Dr. Richardson, so you can tell me whether or not you have reviewed this document before.
A. (Reviewing document.)
No, I don't think I've seen the entire -- the Report in its entirety. I -- I think I might have saw -- seen a couple pages from the Report.
Q. And the page that you cited in your Report was Page 5. Is that one of the pages that you have seen before, Dr. Richardson?

A. Yes, it looks familiar. Yes, it does.
Q. And can you tell me where this number of 3,008 psi would be found in this document, Dr. Richardson?

Page 34:04 to 34:10

A. The exact number of 3,000 -- 3,008 does not -- is not on this page.
Q. (By Ms. King) It's -- it's not on this page, Page 5 of Exhibit 3185.
Do you know where in this EB-702 D Report the number 3,008 psi could be found, Dr. Richardson?

Page 34:12 to 34:15

A. The exact number, no.
Q. (By Ms. King) You don't know where it could be found; or you don't think it appears in this document, Dr. Richardson?

Page 34:17 to 34:23

A. I guess I'll have to look at the document in -- in detail but I have not seen it, as we look at it today.
Q. (By Ms. King) So just to confirm, you haven't seen the number 3,008 psi for a max BSR shear pressure in this document, Exhibit 3185. Is that correct?

Page 34:25 to 36:25

A. Based on the time that I've thumbed through it, yes, I have not seen it.
Q. (By Ms. King) How did you use the number 3,008 psi to validate your model with the drill pipe centered?
A. The number as referenced in the DNV --
Q. M-h'm.
A. -- Report, if I recollect, suggested that that reference was an actual physical test, a cutting procedure that was done on a particular pipe.
And we ran our initial simulation with the pipe centered on the blind shear ram with all the material modeling; boundary conditions; and assumptions, reasonable assumptions, and ran the simulation to cut the pipe, which took a reasonable time.
And after cutting through the pipe, we computed the max shear force on the -- the piston

itself -- well, the reaction force on the blades and, likewise, the -- the riser shear pressure on the piston.
Q. So because your model of the centered drill pipe found a max shear pressure that was close to the number 3,008 psi, which was from the DNV Report, you concluded that your model was accurate?
MS. DEMPSEY: Object to form.
A. Accurate within the realms of what we did. Finite element analyses, the -- the approach as is, is used to -- to decipher detailed information not easily sought, if you look at the entire component. And, in this case, it would be the entire blind shear ram and pipe.
And using our expertise in terms of mesh size, material modeling, plastic deformation, et cetera, and running the simulation, we came to the conclusion, after a couple analyses -- because on the front side of a finite element analysis, you make some assumptions.
So we ran a couple of analyses with the pipe centered to try and understand the sensitivity of the final conclusion. And the final conclusion was the 3,000 -- just slightly over 3,000 psi that's on the pipe.
Q. Let -- let me ask you this: What's the purpose of a validation model, Dr. Richardson?
A. The vali -- the vali -- validating the model is just to gain confirmation that the assumptions that's made on -- made on the front end of the analysis are adequate.

Page 37:05 to 37:23

Q. How about in this specific incident -- instance, were you doing this validation model in order to gain confidence in your model?
A. Well, the -- the validation that was included is -- is -- was done primarily as a -- just a reference, an additional number that compares with -- with ours. The simulations that we've done in the past and -- and now, we feel -- feel pretty confident that -- that those results, even if the model was not validated, within -- are correct within some accuracy.
And the reason is, is because we always test the parameters that is assumed on the front end of the simulation. So we always do multiple analyses to make sure we converge on that particular conclusion. The mere fact that the -- the number aligns somewhat validates the cutting procedure for the centered pipe in terms of real test.

Page 38:01 to 38:03

00038:01 Q. (By Ms. King) Do you know for a fact that
02 it was a laboratory test that resulted in this
03 number, 3,008 psi, from Cameron?

Page 38:08 to 38:12

00038:08 A. Only as cited in the DNV Report.
09 Q. (By Ms. King) And you returned to the
10 document that was cited in the DNV Report, but
11 you don't see this number, 3,008 psi, in that
12 document, do you, Dr. Richardson?

Page 38:15 to 40:15

00038:15 A. If we're referencing the document that we
16 just thumbed through, yes. I have not seen that
17 number.
18 Q. (By Ms. King) So you said that you're
19 confident in your model, even if it's not
20 validated. Is that correct?
21 A. That -- that confidence comes from a --
22 the level of detail analysis we've done in the
23 past. We -- we've got a strong background in
24 aerospace applications, and the fidelity of
25 aerospace applications are within fractions of an
00039:01 inch. And we work with the major gas turbine
02 industries and are pretty adept to provide
03 accurate information that's used, and those three
04 main companies, namely GE, Pratt & Whitney, and
05 Rolls Royce.
06 Q. If you have the opportunity to validate a
07 model, wouldn't you prefer to do so,
08 Dr. Richardson?
09 A. As far as FEA is concerned, the word
10 "validate" is -- is pretty wide in -- in terms
11 of your -- you arrive in -- at a conclusion in
12 the simulation by making certain checks.
13 FEA, as I suggested, involves the
14 discretization of a larger structure. But the
15 equilibrium forces that define that larger
16 structure are inherent to the smaller
17 subdivisions, and the resolution on this solution
18 in terms of the information you get after running
19 the simulation is mesh dependent.
20 So we always do mesh discretization
21 checks, and we also do parameters checks on the
22 boundary conditions assumed. So we feel pretty
23 confident that the results are correct within
24 some reason.
25 And, again, those are based on where the
00040:01 pipe would have been held for the simulation.
02 Q. How did you test the front end parameters
03 that you've used for this model, Dr. Richardson?

A. As tradition in -- in the FEA, if you're going to restrain any portion that's not a hundred percent fixed, you want to hold that area furthest away from the BSR.

And what we did, we did two different lengths of pipes, and in addition to that, locally around the BSR where the cutting procedure takes place, we did two or -- two or three different mesh refinements. And if -- if you look at the -- if I can refer to the -- my Report. And which Appendix is it?

No.

Page 40:24 to 42:09

You'll realize that the original mesh refinement would be in the outer extremities and is subsequently refined as you get closer to the BSR.

So there were several runs made on the continuum refined to that level.

Now, there -- there -- there's -- there's always a -- a tradeoff in terms of studying these parameters. So to -- to help validate any of the approaches, you have multiple scenarios going in a -- a design matrix where you look at the mesh refinement and the advancement of the BSR, and we did several runs before we came to the conclusion of the 3,000 psi.

Q. So the primary refinement you did was on the particular mesh that you used for this analysis. Is that correct?

A. That's correct.

Q. Okay. You considered the March 20th, 2011, Det Norske Veritas in developing your opinion. Is that correct?

A. We considered the information from that Report as -- as a validation to our understanding of the -- the boundary conditions as prescribed. What was contained in -- in that particular Report did not necessarily affect our final conclusions, because our analyses were independent of those analyses, and I'm not -- I'm not aware of the particular assumptions, or what have you, that are -- simulations that were conducted there to come to their conclusion.

Q. But you used a number quoted in this Report to validate your model; isn't that correct, Dr. Richardson?

A. Yes, the 3,000.

Q. The 3,008 psi?

Page 42:13 to 42:22

Q. (By Ms. King) This is the DNV Report from

March 2011 that you reviewed in developing your opinion; is that correct, Dr. Richardson?
A. This Report was used to confirm certain information that's in our model on the front end --
Q. Okay.
A. -- prior to the analysis, yes.
MS. KING: I'd like you to mark this as Deposition Exhibit 11530.

Page 42:24 to 43:01

Q. (By Ms. King) So included in this Report is a finite element analysis of the blind shear rams and drill pipe, correct, Dr. Richardson?

Page 43:03 to 43:14

A. There are certain pictures within the Report that would lead me to believe, yes, there was a finite element analysis conducted on the blind shear ram.
Q. (By Ms. King) Did you -- did you review that portion of the Report, Dr. Richardson?
A. Not -- not in any detail.
Q. Let's turn to Page 155 of the Report.
A. Page --
Q. 1 -- 154 --
A. 154.
Q. -- actually of Exhibit 11530.

Page 43:16 to 44:11

Q. (By Ms. King) Are you familiar with this portion of the DNV Report, Dr. Richardson?
A. I recall seeing some of these pictures, yes. As to the details, I -- I can't recall, but I think I've seen this section before.
Q. And just like the DNV Report, you used ABAQUS to conduct the shear modeling; is that correct, Dr. Richardson?
A. For this particular go-around, yes.
Q. What do you mean by "this particular go-around"?
A. Well, there are multiple finite element packages. On this particular case, we used ABAQUS, yes.
Q. For all of your modeling of the blind shear ram, did you use ABAQUS for your shear modeling?
A. Yes.
Q. And just like the DNV Report, you used the Johnson-Cook model for ductile damage initiation; is that correct, Dr. Richardson?

Page 44:16 to 46:06

A. I -- I don't recall if the DNV Report used Johnson-Cook.
Q. I can point you to the top of Page 155.
A. 155. (Reviewing document.)
Yes.
Q. And just like the DNV Report, you used the damage parameters for 4340 steel for the drill pipe; is that correct, Dr. Richardson?
A. I'm not sure if we used the same damage parameters. Our damage parameters -- and -- and I'm aware of the parameters that they used. Our damage parameters were generated from literature review, published sources, and those parameters are based on a -- the Johnson-Cook damage model is a pretty robust model for damage initiation plastic flow, and there are several publications within that realm.
So we probably had a prop -- a couple of cited parameters and probably used the most pertinent based on experience, because we've used the model, the Johnson Cook model in the past.
Q. What literature did you review to find those damage parameters?
A. Published papers in -- in material and books.
Q. Which papers were those, Dr. Richardson?
A. I don't recall exactly which ones.
Q. Did you cite any of them in your Report, Dr. Richardson?
A. Not directly.
Q. Did you cite them indirectly, Dr. Richardson?
A. If I recall, we might have suggested they published -- published data that we used that data from --
Q. But in --
A. -- published sources.
Q. But in your Report, you did not provide any citation to the literature sources for the damage parameters that you used in your modeling; is that correct, Dr. Richardson?

Page 46:08 to 47:14

A. I don't think so. I'll -- I'll have to review the content again, but I don't think so.
Q. (By Ms. King) The DNV Reports FEA model of the BSR rams with off-centered drill pipe concluded that the BSR blocks were two inches from fully closing; is that correct, Dr. Richardson?
A. I -- I -- I think the -- the number

sounds familiar. I -- I don't recall the -- the exact number, but I'm sure it's probably within their document.
Q. If you would turn to Page 165, does this -- sorry.
Do these diagrams -- does Figure 148 on Page 165 of Exhibit 11530 refresh your recollection that the --
A. Yes, I've -- I've -- I've seen this before.
Q. -- that there was a two-inch --
A. Yes.
Q. -- standoff --
A. Yes.
Q. -- in the Det Norske Veritas FEA modeling --
A. Yes.
Q. -- of the blind shear ram?
A. (Nodding.)
Q. And your final conclusion was that the BSR blocks were 1.9 inches from fully closing, around an off-center drill pipe; is that correct, Dr. Richardson?
A. That's correct.

Page 49:10 to 49:13

Did you review the April 30th, 2011 Addendum to the Det Norske Veritas Report?
A. I don't think I've seen the -- that document.

Page 50:01 to 50:19

Q. (By Ms. King) So looking at this document, you have not reviewed it, Dr. Richardson?
A. Not in detail.
Q. Have you ever seen it before?
A. I don't think I have, but let me look through real quick.
Q. Okay.
A. (Reviewing document.)
If I recollect, I might have seen some of the pictures.
Q. You might have seen some of the pictures?
A. Yes.
Q. Which of the pictures have you seen before, Dr. Richardson?
A. I think -- what's the page -- Page 20, Revised Figure 145, maybe 134.
Q. And did you see figures outside of this Report?

Page 50:21 to 51:20

00050:21 A. I may have seen these pictures on -- on a
22 page of the Report. And -- and when you say
23 "outside the Report," what do you mean?
24 Q. (By Ms. King) I mean did you see the
25 entire Addendum, or did you see these figures
00051:01 separately?
02 A. No. I -- I think I -- I -- I might have
03 seen the Addendum as a package and just looked
04 through and saw these pictures.
05 Q. Okay. If we could look at Section 2.3 of
06 this Addendum, starting on Page 11. It's
07 entitled "An Update of the Off-Center Drill Pipe
08 Shearing Finite Element Analysis...Model."
09 Did you review this portion of the
10 Addendum, Dr. Richardson?
11 A. (Reviewing document.) I don't recall. I
12 don't think so.
13 Q. You don't think so?
14 A. Huh-uh.
15 Q. And you did not cite this Addendum among
16 your reference materials, did you, Dr. Rifard --
17 Dr. Richardson?
18 A. I -- I -- could I look at my Report --
19 Q. Sure.
20 A. -- to double-check.

Page 51:25 to 52:14

00051:25 A. (Reviewing document.) No, I don't think
00052:01 so.
02 Q. (By Ms. King) Turning to Page 12 --
03 A. 12?
04 Q. -- of the Addendum, Exhibit 11531.
05 A. Okay. Same Report?
06 Q. Correct.
07 If -- if -- if you could just review this
08 page.
09 A. M-h'm.
10 Q. Are you familiar with the fact that the
11 CAD files originally provided by Cameron for the
12 lower BSR block for the original DNV Report were
13 incorrect and were later replaced by Cameron with
14 newer CAD files for the lower BSR block?

Page 52:17 to 52:22

00052:17 A. I don't think so, no.
18 Q. (By Ms. King) Do you know whether the CAD
19 files for the lower BSR block that you used in
20 your analysis were the updated or original
21 Cameron CAD files, Dr. Richardson?
22 A. I -- I can't confirm which one it is.

Page 53:02 to 54:13

Q. (By Ms. King) So you don't know whether you used the accurate CAD file for the lower BSR block or the inaccurate CAD file for the lower BSR block. Isn't that correct, Dr. Richardson?
MS. DEMPSEY: Object to form.
A. Well, you use the word "accurate" in terms of what I analyzed, and the intent of the CAD, I'm not sure what the updates that were made to the CAD that I have, but those updates might not have any bearing on what we've done. So there's no way for me to say at this point in time whether or not that update would render the CAD file that we used as an incorrect or inaccurate CAD representation of the BSR.
Q. (By Ms. King) And the difference between the two CAD files as reported in the Addendum to the DNV Report was that the cavity opening was measured as 15.38 inches in the updated lower BSR block compared to 16.875 inches for the originally provided lower BSR block CAD geometry. Do you see that there in Figure B on Page 12 of the Addendum?
A. I see the picture.
Just so I can rehash what you're saying, you're saying the updated geometry is reflective in the -- the 16.875 width or that's -- that's the original?
Q. The original was 16.8.
A. And the red would be the --
Q. The --
A. -- updated?
Q. -- updated was 15.38 inches.
A. Okay. Yes, I see it.
Q. Don't you think it would be important for you to use accurate CAD files for the BSR geometry in doing your finite element analysis of the BSR blocks closing, Dr. Richardson?

Page 54:15 to 55:03

A. If this is the only change update that has been made to the BSR, and as I stand here today, I -- I don't see how that particular -- on this particular side of the ram block would affect the conclusions as reported based on our original CAD.
Q. (By Ms. King) In the Addendum, the DN -- the DNV Report concludes that the updated lower BSR block geometry reduced the clearance between the top blade of the upper BSR block and the opposite relief cavity on the lower BSR block and that caused a change in the block displacement.

Are you aware of that, Dr. Richardson?
A. No.

Page 60:16 to 62:19

Q. (By Ms. King) So your conclusion was that the blind shear rams were 1.9 inches apart after they attempted to close on the drill pipe, the blocks were 1.9 inches apart, correct?
A. For the off-center drill pipe, that's correct.
Q. For the off-center drill pipe. Did you identify any uncertainty bounds on that estimate, Dr. Richardson?
A. Yes, to some degree. That final conclusion is based on several positions of the pipe, itself, as it relates to the blind shear ram, and that particular orientation, as reported, as off-centered, that was the one that pro -- produced the 1.9 inches.
The other conditions that we looked at where the pipe was within the blind shear ram, it actually cut, and cut within a shear pressure that was indicative of the allowable of the piston. So we concluded that as long as the pipe was within the -- the V of the blind shear rams, successful cutting would have occurred.
Q. Are you aware of whether or not the drill pipe was, in fact, completely cut by the BSR in the DEEPWATER HORIZON incident, Dr. Richardson?
A. I think we have seen some pictures where a particular BSR and pipe was not fully cut, yes.
Q. And you're aware that the blind shear ram did not fully close in the DEEPWATER HORIZON incident, when -- when it was attempted to be closed; is that correct?
A. Yeah, I think I've -- I've heard that, yes.
Q. So the uncertainty bound that you mentioned was the position of the drill pipe inside of the rams, is that the only -- did you mention that you were uncertain of the exact position of the drill pipe, Dr. Richardson? Is that the uncertainty you're referring to there?
A. No.
Q. Okay.
A. Again, the -- the -- the goal of the project was to look at cutting the drill pipe in one location, cutting the drill pipe in the potentially buckled configuration, and we looked at several different orientations of the pipe within the wellbore diameter as the position that a pipe relates to where the -- the V is.
Q. M-h'm.
A. And as long as the pipe was within the V

shape, it was completely sheared. As long as there was some portion of the pipe outside the notch in the V, it was not completely close -- cut.

Page 62:23 to 64:07

Q. (By Ms. King) If we would look at Page 3 of Appendix F, Exhibit 11529.
A. Yes.
Q. I'm -- I'm looking at the two pictures, Case 1 and Case 2. You just testified that if the drill pipe was within the V, it would have been completely sheared. Is that correct?
A. For -- for the conditions that we ran, we ran three different positions.
Q. M-h'm.
A. The centerline and progressively moving it out to the extreme, and, yes, the -- the pipe did cut.
Q. Is Case 2 the most extreme case that you've ran, Dr. Richardson?
A. To my recollection, yes. We might have run an additional case outside, but I think it didn't affect the results that much.
Q. Does Case 2 represent your best estimate as to the actual position of the drill pipe during the DEEPWATER HORIZON incident?
A. Based on the information that we were provided and the boundary conditions of the model and -- parameters studied, yes, that is probably the extreme condition for the cutting.
Q. My question was: Does Case 2 represent your best estimate of the actual position of the drill pipe during the DEEPWATER HORIZON incident, Dr. Richardson?
A. Based on the information that we have with respect to the length of the pipe within the blowout preventer, where it's restrained, the potential for it to buckle and the wellbore dimensions, yes. It is probably the extreme case for the conditions we considered.

Page 64:09 to 64:19

A. Now, does it represent the position of it in the -- the -- repeat again, the DEEPWATER -- the DEEPWATER incident?
Q. (Nodding.)
A. That's probably the closest reference we'll have based on the information that we've considered in the model.
Q. But you're not sure of the precise position of the drill pipe as it was between the BSR blocks or blades in the DEEPWATER HORIZON

19 incident. Is that correct, Dr. Richardson?

Page 64:22 to 66:13

00064:22 A. It will be difficult for me to know the
23 precise location, but, as mentioned, the
24 sensitivity analysis that's conducted suggests
25 it's the most likely location based on the
00065:01 information we've compared for the off-center
02 cutting.
03 Q. (By Ms. King) But the position of the
04 drill pipe did have an impact on the final
05 distance between the BSR blocks after they
06 attempted to close on the drill pipe. Isn't that
07 correct, Dr. Richardson?
08 A. There are two governing conclusions. One
09 is the pipe is fully sheared, as long as the pipe
10 is in the BS -- the -- the B -- the BSR blades;
11 and the other is as long as the pipe is outside,
12 there's a portion that is not going to be cut.
13 And the values that were reported would be the
14 most likely distance to the ram block after the
15 cutting procedure on the blades -- I mean, on --
16 on the pipe.
17 Q. As you varied the position of the drill
18 pipe from the center of the V out to the far edge
19 of the V, that impacted the distance between the
20 blocks after they attempted to fully close. Is
21 that correct, Dr. Richardson?
22 A. I would say, again, there are two
23 overriding conditions. If the pipe is within
24 the -- the shearing enterprise of the BSR, the
25 BSR has enough pressure based on the computed
00066:01 values to completely shear the pipe in that
02 region.
03 Q. I --
04 A. So the final -- but as long as the pipe
05 is outside that portion, we have predicted that
06 the 1.9 would be the distance between the ram
07 blocks.
08 Q. So is it your testimony, Dr. Richardson,
09 that you only sought two answers in your
10 modeling: Either the distance was zero because
11 it completely closed at the end, or it was 1.9
12 inches apart. Is that what you found in your
13 modeling?

Page 66:15 to 69:12

00066:15 A. Any differences surrounding the 1.9 were
16 not sensitive enough to change that overriding
17 fact.
18 In other words, we didn't see a 1.2 or a
19 1.3, no. The numbers were within reason of the
20 1.9, and that's what --

Q. (By Ms. King) And what was the range that you saw?
A. If my memory -- if -- if -- if I recollect, maybe plus or minus .05, maybe .07, I think.
Q. Plus or minus .07, so that would be from 1.2 to 2.6 inches?
A. Not .7, .07.
Q. .07. And so plus or minus .07 from 1.9?
A. Yes.
Q. And that's with changing only the position of the drill pipe to get those variations; is that correct?
A. That's from just moving the drill pipe along the -- the apex of the -- the V blades, yes.
Q. Okay.
A. As long as the pipe is within the V, it shears, and it shears at approximately the same pressure.
Q. Okay. So you testified that you determined the BSR blade dimensions from a CAD file, correct, Dr. Richardson?
A. Provided CAD file, yes.
Q. A provided CAD file.
And are you aware of any identifying information on that CAD file, Dr. Richardson?
A. I don't recall the name of the CAD file right now.
Q. Do you recall if it had any kind of a Bates stamp on it, Dr. Richardson?
A. No. As to a Bates stamp, I am not sure what a "Bates stamp" is, either. No, I -- I don't recall. No.
Q. Okay. How did you determine the initial velocity of the BSR blades?
A. Again, in -- in -- in a literature search to ascertain the -- the cutting process and the duration of the cutting process. We -- we studied the impact of the velocity of the cutting blades.
Q. M-h'm.
A. The actual physical time is about 25, 30 seconds if -- if -- if I recall, and the majority of that is from full deployment all the way over to where the -- the blades would engage the pipe. So the -- we moved our blades pretty close to the pipe to avoid that computational space where there's really nothing happening, and then we started the cutting procedure.
And we studied several different velocities, as -- as -- as small as, I think, 1 meter per second, which -- in the computational world, because the elements are so small, that that -- that's a very, very long run. We're talking on the order of weeks. And I think we

went as far as a hundred meters per second.
Q. And the literature that you reviewed to determine the duration of the cutting process, was that cited in your Report, Dr. Richardson?
A. In particular, that might have been a video. That might have been a video condition.
And -- and I think we might have had discussion with -- amongst ourselves, as a Team, and I think somebody mentioned that, yes, that's -- that's probably how long the duration is for the cutting procedure.

Page 69:16 to 70:19

Q. And so you relied on this video and the statement of one of your Engineers to determine the duration of the BSR cutting process; is that -- do I understand you correctly, Dr. Richardson?
A. Well, in terms of physically ascertaining whether the pipe is cut or whether the pipe is not cut, the actual physical time for the BSR to engage the pipe became -- became slightly irrelevant in getting to that conclusion.
Q. But my question was: In determining the duration of the cutting process, you used a video, as well as a discussion with a fellow Engineer. Were those the sources for your understanding of the duration of the BSR cutting process? Is that correct?
A. If -- if my recollection serves me, my knowledge of the entire BSR cutting process were based on those two facts. And, again, that remained irrelevant as to the -- the cutting procedure with respect to the bla -- the -- the blades and the pipe. That was just a video, just so we can have a physical sense of the real-world time.
Q. And the -- so you testified about watching that video and determining the duration in order to come to your determination of the initial velocity of the BSR blades; is that correct?

Page 70:21 to 70:23

A. That video was not the -- the only assessment that was used to come to the velocity --

Page 70:25 to 71:17

A. -- of the -- the cutting.
Again, based on that rough video, the

speed of the -- the rams relative to the cutting procedure, I was pretty -- pretty slow. And the velocity that we used in our model was sensitized to that actual duration to make sure that we weren't imparting any additional forces into the model by using a high initial velocity for the cutting procedure in our simulation.

Q. What was the initial velocity that you used?

A. 20 -- 20 millisecond, I think -- 20 millisecond.

Q. 20 meters per second?

A. 20 meters per second, yes. Sorry. Yes.

Q. And do you believe that the actual initial velocity of the BSR blades was 20 meters per second, Dr. Richardson?

Page 71:19 to 72:09

A. No. But there's a lot of parameters that will affect that cutting velocity in a real-world stance.

Like I mentioned, the -- the velocity of the blades as it pertains to cutting the pipe, that was a parameter that we studied to ensure that speeding up the computational time to arrive at a -- a myriad of analyses wasn't computationally expensive. But we did run a much slower advancement of the blades, and we found the results were within reason as reported for the 20 millisecond.

Q. And so what was the range of variation from the more accurate to real-world properties velocity versus the 20 meters per second velocity that you ended up using for your model?

Page 72:11 to 76:02

A. Again, the -- these analyses take very long. And if my memory serves me right on the validation model, which was a centered drill pipe, we ran a -- a wide array of velocities, probably from one meter per second to as far as a hundred meters per second.

Q. (By Ms. King) Okay.

A. Clearly, at the extremities of a hundred meter per second, that is more like a full-on impact on the pipe, and we found that velocity to impart additional kinetic energy into the solution. So we never ran, to come conclusions, at that high speed.

Q. Okay. How did you determine that the BSR blades had a constant Z axis velocity?

A. It's not a constant velocity that was applied from deployment to engage the blade.

That is a starting velocity with the -- the V blades as close as possible to the numerical model, in this case, the pipe, where we seeking to find failure. So it's not necessary a constant velocity -- velocity that would have created additional kinetic energy away from the wellbore.

Q. So when you write at the bottom of Page 3 to the top of Page 4: "...I applied constant axial velocity (on Z axis) to move the BSR ram blades in the advance direction," is that a part of your Report that you wish to change?

A. No. Again, let -- let me explain. That is a constant initial velocity. When the blades interact with the pipe, the stiffness of the pipe, the local deformation of the pipe could slow that value down.

As the outer parameter -- the outer perimeter is cut and the -- the pipe is engaged and gets thinner and thinner through the wall, that velocity could go slightly higher.

But that is the initial velocity with the blades in the proximity of the domain.

00074:01 Q. You conducted a "Static Stress Analysis" depicted on Page 12 of your Report, correct?

A. Yes.

Q. What was the purpose of this static stress analysis?

A. The static stress analysis was completed first to understand the integrity of the blades while cutting in the centered position and while cutting in the off-centered position, and that was just to confirm that if the -- the pipe is subtended in the shoulders or collars of the ram block, if the blades are deform -- allowed to deform, how does that number be affected in terms of the thickness of the pipe?

And the deformation that we saw, or the stresses that we saw, was local on the blade, closest to the pipe.

If you look at the stress blocks where it's directly in the center, there's some local yielding, but the integrity of the blade remains the same.

Q. And you conducted this static stress analysis to determine the deformation of the BSR blades for both the centered and the off-centered drill pipe position; is that correct?

00075:01 A. That is correct.

Q. Was your conclusion the same for the off-centered drill pipe, that there was local yielding of the BSR blade?

A. There was local yielding in both, but the presumed yield plastic area was minimal in the centered pipe as compared to the off-centered pipe.

Q. In the off-centered pipe, the yield area was not minimal?
A. No, no. I'm saying it was minimal in the centered pipe, and in the off-centered, there was more damage on the BSR blades.
Q. In this static stress analysis, how did you determine what material to -- what material properties to use for the BSR blades?
A. I believe we -- we selected a steel material that was in -- indicative -- a little tougher than the blade itself, because the intent would be to cut the blade. And I think we used a -- a standard metal. We might have gotten that information from literature search.
Q. So you conducted the static stress analysis assuming a material for the BSR blades that was not necessarily the material that the BSR blades were made out of; is that correct, Dr. Richardson?

Page 76:04 to 77:03

A. Well, there are two basic metals that's used in heavy-type structures. And they can either be ferrous based or -- or what you'd call aluminum deriv -- I mean iron derivatives, and they could either be stainless or they could be on the realm of -- of cast iron.
The stiffness of those materials are inherently extremely approximate, so the stiffness between those two materials doesn't change. And the static analysis is just an indication of a stiffness that's consistent across all of those metals, about 29 -- 29e to the sixth psi.
And there's a slight variation. Cast iron, you're down in the lower values of 28.3, and you can do some hardening properties, that will take you to 29.8.
But in terms of percent error with regards to that stiffness, less than a percent, minimal.
Q. (By Ms. King) But the material properties that you assumed for this static stress analysis were not necessarily the precise material properties of the actual BSR blades; isn't that correct Dr. Richardson?

Page 77:06 to 79:17

A. For the static stress analysis, it is possible that the material designation that is -- as it pertains to the BSR blades are not exactly the material designation that we might have quoted in the particular Report.

However, I must point out that the static analysis is based purely on the stiffness of the material or the stiffness of the continuum. And, again, for cast iron based or stainless steel or ferrous-based material, that stiffness varies from about 28e to the sixth to 29.7e to the sixth, so the percent difference is very minimal.

Q. (By Ms. King) Did you request information about the material properties of the BSR blades from Cameron, Dr. Richardson?

A. I don't recall that.

Q. You did not request that information, or you don't recall whether you did or not?

A. I don't think we did, no.

Q. So it is your opinion that the BSR blades likely did deform some amount when closing around the off-centered drill pipe. Is that correct, Dr. Richardson?

A. Yes. It is possible, but, again, the actual amount of that deformation, we can't physically quantify because, in the off-centered position, the simulation, as run, only indicates the condition after the BSR blades would have traveled through the section of the pipe as cut.

So to know exactly -- and, again, this is all based on the capacity of the piston.

So knowing exactly how much of the off-centered pipe was physically -- or the blades were physically deformed at that point, it's not a hundred percent. We're not a hundred percent certain.

But there is some local damage, more than was noted, in the centered drill pipe.

Q. But in your FEA modeling to determine the distance between the BSR blocks after they attempted to close around the off-centered drill pipe, you assumed that the BSR blades were completely rigid. Is that correct, Dr. Richardson?

A. That's correct. That's correct.

Q. So, in other words, you assumed that the BSR blades would not deform at all when closing on the drill pipe in your FEA modeling?

A. During that explicit analysis, yes.

Q. But you knew that the BSR blades likely did deform when they started closing around the drill pipe, as depicted in your static stress analysis. Isn't that correct, Dr. Richardson?

A. Because both materials are inherently ferrous based, there would be some damage on the blades, yeah.

Q. Does your assumption that the BSR blades did not deform -- despite knowing that they did, in fact, deform -- add uncertainty to your calculation that the BSR blocks were 1.9 inches apart after attempting to close on the

17 off-centered drill pipe?

Page 79:19 to 84:22

00079:19 A. I don't think so.
20 Q. (By Ms. King) Why not?
21 A. There are two conditions that's
22 occurring: The cutting event is an explicit
23 event; the static analysis is an implicit event.
24 Okay?
25 Q. Okay.
00080:01 A. And because the cutting event is a
02 dynamic analysis, while cutting, any local
03 deformation that occurs on the blade, the
04 stiffness would redistribute. Okay?
05 And the static analysis, we ran the
06 static analyses just to assess the condition of
07 the blades for the off-centered and the centered
08 drill pipe.
09 The cutting process, when the blades
10 shear the pipes, both materials -- sorry, the --
11 the blade, the integrity of the blades should
12 still be in reasonable contact with respect to
13 the damaged pipe.
14 As to the total damage that's on the
15 blades in the cut position, we have not assessed
16 that, so I will not be able to answer that
17 question.
18 Q. How did you determine the friction
19 coefficient between the blade surfaces and the
20 drill pipe?
21 A. A bit of that is past experience and
22 knowledge from running the Johnson-Cook
23 plasticity model previously and the interaction
24 between steel-to-steel-materials in a dynamic
25 sense. At a low rate of -- a low rate of
00081:01 loading, it typically varies around .3 to .1, so
02 we went with .05.
03 Q. You said it varies from .3 to .1?
04 A. .03.
05 Q. Oh, .03?
06 A. M-h'm.
07 Q. Could the friction coefficient have been
08 .03 or .1?
09 A. The friction coefficient that is --
10 let -- let me explain the friction coefficient.
11 This is a dynamic event; and during the dynamic
12 event, the friction coefficient will vary to the
13 extreme that when the pipe is first engaged,
14 there will be a high-friction coefficient. Okay?
15 And when I say "high," I reference that
16 as being relative, so the high end of that
17 steel-to-steel interaction.
18 As the pipe begins to get sheared by the
19 blades, that friction coefficient is lowered

because now the plac -- the plac -- the -- the pipe is experiencing plastic flow. Okay?

So this is a dynamic number; but, again, it's tuned based on experience and what has been used in the past for the Johnson-Cook model at this particular material.

00082:01 Q. Did you try running your model with the lower or higher friction coefficient to determine the sensitivity of the model to changes in that value?

A. I think we ran one case with a higher friction value for the centered pipe. As to what was checked, I think we only determined or compared the max reaction force on the blades. And that -- that was the overriding parameter in determining the -- the net pressure or the net shearing pressure for the event.

Yes, I think we did one -- we ran one value above the .05. I don't recall what the number was right now.

Q. If you had used a different friction coefficient, would that have impacted the final distance between the BSR blocks after they attempted to close around the off-centered drill pipe in your model?

A. No.

Q. Why not?

A. It might have affected the time it takes for the blades to shear through the pipe, but the final resting position on the off-centered cut represents the -- the material that's left

00083:01 outside on the shoulders of the ram blocks.

So as long as the V blades or the BSR blades would have sheared through the pipe, the final distance -- or the standoff, as it were -- represents the stiffness of the -- the pipe material that's within the ram blocks. So the friction coefficient would only affect the time it takes to cut through it.

Q. How did you determine the material properties of the drill pipe?

A. When you say "the material properties of the drill pipe," the drill pipe has a basic material property that's -- it's stiffness and it's Poisson's ratio. As far as that material is concerned, there are other parameters that could be used but -- but for the intent of the analysis, that is the predominant portion for the elastic definition of the pipe.

Now, when the pipe is damaged during the cutting process, the pipe undergoes plastic flow or plastic strain. And that plastic strain is -- is characterized by the Johnson-Cook model. And that Johnson-Cook model, the parameters for that Johnson-Cook model -- namely, the strain, the strain rate, all that information -- are readily

00084:01 available on published sources for this type of
02 steel. So that's exactly what we used in our
03 model.
04 Q. Okay. You listed in your list of
05 references the specification for drill-through
06 equipment, API Specification 16A. How did you
07 use this reference in your model?
08 A. If I recall, just primarily to get the
09 geometric thicknesses, and what have you, for the
10 pipe.
11 Q. And how did you determine the stiffness
12 of the drill pipe material?
13 A. The -- the API spec on that particular
14 pipe, there's a certain grade, if I recall, for
15 that particular pipe; and that particular pipe
16 has a synonymous steel that's associated with it.
17 And, again, the variation in that
18 stiffness are what's commonly referred to as
19 Young's modulus. The variation in that number is
20 limited for ferrous-based materials.
21 Q. Would the stiffness of the drill pipe
22 change in a higher temperature?

Page 84:25 to 86:12

00084:25 A. Yes, it would.
00085:01 Q. (By Ms. King) Would the drill pipe -- are
02 you aware of the temperature of the oil in the
03 BOP when the BSR was actually closing on the
04 drill pipe during the DEEPWATER HORIZON incident,
05 Dr. Richardson?
06 A. No.
07 Q. Would the steel become less stiff at a
08 higher temperature, Dr. Richardson?
09 A. Yes.
10 Q. Was the stiffness number that you used
11 for the steel in your model taken from a room
12 temperature measurement?
13 A. It would have been, that's correct.
14 Q. Would temperature impact the Poisson's
15 ratio of the steel?
16 A. Slightly.
17 Q. And how would it impact the Poisson's
18 ratio at a higher temperature?
19 A. It depends on the -- the state of stress
20 and the rigor of loading. But the Poisson ratio
21 inherent for hexagonally packed materials, the
22 variation is going to be limited until the grain
23 boundaries start slipping in the plastic flow,
24 and the Johnson-Cook model as used is highly
25 tested for this type application.
00086:01 Again, let me point out, as far as the
02 stiffness is concerned, the overriding conclusion
03 in the assessment with regards to shearing the
04 drill pipe relative to its position within the

BSR, the stiffness would not affect that final conclusion. It will just cut -- or the duration and time taken to cut it, it will go faster because of the lower stiffness on the pipe.
Q. But your model assumed that the steel had the stiffness of room temperature steel. Is that correct?
A. Yes.

Page 86:22 to 88:16

Q. (By Ms. King) Dr. Richardson, in your general practice of doing FEA modeling, do you try to compare your model results to real-world results whenever possible?
A. If the customer has that data, yes, we'll make that comparison, yes.
Q. Were you provided with real-world data here from laser scans of the BOP parts or the BSR parts?
A. I don't recall if they were provided, or we took it from Internet sources. Most likely, we were provided the laser scans, I think, so maybe a picture in one of the Reports. I think I recall it in the DNV Report.
Q. You were provided with a picture from the laser scan via the DNV Report; is that correct?
A. We extracted the picture from the DNV Report, yes.
Q. Were you provided with the laser scans outside of the DNV Report?
A. The actual CAD definition, no, no.
Q. And do you -- did you do a la -- you said a did a literature search for laser scan information?
A. When I use the term "literature search," it could be either on the Internet or through the documents that we were given.
I -- I recall the laser scans, the pink ones, I think, was -- was in the DNV. There was some pink and -- and metallic-looking ones, I think I remember seeing in the DNV Report.
Q. So you reviewed the pictures of the laser scans in the DNV Report. Did you review any other laser scans?
A. Not to my knowledge.
Q. You did not review the high CAD laser scans that were conducted in 2012?
A. I don't recall seeing CAD.
Q. Did you compare your FEA model to the laser scan pictures in the DNV Report?
A. As best as possible, comparing a 3D geometry to a 2D picture, yes.
Q. Wouldn't it have been helpful to have the 3D laser scan CAD files to compare your 3D FEA

16 model to, Dr. Richardson?

Page 88:18 to 88:25

00088:18 A. If -- if available, we could have made
19 that comparison. I'm -- I'm -- I'm not sure if
20 necessarily that -- that would have changed
21 anything. Maybe the intent was in the -- the 2D
22 profile.
23 Q. (By Ms. King) But BP didn't offer to
24 provide those 3D laser scan files to you, did
25 they?

Page 89:22 to 90:08

00089:22 Q. (By Ms. King) Let's look, instead, at the
23 Addendum, I'm sorry, which was marked as
24 Exhibit 11531 on Page 21. Do you see "Revised
25 Figure 147" where the caption reads: "Alignment
00090:01 of Scan Models - 2.8 Inch Standoff between
02 Blocks"?
03 A. Yes.
04 Q. Does the fact that in the laser scan 3D
05 model, the standoff between the blocks was 2.8
06 inches give rise to any uncertainty in your mind
07 about your conclusion that the blocks were 1.9
08 inches apart?

Page 90:10 to 95:07

00090:10 A. This -- this is a -- a 2D picture, and I
11 can't ascertain where the pipe is, and how the
12 pipe is oriented with respect to those blades.
13 And it looks like a portion of the blocks are
14 missing, so I wouldn't be able to communicate
15 whether or not the blocks are actually engaging
16 the pipe, so it's difficult for me to come to any
17 con -- conclusion there.
18 Q. (By Ms. King) If you had the 3D laser
19 scan, would that make it easier for you to come
20 to a conclusion about how far apart the blocks
21 actually were after they attempted to close
22 around the drill pipe?
23 A. The 3D laser scans would remain as -- as
24 a point of reference, but what are the 3D laser
25 scans of? Un -- unless I know what the 3D laser
00091:01 scans represent, it will be difficult for me to
02 just compare 1.9 and 2.8 and make some
03 conclusions.
04 Q. You mentioned, Dr. Richardson, going back
05 a little bit here, that you assumed a faster
06 initial velocity than the actual BSR blade
07 velocity because the slower velocity was too
08 computationally expensive. What did you mean by

"computationally expensive"?
A. Computer runtime, as it pa -- it -- pertains to actual real life duration. The slower the blades would be advancing, the more computations the computer will have to do as it proceeded, so --
Q. Are you saying that at the slower velocity, the computer would have to do so many computations that you didn't have enough time to complete those computations --
A. No, absolutely not.
Q. -- to do your Report?
A. No, absolutely not, because we did consider really slow velocity. But, again, to reiterate, we -- we did several different analyses, and in order to do a full parametric evaluation in the computer environment, you have
00092:01 to make some assumptions based on the boundary conditions that you are placing.
The 20 meters per second would have been selected relative to the kinetic energy and the internal energy in the model, plus looking at a variety of speeds of about 1 meters per second, up to around a hundred meters per second. That's how we ended up selecting the 20, because it was the most cost-effective to get the answer based on the number of analyses we ran.
Q. You mentioned that you did a literature search for the cutting duration of the BSR blades, and you didn't cite any of the literature that you found in that search in your Report; is that correct, Dr. Richardson?
A. Not explicitly, but, again, that particular speed, or the actual duration of cutting the pipe, has very little influence on the final conclusion. That was done when we first got the -- the job, and we were trying to assess what is the BSR, what does the BSR do, how does it engage the pipe, et cetera, et cetera.
So that information was discovered without initial intent.
Q. And, similarly, you mentioned doing a
00093:01 literature search for the speed of the BSR blades, and you did not cite any of the literature that you reviewed to determine that speed in your Report; is that correct, Dr. Richardson?
A. When we refer to the speed of the BSR blades, the speed of the BSR blades is -- is inherent to the time it takes from deployment to get engaged to the pipe. And that was just a general feel-good to know whether or not, in the initial sense, the speeds that we consider in the para -- parametric study envelope something that was realistic.
So, no, we didn't cite it, because we

considered a wide range of speeds. And, again, the duration for cutting the pipe, it varies, right.
Q. In the literature search, I believe you testified that you found the -- the velocity, the initial velocity of the BSR blades was one meter per second; is that correct?
A. I don't recall what is the exact speed of the model.
What I did -- do recall is, that after looking at a couple of videos, we tried to simulate how long it takes for the BSR blades to travel to where the pipe was located. And, again, that's -- that's a velocity assuming that the actuator or the piston is advancing at -- at some constant rate.
Once the cutting begins, we don't know what it is. But we -- we went between one millisec -- one meter per second and I think a hundred meters per second, and we felt that enveloped the travel distance on the BSR blade with respect to the time we saw it take to cut, or start the -- initiate the cutting on the pipe.
Q. And you decided to use an initial velocity of 20 meters per second for the blades, and you did not cite any source for that initial velocity in your Report; is that correct, Dr. Richardson?
A. That 20 meters per second was selected purely based on the parametric evaluation between all speeds, and that 20 meters were selected because we had to do several analyses. And within the realms of explicit analyses, as long as your internal energy with respect to the continuum and the kinetic energy is within reason in a ratio, you can get away with running that speed to reflect the physical condition, and that's why we selected the 20 meters per second.
Q. And you reviewed a number of videos to determine this envelope of one meter per second to 100 meters per second initial velocity, but you did not cite any of those videos in your Report; is that correct, Dr. Richardson?

Page 95:10 to 96:03

A. No, I don't think we cited any of those videos in the document.
Q. (By Ms. King) You mentioned that you did a literature search for damage parameters for your model, and you didn't cite any of the literature that you reviewed to determine those damage parameters in your Report, did you, Dr. Richardson?
A. We probably just referenced the material

and cited just the generally published sources. Again, the Johnson-Cook model is a well-tested model, and for this basis of steel, the parameters are pretty much uniform, depending on the shear damage model that is used.

Q. Okay. So you looked at generally published sources to determine the damage parameters, but you did not cite those generally published sources in your Report; is that correct, Dr. Richardson?

Page 96:05 to 96:25

A. The explicit papers, no.

Q. (By Ms. King) You conducted a literature search for the material properties of the stainless steel that you assumed were the material for the BSR blades in your static stress analysis, correct?

A. I wouldn't say "literature search." I mean, my previous experience with steel and be knowledgeable of the variety of AASE and API-type standard base cast iron and steel materials, it was a reasonable assumption on the front end to have the stiffness at 29e to the sixth, and that's what we proceeded with.

(Discussion off the record.)

Q. (By Ms. King) So when you testified previously that you used a standard metal for the BSR blades and you might have gotten that information from a literature search, are you now saying that you did not get the material properties from a literature search for your static stress analysis of the BSR blades?

Page 97:02 to 98:18

A. The exact number that's used in the analysis, again, whenever we do assessments, because we don't proclaim to be Experts at the particular component that we are examining but more Experts at the approach, we have to understand how sensitive the assumptions that we make affect the results.

So at some point in time, I would imagine that we looked at some variations in that metal, but, again, the 29e to six is typically, within my experience and the Team's experience, the starting stiffness at room temperature for steel.

Q. (By Ms. King) And you didn't cite, in your Report, any of the sources that you looked at to determine the stiffness of that steel that you used for the BSR blades in your static stress analysis, correct?

A. I don't think -- let me see something.

(Reviewing documents.)
Outside of understanding that the pipe was derived from some API spec and using experience for the stiffness of the steel, no, it's not explicitly stated in the list of references.
But, again, the material in question, the stiffnesses don't vary by much. Even up to 400 degrees F, steel or iron-based material still re -- retain a stiffness of 92 percent. So even if their -- their particular environment was as such, we would still be within quite a bit of reason.
The overall goal for the analysis was whether the pipe cut when it was in -- at the center and what was the state of the standoff of the ram blocks when the pipe was off-centered. Those parameters inherently will not affect the overall conclusion of the analysis.
Q. So to be clear, your reference list includes some specifications about the drill pipe material, but it does not include any sources for the material properties of the BSR blades; is that correct?

Page 98:20 to 98:20

A. Explicitly, no.

Page 104:07 to 104:13

And on Page 5 of your Report, if I could point you to the last sentence on the page, it states: "The off-centered drill pipe was intended to simulate pipe displaced to the side of the wellbore under the influence of an external buckling force."
A. Yes.

Page 108:19 to 108:21

Q. You were not familiar with BOPs and blind shear rams before this engagement, correct?
A. That's correct.

Page 110:08 to 110:13

Q. (By Mr. Hartley) Okay. Now, as a part of your finite element analysis, I think you came to the -- to the conclusion that 1.9 inch -- inches that the gap left after the blind shear rams closed?
A. Between the ram blocks, yes.

Page 110:19 to 111:19

00110:19 Q. Okay. Now, I understand, and correct me
20 if I'm wrong, as part of your analysis, that you
21 studied a centered drill pipe?
22 A. M-h'm.
23 Q. And as a result of your simulations, had
24 the drill pipe been centered, then the BSR would
25 have completely sheared it, given the forces
00111:01 applied --
02 A. That's correct.
03 Q. -- on the Macondo Well?
04 A. (Nodding.)
05 Q. Is that fair?
06 A. M-h'm, yes, that's right.
07 Q. And your simulations for off-centered
08 drill pipe were that it did not completely shear
09 because a portion of it was outside of the V?
10 A. That's right.
11 Q. Okay. How far outside the V was it?
12 A. In the original configuration?
13 Q. Yes.
14 A. I don't remember the exact, but roughly
15 half the diameter on the initial -- initial cut.
16 Q. Can you give me a -- a size? Is it an
17 inch outside the V?
18 A. No. It's -- it was more than an inch. I
19 think it was more than an inch.

Page 112:17 to 113:11

00112:17 Q. Okay. Turn briefly to Page 3 of your
18 Report.
19 A. Yes.
20 Q. At the top of that page, above the
21 diagrams --
22 A. M-h'm.
23 Q. -- you talk about the boundary conditions
24 for your simulations for this 3D finite element
25 analysis.
00113:01 A. M-h'm.
02 Q. You see that?
03 A. Page 3, yes.
04 Q. Okay. And for your simulations, you --
05 you have the drill pipe fixed with the upper
06 annular preventer and radially restrained with
07 the VBR?
08 A. That's correct.
09 Q. Those are the parameters you inputted
10 into your FEA?
11 A. That's correct.

Page 116:04 to 116:10

00116:04 Q. (By Ms. Dempsey) Whether you used the CAD
05 file originally provided by Cameron with the
06 cavity opening of 16.875 inches for the lower BSR
07 block, or the updated CAD file with the cavity
08 opening of 15.38 inches, would it impact your
09 conclusion about the standoff between the BSR
10 blocks that you set forth in your Expert Report?

Page 116:12 to 116:18

00116:12 A. Those updated dimensions just pertain to
13 the cavity where the -- the pipe would go. The
14 shoulder dimensions and the standoff width, as it
15 relates to the horizontal sealing plane, they're
16 still the same, based on what I see in the
17 geometry.
18 So I presume, no.

Page 118:07 to 119:04

00118:07 Let's look at your -- your Report, which
08 is Appendix F to Exhibit 11529. If you could
09 turn to Page 5 of your Report.
10 A. Yes.
11 Q. There's a graphic on the page entitled
12 "Comparison of Calculated Max BSR Pressure,"
13 correct?
14 A. Above the table, yes.
15 Q. M-h'm. And within the table there, it
16 says "Calculation Method" and then one of those
17 methods is "Cameron," correct?
18 A. Correct.
19 Q. Okay. And you were asked questions by
20 Counsel for the United States about the
21 calculated shear pressure of 3,008 psi.
22 Do you recall those questions?
23 A. Yes.
24 Q. Okay. What is the source of the
25 Calculated Shear Pressure of -- of 3,008 psi that
00119:01 you have on Page 5 of your Report?
02 A. Originally cited in a -- the DNV document
03 as computed by the procedure in this 8702. It's
04 a calculated shear pressure.

Page 119:16 to 119:18

00119:16 Q. Did your Team verify that the calculated
17 maximum shear pressure using the Cameron shearing
18 formula was 3,008 psi?

Page 119:20 to 119:21

00119:20 A. I believe, at some point in time, we did,

which is why we used it as the validation model.

Page 121:19 to 122:08

Q. Good. If we could return to the Addendum to the Final Report, the April 30th, 2011, in Tab 4.
A. 531.
Q. 11531.
A. Okay. Which page?
Q. And if we could turn back to Page 12.
A. Page 12. Yes.
Q. Ms. Dempsey asked whether -- she asked that you did not have any reason to believe you had not used the updated BSR file, and you said "No."
Do you have any reason to believe that you did use the updated BSR file referred to on this page?

Page 122:10 to 122:17

A. Outside of the -- the date when it was updated, no.
Q. (By Ms. King) Do you know the date of the CAD file that you used?
A. No.
Q. Do you have any other identifying information for the CAD file that you used?
A. Not to my recollection.

Page 123:06 to 123:14

Q. (By Ms. King) All right. In response to questioning by Ms. Dempsey, you testified that your Team verified the max shear pressure formula that you reflected in your Report as 3,008 psi from the Cameron calculation. Is that correct, Dr. Richardson?
A. Yes, I think, at some point in time, we verified the number of 3,008, which is why we proceeded to use it as a validated form.

Page 123:19 to 124:13

Q. Can you walk me through, using the Cameron Engineering Bulletin 702 D, how you replicated that figure of 3,008 psi? This is in Tab 7, Exhibit 3185.
A. Tab 7. Again, as I've mentioned, I -- I don't fully recollect the verification by the Engineer, but I presume that the shear calculations were based on an empirical formula

from Cameron.
When we looked at the DNV Report, the DNV Report cited about four different high shear pressure values, and those shear pressure values were simply computed by dividing the shear force on the piston area for the particular BSR, and the cited number for Cameron referenced that it was computed based on one of the empirical formulas that they generated from tests.
Q. Which formula on Page 4 was used by your Team to validate the Cameron maximum shear pressure?

Page 124:15 to 125:17

A. Page 4 or Page 5. I presume probably the one on Page 5 -- or, it -- it could have been Page 4.
Q. (By Ms. King) Page 5 is simply an example applying both equations, isn't it --
A. Yes, yes --
Q. -- Dr. Richardson?
A. -- yes, yes, yes.
Q. And Page 4 provides the two possible --
A. The two --
Q. -- equations?
A. -- two possible equations, that's right.
Q. And so which of the two possible equations on Page 4 were used by your Team to validate the 3,008 psi from the Cameron calculation?
A. Again, I don't recollect directly, but I presume it's, based on the nature of the equation, probable Equation 1, maybe, probably Equation 1.
Q. How certain are you that it was Equation 1, Dr. Richardson?
A. The certainty would be based on -- I call into the equation the reference of the wellbore pressure, as in Equation 2, so I -- I -- I would suspect that we would have leave that out, since we don't have the direct wellbore pressure for the calculation.

Page 125:19 to 125:21

Q. (By Ms. King) And the top equation is to be used when there are no wellbore pressure effects, correct?

Page 125:24 to 127:08

A. From simple reading, it appears that way.
Q. (By Ms. King) How did you determine that

00126:01 there were no wellbore pressure effects existing
02 at the time of the shear?
03 A. That parameter didn't come into the scope
04 of the assessment, primarily because that
05 information was unknown to us at the point in
06 time we did the simulation.
07 Q. Did --
08 A. Presumably, there -- there was some
09 wellbore pressure.
10 Q. Did you request information about the
11 wellbore pressure for your use in validating the
12 Cameron calculation?
13 A. No.
14 Q. What was the source that your Team member
15 used for the minimum yield strength of the drill
16 pipe, as required by Equation 1, as an input
17 here?
18 A. Most likely, the API designation for the
19 particular drill pipe.
20 Q. But you're not sure where your Team
21 member --
22 A. No. I'm -- I'm absolute --
23 Q. -- found that information?
24 A. I'm absolutely certain that's probably
25 where he got that reference from.
00127:01 Q. And so did your Team member document his
02 or her validation of this Cameron calculation
03 using Equation 1 on Page 4?
04 A. We did not provide it in the Report, if
05 that's what you're asking.
06 Q. Did you provide any documentation of your
07 validation of that calculation that could have
08 been produced to us outside of your Report?

Page 127:17 to 128:08

00127:17 Q. (By Ms. King) My question would be: You
18 testified that you conducted an analysis to
19 validate the Cameron maximum shear pressure. Did
20 you provide -- did you produce any documentation?
21 A. Wait, wait. Hold up. We didn't do an
22 analysis to verify the 3,008. That's discretely
23 there. I think what we did was computed that
24 shear, shear value --
25 Q. M-h'm.
00128:01 A. -- from inferred shear force. Now, did
02 we provide that document in the Final Report?
03 No. It's just cited as referenced in the DNV
04 Report.
05 Q. And did you provide that document? Was
06 that produced to us outside of your Report, as
07 documentation, a "Considered" material supporting
08 your Report?

Page 128:11 to 128:20

00128:11 A. To my -- to my knowledge, no.
12 Q. (By Ms. King) Are you aware if anyone
13 wrote down the calculation that they did?
14 A. Yes, I think we did the calc pre the
15 validation.
16 Q. So documentation should exist somewhere
17 that one of your Team Members calculated the --
18 the shear pressure according to this Cameron
19 equation?
20 A. I would presume so, yeah.

Page 129:01 to 131:02

00129:01 Q. (By Ms. King) Turning to Page 10 of the
02 Cameron Engineering Bulletin --
03 A. Yes.
04 Q. -- I'm going to read from the fourth
05 paragraph, the third sentence: "EB 702 D has
06 been updated to incorporate a shear pressure
07 predicting formula that generates a shear
08 pressure value. This value is derived from the
09 maximum recorded shear force that Cameron has
10 experienced in a test environment for a given
11 drilling tubular size and material designation."
12 Did I read that correctly,
13 Dr. Richardson?
14 A. Yes.
15 Q. Were you aware that the Cameron formula
16 was based on the maximum recorded shear force
17 that Cameron had experienced in a test
18 environment?
19 A. I believe so. It's an empirical formula.
20 Q. It's an empirical formula. And above
21 this Cameron states that there is a significant
22 variance in shear pressure, indeed, they give an
23 example of a variance of up to 57 percent.
24 Were you aware that there was a
25 significant variance in shear pressure required
00130:01 to shear pipes in a blind shear ram,
02 Dr. Richardson?
03 A. Agai -- again, this is a dynamic event,
04 and it depends what's inferred as shearing the
05 pipe. Okay?
06 Q. M-h'm.
07 A. When the pipe -- when the blades engage
08 the pipe, the pipe has -- the -- the blades first
09 has to start cutting through the outer wall
10 thickness, and then it has to cut through the
11 first portion of the diameter of the pipe, until
12 it gets to the back end of the pipe, for this
13 particular geometry.
14 Okay? And during that dynamic event, the
15 shear force that's experienced by the blades do

vary.
So our computations was based on doing that transient shear force load. We took the max load in our FEA analysis.
Yes, there's variation as the blades move from one side through the thickness of the pipe, that's correct.
Q. But that's not what Cameron is talking about here, when it's talking about the maximum shear force that Cameron has experienced in a test environment for a given drilling tubular, is it?

Page 131:04 to 133:07

A. I'm -- I -- I -- I won't be -- I'm not sure exactly what is the basis for Cameron's comments.
Q. (By Ms. King) Okay. I'm going to read from the first paragraph, starting in the second sentence: "Drill pipe specifications allow for large potential variances in mechanical and dimensional properties. Consequently, there is a large variance in the shear force" required -- "requirement for given drill pipe specification. Variances in the material strength, ductility, and thickness have a significant impact on the required shear force. This bulletin has been updated to address this issue.
"Example: the required shearing pressure for 5 inch 19.5 ppf S135 grade pipe has been recorded to be as low as 2250 PSI and as high as 3540 PSI using the same BOP and operator configuration."
Did I read that correctly, Dr. Richardson?
A. Yep.
Q. So Cameron, here, is not talking about a variation in shear force over the course of shearing one pipe?
A. M-h'm.
Q. Isn't that right?
A. That's correct.
Q. Cameron is talking about you take a drill pipe meeting the API specifications, you put it inside of a blind shear ram, close the rams, it's going to require a maximum shear -- the maximum shearing pressure required to cut that pipe is going to vary. Isn't that correct?
A. The maximum shear pressure required to cut the pipe will vary primarily because, in the manufacture of the pipe, there's quite vari -- there could be variation in the thicknesses for that specific pipe. That is correct.
Q. Okay.

A. So the dimensions, as provided for a standard pipe, would be nominal dimensions, but there, of course, there are plus or minus variations in the thicknesses. You're correct.
Q. And because of these variations in the thickness or the pre -- the properties of the drill pipe, Cameron has recorded variable shear force requirements to shear a drill pipe meeting the same specification. Isn't that correct?
A. Based on what's referenced, correct.
Q. And so this Engineering Bulletin is designed to calculate the maximum shear force that Cameron has ever seen in a test environment. Isn't that correct, Dr. Richardson?

Page 133:09 to 133:13

A. I guess to the extent in time when this Report was written, yes.
Q. (By Ms. King) That's what this Engineering -- Engineering Bulletin says it does, isn't it?

Page 133:23 to 134:12

Q. "EB 702 D has been updated to incorporate a shear pressure predicting formula that generates a shear pressure value."
A. M-h'm.
Q. "This value is derived from the maximum recorded shear force that Cameron has experienced in a test environment for a given drilling tubular size and material designation."
Did I read that correctly, Dr. Richardson?
A. Yes.
Q. So this formula is designed to predict the maximum recorded shear force that Cameron has ever experienced in a test environment. Isn't that correct?

Page 134:15 to 134:22

A. It could be inferred, yes.
Q. (By Ms. King) And so you validated your model to this equation, which is not designed to calculate an average required shear force for an average drill pipe, but you validated your model, instead, to this equation, which is designed to calculate the maximum ever recorded shear force. Isn't that correct, Dr. Richardson?

Page 134:25 to 136:09

00134:25 A. That is not correct. Our model simply
00135:01 computes the total shear force that's on the BSR
02 blades during the cutting process. And the
03 resulting shear stress is inferred from the
04 cross-sectional area of the piston that's
05 charging that shear stress.
06 Now, what Cameron has done, and providing
07 within this document, and they provide a range to
08 cut a pipe that has variability and stiffness.
09 And for any material, there's always going to be
10 a three sigma scatter on the potential strength
11 of the material, stiffness of the material, the
12 thicknesses of the API spec. API might -- they
13 might classify a particular pipe as a certain
14 spec, but there's plus or minuses involved.
15 Okay?
16 Now, what Cameron has provided is the
17 range for the max shearing pressure for a
18 selected number of pipes. I won't know how much
19 pipes they have -- they've actually cut, but this
20 is the information they have to this point in
21 time.
22 Our numbers in the FEA model are based on
23 cutting through a nominal specification at the
24 API.
25 Now, in terms of validating that, our
00136:01 number, we directly point to a cited reference,
02 but that number to cut the pipe is clearly within
03 the range as specified by Cameron as the max
04 pressure to cut the pipe.
05 Q. (By Ms. King) Your number was, in fact,
06 above the Cameron-calculated maximum shear
07 pressure, was it not, Dr. Richardson?
08 A. And if -- if -- let -- let me
09 double-check.

Page 136:11 to 137:09

00136:11 It's 3105, and Cameron said 3540.
12 Q. Cameron said 3,008, according to your
13 calculation, correct?
14 A. That 3,008 is based on one unique value.
15 Q. Right. On Page 10 of 10, they're just
16 giving an example for a different spec of pipe.
17 A. M-h'm.
18 Q. That's not what they're giving as, you
19 know, their -- that's not what they're giving as
20 a number that would apply to your drill pipe.
21 Isn't that --
22 A. M-h'm.
23 Q. -- correct, Dr. Richardson? This example
24 is for a different kind of drill pipe. I'm
25 talking about you using the formula on Page 4 --
00137:01 A. M-h'm.

Q. -- applying the specifications for the DEEPWATER HORIZON drill pipe --
A. M-h'm.
Q. -- and reaching the answer of 3,008 psi.
Cameron has said that this equation is designed to calculate the maximum shear pressure, based on their test -- tests that they have run. Isn't that correct?

Page 137:11 to 137:18

A. Based on what's referenced in the document, yes.
Q. (By Ms. King) And the number that you found for shear pressure was, in fact, above what Cameron has described as the maximum shear pressure observed in a test environment. Isn't that correct?
A. 3 percent higher, correct.

I, **NIGEL RICHARDSON, PH.D.**, have read the foregoing deposition and hereby affix my signature that same is true and correct, except as noted on the attached Amendment Sheet.

Nigel Richardson

NIGEL RICHARDSON, PH.D.

THE STATE OF TEXAS)
COUNTY OF HARRIS)

Before me, _____, on this day personally appeared **NIGEL RICHARDSON, PH.D.**, known to me (or proved to me under oath or through _____) to be the person whose name is subscribed to the foregoing instrument and acknowledged to me that they executed the same for the purposes and consideration therein expressed.

Given under my hand and seal of office this _____ day of _____, 2013.

_____
NOTARY PUBLIC IN AND FOR
THE STATE OF _____
COMMISSION EXPIRES: _____

WITNESS NAME: Nigel Richardson

DATE TAKEN: July 10, 2013

IN RE: OIL SPILL BY THE OIL RIG "DEEPWATER HORIZON" IN THE GULF OF MEXICO, ON APRIL 20, 2010

GENERAL CORRECTIONS:

PAGE: 8	**LINE:** 3	**CHANGE:**	"lateral" to "large"
PAGE: 71	**LINE:** 3	**CHANGE:**	Delete "I"
PAGE: 96	**LINE:** 12	**CHANGE:**	"Be" to "being"
PAGE: 119	**LINE:** 3	**CHANGE:**	"8702" to "ED-702"
PAGE: 125	**LINE:** 8	**CHANGE:**	"probable" to "probably"
[redacted]			
PAGE:	**LINE:**	**CHANGE:**	
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SIGNED: Nigel Richardson DATE: 08/26/2013