

THE ALBERTA ENERGY REGULATOR

PROCEEDING ID NO. 430

IN THE MATTER OF the Responsible Energy Development Act, SA 2012, c R-17.3 and the Regulations and Rules made thereunder;

AND IN THE MATTER OF an Application to Amend Commercial Scheme Approval No. 11475 for the Kirby In Situ Oil Sands Project, KN08 and KN09 Development (Application No. 1936092)

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AER PROCEEDING

VOLUME 3

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Calgary, Alberta

February 8, 2024

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1 Proceedings taken at Govier Hall, Calgary, Alberta

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3 February 8, 2024 Morning Session

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5 Cindy Chiasson Panel Chair

6 Brian Zaitlin Panel Member

7 Meg Barker Panel Member

8

9 William McClary AER Legal Counsel

10 Shannon Peddlesden AER Legal Counsel

11 Andrew Lung AER Staff

12 Denise Parsons AER Staff

13 Anastasia Stanislavski AER Staff

14 Fahad Hamdan AER Staff

15 Maryam Rahimabadi AER Staff

16 Susan Harbidge AER Staff

17 Maksim Khaferllari AER Staff

18 Felix Chiang AER Staff

19 Scott Botterill AER Staff

20 Baohong Yang AER Staff

21 Elwyn Galloway AER Staff

22

23 J.P. Jamieson For Canadian Natural

24 Resources Limited

25

26

1 M. Riley For ISH Energy Ltd.

2 A. McLeod For ISH Energy Ltd.

3

4 S. Murphy, CSR(A) Official Court Reporter

5 S. Burns, CSR(A), RPR, CRR Official Court Reporter

6

7 (PROCEEDINGS COMMENCED AT 9:10 AM)

8 Opening Remarks

9 COMMISSIONER CHIASSON: Good morning, everyone.

10 Welcome back to Day 3 of our proceeding.

11 Mr. Lung, a question before we start: The room  
12 seems rather dark, but if I remember correctly, I think  
13 I was told that we need to have the shades down because  
14 it affects the quality of the video cast. Yes. Okay.  
15 No. That's fine. We will -- we will manage. I will  
16 get used to it. It just -- I think it's probably  
17 because it's foggy and that outside, but it seems a  
18 little -- a little dreary today, but welcome back. Let  
19 me just find my notes.

20 So the reminder, again, as every morning, is that  
21 we are video cast, and so that anyone who is in the  
22 room may be seen on the video cast. If you have  
23 concerns, please make them known to Mr. Lung.

24 I would just also remind, because we have a new  
25 set of witnesses here, is just the reminder about using  
26 the microphones, so -- that you can move them around,

1 pull them closer to you, get the mic close to you. Use  
2 your best, nicely projecting voice, and it will all be  
3 good that way. We'll let you know if we're having  
4 problems hearing.

5 And I believe that we need -- that we have some  
6 potential new material in that we need to address? So,  
7 Ms. Riley, why don't you tell us about that, please.

8 Discussion

9 M. RILEY: Certainly. Good morning.

10 COMMISSIONER CHIASSON: Good morning.

11 M. RILEY: Give me one moment while I do  
12 this.

13 COMMISSIONER CHIASSON: Thank you.

14 M. RILEY: Does that work? It sounds  
15 like it works.

16 COMMISSIONER CHIASSON: That's fantastic. You're  
17 coming through beautifully.

18 M. RILEY: Wonderful. This morning we  
19 had sent updates or a record correction to two of the  
20 CVs that we have filed, one for Dr. Chalaturnyk and one  
21 for Mr. Barrie. I have spoken to Ms. Jamieson about  
22 it. As I understand it, they do not have any  
23 objections to this record correction being filed at  
24 this time. If that is still the case -- and she nods,  
25 so I believe that is still the case -- I would just ask  
26 that that record correction be filed.

1 COMMISSIONER CHIASSON: Thank you.

2 Thank you for the agreement on that.

3 So, Mr. Lung, we'll -- as it's corrections, does  
4 it just go in as the same document number or new  
5 document numbers on that?

6 W. MCCLARY: Yeah. We've got them as new  
7 documents. So the CV updated of Dr. Chalaturnyk is  
8 Exhibit 061.001, and the updated CV for Mr. Barrie is  
9 061.002.

10 EXHIBIT 061.001 - Updated curriculum vitae  
11 for Rick Chalaturnyk

12 EXHIBIT 061.002 - Updated curriculum vitae  
13 for Brad Barrie

14 COMMISSIONER CHIASSON: Thank you, Mr. McClary.

15 All right. And I see that we have -- it looks  
16 like an addition to our hearing in terms of an easel  
17 flip chart here. That -- and I'm assuming that's part  
18 of what -- that ISH will be making use of that, the  
19 witnesses will be?

20 M. RILEY: Only in the event that it is  
21 necessary, yeah. We do hope that the Panel can see it,  
22 and we propose that after the Panel has seen it that we  
23 turn it around so that everyone else can just also have  
24 a look.

25 COMMISSIONER CHIASSON: Okay. And are there any  
26 thoughts, then, in relation to or suggestions with

1 relation to being able to capture it for the record,  
2 then?

3 M. RILEY: I believe we have discussed it  
4 with Mr. Lung, and he -- well, the suggestion is that  
5 we photograph it and it be uploaded as we go along.

6 COMMISSIONER CHIASSON: Okay. Any concerns,  
7 Ms. Jamieson?

8 J. JAMIESON: It's unconventional, but we're  
9 willing to give it a try.

10 COMMISSIONER CHIASSON: All right. Thank you. We  
11 appreciate your willingness to -- to try that.

12 All right. That being said, we may as well start  
13 off with ISH's direct evidence. The court reporters  
14 will deal with swearing or affirming the witnesses, and  
15 then we'll proceed from there. Right now we are  
16 looking to target around 10:45 for a break, but please  
17 let us know when it -- when it suits in the flow of  
18 your evidence. Okay. Let's proceed.

19 MARTIN FOWLER, BRAD BARRIE, AURELIE LAGISQUET, RICK  
20 CHALATURNYK, JOHN CHODZICKI, Sworn  
21 KRISTOFFER VICKERMAN, Affirmed

22 M. RILEY: With that done, I will  
23 commence with some opening marks and then turn it over  
24 to our witness panel.

25 ISH Energy has been an oil and gas producer in  
26 Alberta, Saskatchewan, and British Columbia for over



1 30 years. ISH is proud to work in Alberta's oil and  
2 gas sector and to employ highly skilled workers in a  
3 sector that is so vital to Alberta's economy.

4 ISH's core values are integrity, long-term  
5 performance, humility, agility, and sharing knowledge.  
6 We believe that ISH is the last non-SAGD operator that  
7 still owns gas rights in the gas over bitumen or "GOB  
8 zone". That is, in part, what makes this SAGD  
9 development application unique. Subject to the  
10 statutory requirement not to develop and operate in a  
11 manner that will result in waste, other SAGD operators  
12 need not concern themselves with adversely impacting  
13 their vertical neighbours.

14 Because ISH is not a SAGD developer, ISH  
15 instructed its legal counsel to retain various external  
16 experts to speak to the questions this hearing seeks to  
17 answer. The difficulty, of course, was to provide the  
18 external experts with the data required to underline  
19 the expert opinion. Through CNRL's application and  
20 evidence, we have come across a great number of  
21 conclusions and opinions but very little actual  
22 underlying data.

23 CNRL made it clear that the approval they request  
24 through this application is strictly limited to the  
25 production of McMurray bitumen and does not include  
26 Wabiskaw bitumen zones. We have a record extending

1 over thousands of pages, but every time we have  
2 received actual verifiable data, it was because either  
3 ISH or the AER requested it. As will be more fully  
4 dealt with in evidence, when data was provided -- and  
5 despite the fact that CNRL had it in a format that  
6 would allow ISH and the AER simply to verify their  
7 conclusions, CNRL in many instances provided data in  
8 the least accessible manner possible. This obstructive  
9 approach, together with a strange reluctance to agree  
10 to reasonable steps to ascertain fundamental in situ  
11 conditions and reasonable monitoring routinely  
12 undertaken by CNRL's peers throughout the lifetime of a  
13 SAGD development, has resulted in this hearing. It was  
14 only after the fourth round of SIRs by the AER and  
15 after ISH had already filed its evidence that the bulk  
16 of the information regarding static and dynamic FMI,  
17 geomechanics, and, frankly, any actionable information  
18 regarding monitoring has become available.

19 COMMISSIONER CHIASSON: Ms. Jamieson.

20 J. JAMIESON: Excuse me. I hate to  
21 interrupt, Commissioner Chiasson, but what Ms. Riley is  
22 presenting sounds a lot like final argument, and I  
23 would have thought those comments would be made  
24 tomorrow when we get there, but I leave it to you.  
25 Just the tone of it sounds like argument to me. Thank  
26 you.

1 M. RILEY: I will move on to what we're  
2 going to do next.

3 COMMISSIONER CHIASSON: Thank you.

4 M. RILEY: That was my next remark.

5 We have taken heed of the Panel's suggestion to  
6 focus our evidence on areas of disagreement, and given  
7 the time constraints, we will attempt to not repeat  
8 evidence already on the record. Instead, we will focus  
9 our evidence on the issues or part of issues not yet  
10 canvassed in full. The fact that we will not be  
11 repeating our written evidence does not mean that ISH  
12 is no longer relying on it and has not abandoned any  
13 part of it.

14 ISH's panel will commence its direct evidence by  
15 discussing its geologic interpretation, followed by  
16 some conclusions from its GCMS interpretation, and will  
17 very often turn to its FMI analysis.

18 ISH's panel will then turn to the issue that was  
19 initially described as the "coinjection issue", but  
20 there seems to be agreement between the parties that  
21 solvent "assisted start-up" is a more accurate  
22 description. We will then move on to the risk analysis  
23 and the economics underlying the risk analysis.

24 Finally, ISH will address the geomechanical work  
25 that was done after ISH had filed its evidence. We do  
26 not plan to present further evidence on Hearing Issue 5

1 because we believe that was covered sufficiently  
2 yesterday. ISH's panel is, however, available should  
3 there be any questions on that issue.

4 We will further introduce our Panel Members as we  
5 move through the evidence because we believe that it's  
6 more useful to have that information fresh in mind when  
7 we speak about the evidence that is being presented.

8 With that in mind, we will then proceed with  
9 Mr. Barrie.

10 COMMISSIONER CHIASSON: So, Ms. Riley, just -- and  
11 this is something I should have brought up at the start  
12 of the hearing, and I apologize for not doing it  
13 sooner, is just -- because we recognize we've got a lot  
14 of material and the rest of it here, is that just to  
15 make you and your witnesses aware, we have got all the  
16 CVs on the record, including the updated. We have  
17 looked at them, so it's not necessarily necessary to go  
18 through their backgrounds in detail. That being said,  
19 please highlight for us what you -- what you feel is  
20 important for us to know about their -- their  
21 background and experience, but just -- we don't -- we  
22 don't need a chapter and verse.

23 M. RILEY: Thank you. We did not plan to  
24 do that --

25 COMMISSIONER CHIASSON: Okay. Thanks.

26 M. RILEY: -- because we took heed of the

1 advice at the beginning of the hearing.

2 COMMISSIONER CHIASSON: Lovely. Thank you.

3 Direct Evidence of ISH Energy Ltd. Witness Panel

4 Q M. RILEY: Mr. Barrie, please tell the  
5 Panel what your position with ISH is?

6 A B. BARRIE: I am senior staff geologist.

7 Q Please confirm that your curriculum vitae is filed on  
8 the record in Exhibit 061.02?

9 A I confirm.

10 Q Please confirm that your CV sets out your professional  
11 qualifications accurately, was prepared under your  
12 direction and control?

13 A I confirm.

14 Q You have had the opportunity to review CNRL's responses  
15 to your geological interpretation. Please provide the  
16 Panel with your comments.

17 A Okay. I'd like to take this time, approximately  
18 45 minutes, to give you a geological presentation.

19 Before I get started, I wonder if there's somebody  
20 with technical support that can get my monitor going  
21 for me. It seemed to have cut out. Or we can switch.  
22 Oh, okay. So that one doesn't work. Okay.

23 Excuse me. I will need a minute here to switch.

24 W. MCCLARY: Just so everyone is aware, the  
25 configuration for the witnesses, the right-hand monitor  
26 will be the screen, and the left-hand monitor is

1 available for other machines to be plug into, if  
2 necessary.

3 A B. BARRIE: So if I want to view the  
4 monitor, I'd look at this one?

5 W. MCCLARY: Correct. Not the right --  
6 your right-hand side there.

7 A B. BARRIE: Okay. Good morning,  
8 Commissioner Chiasson, Commissioner Zaitlin, and  
9 Commissioner Barker, Mr. Lung, and other participants.

10 I would like to begin with a -- Exhibit 50.002,  
11 paragraph 27, PDF page 10, please. In the middle of  
12 the screen, I'm going to address paragraph 27 in which  
13 CNRL states that they: (as read)

14 Consider the confinement strata to provide  
15 effective containment of Canadian Natural  
16 SAGD operation in the McMurray formation.  
17 They go on to say that there are six correlatable  
18 units, and they describe those units as having:  
19 (as read)

20 ... a high volume of shale, low vertical  
21 permeability, and being geomechanically  
22 competent.

23 So I would like to respond to each of those statements  
24 regarding the high volume of shale.

25 We estimate the volume of shale in the so-called  
26 "confining strata" to be approximately 35 percent. In

1 other words, 65 percent of the material in the  
2 confining strata is sand, porous and permeable sand.  
3 This volume of shale, the 35 percent, is much lower  
4 than at most other SAGD developments where the volume  
5 of shale is typically 60 to 80 percent. Regarding the  
6 low vertical permeability, as I'll show in a few  
7 moments, the confinement strata consists generally of  
8 massive to bioturbated sandstones with moderate  
9 permeability with some thin bioturbated and thus  
10 permeable sandy mudstone beds.

11 Many of these sands also have excellent horizontal  
12 permeability that will allow SAGD reaction products to  
13 migrate freely in the reservoir and the confinement  
14 strata.

15 Regarding the comment about being geomechanically  
16 competent, the so-called "confinement strata" by CNRL  
17 has been fractured by a geological process called  
18 "differential compaction" that has rendered the rock  
19 weak and incompetent. Of the six so-called confining  
20 strata, it is my opinion that only two would be  
21 barriers, the marine A2 mudstone and the mid-B1  
22 mudstone. However, the evidence shows that those two  
23 units are absent over the majority of KN08 and 09. The  
24 evidence shows that the four remaining so-called  
25 "confinement strata" have a high percentage of  
26 permeable sand that has been fractured by the process

1 of differential compaction. I will now describe those  
2 four units in a little bit more detail.

3 Could you please go to Exhibit 32.02, PDF page 12,  
4 and Figure 2? Thank you.

5 So I'm going to start with the highest unit, which  
6 is the Wabiskaw C shown here in the middle of the  
7 screen. To orient you on the photographs -- and, by  
8 the way, is there a mouse I could use to point out  
9 things, please?

10 W. MCCLARY: And just as a reminder for  
11 everyone on the witness panel, if you're using a mouse  
12 to identify portions of the presentations that's on the  
13 screen, please indicate for the record -- for the  
14 transcript what you're gesturing towards as well so  
15 that we can capture that for posterity, because as  
16 we've said before, the transcript is the only record of  
17 the proceeding that we have available. Thanks.

18 A B. BARRIE: Okay. So --

19 COMMISSIONER CHIASSON: Ms. Wheaton, could we have the  
20 photo portion made a little larger, please. Thank you.

21 A B. BARRIE: Okay. So to orient us on this  
22 and future photographs provided by CNRL, I will point  
23 out that the bottom of this core is in the lower right  
24 side of the two photographs, which I'm using to show  
25 with my mouse, and the top of the unit is in the upper  
26 left of these two photographs. The labels that you'll



1 see here in red are CNRL's.

2 So CNRL describes this unit as a argillaceous  
3 heterolithic mudstone and sandstone succession that is  
4 heavily bioturbated.

5 As can be seen in Figure 2 here, the image that  
6 I'm pointing to, the vertical permeability created by  
7 burrows is quite high, and I'm pointing now to this  
8 brown oil-stained sand-filled burrow extending  
9 vertically up through the rock.

10 So it's up this higher permeability created by  
11 these vertical burrows that we're concerned will allow  
12 reaction products from any SAGD operations to  
13 eventually breach into our Wabiskaw B gas zone.

14 Could I now please have Exhibit 32.02, PDF  
15 page 13, Figure 3. Thank you.

16 Can you scroll up just a little bit, please, so I  
17 can see the text just above Figure 3. Okay. So, yeah,  
18 if you -- sorry. You'll need to go to the preceding  
19 page just momentarily, and we'll come back to this.

20 So right there at 32, CNRL describes this stratum,  
21 the Basal Wabiskaw D heterolithic unit as having high  
22 mud content and wavy centimetre to decimetre thick beds  
23 containing 50 percent volume shale and a mappable  
24 calcite cemented layer. So now please if you could  
25 scroll to the next page. Thank you.

26 I would like to point out again the bottom right

1 is -- of the core is on the lower right here, so  
2 depositionally this is the bottom, and then we move up.  
3 The dark brown-coloured portions of this core are the  
4 porous permeable oil-stained, bitumen-stained  
5 sandstone. So you can see immediately that there is a  
6 lot of excellent quality sandstone throughout this  
7 interval.

8 The calcite layer described by CNRL as "mappable",  
9 in my opinion, is a concretion essentially shaped like  
10 a ball no more than 2 to 3 metres in diameter. It is  
11 not a widespread layer across the region and is,  
12 therefore, not a barrier.

13 Yesterday, Mr. Lavigne describes these rocks as  
14 tidal. He said that they were deposited in an estuary  
15 affected by tides. He showed sand dunes created by  
16 tidal current and that the lows between these sand  
17 dunes contained muds which compact over time.

18 So if you could've looked at the sea floor at the  
19 time that this was being deposited, you would have seen  
20 a series of sand dunes punctuated by low areas  
21 containing some mud. So the muds here are not  
22 continuous. They are not a continuous barrier.

23 COMMISSIONER CHIASSON: Excuse me, Mr. Barrie. As I  
24 think I mentioned the other day, I'm not a geologist.  
25 Would you mind just pointing out on the photograph, for  
26 my benefit, where you're saying there's the concretion?

1 A B. BARRIE: Okay. You've asked a good  
2 question. It's not on this photograph, so --  
3 COMMISSIONER CHIASSON: Okay. Thank you.

4 A B. BARRIE: I wasn't prepared to talk  
5 about it, but I can -- I can address --  
6 COMMISSIONER CHIASSON: No. It's just --

7 A B. BARRIE: It is a diagenetic -- okay.  
8 So in sort of non-geological terms, after these rocks  
9 were deposited, there were chemical changes within the  
10 reservoir that resulted in changes to the --  
11 essentially some of the pores were filled up with  
12 calcite that plugged the pores reducing the porosity  
13 and permeability.

14 COMMISSIONER CHIASSON: Oh --

15 A B. BARRIE: But these -- oh, sorry.

16 COMMISSIONER CHIASSON: Sorry. I do understand the  
17 concept. It's just I wasn't --

18 A B. BARRIE: Okay.

19 COMMISSIONER CHIASSON: I wasn't sure where it might  
20 be visible on -- on this photo.

21 A B. BARRIE: Right. It's not here. I'm  
22 sorry.

23 COMMISSIONER CHIASSON: Okay. Thank you. No. I  
24 appreciate that. Thank you.

25 A B. BARRIE: Okay. So we'll go to the next  
26 slide, please, which is going to be exhibit -- I think

1 it's just Exhibit 32.02, PDF page 13, Figure 4. Right.  
2 So if we could stop a little bit above that, please, so  
3 I can see the text. There we go. Thank you.

4 So this is the Wabiskaw D non-reservoir unit,  
5 which CNRL describes as having bioturbation, wavy mud  
6 beds deposited also in a tidal bar setting. So the  
7 geological environment here is very similar to what I  
8 described. You can see again in the photograph the  
9 high percentage of sand and then the abundant  
10 burrowing. So a lot of this rock has been churned up  
11 and broken creating potential vertical pathways for  
12 SAGD reaction products.

13 Could I have, please, Exhibit 32.02, PDF page 16,  
14 and it would be Figure 8. So this is the last of the  
15 four so-called confinement strata that I wanted to  
16 describe. Based on CNRL's description, they describe  
17 this as heterolithic strata. It's mudstone pruned  
18 inclined heterolithic strata. In other words, "IHS" is  
19 the acronym for that.

20 This unit shown here can be made of very porous  
21 permeable sand or of argillaceous muddy sandstones like  
22 shown here. Since these units were deposited in a  
23 non-marine environment, the muddy sandstones are not  
24 continuous and thus do not provide a barrier on a  
25 regional basis. In other words, the muddy sandstones  
26 have a limited extent.

1           In summary of this portion, there are no marine  
2           mudstone barriers over KN08 and 09 according to the  
3           evidence shown. The remaining rocks between the top of  
4           the SAGD chamber and our Wabiskaw gas are made up  
5           mostly of sand with porosity and permeability. Many of  
6           these rocks have been heavily bioturbated, which has  
7           enhanced their vertical permeability.

8           If I could now please have you pull up  
9           Exhibit 32.03, PDF --

10    Q    M. RILEY:                    Mr. Barrie, I apologize, but  
11           can you go a little bit slower, please.

12    A    B. BARRIE:                  Absolutely.

13           Could I have somebody please pull up  
14           Exhibit 32.03, PDF page 26, Figure 20. Thank you.

15           My model is that gas was generated in the McMurray  
16           as a byproduct of degradation of oil there into bitumen  
17           and has migrated up a network of open fractures created  
18           by differential compaction. The map on the left is  
19           provided by CNRL of SAGD pay in the McMurray. On the  
20           right is gas pay in the Wabiskaw B, again provided by  
21           CNRL.

22           So I wanted to point out here on the SAGD pay map  
23           these brown-coloured ellipses which highlight the  
24           thicker portions of the Wabiskaw -- or of the McMurray  
25           oil sand deposit -- so I'm pointing to these brown  
26           ellipses -- and I noticed early on that there's a

1 direct correlation to the thick gas pay in the Wabiskaw  
2 B.

3 So I said that I felt that the direct correlation  
4 between gas and the Wabiskaw B and the McMurray proved  
5 my point. CNRL rejected the model saying that gas is  
6 where it is in the Wabiskaw B because it's on a closed  
7 structural high. So my response was to point out an  
8 area to the northeast of the two pads where there is a  
9 closed high on the Wabiskaw B seismic structure map,  
10 which I'm not showing today, and I said that there's no  
11 gas there because there's no bitumen pay there.

12 Could we now please pull up Exhibit 32.03, page --  
13 PDF page 25.

14 So the record shows that CNRL has submitted  
15 various versions of the Wabiskaw B gas pay maps. In  
16 this submission from December of 2021, which is the  
17 same as on the previous slide, you can see I've plotted  
18 on here the area where there's no gas in the  
19 Wabiskaw B, and in the previous map, I showed there was  
20 no bitumen pay there either.

21 Could you please pull up Exhibit 22.02, PDF  
22 page 5. So this is another version of the same zone.  
23 They've mapped the Wabiskaw B net gas pay here from  
24 November 2023 -- so a few years later -- and what isn't  
25 shown on this map is the -- but I'll use my mouse to  
26 point out -- first of all, you can see there's a large

1 area of gas over in this area that they've mapped, and  
2 there's a large area to the northeast of all of the  
3 pools here up in Section 9 where there is some gas pay  
4 mapped, but closer than that near to the area in  
5 Section 12 is the area that I had my black circle on  
6 showing no gas pay.

7 Could I now have, please, Exhibit 50.003.

8 W. MCCLARY: Mr. Barrie, if I could just  
9 remind you, please, to indicate for the record where  
10 you're placing your cursor on these figures and maps.  
11 It will be helpful --

12 A B. BARRIE: Okay.

13 W. MCCLARY: -- for the record here.  
14 Thanks.

15 A B. BARRIE: Okay. For sure. Would you  
16 prefer me to say, like, sections and townships and  
17 ranges and so on, or ...

18 W. MCCLARY: To the extent possible --

19 A B. BARRIE: Sure.

20 W. MCCLARY: -- if you could use a visual  
21 cue on the figure to identify -- that is easily  
22 identified on review later. We can use that in the  
23 transcript and then pinpoint what you're talking about.

24 A B. BARRIE: Okay.

25 W. MCCLARY: Because recall we'll just have  
26 a written version of this --

1 A B. BARRIE: Okay.

2 W. MCCLARY: -- if we're ever looking at it  
3 in the future. Thanks.

4 A B. BARRIE: Okay. I will do my best  
5 there. Thank you.

6 So I requested --

7 S. PEDDLESSEN: Dr. Fowler [sic], would you  
8 mind reviewing the previous exhibit again.

9 COMMISSIONER CHIASSON: Do you mean Mr. Barrie?

10 S. PEDDLESSEN: Oh, pardon me.

11 A B. BARRIE: We have to switch, yes, our  
12 name tags.

13 S. PEDDLESSEN: Just that previous exhibit --

14 A B. BARRIE: Sure.

15 S. PEDDLESSEN: -- if you could use the  
16 pointer --

17 A B. BARRIE: Sure.

18 S. PEDDLESSEN: -- and identify the location.

19 A B. BARRIE: Sure.

20 S. PEDDLESSEN: Appreciate it. Thanks.

21 A B. BARRIE: Let's go back to --

22 THE COURT REPORTER: Sorry. Sorry. You are  
23 interrupting, and I can't get the full sentence. It  
24 helps if I can get the full sentence and answer on the  
25 record, please.

26 A B. BARRIE: Okay. Okay. So I'm not sure



1    how much you want me to point out, but I will start  
2    with the important thing is the -- there's a large area  
3    to the southwest of the gas pool mapped in the  
4    Wabiskaw B shown in the very southwest corner of this  
5    map near the number "33" that has some gas pay mapped,  
6    and then up towards the northeast side of the map in an  
7    area where you can see the Number 9, there's some gas  
8    pay mapped. But near the number "12", much closer to  
9    the KN08 and 09 pads, is an area that I indicated had a  
10   large closed structural high with no gas.

11            Could we pull up now, please, Exhibit 50.003, PDF  
12   page 64. So over the two years that I've been working  
13   on this project, I've just shown you CNRL's mapping had  
14   stayed pretty much the same showing an area where there  
15   was no gas immediately to the northeast of the large  
16   gas pool mapped over the two pads, 08 and 09, and this  
17   is their most recent map after I raised these issues  
18   from January -- this map is from January 23rd of 2024,  
19   and you can see now CNRL has annotated in dashed orange  
20   the black feature that I had been referring to before,  
21   and they now have a gas pool mapped here.

22            When I was in the audience yesterday, I heard them  
23   say that they never mapped this area because it was  
24   isolated from the Upper II pool. However, in my  
25   opinion, it can be observed that the two could be  
26   easily connected. If you look at the area between the

1 purple-dashed line and the orange-dashed line, there's  
2 no wells here to suggest that there should be a zero  
3 value here. These -- these could easily be mapped as  
4 one pool.

5 Okay. Next slide, please, which will be  
6 Exhibit 50.003, and this would be page PDF 50. Okay.  
7 So now I'm going to change to a different topic, which  
8 is the distribution of the mid-B1 mudstone.

9 The map in the centre of the display is an isopach  
10 map provided by CNRL of the mid-B1 mudstone. I had  
11 provided mapping earlier which showed a large area  
12 where the mid-B1 mudstone is absent, and I indicated  
13 that, and they have transposed that area onto this map.  
14 It's the area within the two blue solid lines.

15 So just to be clear, the white area on the north  
16 side of this map that I'm pointing to is an area that  
17 CNRL has -- and ISH agree completely that there's no  
18 bid -- no mid-B1 mudstone present here. We disagree in  
19 how far southwest of that area that the mid-B1 mudstone  
20 is absent or present. So I'm going to try to address  
21 that by talking to some of these slides that CNRL have  
22 provided.

23 I'd like to start by pointing out there's a few  
24 areas where we simply have no well control, and that  
25 would be where my cursor is now, which is -- I would  
26 say if the court reporter can -- it's 600 metres south

1 of where CNRL has mapped their zero at. So there's an  
2 area here where there's absolutely no well control. So  
3 there's no way of knowing in this area if there is  
4 mid-B1 mudstone present like they've mapped.

5 Similarly, at the very far southwest side of this  
6 blue area that I'm pointing to -- so the very -- it  
7 looks like the toe of a boot, so to speak, there's a  
8 well here that was cored by CNRL in which they indicate  
9 that the mid-B1 mudstone was missing from core. So  
10 that's another area where there's no basis for the  
11 mapping that they provided here.

12 Now I wanted to point out a couple of things. The  
13 first one I will do is show you where we completely  
14 agree on the presence of the mid-B1 mudstone. And to  
15 do that, I might just have you zoom in on the area  
16 of -- of the 1AA/11-2, please. It's on the far right  
17 side in the middle of the screen. Yes. You're getting  
18 closer there. Thank you.

19 Okay. It's coming into view. If you could just  
20 scroll a bit more to the right, please. Thank you.

21 So in this photograph provided by CNRL at this  
22 Well 1AA/11-2, you can see the red labelling that says  
23 "mid-B1 mudstone". And ISH -- I essentially agree with  
24 this. When it's present, the mid-B1 mudstone is  
25 characterized by medium to dark grey shale. There is  
26 some -- as CNRL pointed out and we agree, there is some

1 bioturbation in that interval as well, and it's -- it's  
2 present.

3 And so now if we could zoom out a little bit  
4 and -- or just go to the bottom of this page in the  
5 centre, and this is bringing me to a key and early  
6 discrepancy that I pointed out between my  
7 interpretation and that of CNRL, and that is regarding  
8 this well, which is the 100/1-3 well, which, again, is  
9 labelled here by CNRL as the mid-B1 mudstone.

10 I pointed out early in our -- in my submissions  
11 that this is not a mudstone. This is 60 percent porous  
12 permeable oil-stained sand and then 40 percent of fine  
13 grained argillaceous also somewhat lightly oil-stained  
14 sand. What you will see in the coming slides is how  
15 CNRL has now completely changed their interpretation.  
16 They now interpret this as a tidal channel.

17 So before we leave this map, I would like you to  
18 please zoom out a little bit, and I would like to talk  
19 to two more wells that are important to me, and that  
20 would be in the very upper right of the -- of the  
21 screen, please. There we go. Thank you.

22 If you can zoom in to the mid -- to the -- yeah,  
23 the core in the very upper right of the screen, the  
24 11-2 well, to where you can read their label of mid-B1  
25 mudstone, please.

26 So, you know -- and in the interest of time, I'm

1 going to go quickly through this, but when you look at  
2 what they have labelled here as mid-B1 mudstone, this  
3 is clearly not a distal or an offshore marine mudstone.  
4 This looks like, to me -- like I'll show in a minute --  
5 a continuation of the tidal flat environment which  
6 exists below and above this unit. This is not a unique  
7 unit at all. And in the interest of time, I'm going to  
8 skip the next thing I was going to talk about. It's  
9 just a similar example as that.

10 What I'd like to do now is to go to Exhibit 32.03,  
11 please, PDF page 7 and Figure 5. So this is a  
12 photograph, again, of a comparison between the mid-B1  
13 mudstone, when it's present -- is shown here from the  
14 1AA/1-1 well. It's a very -- like I said earlier, a  
15 medium grey mudstone, and then the well I mentioned  
16 earlier, the 1-3 well here, this is the interval where  
17 CNRL labelled this as mid-B1 mudstone.

18 And, incidentally, I should point out that all the  
19 bedding -- or the inclination that you see to the  
20 bedding here might appear sedimentary, but this is  
21 simply because the well is drilled directionally. So  
22 it's all an artifact of the way that the well was  
23 drilled and not reflecting sedimentary structures and  
24 the such.

25 Scroll up a little bit on that page and perhaps up  
26 a little more to the page before. Thank you very much.

1           So I'm now talking to this exhibit, and I'd like  
2 to start by mentioning that CNRL describes this rock  
3 here as the "lower B1", and we agree. And they  
4 describe this as a "tidal flat", not marine, and we  
5 agree with this as well. Our opinion, this is the same  
6 tidal flat sequence as below and above.

7           If you could please scroll down just a little bit,  
8 please.

9           What I've done in this photograph is I removed the  
10 red lines which CNRL had put on the photograph to help  
11 make the point that this is one, in my opinion,  
12 continuous rock type within a tidal flat sequence.

13           So now what I'd like to do is go into a bit more  
14 regarding CNRL's change of their description -- or  
15 their interpretation of the -- of the rock that you've  
16 just seen. So if we could go, please, to  
17 Exhibit 50.003, and this would be PDF page 52. Thank  
18 you.

19           If you could maybe zoom out on this one a little  
20 bit, please, so we can see more of the graph. Yeah.  
21 That's good. That's perfect right there. Thank you.

22           So, again, all of the annotations on this tab are  
23 CNRL's in red, and they've indicated here what they  
24 call a -- now "upper B1 tidal channel", and they've  
25 made some references that are circled in ellipses down  
26 here in the two photographs below. And it's to those

1 two that I would like to talk in a little bit more  
2 detail. But before I do, I just wanted to remind  
3 everybody that's listening that this inclination to the  
4 bedding is not geological. It's not depositional.  
5 It's just an artifact of the fact that the well was  
6 drilled directionally.

7 So now, if I could please get somebody to zoom in,  
8 please, on the same page, but it's going to be the  
9 below -- if you could zoom in to the large ellipse at  
10 the bottom of the page. Thank you. Yeah. And if you  
11 can zoom in more on that ellipse, please, and maybe one  
12 more time if you wouldn't mind, please and thank you.

13 Okay. So, again, this is the photograph I just  
14 showed you a minute ago of what CNRL originally called  
15 the "mid-B1 mudstone". I challenge this indicating  
16 that it's a coarse grained sand, but it can be observed  
17 that these are flat line tidal deposits of the B1.  
18 There is no mid-B1 mudstone to separate here the upper  
19 B1 and the lower B1. These are not IHS beds within a  
20 channel. These are flat-lying deposits.

21 In my opinion, this unit has none of the features  
22 of a tidal channel deposit such as a sharp erosive base  
23 with lag. It does not contain ebb and flood tidal  
24 bundles, such as cross-bedding, ripple marks, et  
25 cetera, but it has all of the features of a tidal  
26 channel deposit -- sorry -- tidal flat deposit.

1           If we could now -- on the same view, there's a  
2 circle just to the left of the ellipse here that I  
3 would like you to zoom in on that one a little bit  
4 more, please. On the same -- no, just where you were,  
5 but just a left -- here, I will use my mouse, and I'll  
6 point to it. Here we go. So I'm trying to get you to  
7 zoom in on that feature there, please.

8           And then I'll talk to that for a second, and then  
9 a second later, I'm going to get you to zoom in a bit  
10 more, please.

11           But, again, CNRL has identified this in red as a  
12 "tidal channel base small breccia", but, in my opinion,  
13 this is not a clast. It is simply bioturbated sand.  
14 And if we could zoom in quite closely now to that  
15 feature that you've zoomed in on, that circle there,  
16 please zoom as -- as -- almost so that the whole circle  
17 fills the screen, please, if you could. Thank you.  
18 And maybe a couple more times right into that.

19           So what I wanted to point out here was that --  
20 yeah, and maybe even one more time, if you wouldn't  
21 mind -- that when we look at this, again, the bedding  
22 here is -- it's not inclined. This, where I'm drawing  
23 my mouse at the top of the grey-coloured rock, is  
24 inclined in this photograph, but it's flat when it was  
25 deposited. And I interpret this dark brown oil sand to  
26 be a burrow of some kind, perhaps an escape burrow.



1 But the real reason I wanted to draw your attention to  
2 this photograph was to look at this feature, what CNRL  
3 has identified as a "clast". And you can notice that  
4 on the edges of this so-called "clast", there are quite  
5 sharp irregular, I presume, argillaceous sandy wisps,  
6 if you will, or protrusions sticking out into the --  
7 into the homogenous sand body here, and there's another  
8 one up in this area. A very delicate lithology  
9 sticking out, and, in my opinion, there's no way this  
10 has been subject to any kind of erosion, otherwise  
11 these would have broken off. So, to me, this is an  
12 in -- in-place rock. It's not a clast, so it's not an  
13 indication of the bottom of a channel.

14 Now, this is where I was going to -- because I  
15 like to -- instead of talking I like to draw, but I  
16 think I'm going to try to just speak through this,  
17 but -- rather than using the flowchart -- and that is  
18 to say that my work has shown that the mid-B1 mudstone  
19 is absent over most of these two pads, and I have two  
20 potential models to account for that. One of them is  
21 that the McMurray channel underlying this area, as I  
22 mentioned earlier, has created some differential  
23 compaction that allowed for slightly more accommodation  
24 space on the flanks of the channel, and so on the  
25 flanks of the channel, we have a distinct lower B1  
26 tidal flat deposit, which is punctuated by an incursion

1 of the marine mid-B1 mudstone, and then normal tidal  
2 flat deposition resumed in the upper B1 tidal flat.

3 So on the area surrounding the underlying McMurray  
4 channel, we have a bit of a low that allowed a bit more  
5 accommodation space and little bit of room for the sea  
6 to transgress and deposit the mid-B1 mudstone.

7 But over the highest portion, i.e. over the top of  
8 the channel, there wasn't any accommodation space, so  
9 the mid-B1 mudstone was not deposited there, so what --  
10 you look at cores of that area. You -- you essentially  
11 have one continuous tidal flat deposit.

12 Okay. The next slide will kind of try to  
13 summarize the points for this part of my talk, so that  
14 would be Exhibit 50.003 and then PDF page 50, please.  
15 Okay. Thank you. So if we could kind of zoom in on  
16 the map more, please, yeah, so it kind of fills the  
17 screen a bit. Thank you.

18 So CNRL indicates the mid-B1 mudstone is absent in  
19 the area shown in white, and it goes further to the  
20 northeast. Based on the evidence that -- provided, we  
21 have shown that the mud -- the mid-B1 mudstone is  
22 absent much further to the southwest inside the area of  
23 the thick blue line. A key well is the 1-3 well, which  
24 I've just shown you the photographs of, and a couple  
25 more wells that I referred to earlier, these two up  
26 here, in which, clearly, in my opinion, there's no

1 mid-B1 mudstone present. I wanted to point out too --  
2 and the geologists may appreciate this more, but what I  
3 see here supports my model quite nicely. If you look  
4 to the southeast side of the map, you can see that the  
5 mid-B1 mudstone is quite thick. I'm seeing values here  
6 of 79. I don't know. It's 69 there, et cetera, and  
7 then farther northwest you see it's quite thick here.  
8 As you move closer and closer to the high area here,  
9 which I map where the mid-B1 mudstone is absent, the  
10 values feather out. It progressively thins more and  
11 more as you approach this high. So it's thick here, it  
12 thins gradually, and eventually it's gone in this area.

13 I'm going to skip that part of -- which is to say  
14 that -- let me just say that there is an alternate  
15 interpretation here which is quite simple in that the  
16 incision that preceded the deposition of the Wabiskaw D  
17 valley fill, in my mind, simply could have continued  
18 further to the southwest. And instead of having any  
19 deposits here of the Wabiskaw D, there simply was no  
20 deposition, so the Wabiskaw -- the mid-B1 could have  
21 been removed and then just a tidal flat resumed on top  
22 of that, so ...

23 The key point is that the mid-B1 mudstone is  
24 absent within the area in blue, which is over large  
25 portions of the two pads.

26 Okay. Now we'll move on, please, to

1 Exhibit 32.03, PDF page 30. CNRL has written several  
2 times that the geology at the established KN01 and 04  
3 pads is similar to geology at KN08 and 09. I'm  
4 providing the next figure to show that they're actually  
5 very different.

6 I want to start with the well that I've selected  
7 in the middle of this development to the east at KN01  
8 to 04, and you can see here the top of the McMurray  
9 channel pay zone, which is just below this black double  
10 arrow, and then what I've interpreted to be IHS beds,  
11 so there's a lot of shale and a lot of sand in here and  
12 then a very thick -- an 8-metre thick mudstone bed  
13 before we get up to the base of the Wabiskaw B zone  
14 here.

15 So this package is 27 metres thick. When you look  
16 at my mud baseline, which I do by drawing a red line  
17 through a rock that we know to be essentially pure mud,  
18 and if you look down below that line, you can see that  
19 there's a lot of this rock in the confinement strata  
20 that is to the right of that line; in other words,  
21 it's -- it's -- it's mud and very pure mud. And down  
22 in this area there's also a lot of mud.

23 Now, if you look at the well that I've chosen from  
24 the centre of these KN08 and 09 pads, you can see that  
25 the geology, in my opinion, is completely different.  
26 If we look at the top of the McMurray channel pay,

1 which I've indicated here, we're only 14 metres to the  
2 base of our Wabiskaw B gas zone. 14 metres is not very  
3 far. You can see also that there's no thick mudstone  
4 bed here like there is to the east and that the amount  
5 of shale, as indicated by the mud baseline, is quite  
6 low here. There is definitely some, but it's -- it's  
7 not as shaley as it is over to the east.

8 Okay. So now I'd like to please move to  
9 Exhibit 50.002 -- I'm just looking at the clock -- PDF  
10 page 61. I'm going to go through this one really  
11 quickly -- oh, sorry -- and paragraph 53.

12 And -- okay. So Exhibit 50.002, paragraph 53 on  
13 page PDF 61. If that -- if that's not it, then I'll  
14 just read it here. And, in essence, in that paragraph  
15 CNRL says that only one of the six potential fractures  
16 that I've identified is within the confinement strata,  
17 and my reply is that they are.

18 So if we can go now, please, to Exhibit 50.002,  
19 PDF page 17, Table 1. Very good. Thank you.

20 So CNRL provided this recently, and I've read  
21 through this, and I believe that the fractures that  
22 I've shown in photographs are naturally occurring. I  
23 believe that if these photos were shown to a panel of  
24 independent geologists, perhaps not working in the oil  
25 sands, many would reach the same conclusion. Indeed,  
26 Ogilvie report completely validates my interpretation.

1 I do agree that -- with CNRL's comments in some of  
2 the boxes. They said that some of my names may have  
3 been incorrectly named, and I do agree with that --  
4 that that's possible to within 20 centimetres. I was  
5 working with core photographs, not the actual core. I  
6 wasn't able to map them in detail.

7 However, the key point and the focus of ISH work  
8 at the time was that these fractures incur in the  
9 interval between the top of the McMurray SAGD reservoir  
10 and the Wabiskaw B gas zone.

11 The next photo I would like you to pull up,  
12 please, would be Exhibit 50.003, PDF page 60. This is  
13 Tab 15. Thank you very much. And if you could zoom to  
14 the upper left portion of this, CNRL has made a  
15 schematic of the model that I did to illustrate  
16 differential compaction, and they state here that:  
17 (as read)

18 The maximum amount of differential compaction  
19 in channel point bar deposits occurs above  
20 mudstone abandonment plugs. The overlying  
21 strata are not bent over the top.

22 So CNRL agrees that differential compaction exists at  
23 the two pads. They write that the maximum amount of  
24 compaction occurs over the mudstone abandonment plugs,  
25 and I agree with -- that there is differential  
26 compaction over the mudstone plugs, but the maximum

1 amount of compaction is occurring by the fact that  
2 these rocks have been bent over the full width of the  
3 McMurray channel sand, not just these little mudstone  
4 plugs.

5 If I could go now, please, to 32.03, PDF page 33,  
6 and I'll just advise the room that I'm getting very  
7 close to the end here. Thank you.

8 So this model was conducted for illustrative  
9 purposes to demonstrate the effects of differential  
10 compaction. It -- differential compaction creates an  
11 extensional stress regime that results in faults and  
12 fractures.

13 The next slide would be to Exhibit 1.03, PDF  
14 page 17. This is a seismic section provided by CNRL  
15 early on in our exchanges -- and if you could maybe  
16 just zoom in on that a little bit, please. And I won't  
17 go into all the detail, but the point I'm trying to  
18 make I will do by pointing out what CNRL has picked as  
19 the McMurray channel -- this is the interval below the  
20 mid half of the section in orange here, and the base of  
21 that channel is the black line here. The overlying  
22 heterolithic interbedded mud deposits are this area, in  
23 flanking it in this area and then over to the right.

24 And what I'm trying to point out is that this  
25 whole area has been folded over the structure creating  
26 a network of open faults and fractures in addition to

1 the fractures created by the smaller differential  
2 compaction features in these mudstone abandoned plugs.

3 And the final exhibit -- or second-last would be  
4 to pull up, please, 50.002, PDF page 25, and  
5 paragraph 80.

6 And CNRL states here that differential compaction  
7 is a common process, and essentially, if I can  
8 paraphrase, they're saying it occurs everywhere.

9 But I would love to now move to -- the last of my  
10 requests would be for Exhibit 20.02, and this would be  
11 PDF page 92.

12 So what's unique about the KN08 and 09 that makes  
13 it different from many other SAGD deposits is its  
14 narrow width. So the effects of differential  
15 compaction are more pronounced in an area where the  
16 rock has to be folded over a much more abrupt  
17 structure. If you look at the diagram labelled as "B  
18 to B Prime" by CNRL, you can see that the width of the  
19 channel here is approximately 1 mile. So the effects  
20 of differential compaction occur mostly where the rock  
21 is being folded, which is on the -- kind of towards the  
22 flanks of the channel, which is the lighter green  
23 colours. And over the top there is some fracturing  
24 occurring here, but, again, a lot of it is going to  
25 occur as you approach the edge of it where the rock is  
26 being folded the most.



1           If you look -- if you could imagine drawing a line  
2 north to south through the word -- or letters "KN09",  
3 you can see that the pay body is much narrower here.  
4 It's only -- less than an LSD across. And so that  
5 rock -- all the extension has to be taken up in a very  
6 short distance. It's all occurring right over the top  
7 of the sand body in this area.

8           So, in summary, the evidence shows that the mid-B1  
9 mudstone is absent over much of KN08 and 09. Since the  
10 A2 mudstone is also absent, it means that there are no  
11 barriers at KN08 and 09.

12           Differential compaction has created a network of  
13 open fractures and faults that we feel will be conduits  
14 for SAGD reaction products to migrate into our  
15 Wabiskaw B gas reservoir.

16           And, lastly, the geology at the KN08 and 09 pads  
17 is much different than that at KN01 through 04. Thank  
18 you.

19 Q Thank you, Mr. Barrie.

20           Dr. Fowler, are you well situated? Can we  
21 proceed?

22 A M. FOWLER:                   (NO VERBAL RESPONSE)

23 Q Excellent.

24 A Yes.

25 Q Dr. Fowler -- Dr. Fowler, please confirm that the  
26 purpose of your appearance in this proceeding is to

1 speak to the report that you have prepared as an  
2 independent expert in the field of GCMS data  
3 interpretation.

4 A That's correct.

5 Q Please confirm that your curriculum vitae is filed on  
6 the record as part of Exhibit 32.09 and again as  
7 Exhibit 38.01, Appendix C.

8 A Yes.

9 Q Please confirm that your CV sets out your professional  
10 qualifications accurately and was prepared under your  
11 direction and control.

12 A That is correct.

13 Q Do you acknowledge and confirm that you have a duty to  
14 provide evidence to the Regulator that is fair,  
15 objective, and non-partisan?

16 A Yes.

17 Q Please confirm that Exhibit 32.09, Tab 5 to the ISH  
18 evidence -- it is your report -- was prepared under  
19 your direction and control and that the contents  
20 thereof is accurate.

21 A Yes.

22 Q We have listened to a great deal of GCMS evidence  
23 yesterday, and I would just like -- we have one last  
24 issue that we would like to canvass with -- in front of  
25 the Panel, and it's one question. Does the fact that  
26 you observed a barrier in each well you reviewed mean

1           that there is nothing to be concerned about? Steam,  
2           fluid reaction products -- fluid -- steam, fluid, or  
3           reaction products will remain contained?

4    A    While I observed different reservoir compartments and a  
5           strong barrier in each of the six wells for which  
6           geomechanical data was provided, similar to what  
7           Mr. Barland stated on Tuesday, I cannot comment on the  
8           lateral extent.

9           As different intervals are providing a barrier in  
10          different wells, this suggests that individual barriers  
11          are not laterally continuous over the whole area of the  
12          proposed development. That wherever this means, there  
13          are possible gaps between the different barriers that  
14          would enable steam reaction products to escape into  
15          shallow areas. From McMurray, I cannot say, as I -- as  
16          I am not an expert on the detailed geology of the area.

17   Q    Thank you, Dr. Fowler.

18          I must point out that the next witness will be  
19          speaking for at least 45 minutes, so I do wonder if we  
20          should try and get through that or whether we should  
21          take the break now.

22   COMMISSIONER CHIASSON:   That's a very good question.

23          Mr. Lung, do we have the same hard stop on our --  
24          or the concern -- timing concern about our lunch space?  
25          No.

26          Okay. You know what? Let's -- let's go through

1 with -- with this material because it only takes us  
2 15 minutes past the time we were planned, and then we  
3 will take the -- take the break after that and see --  
4 see -- see how we move from there towards the lunch  
5 break. Thank you for checking.

6 M. RILEY: Very well. We'll then move on  
7 to Mr. Vickerman.

8 Q R. RILEY: Mr. Vickerman, please confirm  
9 that the purpose of your appearance in this proceeding  
10 is to speak to the reports that you have prepared as an  
11 independent expert in the field of BHI, which I  
12 understand you will explain, data interpretation.

13 A K. VICKERMAN: I confirm.

14 Q Please confirm that your curriculum vitae is filed on  
15 the record as part of Exhibit 49.01, Appendix A.

16 A I confirm that too.

17 Q Please confirm that your CV sets out your professional  
18 qualifications accurately and was prepared under your  
19 direction and control.

20 A I confirm that.

21 Q Do you acknowledge and confirm that you have a duty to  
22 provide evidence to the Regulator that is fair,  
23 objective, and non-partisan?

24 A Yeah, I do. If I may, I -- HEF, the company that I  
25 work for, has lots of different clients we work for,  
26 you know, maybe 40 different companies in any

1 particular year. ISH is only one of those companies.  
2 We've, in the past, worked for CNRL. We've -- we work  
3 for -- we're looking at four, I think, different oil  
4 sands operators work this -- this winter. And so we do  
5 have that duty. I -- I -- I feel that the -- the  
6 interpretations and reports that I gave to ISH is the  
7 same report that I would've given to CNRL if I had  
8 been -- been instructed to do so.

9 Q If you would then speak to your reports and  
10 conclusions.

11 A Thank you.

12 If we could bring up Exhibit 101, page 273,  
13 please.

14 So this is CNRL's slide that shows how image logs  
15 work and how the different geometries are working.

16 Actually, could I have the mouse, please.

17 W. MCCLARY: And just the requisite  
18 reminder to please identify verbally any visual cues to  
19 help us --

20 A K. VICKERMAN: Yeah.

21 W. MCCLARY: -- in the future. Thanks.

22 A K. VICKERMAN: So if I'm -- if I point to the  
23 coloured vertical well cartoon in the centre left, what  
24 it shows is a vertical well on the left-hand side of  
25 that diagram with -- with these horizontally oriented  
26 ellipses that are meant to show what a -- a bedding

1 plain might look like in a vertical well, within  
2 inclined fracture cutting down through it from the top  
3 right to the bottom left.

4       When you -- the borehole image log is -- is a -- a  
5 measurement that reaches out to the sides of the  
6 borehole wall and is measuring -- in the case of the  
7 images that we'll be seeing today, the microresistivity  
8 or the rock, but it might be measuring something like  
9 the gamma ray or the neutron density or the sonic  
10 reflectivity. And then those measurements are then  
11 projected around the wellbore and positioned in space  
12 for an interpreter to -- to make their interpretations  
13 on.

14       And so when you look at an image that cuts on --  
15 that cuts flat through a -- a borehole image -- or  
16 through the cylinder of the borehole, when that data  
17 gets unrolled and shown like on the right side of that  
18 vertical well cartoon anything that's an inclined bed  
19 that crosses all the way through the borehole now  
20 becomes this full sinusoidal shape, like the sinusoid  
21 that's labelled.

22       Anything that's perfectly flat relative to the  
23 borehole, basically -- planer to the borehole becomes  
24 this -- the horizontal plane. And I'd ask you to  
25 imagine -- for instance, if we had a -- a factor that  
26 was running parallel to the borehole, so an extremely

1 steep one, this sinusoid would start to become very,  
2 very long. And from the point of -- say, if you were  
3 looking at 2 metres of data, it would -- it would  
4 appear as something that ran up the page of the screen.

5 And, similarly, if we were to take this -- this  
6 cylinder and imagine that we drilled a well  
7 horizontally through it, now the bedding would be the  
8 features that would be really long on the screen, and  
9 any fractures that were coming vertically into it would  
10 be horizontal across it. So there's a bit of a  
11 question of perspective. So is it a deviated well; is  
12 it a vertical well; is it a horizontal well for -- for  
13 how the features appear?

14 As was intimated, we've -- we've used a few  
15 different terms to talk about these kinds of tools. I  
16 prefer the more generic term of "borehole image log"  
17 because that describes the -- the -- a suite of -- a  
18 suite of -- of petrophysical measurement tools that  
19 might be run by a -- numerous different logging  
20 companies.

21 The more specific -- the -- the -- the term that  
22 has -- has also been used here has been "FMI". "FMI"  
23 is sort of -- it's a brand name. So it's sort of like  
24 Kleenex. We say the word "Kleenex" when we mean  
25 tissue. Kleenex is owned by a particular company.  
26 That tissue might be a -- a Scotties brand tissue or a

1 no-name brand or -- or whatever. But "FMI" refers to  
2 an eight-pad tool that's owned by Schlumberger and is  
3 shown in the example on -- on the right here.

4 We'll see later on some six-pad imagers. Those  
5 are -- were star logs that were logged by Baker, and  
6 for that reason -- because there's not that much  
7 difference in terms of how you interpret them, I -- I  
8 would refer to, say, a "borehole image log" and --  
9 and -- and avoid the -- the -- the commercial terms  
10 between them.

11 Can we zoom in on the -- on the right side of the  
12 image in the centre on the -- the fractures and image  
13 logs?

14 This is a good example. So I'm looking at the --  
15 the top of the two coloured fracture logs, and I'm just  
16 going to trace with the mouse the -- the -- trace the  
17 upper most sinusoid going from the right of the image  
18 across to the left. And it -- it makes a -- it makes a  
19 sinusoidal trace, so there's a green line that's fit  
20 through the middle of it, and the feature is indicated  
21 as an open fracture because it has this conductive dark  
22 response. The reason that the fracture itself is  
23 conductive is because during the drilling process,  
24 regardless of what the -- the fluids that were --  
25 happen to have resided in that fracture, those have  
26 been washed away and replaced by drilling fluid which



1 is relatively salty. And so on these image logs,  
2 conductive things -- salty things are shown as -- as  
3 black, and resistive features are shown as white.

4 So this upper one is -- is an -- an end case kind  
5 of feature. I think you can -- you can see that it  
6 makes the full trace. There's evidence of it near --  
7 near the right side of the image that -- that it makes  
8 a full sinusoid trace. So this -- this fracture has  
9 fully crossed the borehole from one side to the other.

10 The one that's shown below it in the same diagram,  
11 if we look over to the left side -- I'll just follow  
12 the arch of the upper part of that -- that -- that  
13 fracture that's highlighted in green, the lower of the  
14 two. I can only really see it on the -- from the --  
15 about the one-quarter mark to about the half mark  
16 around the borehole. So this -- this is -- this  
17 fracture is basically, in my opinion, the same kind of  
18 feature as the full -- full intersection sinusoid that  
19 we see above, but this fracture terminates on a bed.

20 I -- I don't like to differentiate between the two  
21 of them when we do interpretations, so I -- I believe  
22 they're both fractures. Just one of them happened to  
23 end within the borehole, and the other one ends  
24 somewhere else because this fracture -- these other  
25 fractures don't extend off into -- into the infinite  
26 void. They all terminate on another bed, or they

1 terminate on another fracture somewhere.

2         If we take our focus now to the -- the bottom pair  
3 of images here, this is attempting to show what a -- a  
4 closed fracture would look like in an image log. And  
5 whoever made this slide was -- was trying to show that,  
6 you know, a -- a closed fracture might be filled with  
7 a -- a resistive cement -- remember resistive features  
8 are -- are white in the borehole image log world,  
9 and -- and so they're arguing that this is a -- a  
10 healed fracture. I'm actually not really sure that  
11 these -- these features that are on here are actually  
12 healed fractures. The reason is that most of the  
13 healed fractures we see don't actually look like this.  
14 They don't look like white sinusoidal traces that cross  
15 all the way across the borehole. That's very, very  
16 uncommon. Because these measurement tools are  
17 physically measuring the return of electrical current  
18 from a source up -- uphole -- uphole on the tool  
19 through the formation and down through the buttons.  
20 And because of that, the -- the physical path of the --  
21 that electrical current tends to find the most  
22 conductive path possible, and so features that are  
23 resistive are -- end up being hard to see, and they end  
24 up downplayed in -- in the image log. I would say  
25 maybe one in a hundred healed fractures actually looks  
26 like what's on the screen here. Very, very uncommon.

1           Okay. Can we move to Exhibit 32-08, PDF page 34,  
2 please. Just expand the scale a little bit so that --  
3 yeah. There we go.

4           So this is from my report. This is a couple of  
5 fractures that I excerpted from the interpretation that  
6 I did. First, I'd like to note that when the -- the  
7 image that's on -- the image pair that's on the right,  
8 the upper one is showing a -- a -- a conductive open  
9 fracture that I've labelled with this pink tadpole and  
10 also with the pink sinusoid. And you can see in the  
11 image on the upper left that that pink sinusoid only  
12 extends where the feature exists and doesn't extend  
13 beyond it. And I think that's the better way to report  
14 this fracture, that it has terminated, it has a  
15 particular angular width to it, and -- and that all --  
16 all of that information is -- is contained in an -- a  
17 file that would be given to the -- to the client  
18 that -- that asked us to do this.

19           And so this upper feature, I think, is very  
20 clearly an open fracture. It's more typical of the  
21 kinds of fractures that we see. And, again, this is a  
22 very, very bright example. This is what a strong open  
23 fracture example would look like.

24           In our experience in oil sands fracture imaging is  
25 that the fractures in the caprock tend to be fairly  
26 subtle features, and the reason that we come to that

1 conclusion is based on the -- you know, the wealth of  
2 having looked at perhaps somewhere around 3,000  
3 borehole image logs in the oil sands with several  
4 hundreds of those having had core comparisons to them  
5 where we were asked to shift the core so that it was  
6 alongside the image and see them side by side. Plus  
7 occasional times when we're asked to review a specific  
8 spot and say, you know, is there a fracture here? We  
9 say -- we see something in the core. Is there  
10 something in the -- in the -- in the image log? And  
11 what we find is generally that we tend to undercount  
12 them in -- in the image log. And so for that reason,  
13 we try to be a little more aggressive in picking  
14 fractures in borehole image logs in the oil sands  
15 because they're such a -- an -- important. So they're  
16 important for this kind of hearing.

17 So we would like to identify -- you know, instead  
18 of a feature that we would be normally looking for a  
19 70 or 80 percent confidence, maybe we would look for a  
20 60 percent confidence in the -- in the fracture.

21 If we can look at the -- the second -- the second  
22 pair of images in the -- in the bottom, this is my  
23 example of a healed fracture. So the healed fractures  
24 are identified with -- with yellow sinusoids and yellow  
25 tadpoles. And the feature at the top of the image on  
26 the right is a very clear, in my mind, example of what

1 a healed fracture looks like in a borehole image log.  
2 You can't really see a -- a white sinusoidal trace  
3 going through it. What you see from the static log is  
4 the presence of an -- an overly dark zone in the inside  
5 of the trough of the feature and perhaps an overly dark  
6 zone on the inside of the cusp of the feature.

7 So I was pointing -- the trough being the -- the  
8 low part of the sinusoid on the upper half of the right  
9 image and the peak being the edge of the image.

10 To my mind, I -- this is a very high confidence  
11 healed fracture. I would say hundred percent that I  
12 would -- any of -- any of my colleagues would pick this  
13 as a healed fracture every single time.

14 Looking below this, there are other features that  
15 come in that make this -- that are basically parallel  
16 to that and have a similar -- a similar geometry and a  
17 similar presence of -- of the -- of the overly dark on  
18 the inside of the cusp. And you don't actually see the  
19 plane of the feature itself, but you just see the  
20 presence of that darkness.

21 When -- this might be a good time to talk about  
22 the difference between the images on the -- on the  
23 right side versus the left side. So the images on the  
24 right side are -- this is what was supplied by CNRL.  
25 This was the bitmap that was in their -- in their  
26 exhibits. And as was discussed yesterday, this is a

1     statically normalized image log.

2             So to generate this kind of log, the -- the -- the  
3     data is loaded into your software, and your software  
4     then separates the -- the image resistivities and --  
5     and bins them into particular -- particular bins, so  
6     maybe the -- the top -- the most resistive 10 percent  
7     would be then shown as the white colour on the log, the  
8     most conductive 10 percent might be the black colour on  
9     the log, and all of the different shadings that you see  
10    in the -- in the image log, then, are -- are -- are  
11    assigned based on how much of that is present in -- in  
12    the well in question.

13            The problem is -- that was discussed yesterday is  
14    that there are some zones that might be all resistive  
15    or all conductive. And so you might have a zone, you  
16    know, perhaps like the top one on top -- pointing at  
17    the top right, where it's all kind of the same orange  
18    colour, and it's -- it's harder to see the features  
19    that are coming through on the log here.

20            And so from that, then, we generate a -- a  
21    dynamically normalized image log. There are a few  
22    examples later on in -- in CNRL's rebuttal submissions  
23    that came where they -- where they showed the static  
24    image and the dynamic image. That's my preferred way  
25    of showing all of these logs.

26            Now, on my dynamic image, because I was working

1 with the bitmap, there's a lot of streaking between the  
2 pads. So I'm looking at the -- the two images on the  
3 left side of the screen. There's the -- the -- the --  
4 the pink sinusoidal trace that shows where the fracture  
5 is, and then there's a bit of noise in between each  
6 pad. That is because I -- I've taken a -- a log that  
7 was a bitmap. I've now applied that vertical dynamic  
8 normalization to change the colour pallet to enhance  
9 the contrast. So to generate this image, for each  
10 pixel, it looks at the metre of data above and below it  
11 and says -- and analyzes, Is that most the resistive or  
12 the most conductive in that metre, and reassigns the  
13 colours. And so we can see more contrast because of  
14 that.

15 COMMISSIONER ZAITLIN: Can you also explain the  
16 central column, please?

17 A K. VICKERMAN: Oh, sure. Yeah. So the --  
18 the central column shows a standard dip meter-type  
19 interpretation -- or tadpole log. And so what we have  
20 is the -- there's no legend on here, but the -- the  
21 left edge of that gridded central track is where zero  
22 degrees of -- of bedding dip would be or zero degrees  
23 of -- of feature dip. And the right side would be  
24 where it's 90 degrees of dip, so it's a vertical --  
25 vertically oriented feature.

26 So if you look at the -- at the -- or the pink

1 tadpole at the top, it -- because it's  
2 positioned between the 80 degree and the 90 degree  
3 range -- you can see at a glance that it's, you know,  
4 some -- it's somewhere in the high 80 degrees in terms  
5 of -- of dip, and then the tail of the tadpole points  
6 in a -- in a 360 degree, you know, looking down grid  
7 towards where the down dip direction of that feature  
8 is. So this feature -- it may be hard to see at this  
9 scale, but it says it's 87 point something at 257. So  
10 that means it's 87 degrees of dip and that the dip  
11 direction is towards 257, so west/southwest.

12 I guess it's worth -- worth talking when -- when  
13 we're saying about how images might look different if  
14 we're looking at the -- if it's a borehole that's  
15 cutting in a different orientation. So the -- the  
16 features on the -- on the bottom right -- and I'm  
17 just -- I'm just sweeping from the bottom edge maybe  
18 a -- a -- a quarter of the way across up to the middle,  
19 there's a -- there's a -- there's a dark hump that's  
20 shown there. Because there's lots of these general  
21 tracks of similar colour that are cutting across, I --  
22 I would say that all of these features that I can see  
23 going in this orientation are beds. So I'm making a --  
24 a -- a sweep where there's an upward -- there's a peak  
25 in the -- in the centre of the image and a trough on  
26 the edge of the image. And then anything that's



1 cutting across that feature is not a bed. It's -- it  
2 could be a -- a fracture, or it could be, you know,  
3 something else.

4 So with that -- with that introduction out of the  
5 way, I thought I would go through the -- the -- the  
6 various image logs that were submitted to this -- this  
7 hearing process. So if we go first to 15.01, page 195,  
8 please. So this is fine at this scale.

9 So this image was submitted statically normalized  
10 with no dynamic images supplied. So at this scale,  
11 it's very hard for an interpreter to make any judgments  
12 about whether there is a -- a fracture or not present  
13 in this -- in this interval. And so from my point of  
14 view, there's -- you cannot justify any conclusions  
15 about the presence or absence of fractures based on  
16 this image alone.

17 Further, this image is presented without any  
18 orientation. I can tell from the header at the very  
19 top of it -- if you look at the top of the column,  
20 there's a 'U' on the left, then an 'R', then a 'D',  
21 then an 'L', then a 'U', as you go from left to right  
22 across the top of the image, and that tells me that  
23 this -- this is plotted on the high -- with the high  
24 side of the hole as the orientation of that sinusoidal  
25 presentation. So the 'U' is up; 'R' is right; 'D' is  
26 down; 'L' is left; 'U' is up again. But I cannot tell

1 from this what the magnitude of the deviation is, what  
2 the whole azimuth is, what the calipers are reading. I  
3 can't verify that the -- the processing is correct.  
4 And so, in my mind, this is a -- an incomplete image.

5 Further, there's no interpretation shown on this.  
6 So there's no sinusoids, there's no tadpoles, and it  
7 would -- it's impossible for me as a skilled  
8 interpreter to know for sure -- to -- to tell whether  
9 this interpretation was done well or not, and it's  
10 definitely impossible for the Panel to do that because  
11 I -- I imagine that in this field you're lay people.

12 In -- in -- in my opinion, anytime borehole image  
13 data is shown, it's -- it's incomplete to show it in  
14 this format, that it should be shown -- it should be  
15 supplied as a raw and DLIS -- a -- a -- a -- raw DLIS  
16 file which contains, in a digital format, all of the  
17 measurements of all of the -- the buttons for each pad,  
18 as well as the information about the orientation of  
19 the -- those pads, the orientation of the tool, the  
20 orientation of the hole, the caliper measurements of  
21 the -- of the features.

22 From that kind of data, then, anybody with proper  
23 processing software could load the data in and do an --  
24 do a full interpretation and be able to verify, you  
25 know, whether -- whether the data is -- was correctly  
26 interpreted.

1 I would like to see -- if you're just going to  
2 show a plot of the data like this, I would like to see  
3 the static image plus the dynamic image plus an  
4 interpretation all in the same presentation. If -- if  
5 that had been done, it would've been possible for  
6 somebody to take a look through those logs and -- and  
7 make an assessment without going through great expense  
8 of hiring somebody like me to interpret the fractures  
9 in the bedding and just verify, Do you agree with how  
10 it was done or not?

11 And then further you should be supplying that  
12 answer as a table, What -- what's the magnitude of the  
13 bedding, dip, the dip direction, what's the dip type,  
14 those kind of -- those kind of things, usually in an  
15 LAS file.

16 THE COURT REPORTER: "LAS file"?

17 A K. VICKERMAN: L-A-S. A -- it's a log ASCII  
18 standard.

19 Oh, before we leave this -- so this is -- this is  
20 one of those six-pad tools that has been misnamed as an  
21 "FMI" in the discussions here today. This is a star  
22 image log but, more generally, a borehole image log.

23 If we can go to 32.07, Tab 3, please.

24 So after ISH received these static image logs,  
25 they, like many in this room, are not borehole image  
26 log interpretation experts, and so they weren't able to

1 do a proper assessment of whether there were fractures  
2 or not based on the evidence that was there. And so  
3 they then went to the -- a public -- a third-party log  
4 vendor and acquired this image which was entered into  
5 evidence. We would note at the top here that this is  
6 a -- a Schlumberger processed and interpreted log.  
7 There's a -- a name of the interpreter log analyst  
8 maybe halfway down on the -- on the screen in the -- in  
9 the header part of the -- of the image.

10 If we can scroll down a little bit on this image,  
11 please.

12 So this image is shown with a static image on the  
13 left, a dynamic image on the right. It's -- it's  
14 really unfortunate, and this is typical of the quality  
15 of the images that is in the public domain. It's shown  
16 in the very least contrast possible. There's really  
17 only four colours that you can see in this image log,  
18 which is a travesty because it's -- it's logged with --  
19 with hundreds or maybe a thousand significant digits  
20 of -- of possible different resistivity measurements,  
21 and it -- and it's been boiled down to four. It's  
22 either white, it's black, or two shades of grey.

23 In the -- in the centre of this plot is a -- a  
24 depth track where it starts at 430.

25 Can we scroll down to 436, please.

26 So we can see on the -- on the right track here

1 some of the tadpoles coming in. And so there are --  
2 if -- comparing the -- the shape of the -- this tadpole  
3 to what's shown in the header, the interpreter has --  
4 has identified a number of beds. And then right near  
5 the bottom -- I don't know if we want to bring that to  
6 the centre of the screen, but the -- the Schlumberger  
7 interpreter at the time called this feature a -- a  
8 "partially open fracture". And I -- I don't like that  
9 terminology. I think if you're going to say it's a --  
10 an open fracture, call it an "open fracture" because  
11 what I -- I know that Schlumberger means by this is  
12 that it's open for part of the borehole and not open  
13 for others rather than meaning that it's partially  
14 healed or partially not.

15 Now, I might disagree with this interpreter, and  
16 I'll talk about that later when I get here, but this  
17 data that's in the public domain was enough to get ISH  
18 suspecting that there may be fractures present, and so  
19 that's why it was submitted.

20 At that point, I was brought in. If we can bring  
21 up 15.01, page 195 again.

22 So I was asked by ISH to look at these -- at the  
23 image logs that were in both the confidential and  
24 non-confidential submissions and help them to pick a  
25 couple of them to do a bit of further work to see if we  
26 could -- whether there was fractures or not in the --

1 present in the well.

2 Can we scroll down to the depth of 313.

3 So looking at this, this was the very clear healed  
4 fracture feature that I talked about -- showed in my  
5 report before. So at a glance, I -- I told them, Yeah,  
6 no, this is a good well. I can see some -- I can see  
7 some features between 314 and 315 that -- that look  
8 like some amount of fracturing.

9 If we scroll further down to -- to 323.

10 THE COURT REPORTER: Sorry. I can't quite see. Is  
11 it 5-23 like a well?

12 K. VICKERMAN: Or five -- sorry. 523. So  
13 that's the -- the depth track that's on -- on the -- on  
14 the right side. So if we stop here.

15 When I -- when I look at the -- at the feature  
16 that's just above 523, I -- my eye sees, looking  
17 through the centre -- maybe the centre half of the  
18 image, an -- an -- an upward curving cusp of -- of dark  
19 conductive features that could possibly be a -- an open  
20 fracture that crosses through this bed.

21 Like was said yesterday, I -- I -- I would not  
22 want to make an interpretation based on this static  
23 image alone. I would want to have, you know, first  
24 off, the -- the raw digital data and -- and do a proper  
25 processing interpretation myself. But I would look at  
26 this -- and we'll do that dynamic normalization that I

1 showed elsewhere.

2 Can we go to page -- or to Exhibit 15.01,  
3 page 201, and scroll down to 499.

4 So in the -- in the top of this resistive zone, so  
5 where the -- in the centre between 499 and -- and 501,  
6 the -- these beds are -- are resistive, and so they  
7 have that light colour. And at -- at the upper part of  
8 it maybe in the 499.3 or so, I can see a -- a dark  
9 partial sinusoidal trace coming through and crossing  
10 the -- the middle four paths where the -- the curvature  
11 is -- is down towards the centre of the image. And so  
12 I would suspect from this that there might be some kind  
13 of fracture at this depth.

14 So I -- I then suggested to ISH, you know,  
15 these -- these are a couple of good wells to look at.  
16 These are the ones that we chose, and this is what HEF  
17 processed and -- and interpreted and submitted in our  
18 report.

19 If we go to page -- Exhibit 32-08, page 48. And  
20 just zoom back a little bit.

21 So this is the -- this is what I produced for ISH.  
22 There -- there's quite a lot of noise in the -- in the  
23 image on the left here, and so it's this kind of  
24 streaky non-response to the dynamic normalization. And  
25 that's because the image that's on the right is showing  
26 all black, all one colour, and there was nothing to

1 expand out into a -- a properly dynamically normalized  
2 image. So even though I've done what I can, you still  
3 can't know whether there's a bed or a fracture in this  
4 zone.

5         If we can scroll down to a depth of 514. So this  
6 is that -- that healed fracture that's -- that I have  
7 shown a few times. If we go through the tracks from  
8 the -- from the left to the right, so the left-most  
9 track is -- the deviation is shown as this tadpole  
10 that's in the centre. It -- the scale -- its scale is  
11 between 0 degrees and 100 degrees, I think, of -- of  
12 deviation. So this is quite a deviated well, being  
13 at -- at -- at 50 degrees or something like that and --  
14 and trending towards the southeast, just where the tip  
15 of this deviation tadpole points.

16         I have a -- a green indication of the gamma ray  
17 and then the -- the -- the dotted curves on the left  
18 edge of the calipers. So those are -- those are  
19 measuring the -- the diameter of the borehole in the  
20 various image pad directions.

21         I have interpreted four different healed fractures  
22 in this zone. You know, looking at it today and in  
23 preparation, I might have drawn another fracture below  
24 here because you see that overconductive cusp. So  
25 that's in a similar orientation to the yellow ones  
26 outlined above but just below 515, maybe 515.1.



1           And this is probably a good time to mention that,  
2   you know, these are all interpretations.  When I look  
3   at an image log, I might be making 300 really small  
4   decisions.  So, Is this feature bad or not?  Is it a  
5   lateral cretion or not?  Is it a scour surface or not?  
6   Is this thing that's crossing it, is it a fracture, is  
7   it a bit mark, or is it something else?  So there's  
8   lots of decisions, and any one interpreter, if I  
9   come -- came back and interpreted this again, I might  
10  come up with -- I would come up with something that is  
11  90 percent the same as what's been shown here, but  
12  probably not 100 percent the same.  And it's okay to  
13  have some variation between interpreters.

14           If we scroll down to depth 523.

15           So just above -- just above 523, there's that  
16  partial -- partial sinusoid that I had -- that I had  
17  indicated that I saw before.  I -- I think I have good  
18  evidence that there is a -- a dark feature that is  
19  crossing through the bed -- through the bedding.  It  
20  looks like a fairly low-angle feature on the screen,  
21  but it calculates out to a dip of 71 degrees.  So this  
22  is a very steep feature that is -- is -- is crossing  
23  the bedding at a -- at a high angle.  It's conductive.  
24  So my determination is it's an open fracture.

25  COMMISSIONER ZAITLIN:       Excuse me.  When you point out  
26  these features, do you also know the stratigraphic

1 horizon which is being shown.

2 A K. VICKERMAN: That's a -- that's a great  
3 question. So I -- when I was tasked -- when we were  
4 tasked with doing any -- any image interpretation,  
5 we're agnostic to what -- the situation of the -- of  
6 the oil companies or the gas companies' situation. I  
7 just go through and identify all of the features in the  
8 zone that I see and that I believe in, and so I --  
9 the -- if we maybe jump to the bottom of this image --  
10 I don't know if -- that's probably not easy to do  
11 without scrolling. If you could maybe zoom way out and  
12 then ...

13 Yeah. So at this scale near the bottom of the  
14 image -- yeah, this -- this scale is fine -- is that  
15 fracture that I identified before. It didn't matter to  
16 me that this fracture is in the -- is in the Paleozoic  
17 basement at the bottom. I'm just identifying the  
18 fracture in the beds that I see. I didn't know where  
19 the -- where the confinement strata was or any of the  
20 other high-level discussions. I only identify the  
21 features that I could see and put them in my reports.

22 COMMISSIONER CHIASSON: Just a question: In your  
23 middle gridding here between the two, I'm going to say,  
24 photos, because I don't know the right term. Yes.  
25 That -- that there. Is that -- what is that?

26 A K. VICKERMAN: So can we just scroll up to

1 see the next one above it. I think that might be a  
2 little bit easier. Oh, no it's not great.

3 So this is a Stereonet presentation of the dip  
4 direction. Maybe if we can jump to page 42 in my  
5 report. So just remember the shape of that. It's a  
6 round thing with bars going out from the side of it.

7 So this is a Stereonet plot of the fracture data.  
8 I don't know if everybody is used to seeing these, but  
9 this is shown, you know, with "north" on the top of the  
10 plot, "east", "south" "west", and then the magnitude of  
11 the dip goes from zero at the middle of the plot out to  
12 90 degrees of dip at the edge of the plot, and then any  
13 of these dots that are shown on here would be a  
14 particular feature that's plotted. So this one that  
15 I'm highlighting right in the -- near the edge of the  
16 diagram in the top left -- there's a -- there's a  
17 magenta dot there -- so this fracture that's here is  
18 near vertical because it's near the edge of the -- of  
19 the feature, and it dips towards the northwest.

20 Now, that it dips towards the northwest and is  
21 almost vertical, it's not different, actually, from  
22 this feature in the bottom right of the -- of the  
23 diagram which is near vertical and dips to the  
24 southeast. So for that reason, we then show on this  
25 same plot a summary of the azimuth, but we don't show  
26 the -- the dip direction azimuth; we show the strike

1 azimuth, which is 90 degrees towards -- from the  
2 down-dip direction, and that's what creates these --  
3 these triangles here, so this -- this is a histogram of  
4 the azimuths of the features of the dip direction of  
5 the feature.

6 So this could be shown as an unwrapped histogram  
7 plot where you had zero degrees, you know, 30 degrees  
8 of azimuth, and so it would look like a normal bar plot  
9 with -- with a peak at a particular direction.

10 In this case, the peak is over here in the  
11 northeast -- northeast corner, and there's a peak in  
12 the southwest corner.

13 COMMISSIONER CHIASSON: Thank you.

14 A K. VICKERMAN: Yeah. No problem.

15 If we can go down to page 46. So after we did our  
16 interpretations, we generated this kind of summary  
17 fracture density plot. Again, I have no idea where --  
18 what -- what the zone of interest is or anything like  
19 that. I have just observed, yes, there are a certain  
20 number of these pink open fractures at particular  
21 depths and that I've observed these yellow healed  
22 fractures at different depths and then supplied a  
23 fracture density curve on the right side of these  
24 tracks. And so the fracture density is a calculation  
25 with a sliding window saying how many fractures are  
26 present in a metre.

1           And what we can see from this is while there are  
2 some fractures present, it's not a continuous presence  
3 of fracturing through the whole image log.

4           Maybe jump to page 43, please. So this is -- oh,  
5 there we go. So this is that -- that same Stereonet  
6 plot of the healed fractures. So we've counted  
7 14 healed fractures in the well. They have a similar  
8 orientation in that they're oriented northeast to  
9 southwest maybe a little bit more northerly if we go up  
10 one page to the open fractures. Sorry. I rolled them  
11 out. I'm usually used to doing these.

12           So this one is more -- is more  
13 northeast/southwest, and the healed fractures was a  
14 little more northerly. That's not uncommon to have a  
15 bit of variation between the heal fractures and the  
16 open fractures because heal -- heal fractures can be --  
17 can be older in that they could be fractures that  
18 are -- have been present longer, have been exposed to  
19 more groundwater, had more chance for mineral cements  
20 to be deposited in the -- in the open aperture, or they  
21 could have been created with a different process.

22           If we could jump to page 26 -- oh, sorry -- 27. I  
23 can't read my own handwriting. Thank you.

24           So I -- I made the comment in my executive summary  
25 that it has a low to locally moderate intensity of open  
26 fracturing. So if you remember back to that fracture

1 density plot, there were gaps between where there were  
2 fractures present and that at some points the fracture  
3 density approached maybe five fractures per metre in a  
4 confined layer. So I'm saying it's low -- low overall  
5 to locally moderate -- in some places it's moderate  
6 density -- and with a similar orientation and intensity  
7 of healed fractures. There were -- there were similar  
8 number counted.

9 It said many of them are bed terminating, and they  
10 appear to be fine in aperture. So the fractures  
11 weren't, in my view, extremely large-looking, and  
12 that's what that comment is meant to say. They had a  
13 particular orientation, and there were no observed  
14 shears or interpretable large fractures in the image,  
15 so I can't see a fault. I can't see anything that  
16 looks like a major fracture.

17 Maybe in the interest of time -- so we looked at  
18 the -- we looked at two wells. The second well would  
19 be Exhibit 32.08, page 22. And I'll just jump to --  
20 yeah, page 22 is good. So this is the fracture density  
21 plot for the second well that we -- that we looked at.  
22 Zoom out a little bit, please, so we can see a bit more  
23 context. What I can see here is that while there are  
24 some fractures present, there are less than the  
25 previous well. And that's what I reported to ISH.  
26 There's fewer fractures present in this well, and this

1 is where they're located; this is where they're  
2 oriented.

3 And if we can jump to page 3 of this report. In  
4 my executive summary, I say the fractures are sparse,  
5 and there's not enough of them to comment on the  
6 orientation trends. The reason -- there may be three  
7 or four features. It's -- it's hard to say that  
8 there's an average based on three points. I don't like  
9 to do that. So if there's -- if it's not a  
10 statistically significant number of features, I -- I  
11 wouldn't show a -- a comment on the orientation.

12 I don't see any drilling-induced fractures; I  
13 don't see any faulting or any of those kinds of  
14 features in this log.

15 Now, all of this is -- is couched a little bit  
16 because I'm working with a flawed image log. I took  
17 their -- the static image. I dynamically normalized it  
18 as well as I could, but there are zones that are in  
19 this interval that I can't necessarily tell whether  
20 it's fractured or not.

21 Move to 44.10, page 10. Oh, can we not show that  
22 one?

23 So subsequent to doing my report, I -- I was asked  
24 with a few emails to look at and comment on some of the  
25 image excerpts that have also been shown. So we go to  
26 page 10 in this file. And can we zoom in so that the

1 image log, you know, makes at least the half the  
2 screen? Yeah. Scroll down to it.

3 When I was looking at this image log -- again, I'm  
4 looking at a static log and not the dynamic -- I can  
5 see a discontinuity that crosses here. I said, Okay.  
6 There's one over here, and I thought there might be  
7 something on this edge over here. There's a bit of  
8 interpreter's liberty in there, and there's definitely  
9 a lot of uncertainty. So when I advised ISH that  
10 there's a feature at this depth, that's a possible but  
11 not definitive healed fracture based on this evidence.

12 So if -- if this and this and this all linked up  
13 when you looked at it with a dynamically normalized  
14 image, I would say it's probably a healed fracture.  
15 You know, again, it's more 60, 70 percent confidence.  
16 Just based on this alone, I would say it may be  
17 40 percent confidence that there's a healed fracture.

18 The other possible description for this is that  
19 these two things on the -- on the right and the centre  
20 that are pointed out by the arrows make a line that is  
21 inclined up to the right -- up to the left on the  
22 image. And the typical kind of feature that would look  
23 like that in a image log is a bit mark, what I would  
24 call a "bit mark", so that is either from the bit  
25 itself as it's corkscrewing down. It would scratch --  
26 scratch a line that's rotating down through the image,



1 and it makes something that is a line on the borehole  
2 image log. And if you remember back, anything that's a  
3 plane makes a sinusoid, so anything that's a line can't  
4 be a sinusoid. It has -- it can't -- anything that's a  
5 line on the image log can't be a plane in 3D space, so  
6 that line makes a helix. And when describing, I like  
7 to talk with my hands. I'm kind of showing a  
8 corkscrew-shape thing, and that would be the scratch of  
9 the bit as it's -- it's coiling down through or coiling  
10 up through or any part of the drill stem assembly that  
11 has either scratched the surface of the -- of the  
12 borehole or somehow impacted the mud or scratched in  
13 the mud cake that might be present there.

14 We can jump to Exhibit 50.03, page 56. So this  
15 was CNRL's rebuttal. And you'll note that when they  
16 want to actually show and make their point, they show  
17 the image in the format that I would have requested.  
18 So they have a static image on the left here of the --  
19 of the images that are on the left-hand side and a  
20 dynamically normalized image on the right. We can see  
21 many more features. I'm just pointing at a depth of  
22 453.5. There's a resistive band that's maybe  
23 20 centimetres thick in there. It's hard to see any  
24 contrasted features that are in that 20-centimetre  
25 interval, but if we look at the dynamic image on the  
26 right, there's many more little fine beds that appear

1 in the dynamic image log. And they've shown some kind  
2 of interpretation; in this case, they have shown these  
3 little arrows that are present, and if I had been  
4 provided this image log, I don't think I would have  
5 said that there was a healed fracture at that depth. I  
6 would have said, Yeah this looks like a bit mark. This  
7 is a properly statically normalized image. They may  
8 have had a chance to adjust -- adjust the colour scheme  
9 that's on the screen, and I would have agreed with the  
10 interpreter in this case.

11 I'm not sure that all of the features that have  
12 arrows on here are tool marks. I think in their  
13 terminology they're using "tool mark" to mean "bit  
14 mark" like I would. But I think two people can  
15 disagree, and that's fine. I think there's a fair  
16 amount of this helical scratch that -- that stands out  
17 a bit more on this log compared to the log we saw  
18 before.

19 If we can go to page 55. So remember this plot  
20 that's on the right side. This is that black-and-white  
21 or near black-and-white image plot that -- that ISH  
22 provided that had a Schlumberger-interpreted pick on  
23 it, and we can see the legend here. I don't know if we  
24 want to zoom in close or not, but this -- this tadpole  
25 has a square head on it, and comparing to the header,  
26 it's a square filled-in head which is that partially

1 opened fracture. That was the interpretation of the  
2 Schlumberger interpreter.

3 If we look at the CNRL log interpretation on the  
4 left, there are numerous arrows showing tool marks, and  
5 I would disagree with this interpretation. I don't  
6 think these look like those -- that helical scratch  
7 that was present in the previous log. I think this is  
8 something different, and I also don't agree with the  
9 Schlumberger interpreter either. The Schlumberger  
10 interpreter has picked -- and I'm pointing with my --  
11 my feature on the image on the right at the dark blob  
12 that's about halfway up the right-most image near the  
13 edge of the track and about halfway across the -- that  
14 same track is the similar -- a similar feature on the  
15 opposite side of the borehole.

16 If we look to the CNRL image, that -- that same  
17 feature is rotated a little bit because the  
18 Schlumberger image is shown oriented to north, and  
19 there's a -- presumably a -- oriented to the high side  
20 of the hole. And so that -- that feature that was near  
21 the edge of the Schlumberger plot is now a third of the  
22 way in from the right side of the -- of the CNRL plot.

23 This looks to me -- it's dark and conductive. I  
24 can't see any features within it. And so, in my mind,  
25 this is a -- a -- a spot where a bit of the borehole  
26 has broken in. So the -- it's a borehole failure

1 feature.

2 And what I see, looking at this log, is that there  
3 are many of those. There's lots of irregular dark  
4 conductive non- -- they're -- they're not -- they're  
5 not part of a continuous bed that crosses across a --  
6 discontinuous spots where the -- in my view, the -- the  
7 borehole wall has fallen in.

8 And that's supported a little bit with the caliper  
9 log that CNRL posted on the side here. So the calipers  
10 are -- and I'm now looking at the -- the -- the third  
11 track from the left on the left-most image. There are  
12 dotted lines coming down that -- from the header here,  
13 it says that these are the -- the caliper. And the  
14 caliper enlarges at this -- at this depth, and so  
15 the -- the hole has -- has -- has become larger, at  
16 least in the direction that the caliper was oriented.

17 You may note that only one of the caliper swings  
18 out, and the other remains static and stationary. What  
19 I believe is that this -- this feature is a borehole  
20 breakout feature. So because of its orientation --  
21 it's -- it's oriented on the -- on the -- the southeast  
22 and the northwest sides of the borehole. Because it's  
23 a paired feature that is present on -- on -- on one --  
24 on -- on one side of the borehole and 180 degrees apart  
25 on the opposite side of the borehole, because it has  
26 this irregular edge and no internal bedding or anything

1 else, this looks to me like a borehole breakout  
2 feature, which is a -- a stress-induced well failure  
3 feature that -- where the -- the borehole tends to fall  
4 in -- in the minimum horizontal stress direction.  
5 These are commonly seen in borehole image logs  
6 generally and also specifically in the oil sands.

7 The other artifacts that I can see on the screen  
8 is this -- this dotted spotty bits that are present  
9 near the top of especially the dynamic image of CNRL.  
10 There's sort of clouds that look black and white  
11 spotted. There's several of them at various depths,  
12 including in the middle of the log and including near  
13 the -- the bottom of the log in -- in the centre of the  
14 CNRL static image -- or dynamic image -- normalized  
15 image on the right.

16 My interpretation is this is also a common feature  
17 especially seen in the oil sands. This is a -- a --  
18 oil smearing, mud smearing kind of an artifact. And so  
19 perhaps bitumen or some mobile oil from somewhere else  
20 in the -- in -- in the drilling process that's been  
21 brought to this particular depth and smushed onto the  
22 side of the -- of the borehole wall, and it -- you end  
23 up with those resistive speckles of -- of bitumen that  
24 are making it so that the electrical current return  
25 can't come back to the pads. And so any time it comes  
26 to the -- one of those bits of bitumen, it -- it can't

1 read the -- the bed beneath. And so I -- I don't think  
2 you can see any of the features behind any of these  
3 images -- any of these artifacts. And that's just a  
4 fact of life when -- when dealing with image logs,  
5 especially in the oil sands. These are -- this kind of  
6 artifact is present. But I also don't think that this  
7 is a tool mark as indicated on the plot here.

8 So this is not a bad spot to make that comment  
9 again. I agreed with the CNRL interpreter that the  
10 previous thing on -- that I had called a "healed  
11 fracture" is a tool mark or bit mark as I recall it. I  
12 don't think that anything that's on this screen is  
13 necessarily a -- a tool mark. I think it's a -- a  
14 borehole failure feature and some of these speckles  
15 from that -- that mud smearing.

16 If we can go to 15.01, Tab 25. I think that's  
17 page 339. Can we zoom way in on the -- just the image  
18 logs first. So I -- I would like it so that the two  
19 image logs face -- fill the screen or get as close to  
20 it as we can. Maybe one more. If we can go one more  
21 in. Thank you.

22 Now, I'm going point to some features -- this  
23 image was discussed yesterday, so I thought I'd offer  
24 an opinion on it. I'm going to point to some features  
25 at the bottom of the image below the black rectangle  
26 that are especially visible on the -- on the image on

1 the -- on the right, so the dynamically normalized  
2 image.

3 If I look at -- from looking at the full pad  
4 that's first visible on the right side of the image  
5 that's touching the bottom of that black rectangle and  
6 then skip two pads over, there's a similar-appearing  
7 kind of feature, and then two pads over there's another  
8 similar kind of appearing -- appearing feature where  
9 the -- it looks like it's smeared out or something has  
10 been stretched. So if you were to have taken a picture  
11 and then pulled it apart 10 centimetres, it -- it might  
12 look like this.

13 If you look at the other pads and not the -- the  
14 first and third and fifth from the right-hand edge but  
15 the -- maybe the first and third and fifth from the  
16 left-hand edge, we can see a similar smear that is  
17 or -- that is offset a little bit in depth. So it's a  
18 little bit below that black rectangle. This -- this  
19 feature that we're seeing here is a -- is what we call  
20 a "pull". This is a spot where the -- the logging tool  
21 got stuck in the hole. And when it's stuck, it --  
22 depth is still being accumulated. So at -- at the  
23 surface, the -- the -- the logging cable that's above  
24 this tool is building up tension, it's stretching, and  
25 it's recording depth measurements, but the tool itself  
26 isn't moving. So the -- what you end up with is a

1 repeated measurement until the tool can jerk forward,  
2 it gets enough tension, it gets unstuck, and then jerks  
3 forward. So this feature is -- is a pull. It's an  
4 artifact of -- of -- of the logging process and -- and  
5 not anything else.

6 The -- if we look above -- within this black  
7 rectangle, maybe a third of the way up from the bottom,  
8 there were several sigmoidal features identified in  
9 the -- in the -- in the static image, so the right-most  
10 image and the first pad near the centre. There's this  
11 S-shaped feature and fourth pads, and then in the third  
12 pad in the middle, a bit of a stretch. So it's a -- in  
13 my mind, this is exactly the same kind of feature as  
14 the stretch below. It's -- what you're seeing is  
15 the -- the tool slowing down as before it got stuck,  
16 being stuck, and then jerking forward. And so this  
17 feature that is an S shape in the image log properly  
18 should be shown as a -- as a plane. This is a  
19 processing artifact that should have been corrected  
20 before interpretation, and, in a way, it gets in the  
21 way of the -- of the interpretation.

22 At -- at this scale, looking at the dynamic image  
23 log, I can see a number of discontinuities that cross  
24 vertically along a couple of the pads. So I'm going  
25 to -- looking again at the dynamic image on the right,  
26 inside of the black rectangle, maybe a quarter of the



1 way down is a -- is a bright feature that comes -- and  
2 maybe this bed actually looks like it might offset a  
3 little bit. So the bed in the third pad seems to have  
4 a bit of a step up, and then there's a bit of a white  
5 feature above it.

6 We continue that trace down. Oh, what's this  
7 thing? There's another thing that is vertically  
8 oriented that is running parallel to the pad and  
9 maybe -- you know, whether it terminates or crosses  
10 that bed, I don't know.

11 And then down sitting in that third pad, there's  
12 another feature that is inclined down to the right, a  
13 series of -- of blobs that, you know, could be an  
14 open -- an open fracture of some kind.

15 If we jump over to the bottom right of the image  
16 that is shown within the black rectangle, there is  
17 again another feature that runs parallel to the pad and  
18 up through the centre of it. It's dark and conductive.

19 I -- there's a question of what this is. This is  
20 possibly a fracture that is running parallel to the  
21 borehole at this depth. There are other explanations.  
22 This could be a drilling-induced fracture which might  
23 have a similar appearance. It could be a burrow. But  
24 one possibility is that this is a -- a fracture that is  
25 present at this depth.

26 If we look at the scale that's shown on the

1 right-hand -- or left-hand side of this log, this is  
2 from 529 to 530, so any one of these features might be,  
3 say, 20, 30 centimetres long.

4 Can we zoom out a little bit so that we can see  
5 the core as well as the image. Maybe just, yeah,  
6 scroll it down at this zoom level. Yeah. This is  
7 good.

8 Now, the features that were identified in the  
9 core, I can't -- I -- I don't really comment. I -- I  
10 didn't look at the -- the core myself. But I would  
11 note that the scale of these features are similar to  
12 those that we saw in the image log. So this feature is  
13 maybe 30, maybe slightly larger than 30 centimetres  
14 long. It is very much parallel to the core. And so it  
15 doesn't -- like in the -- in the example that I talked  
16 about at the beginning of the sinusoidal thing crossing  
17 the borehole, making a sweep, and crossing all the way  
18 out the side of the borehole, that would -- that would  
19 make a sinusoidal shape. But if you had a feature that  
20 was parallel to the borehole, parallel to the core, it  
21 could exist as this feature that's parallel to the pad.  
22 So I -- I don't know that you can say that this image  
23 disproves that there is a fracture here. I think it's  
24 a -- from this image, there's a possibility that this  
25 feature that's on the -- on the right side that I  
26 showed that's kind of below the continuous bedding

1 arrow and then three pads over to the left extending  
2 upwards from that, that that could also be a feature  
3 that would be parallel to the borehole, a  
4 non-sinusoidal feature, and it -- I would say it's  
5 definitely a possibility that there's a fracture here  
6 given the evidence from the image log.

7 So my conclusions would be that the -- the image  
8 logs were submitted without dynamic normalization  
9 and -- or -- or interpretation and that this is  
10 incomplete and not sufficient to justify any  
11 conclusions. There's no way that I could -- I could  
12 justify the conclusions based on what was submitted. I  
13 don't know that the -- the AER could do likewise.

14 Given this, ISH sought out the third-party images  
15 that indicated some possible fracturing in the area.  
16 That was that Schlumberger interpretation and image  
17 that I disagree with. But that was enough for them to  
18 say that there -- maybe there's some fracturing here.

19 We were brought in to look at that -- at the --  
20 the CNRL-submitted and the third-party images, and  
21 selected a couple that looked like they had some --  
22 some fracturing in them. We then digitized the  
23 orientation because we weren't supplied it and the  
24 image data from CNRL and -- and did the  
25 interpretations. I produced reports on the two wells,  
26 and I found evidence of fracturing in both. Thank you.

1 COMMISSIONER CHIASSON: Thank you.

2 So I would suggest at this stage we take a break.  
3 Our court reporters have been going hard for a couple  
4 of hours. So we will break now. We will return back  
5 at 11:35, and we'll test things then in terms of what  
6 sort of time span we're looking at till a lunch break.  
7 Thank you.

8 (ADJOURNMENT)

9 COMMISSIONER CHIASSON: Thank you, everyone.

10 Ms. Riley, can you give me an idea of what might  
11 be a reasonable chunk of time -- if we were to look to  
12 go roughly an hour, will that suit for your timing? I  
13 know that the parties have breakout rooms and that type  
14 of thing. If you would like to go shorter, that's  
15 fine. I'm just thinking in terms of the people will  
16 need to be fed at some point.

17 M. RILEY: Yes. We are also part of  
18 those people that would like to be fed.

19 I've discussed it with my co-counsel, and we agree  
20 that the topic that we want to canvass next can be  
21 canvassed in half an hour, so --

22 COMMISSIONER CHIASSON: Okay.

23 M. RILEY: -- so we hope that we'll be  
24 done with that topic at noon, and then --

25 COMMISSIONER CHIASSON: Okay.

26 M. RILEY: -- that might be a good time

1 for a break.

2 COMMISSIONER CHIASSON: And then suggest that we break  
3 for lunch then?

4 M. RILEY: Yes.

5 COMMISSIONER CHIASSON: Okay. Thank you very much.

6 A. MCLEOD: Good morning, Commissioners.  
7 Andrew McLeod, for the record again.

8 This morning I'm going to be canvassing some  
9 evidence with Ms. Lagisquet.

10 Q A. MCLEOD: Now, Ms. Lagisquet, would you  
11 please confirm that the purpose of your appearance in  
12 this proceeding is to speak to the report you prepared  
13 as an independent expert witness in the field of in  
14 situ project development and risk assessment?

15 A A. LAGISQUET: That's correct.

16 Q And would you please confirm that your CV is filed on  
17 the record as part of Exhibit 32.11, which is Tab 7 of  
18 your report and again in Exhibit 38.01, Attachment A?

19 A That's correct.

20 Q And would you please confirm that your CV sets out your  
21 professional qualifications accurately and was prepared  
22 under your direction and control?

23 A Yes.

24 Q And do you acknowledge and confirm that you have a duty  
25 to provide evidence to the Regulator that is fair,  
26 objective, and non-partisan?

1 A Yes.

2 Q And please confirm that Exhibit 32.11, Tab 7 to ISH's  
3 submission, which is your report, was prepared under  
4 your direction and control and that the contents  
5 thereof are accurate.

6 A That's correct.

7 Q Are there any additions that you have to your report?

8 A Yes, Mr. McLeod. I would like to make two additions to  
9 my report.

10 Q Could you just speak closer to your mic?

11 A Yes.

12 Q Thanks.

13 A So they would be -- they would be in Exhibit 32.11,  
14 page 18, paragraph 1313.

15 Q Would you like that brought up on the screen?

16 A If it's necessary.

17 Q Sure.

18 A Otherwise I can just state the changes or the  
19 modifications.

20 A. MCLEOD: Would you please bring up  
21 Exhibit 32.11.

22 A. LAGISQUET: Page 18, please. So I would  
23 like to add risk of direct communication between the  
24 McMurray and Wabiskaw D formations at Cenovus Christina  
25 Lake.

26 Q A. MCLEOD: Okay. And so that is at

1 line 312 there? Is that where you wanted to make that  
2 addition?

3 A No. In the title of the section.

4 Q Oh, I understand. Okay.

5 A Yes.

6 Q And so would you just read into the record again what  
7 you intended that to say?

8 A Yes. So the title of that section needs to read  
9 "Subsurface Steam Loss of Containment -- Containment:  
10 Direct -- Risk of Direct Communication Between the  
11 McMurray and Wabiskaw D Formations at Cenovus  
12 Christina -- Christina Lake".

13 Q Very good. And I think that you mentioned that you had  
14 a second addition?

15 A Yeah. Again, on page 33 now, please.

16 Sorry. It's in the references. So it would be  
17 page 40. Sorry. Line 731. The paragraph needs to  
18 read "Risk of steam breach in Wabiskaw zone at  
19 Christina Lake".

20 Q Okay.

21 A That's all.

22 Q Very good. Thank you.

23 Now, Ms. Lagisquet, what experience do you have  
24 with SAGD solvent injection?

25 A I'm a technology development specialist. I've been  
26 working for the last 20 years in the oil sands industry

1 both at Statoil and Suncor. And during the span of my  
2 career, I've been leading multiple analysis [sic] on  
3 solvent -- solvent-assisted and various other variation  
4 on the steam-solvent processes. I prepared reservoir  
5 simulation studies in that space. I led teams of  
6 development specialists in the commercialization of  
7 various solvent processes. And I led two field pilots;  
8 one at Statoil and one at Suncor.

9 Q Thank you.

10 Now, in relation to the solvent-assist start-up  
11 that you discussed in your report, I believe that  
12 Dr. Boone took exception with some of the example  
13 projects you used in your report to show that  
14 solvent-assist start-up is an experimental process.  
15 Can you comment on the literature view that Dr. Boone  
16 provided in response?

17 A Yes. If we can look at Exhibit 15.01, page 48. And if  
18 we scroll down, I believe, there is the beginning of a  
19 literature review that was provided by Canadian  
20 Natural. Yeah.

21 So Canadian Natural provided a list of field  
22 pilots associated with solvent-assisted start-up, and  
23 they have listed six -- six of them and provided some  
24 details of when they were tested, where they were  
25 tested, and a qualitative analysis of their success.  
26 So if you scroll a little bit more because it's over



1 two pages -- yeah.

2 So what we can see from that literature review is  
3 that there is limited information about  
4 solvent-assisted start-up in the industry. A total of  
5 four -- five operators tested it. Usually they are  
6 tested -- they have been tested in the past on one to  
7 two well pairs. There might be an inference that  
8 Cenovus has tested it on more well pairs. But there is  
9 relatively little information available to actually  
10 make a determination as to whether or not  
11 solvent-assisted start-up is a mature technology at  
12 this point in time. And that's the reason why I  
13 mentioned that, in my opinion, it's still highly  
14 experimental.

15 I'm also saying that because the range of outcomes  
16 that have been observed vary quite a bit, and usually  
17 what that means is that there is residual risk  
18 associated with the technology, and it could be in many  
19 different areas, right. When you de-risk a new  
20 technology, there are various aspects that you are  
21 looking at de-risking. You are looking at de-risking  
22 the technical aspects, you know, how it's going to  
23 behave subsurface. You're also looking at de-risking  
24 the surface technical aspects, how the facilities are  
25 going to behave with the introduction of a product that  
26 is not standard to SAGD operations. And you are also

1 looking at de-risking the economics of the technology.

2 We know that pilots are seldom economic. If you  
3 want to de-risk aspect of the projects, you also need  
4 to de-risk the economics such that at scale it still  
5 makes sense to deploy the opportunity.

6 Q Thank you.

7 Now, you just mentioned that you see CNRL's  
8 approach here as experimental. But CNRL tells us that  
9 they've used solvent-assisted start-up on other  
10 projects in the past and without lost monitoring.

11 So can you tell us what is different about the  
12 proposal that CNRL has before the -- the Tribunal  
13 today?

14 A Yeah. Absolutely. We can go to Exhibit 32.11,  
15 page 32. Sorry. I meant 20.02. Page 141. Yes.

16 So this is a summary that CNRL has provided on  
17 their test to KN01 Well Pair Number 8 and -- but the  
18 only cords they concluded on the last bullet point:  
19 (as read)

20 More piloting is required to commercialize  
21 the hydrocarbon agent enhanced start-up  
22 technology.

23 Now, if you zoom out a little bit, just to orientate  
24 ourself as to where KN01 is located. So we've seen  
25 maps of the Kirby north project development area. KN01  
26 is on the eastern part of the project development area;

1 KN08, KN09 on the western part of the development area.  
2 I think we have already highlighted that there are some  
3 geological differences between the two areas, so going  
4 from the results of one well pair to the  
5 commercialization to -- up to 33 well pairs, you know,  
6 increasing the rates potentially from a hundred cubes  
7 as tested at KN01, 08 to potentially 350 cubes per well  
8 pair, is, you know, a leap in terms of how the  
9 technology is being -- at this point, I would say on  
10 two pads -- being commercialized.

11 Q Okay. And -- and so you pointed out there that CNRL  
12 has come to the conclusion that more piloting is  
13 required to commercialize their hydrocarbon agent  
14 enhanced start-up technology. What -- what would that  
15 involve, in your view?

16 A On the subsurface, if I started with that, as you can  
17 see on this test, they had one well pair that was used  
18 as the pilot well. And I can only guess that the  
19 reason why they selected that well pair is because it  
20 has, you know, similar geology. If you look at the  
21 isopach, they look similar. So that would be used to  
22 compare the performance on the well, what you tested,  
23 the technology versus the performance of the -- of the  
24 well that doesn't have the technology.

25 I haven't seen the plan to have any control wells  
26 at KN08 and KN09. I believe it was mentioned yesterday

1           that an option would be putting it on every other well  
2           pair. Also appreciate that those wells are not drilled  
3           yet, so making a determination today as to how many  
4           control wells you're going to have versus the number of  
5           wells where you're going to test the technology is  
6           difficult. But I think it's -- it's important to  
7           remind ourselves that, yes, those wells are not drilled  
8           yet. So we don't know what we're going to find out as  
9           we drill them; right? And there may be a determination  
10          that either is not necessary to test the technology  
11          there, or there is no value in testing the technology  
12          there because of reservoir considerations, whatever the  
13          case may be.

14    Q    Okay. Now, I'll turn to page 20 of Exhibit 50.03. And  
15          if you can just scroll down a little bit there. I  
16          believe it's the third heading. Actually, let me --  
17          let me walk back just a little bit of that page. Okay.

18                 Okay. So Dr. Boone responded to your definition  
19          of "discontinuities", and -- and he indicates that none  
20          of these examples are discontinuities that would alone  
21          allow fluid migrations from the McMurray to the  
22          Wabiskaw B zone.

23                 Was it your intention in providing those  
24          definitions to suggest that one of those mechanisms  
25          would allow for fluid migration?

26    A    It is possible. I think we've seen through -- or we've

1 heard over the last couple days and we've seen on the  
2 maps that, you know, those confinement interval do  
3 not -- to a large extent, none of them covers the  
4 entire project development area; right? My fellow  
5 panel member this morning also reiterated that. And so  
6 as a result, you know, it is entirely possible that  
7 there are pathways already established that would allow  
8 the migration of either steam or reaction product. I  
9 can bring a map if that's helpful to kind of  
10 contextualize what I'm saying.

11 Q Sure. Yeah.

12 A Can you please bring Exhibit 44.10. Page 15 would be  
13 the last page. Yeah.

14 Okay. And can you please try to centre the image  
15 so that I can see the bottom two. Perfect. Yeah. A  
16 little bit more -- little bit down so that I can see  
17 the header where it starts with "Local Versus  
18 Regional", please. There you go. Perfect. Thank you.

19 And so what we've seen or what we heard  
20 yesterday -- what we've heard with Dr. Fowler this --  
21 this morning is that, you know, at the local scale --  
22 so when you look at it at the core level and you have  
23 your GCMS data, there may be one -- at least one  
24 barrier that you can say is -- is there. And the  
25 challenge is that, you know, life is not 1D; life is  
26 not 2D. We've seen a lot of cores; we've seen a lot of

1 maps. What we're trying to resolve here is the  
2 continuity, like the 3D behaviour of SAGD on this  
3 proposed project development area.

4 So if you go from the local scale to the regional  
5 scale and you put together the information from the  
6 geology, you put together the information from the GCMS  
7 data, what you can conclude is that there are holes  
8 here and there. And what those holes provide for the  
9 steam chamber that I have illustrated at the bottom  
10 of -- of those schematics is the fact that through  
11 those purple lines that are little squiggles, you have  
12 pathways from the McMurray up into the Wabiskaw B for  
13 either steam or reaction products, and that would be  
14 exsolved gas from bitumen or H<sub>2</sub>S due to a  
15 aquathermolysis that could end up contaminating the  
16 Wabiskaw B.

17 Q Understood.

18 Now, I apologize. I kind of got us a little bit  
19 off track of the solvent assist. So we'll turn back to  
20 that. But from what you've been telling us, I mean, it  
21 sounds like there's quite a bit of uncertainty in what  
22 CNRL's plans to do with its solvent assist start-up  
23 commercial test. What additional information or  
24 analysis would you recommend that CNRL do before  
25 proceeding with this -- this commercial scale test?

26 A Well, the -- the whole point of doing a field test is

1 to collect data such that you can calibrate your  
2 simulation models, history match them, and predict  
3 future behaviour.

4 So, you know, one of the first, you know, steps  
5 that we take is actually building a reservoir model. I  
6 don't know if it's available as of yet, but if it  
7 isn't, it's probably something that I would endeavour  
8 to do. Then, you know, once you complete -- once you  
9 do your test, you know, collect data that -- you know,  
10 that can be available -- and in that case, that would  
11 require some monitoring to understand, you know, the  
12 behaviour that is being observed.

13 What -- from what I understand from the way the  
14 test is planned on being conducted is that it's very  
15 temporary. They're going to steam their --  
16 circulate -- circulate their well pairs, inject  
17 solvent, let it soak, produce back, move on to the next  
18 well pairs. So very temporary surface facilities. So  
19 I don't know if there is much to de-risk there, but  
20 there is always an aspect of -- you bring a new product  
21 to your pad. That introduces a risk; right?

22 So ensuring that the surface facility is  
23 compatible with the technology that you want to test, I  
24 think, is an important aspect, especially in terms of  
25 scaleup. I don't know if they would necessarily follow  
26 the same implementation. Like, it sounds like they

1           might be trucking the -- the solvent.  It's not  
2           entirely sure to me if it's going to be a -- a solvent  
3           bullet or if it's going to be a number of trucks that  
4           you're going to bring back and forth until you're done  
5           that stimulation.  But no matter what you do, as I  
6           said, the whole point of doing a test, it's to collect  
7           data; and to get data, you need to have some form of  
8           monitoring.  Without more information about how the  
9           test is going to be conducted, how many well pairs,  
10          what are going to be the ultimate volumes injected in  
11          the ground, it's -- it's challenging for me to -- to  
12          establish how they could, you know, further de-risk  
13          their -- their activities and as a result comment on  
14          any more tests, but I'll leave it at that.

15        Q    Okay.  Thank you.

16                    Now, one other question I've got for you -- and I  
17                    don't know much about these -- these chemicals, but I  
18                    understand that ISH already uses xylene in its  
19                    gas-recovery operations.  So how does that differ from  
20                    what CNRL is proposing?

21        A    Yeah.  I think if you could go to my report.  It would  
22                    be -- let me check -- Exhibit 32.11, page 26, Table 4.  
23                    Yes.  So the bottom part would be the table.  Yeah.

24                    So, you know, to -- to get a sense of the scale of  
25                    hydrocarbon solvent that might be injected during the  
26                    solvent-assisted start-up, I was, you know, looking at



1 ranges. So it is mentioned that KN08 could have, you  
2 know, a minimum of 20 -- 18 well pairs, maximum of 24.  
3 KN09 might -- might have 7 to 9 well pairs. So, you  
4 know, the range is 25 to 33 well pairs. So at a -- at  
5 a max rate as is currently proposed up to 350 cubes per  
6 well pair, it would be, you know, 9,000 to 12,000 cubes  
7 that would be injected, roughly, and I'm rounding up  
8 here. If you want an order of magnitude, it's, you  
9 know, pretty visual. It's like, you know, three to  
10 five Olympic pool size. So that would give you an idea  
11 of the volume.

12 What ISH uses for their wells is .5 litres. So,  
13 like, in terms of scale, it's -- it's absolutely not  
14 comparable.

15 Q So, like, quarter of a pop bottle versus --

16 A Yeah, pretty much.

17 Q -- three to five swimming pools?

18 A Yes.

19 Q Okay.

20 A Yeah.

21 Q I understand.

22 Now, the last question that I have for you -- if  
23 we can turn to Exhibit 50.002 at page 44.

24 All right. So one of the -- the issues that CNRL  
25 has raised with the solvent loss monitoring that you've  
26 recommended is the -- the cost. And -- and they've

1 suggested that it would be about \$2-and-a-half million  
2 to do this monitoring for 90 days.

3 Now, in your experience as an in situ project  
4 development expert, how do the figures in this table,  
5 and specifically the figures associated with -- with  
6 solvent loss monitoring, compare with the expected  
7 total installed cost for a well pad of this nature?

8 A It's minimal. I would say the infrastructure for a  
9 well pad would be upwards of 200 million, so --

10 Q Okay. So --

11 A -- this would be minimal.

12 Q Talking about a drop in the bucket then?

13 A Yes, pretty much.

14 Q Okay. Thank you.

15 Do you have any other comments about the  
16 solvent-assist start-up that is being proposed? And  
17 it's okay if you don't have any.

18 A No. I would say -- we looked yesterday briefly at the  
19 plot plan. I didn't review the plot plan in -- in much  
20 details because I think there was only limited  
21 information. I would say as you introduce -- as -- as  
22 I mentioned before, as you introduced a new product to  
23 your facility, there is a certain amount of usually  
24 surface modification that is required.

25 So, again, everything is a risk-based decision;  
26 right? When you -- when you develop a project, you

1 start your project development, and you initiate a risk  
2 matrix; right? And so as you do that, you identify the  
3 areas that are, you know, risky or maybe things you  
4 don't know about that introduce uncertainty. As a  
5 result, it creates a risk. I would say it's the only  
6 area that I haven't looked into much detail that I  
7 would say could introduce a risk relative to the other  
8 pads where that technology hasn't been tested.

9 Q Okay. Well, we can talk a little bit more about risk  
10 after lunch, but it sounded like you're saying that  
11 there's a specific risk with xylene that you didn't  
12 consider?

13 A Xylene or any kind of solvent. You know, there is --  
14 like, every product has an auto ignition temperature as  
15 well as flash point. And so, you know, again, as you  
16 introduce a new product to a facility, depending on how  
17 they are designed, they may or may not be able to  
18 handle that new product, and that's why you would do  
19 surface facilities. I haven't looked at this in much  
20 detail because there is not much information about it  
21 in this material, but I would say that's an area that,  
22 yeah, I would have liked to look more into the details.

23 Q Very good. Well, those are all my questions about  
24 solvent-assist start-up.

25 A. MCLEOD: So, Commissioner Chiasson, I'm  
26 ready to go for lunch.

1 COMMISSIONER CHIASSON: As I suspect are most of the  
2 people in the room. So thank you very much. We will  
3 break now for lunch and return at ten past 1.

4 \_\_\_\_\_

5 PROCEEDINGS ADJOURNED UNTIL 1:10 PM

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1 Proceedings taken at Govier Hall, Calgary, Alberta

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3 February 8, 2024 Afternoon Session

4

5 Cindy Chiasson Panel Chair

6 Brian Zaitlin Panel Member

7 Meg Barker Panel Member

8

9 William McClary AER Legal Counsel

10 Shannon Peddlesden AER Legal Counsel

11 Andrew Lung AER Staff

12 Denise Parsons AER Staff

13 Anastasia Stanislavski AER Staff

14 Fahad Hamdan AER Staff

15 Maryam Rahimabadi AER Staff

16 Susan Harbidge AER Staff

17 Maksim Khaferllari AER Staff

18 Felix Chiang AER Staff

19 Scott Botterill AER Staff

20 Baohong Yang AER Staff

21 Elwyn Galloway AER Staff

22

23 J.P. Jamieson For Canadian Natural

24 Resources Limited

25

26

1 M. Riley For ISH Energy Ltd.

2 A. McLeod For ISH Energy Ltd.

3

4 S. Murphy, CSR(A) Official Court Reporter

5 S. Burns, CSR(A), RPR, CRR Official Court Reporter

6

7 (PROCEEDINGS COMMENCED AT 1:13 PM)

8 COMMISSIONER CHIASSON: Okay. It looks like we have  
9 everyone we're expecting to see here. So welcome back.

10 So, Ms. Riley, Mr. McLeod -- and this is not to  
11 pressure you in any way -- I just ask in terms of if  
12 you can give me an idea of what you anticipate for your  
13 timing on your direct, and it's more so I ask because  
14 we need to make sure, depending on our timing, that our  
15 court reporters get the opportunity to have the break  
16 and switch over their pieces of -- their bits of what  
17 they're doing, and that, so ...

18 M. RILEY: We discussed that during the  
19 lunch adjournment, Mr. McLeod and I, and he will be  
20 done with what he needs to do by about half past 1.  
21 Then I intend to move over to Dr. Chalaturnyk, and he  
22 should be done by 2, perhaps shortly after 2, because I  
23 see it's now almost quarter past. So five or ten  
24 minutes after 2 at the most.

25 COMMISSIONER CHIASSON: And -- and that takes you to  
26 the end of your direct, then?

1 M. RILEY: Correct.

2 COMMISSIONER CHIASSON: All right. Thank you. So you  
3 said about quarter past 2 or so?

4 M. RILEY: At the very latest.

5 COMMISSIONER CHIASSON: All right. So then,  
6 Ms. Jamieson, would you be looking to have a break  
7 before -- before you start your cross-examination,  
8 then?

9 J. JAMIESON: That would definitely be  
10 appreciated.

11 COMMISSIONER CHIASSON: All right.

12 J. JAMIESON: 15 or 20 minutes is all we  
13 need.

14 COMMISSIONER CHIASSON: All right. Let's -- let's  
15 plan, then, that we will go -- go 'til ISH is done with  
16 their direct, and then we will -- we'll take a break,  
17 and we'll check in with you then on the -- on the  
18 optimum time, if that time window still -- still works  
19 for you, and we will plan to take a break then.

20 J. JAMIESON: Thank you.

21 COMMISSIONER CHIASSON: Super. Thank you all thank  
22 you so much.

23 So, Mr. McLeod, I think we're back to you then.

24 A. MCLEOD: Thank you, Commissioner  
25 Chiasson, and good afternoon.

26 MARTIN FOWLER, BRAD BARRIE, AURELIE LAGISQUET, RICK

1 CHALATURNYK, JOHN CHODZICKI, Previously Sworn  
2 KRISTOFFER VICKERMAN, Previously Affirmed  
3 Direct Evidence of ISH Energy Ltd. Witness Panel

4 Q A. MCLEOD: I'm going to proceed now to  
5 discuss the evidence surrounding the risk assessments,  
6 and in -- in that respect, Ms. Lagisquet, would you be  
7 able to -- actually, let's bring up an exhibit first.

8 A. MCLEOD: Shall we bring up  
9 Exhibit 50.003 at page 20?

10 Q A. MCLEOD: All right. So, Ms. Lagisquet,  
11 I apologize. I've been just waiting to mess that up  
12 all morning.

13 So as I understand it, Dr. Boone, in his -- in his  
14 first report, conducted an informal risk assessment.  
15 You conducted a formal risk assessment under the APEGA  
16 guideline, at least with respect to some of the risks  
17 on this project, and Dr. Boone responded with this  
18 revised risk assessment that I've brought up on the  
19 screen here. So I'm wondering if you can comment on  
20 Dr. Boone's risk assessments.

21 A A. LAGISQUET: Yeah. I can to some extent,  
22 but I would say that we probably focused on different  
23 areas of the risk. If I understand it well, what  
24 Dr. Boone was focusing on is -- was whether or not  
25 there were -- there were faults or fractures present,  
26 and I don't take that into account in my -- in my risk



1 assessment. I do highlight the presence of  
2 discontinuities, and those could be many different  
3 things, right. We've seen it over the last couple of  
4 days, and as I said earlier this morning, we've seen  
5 that from the map.

6 We -- we don't see a continuous layer over the  
7 project development area. The GCMS data validates  
8 that. We don't have an idea of the lateral continuity  
9 of barriers when they exist. You know, they could be a  
10 risk of, you know, induced fractures during start-up,  
11 depending on the MOP. So I -- I took a broader  
12 approach to risk assessment rather than focus on the  
13 very -- on a narrower kind of assumption that there  
14 would or wouldn't be fractures or faults.

15 Q Okay. Now, if we turn to page 22 of this same exhibit.  
16 I believe here Dr. Boone has mentioned that he's taken,  
17 I think, three likelihood credits on -- on this risk,  
18 and I'm wondering if you can comment on the  
19 appropriateness or -- or the -- whether -- whether you  
20 too would have taken those three likelihood credits?

21 A Yes. So I think you are pointing to Risk Number 2,  
22 Bullet Point 4 --

23 Q Yeah.

24 A -- and three likelihood credits are taken for the  
25 presence of leak of barriers, stress barriers in  
26 proximity to gas well. I would say that the first two

1 would be subsurface considerations, and I think there  
2 is still quite a lot of uncertainty around the  
3 subsurface to kind of be able to assert that there  
4 would be leak of barriers or stress barriers.

5 Proximity of a gas well, I think Dr. Boone and I  
6 had a bit of back-and-forth around, you know, whether  
7 monitoring wells are a way to prevent the risk, and I  
8 think he made it clear in his report answering my risk  
9 assessment that it's not a good way to prevent the  
10 risk, which I agree with, and I haven't taken any  
11 likelihood credit for, you know, the addition of an  
12 observation one or gas monitoring well.

13 So I think it's extreme in this case to take three  
14 likelihood credits.

15 Q Okay. Now, if we just turn to the next page, page 23.  
16 So I see here under the -- the second risk that  
17 Dr. Boone initially graded this as a likelihood of 4,  
18 and -- and after taking the likelihood credits, the --  
19 the likelihood is reduced to 1?

20 A M-hm.

21 Q And so I guess out of these three risks -- sorry. Let  
22 me approach that in a slightly different way. The --  
23 the most likely risk that Dr. Boone identified was Risk  
24 Number 2. You'll agree with me?

25 A Correct.

26 Q And -- and if he hadn't applied these three likelihood

1 credits, ultimately the -- the likelihood of this risk  
2 would not have been reduced to a white risk?

3 A Yeah. That's correct.

4 Q All right. Thank you.

5 Now, what were the risks you identified and -- and  
6 assessed for this proposal?

7 A Yeah. So I took a broad approach to -- to risk  
8 assessment, and I considered various variable,  
9 including the uniqueness of the geology, namely, the  
10 presence or absence of discontinuities providing a  
11 pathway to steam or a reaction product migration  
12 upwards.

13 I looked also at the uniqueness of the situation.  
14 We're looking at GOB shut-in wells above the proposed  
15 development area. There's a presence of thick bitumen  
16 pay in the Wabiskaw D directly adjacent to the McMurray  
17 bitumen in the proposed development area. The lack of  
18 control wells in -- in KN09 and also in KN08 was taken  
19 into account. I looked at the fact that, you know,  
20 there isn't a clear strategy on the MOP, and through  
21 the various submissions, there was clarification that  
22 was attempted to be provided, but I don't know if we --  
23 we have a better understanding of what the MOP is going  
24 to be, how the temporary MOP is going to be used.

25 I also took into account the scale-up of the  
26 start-up technology that is not commercially proven --

1 proven, and also looking at the risk assessment  
2 holistically, right. I think in Dr. Boone's report  
3 there was an attempt to look at what happens around the  
4 start-up, and that is relevant, but I looked at the  
5 start-up as well as what could happen over the 20-plus  
6 years of SAGD operations, and that's what drove, you  
7 know, how I developed the -- my risk assessment.

8 And so from that, I identified three main risks,  
9 and you may want to bring up my table.

10 Q Sure. Yeah. We'll bring up Exhibit 32.11.

11 A And as we do so, I can -- I can go through the risk.  
12 So the first risk that I identified was the risk to  
13 ISH's gas shut-in assets over the lifetime of SAGD  
14 operations at KN08 and KN09. I looked at the risk to  
15 ISH's assets due to long-term consequences of  
16 high-pressure SAGD start-up at KN08 and KN09. And the  
17 third one that I looked at was the risk to ISH's  
18 shut-in assets due to xylene losses in the reservoir  
19 due to high-pressure hydrocarbon-assisted SAGD start-up  
20 at KN08 and KN09. And so what's important to -- to  
21 highlight here --

22 Q Sorry. Let me -- I'll just interrupt you for a  
23 moment --

24 A Yes.

25 Q -- so that I can get Tab 7 brought up, which is PDF  
26 page 33. Is that the -- the table --

1 A Yeah, that's right.

2 Q -- you wanted to discuss?

3 A Yeah. Or if you want to go to the table above, that  
4 is, you know, the summary, basically, of the risk  
5 assessment, so the one with the -- the dots.

6 Q Sure.

7 A Yeah. Right. So when you evaluate the risk, you look  
8 at the likelihood of that risk; you look at the  
9 consequence of that risk, and you determine based on  
10 your inherent risk if you need to mitigate it, and if  
11 you do, what are relevant mitigating strategies to  
12 prevent or reduce the risk, and depending on what you  
13 identify, you can lower the likelihood of that risk  
14 happening, and that moves you from the left to the  
15 right in -- in your risk map.

16 So after I took some -- identified some mitigation  
17 strategies, which were primarily acquiring additional  
18 strat wells to delineate, you know, the areas where  
19 there is little well control in the KN09 area in  
20 particular because there is uncertainty around where  
21 the mid-B1 mudstone is actually deposited, and also by  
22 lowering the MOP during start-up and throughout the  
23 life of the SAGD operations, I was able to take either  
24 one or two likelihood credits to lower my -- my risk  
25 profile.

26 Q Perfect. And it sounded like from what we heard

1           yesterday from CNRL that you and they agree that  
2           reducing the MOP will have an effect on the risk?

3    A    Yes.  Correct.  That's what I heard too, but I don't --  
4           I don't think I heard the technical justification for  
5           lowering the risk from 6,000 kPa to 55 [sic] kPa.  So,  
6           yes, lowering their MOP, generally speaking, might  
7           lower your risk, but what I'm most interested in is  
8           understanding the technical justification to propose to  
9           lower the MOP.

10   Q    Okay.  Now, if we just turn to Exhibit 50.03 at  
11           page 21, so I think that you've already told us that --  
12           that you and Dr. Boone evaluated different risks.  Now,  
13           for -- for Risk Number 1 that Dr. Boone identified, I  
14           see that under the "Consequence", he notes that the  
15           consequence is somewhere -- is a financial consequence  
16           somewhere between 274,000 and \$711,000.

17                 Can you comment on -- on the -- whether -- whether  
18           that value is -- is a realistic one to use for this  
19           risk?

20   A    I mean, he -- Dr. Boone justified his -- his numbers,  
21           but I would disagree with those numbers, given the  
22           valuation that ISH provided on their shut-in gas  
23           assets.  I would also highlight the fact that when you  
24           conduct a risk assessment, you're trying to understand  
25           the inherent risk, you know, based on, you know, the  
26           controls you have, and there is no control here.

1 That's what we are talking about. You know, there is  
2 no control.

3 So it's fair to assume that without any control  
4 over the life cycle of the -- those two drainage boxes,  
5 it is fair to assume that the entire value of those  
6 asset would be lost if they were contaminated because  
7 you have no way to know what's happening.

8 Q And -- and is it reasonable to have first discounted  
9 the value of those assets for 20 years, or ...

10 A My understanding is that the valuation, as ISH provided  
11 it, is consistent with the way you value reserves.

12 Q Okay. So, in other words, once you know that a reserve  
13 exists, you've produced some of it, and then it's been  
14 shut in, you don't apply a discount to the -- the  
15 remaining value?

16 A Correct.

17 Q Okay. Now, the one last thing that I wanted to ask you  
18 about is -- and I think that you briefly covered this  
19 before, but Dr. Boone asserts that monitoring itself is  
20 not a mitigation. What are your thoughts on that?

21 A Yeah. I tend to agree with that statement. However,  
22 if you do have monitoring and you get data that  
23 indicates that something is happening, then you can  
24 take actions -- potentially modify your operating  
25 strategy to lower the risk -- and as a result you don't  
26 prevent the risk, but you lower the financial

1 consequence associated with the risk.

2 Q Right. So producing information isn't useful, but  
3 reviewing that information and doing something with it  
4 is?

5 A Yes.

6 Q Thank you.

7 Now, those are all my questions on the risk  
8 assessment unless you had anything that you wanted to  
9 add.

10 A Yeah. Maybe something that I would like to add is,  
11 like, even though Dr. Boone and I potentially disagree  
12 on how we conducted the risk assessment, what I did  
13 notice through the submissions is that CNRL actually --  
14 Canadian Natural -- sorry -- actually leveraged some of  
15 the mitigations that I had identified; namely, you  
16 know, drilling additional strat wells to, you know,  
17 lower the subsurface uncertainty as well as lowering  
18 the -- the MOP. So that tells me that -- somehow that  
19 my assessment is -- is validated by Canadian Natural.

20 Q Very good. Thank you.

21 Now I'm -- I have very few questions for  
22 Mr. Chodzicki.

23 Mr. Chodzicki, will you please confirm that the  
24 purpose of your appearance in this proceeding is to  
25 opine or speak to the thermal compatibility issues as  
26 well as the 10-1 well?



1 A J. CHODZICKI: That is correct.

2 Q Okay. And my friend Ms. Riley indicated this morning  
3 that we have covered the thermal compatibility issues,  
4 so I'm not going to ask you a bunch of questions about  
5 that nor about the 10-1 well.

6 A Okay.

7 Q But can you please confirm that your CV is filed on the  
8 record as part of Exhibit 38.01, Appendix E?

9 A Yes, it is.

10 Q And would you please confirm that your CV sets out your  
11 professional qualifications accurately and was prepared  
12 under your direction and control?

13 A Yes, that is correct.

14 Q And, Mr. Chodzicki, you're available to speak to the  
15 concerns with the 10-1 well and Hearing Issue 5, if  
16 needed?

17 A That is correct.

18 Q Very good. Those are all my questions.

19 Q M. RILEY: Dr. Chalaturnyk, we now turn  
20 to you last but not least. Sorry. I'll just bring  
21 this closer.

22 Please confirm that the purpose of your appearance  
23 in this proceeding is to speak to the report you  
24 prepared as an independent expert witness as well as  
25 the other evidence filed on the record in the field of  
26 geomechanics.

- 1 A R. CHALATURNYK: I -- I confirm.
- 2 Q Please confirm that your updated curriculum vitae as  
3 filed on the record is part of Exhibit 61.001?
- 4 A That's correct.
- 5 Q Please confirm that your updated CV sets out your  
6 professional qualifications accurately and was prepared  
7 under your direction and control.
- 8 A It was.
- 9 Q Do you acknowledge and confirm that you have a duty to  
10 provide evidence to the Regulator that is fair,  
11 objective, and non-partisan?
- 12 A I can confirm that.
- 13 Q Please confirm that Exhibit 32.10, Tab 6 to the ISH  
14 evidence, your report, was prepared under your  
15 direction and control and that the contents thereof is  
16 accurate?
- 17 A It is, subject to a few corrections that are provided  
18 in the Exhibit 47.002, which was ISH's reply to CNRL's  
19 geomechanics IRs. Other than that, it's correct.
- 20 Q CNRL filed geomechanical modelling in response to  
21 information requests by the AER. CNRL has also  
22 indicated that, in its view, the material above KN08  
23 and KN09 is in a stress state and will not exhibit  
24 brittle behaviour. Please provide the Panel with your  
25 comments on these issues.
- 26 A Thank you. Thank you, Ms. Riley.

1           Good afternoon, Commissioners Chiasson, Barker,  
2           and Zaitlin. I -- I do know the schedules have been  
3           adjusted slightly to provide an opportunity for  
4           cross-examination for me, so I do very much appreciate  
5           that, and I will try and be as -- as -- as quick as I  
6           can.

7           If I can -- if I can bring up Exhibit 46.002,  
8           page 38. And -- and just as it's coming up, let me  
9           provide a little bit of context. In the first initial  
10          review of the evidence provided by CNRL, there was a --  
11          a great deal of effort and -- and I think, quite  
12          appropriately, a great deal of effort -- and we heard a  
13          great deal of that evidence yesterday -- on conclusions  
14          and evidence provided around fracture containment  
15          behaviour of the McMurray formation under short-term  
16          conditions, 48 hours, days, 6.6 MPa, and also a  
17          conversation around work that was done for caprock  
18          integrity, which in general is the Clearwater clay  
19          shale, Wabiskaw shale caprocks overlying the entire --

20          THE COURT REPORTER:           Can you slow down a bit,  
21          please.

22          A    R. CHALATURNYK:           I'm going too fast? Okay.  
23          Yeah.

24                 The Clearwater and Wabiskaw shale form caprocks.  
25                 In reviewing the information, in fact, I -- I didn't  
26                 see any issues with that. What I did find, given the

1 condition -- the questions for the hearing which had to  
2 do with whether there was the potential for fluid  
3 migration from the SAGD chambers through the  
4 confinement strata into the Wab B gas pool is that what  
5 I found absent in that original information was a  
6 conversation or evidence that talked about how those  
7 zones would behave under the change in pore pressures  
8 and deformations that would occur from SAGD over the  
9 lifetime of the SAGD project.

10 So it -- it was with some of the geo --  
11 geomechanical modelling that was -- was put forward  
12 that attempted to speak to that issue, but the  
13 geomechanical modelling as well was presented to  
14 support the issue around fracture containment and  
15 caprock integrity.

16 And so what I'd like to do as a part of this  
17 direct evidence is offer some observations on that  
18 modelling and some observations on brittle ductile  
19 behaviour, which -- it was noted by Dr. Boone, and I  
20 agree that it -- it's an important subject at the  
21 moment given the paucity of -- of direct evidence over  
22 KN08 and KN09 and -- and some general observations  
23 around in situ stress.

24 And so for this figure that's up on the screen for  
25 geomechanical modelling, this does represent a -- a  
26 standard accepted workflow for caprock integrity.

1 You -- you look at the three-dimensional geology of the  
2 condition here and you extract a 2D cross-section,  
3 which you can see in the dotted line and -- and clearly  
4 labelled in the -- in the image, and you build an -- an  
5 assessment, and you run simulations to look at -- at --  
6 at how stresses change in the caprock, and you ensure  
7 that those are meeting the requirements of your  
8 project.

9 One of the issues with extracting a 2D section  
10 like that when you turn your attention to the detailed  
11 mechanics of the confinement strata is that you're left  
12 with some generalizations that make it very difficult  
13 to try and interpret how those geomechanical responses  
14 affect the behaviour of the confinement strata.

15 And -- and to just touch on that, if I could bring  
16 up 46.002, page 42. And -- and the top image is fine;  
17 it's permeability.

18 But what that image does show was the lithological  
19 distributions that were assumed for that 2D model. And  
20 what you can notice in the model, the -- the dark red,  
21 is -- is the McMurray. It -- it -- it pretty much  
22 assumes that the McMurray properties and the -- and the  
23 lithological heterogeneity within the McMurray is -- is  
24 homogeneous. But you can see in the upper zones, the  
25 lower B1, the -- the interpretation of the mid-B1  
26 mudstones, the upper B1s, those are assumed to be

1 continuous all the way across the model, and we'll --  
2 we'll see in a minute the table of properties that each  
3 of those lithological units have been assumed to have  
4 constant properties.

5         And so what -- what I wanted -- what I want to  
6 draw your attention to and why I think this is a  
7 particular issue when it comes to looking at the  
8 details of fluid movement through the confinement  
9 strata is that where I have the mouse -- if you look at  
10 this elevation about two -- minus 220 -- I think it's  
11 about 224, and if we look just at the -- for instance,  
12 just as an example, the lower B1, and you look at the  
13 grid blocks that were used there, the vertical  
14 resolution of that grid block is on -- on average --  
15 others change, but let's say 2 metres. So this is that  
16 very first interval when the rising steam chambers,  
17 rising pore pressures from the SAGD process, you know,  
18 will contact these zones. And that's -- that's roughly  
19 in that -- in that 2-metre zone.

20         So -- so beyond the issues of treating the  
21 properties, if we just go back again to the -- page 38.

22         So if you just keep in mind that image that just  
23 disappeared and you look at the 2D cross-section, that  
24 dotted line that was chosen, when -- when we do  
25 modelling in that 2D cross-section, what that does or  
26 what that means is that for the interpretation on that

1 section -- many more sections could be chosen, but for  
2 this particular instance, it assumes that the  
3 properties in that section are equal in all directions.  
4 They're equal all the way to the bottom left, and  
5 they're equal all the way to the bottom -- upper right.  
6 So that cross-section is assumed -- if I look at the  
7 results of that cross-section, the behaviour that I'm  
8 going to get from it, I'm going to -- at this  
9 particular point, I would make the -- the assumption  
10 that I'm -- I'm thinking that the behaviour is equal  
11 all the way across this site. And that clearly is not  
12 going to represent the three-dimensional heterogeneity  
13 and the geology of the confinement strata that has been  
14 given in a range of evidence by CNRL and evidence this  
15 morning by my colleague Brad this morning. So that  
16 degree of heterogeneity isn't reflected in -- in the  
17 model.

18 So if we could go back again to that page 42 since  
19 it's in the same section. And I just draw your  
20 attention again to this 2 metres-ish roughly here in  
21 terms of the height, and if I could bring up  
22 Exhibit 50.003, page 50.

23 W. MCCLARY: Dr. Chalaturnyk, if I could  
24 please just remind you when indicating on slides to  
25 use a visual cue on the slide. Thank you.

26 A R. CHALATURNYK: Thank you. Thank you.

1           So we've seen this in the evidence provided for  
2 geological interpretations across the site, but what  
3 I'd like to do is point out, and I'm -- I'm pointing to  
4 the well 1 of AC/07-03. If you could scroll down just  
5 a little bit. And -- and if you like, for -- for  
6 visual reference -- I can't see the number down below.  
7 The one in the bottom right-hand corner I am pointing  
8 at, which is 1AD/04-02. And these wells are more or  
9 less in the -- in the location where the 2D  
10 cross-section was chosen for the modelling study.

11           And so in looking at -- and -- and I'm just  
12 pointing at the 07-03. You can look at the variability  
13 in the sand and the shale distributions. If you look  
14 at the well in the lower right, the 04-02, which I'm  
15 pointing at, you can also see a difference in -- in the  
16 lithological distribution of the shale and the sand  
17 lithologies.

18           And the -- so the challenge becomes that when you  
19 take the 2-metre element that I had chosen before that  
20 says the -- the -- the upper B1 and I look at this kind  
21 of heterogeneity, I have to upscale those  
22 characteristics. I need to -- I need to make some  
23 decision about -- if -- if I say 07-03, which I'm  
24 pointing at, if I stack those core, that's roughly a  
25 1.75-metre height. So from a variability point of  
26 view, you could think that this variability has to sit



1 within that one grid block.

2 And when you upscale the properties, you basically  
3 have to homogenize that heterogeneous behaviour. So I  
4 assume average properties; I assume a Young's modulus;  
5 I assume -- but what happens is for the -- for the  
6 determination of potential leakage pathways through  
7 these systems is that by homogenizing that layer, I  
8 can't extract the detailed failure mechanisms that  
9 happen in this heterogeneous material with an upscaled  
10 homogeneous-type element.

11 So when I'm looking at the test -- or the  
12 simulation results, it's very difficult to try and  
13 understand how pore pressures and deformations affect a  
14 homogeneous upscaled element and -- and try and  
15 understand the detailed mechanisms that might lead to  
16 migration pathways through this heterogeneous interval.  
17 And now this becomes true for the complete confinement  
18 strata. Each of the elements in each of the major  
19 lithological zones all had to be upscaled.

20 So, for instance, if we -- if you could go back to  
21 Exhibit 46.002, page 43, which is Table 1. And I --  
22 and I will apologize that this is not the updated  
23 table, but that -- that -- that's okay. There was a  
24 submitted updated table that primarily adjusted the  
25 maximum horizontal stress. But really what I wanted  
26 to -- to -- to point your attention to was the --

1 the -- the last -- the second column, if you like,  
2 which is the Young's modulus.

3 So this is what happens in -- in upscaling is I --  
4 I need to make a determination of the upscaled modulus.  
5 And in this particular case, these zones have all been  
6 upscaled to an average Young's modulus of 500 MPa. We  
7 know there's variability in the geology. We know  
8 there's variability in the shale sand divisions, yet  
9 the stiffness, which controls issues around deformation  
10 and how the -- how the behaviour stress changes that  
11 are going to occur towards failure have just been all  
12 upscaled to a single value, which hides what the  
13 influence would be of that heterogeneity.

14 And to give you a sense of what that means  
15 relative to this SAGD process, if I could bring up --  
16 go back to Exhibit 46.002 on page 51, PDF page 51.

17 So -- so this is a -- I think if you scroll down  
18 to time period 6.8 years, yes, which is two thousand --  
19 yeah, just the lower one. And that's okay. That's --  
20 that's good enough.

21 So I'm just pointing to the time scale here. We  
22 could -- you know, you could look at the just over  
23 three-year time scale or -- or if we just do look at  
24 the -- the bottom one, which is 6.8 years, which is,  
25 you know, roughly in that half of the -- half of the  
26 SAGD pilot phase, what you see in the results that come

1 out of the modelling is the predicted distribution of  
2 the steam chamber, which is primarily the red zone, and  
3 the -- and the heating that is occurring around the  
4 boundaries and up into the confinement strata.

5 And so now what you see is a very uniform steam  
6 chamber development because of the assumed homogeneous  
7 properties of the McMurray, which is typically for  
8 caprock integrity studies, is the kind of thing you  
9 would do, but the question here is: What are the  
10 detailed mechanisms -- potential mechanisms for fluid  
11 migration through the confinement strata.

12 So these uniform steam chamber developments don't  
13 reflect the kind of complex steam chamber development  
14 that will happen when you include the heterogeneity in  
15 the McMurray. And -- and people see it -- see it in a  
16 whole range of SAGD projects, even in -- as they do 3D  
17 and 4D time-lapse seismic data.

18 But the other thing you can see is that because of  
19 this uniform distribution, these homogeneous properties  
20 that are assumed in this confinement strata then don't  
21 reflect the complexities of both this Delta T, which  
22 will affect deformations, thermal-induced stresses.  
23 And if you just flip to page -- same -- same document  
24 but page 49, so it's just back two. Yes. So -- yeah,  
25 flip down to the -- thank you very much.

26 So if we look at the same time frame, 6 point --

1 6.8 years, this is the assumed or -- or computed pore  
2 pressure distribution up into the confinement strata.  
3 And I'm pointing my mouse now at -- at this -- this --  
4 this one -- lower B1 that I was pointing to in terms of  
5 the heterogeneity and the upscaling. And you can see  
6 that there's an upward migration of pore pressure, and  
7 the pore pressure rises.

8 Well, those pore pressures, in a -- in a  
9 homogeneous element, hides the complexity in which pore  
10 pressure changes in the heterogeneous elements of sand  
11 and shale units, how those would migrate under the  
12 loading conditions.

13 And so it makes it difficult in -- in this  
14 particular modelling and the results that were  
15 presented to try and decipher detailed mechanisms and  
16 how migration pathways may evolve over the lifetime  
17 of -- of the SAGD project.

18 The -- the other thing -- and this is less of  
19 an -- an issue with -- with the modelling, per se, but  
20 these results were presented for an operating condition  
21 of 4,000 kPa -- I'm not worrying about the short-term  
22 6.6 -- 6,000 -- I don't have an issue with the fracture  
23 containment -- is that these were -- these were  
24 conducted for the long-term SAGD project of 4,000 kPa,  
25 4 MPa, but there's been lots of discussion around the  
26 approval for a temporary MOP of 5,500 kPa. 5,500 kPa

1 brings with it a higher steam temperature, a higher  
2 pore pressure gradient up and into these confinement  
3 strata, and so, yes, there are the operational  
4 challenges that were discussed by CNRL, which are real,  
5 having to balance against bottom water, absolutely.

6 But there is the potential, given the approval of  
7 5,500 kPa that if, for some reason, in that  
8 heterogeneous geology over KN08 and KN09 that, in fact,  
9 the communication with the bottom water is not as  
10 actually prolific as it's expected to be, there may be  
11 instances where you may want to actually operate at a  
12 higher pressure, maybe up to the 5,500, but it might be  
13 some modest number above 4.

14 And so what happens is at this point, this  
15 modelling, again, doesn't help us inform what might  
16 happen in these scenarios with the confinement strata  
17 that would speak to this issue of fluid migration up  
18 and into the Wab B gas pools.

19 So if I could -- and I'll just make a transition  
20 to the second topic, but if you could bring up  
21 Exhibit 47.002, pages 20 and 21. And the reason for --  
22 for bringing this up is to make the transition to the  
23 conversation around brittle and ductile behaviour.

24 So in response to some IRs, information requests,  
25 from CNRL, there was -- there was a conversation  
26 around, you know, what was -- what evidence did I have

1 that suggested that the behaviour for this class of  
2 materials, the mud-dominated or fine-grained horizons  
3 within the confinement strata, exhibited a brittle  
4 response? And by "brittle" in this context, it was  
5 interpreted to mean what we refer to as a "strained  
6 softening response", and just by pointing to the stress  
7 strain curve, which is the upper curve, this post-peak  
8 strain softening response, which was also spoken to in  
9 the -- in the modelling report, is that underloading  
10 the material will reach a peak strength and under  
11 continued loading and straining, the strength will drop  
12 off. It will decrease to some post-peak value that is  
13 lower. That's typically what we refer to as a "brittle  
14 response".

15 And in the testing as a part of the IR,  
16 information request, I gave full stress strain and  
17 volumetric strain data. The volumetric strain data is  
18 in the bottom that talks to how the volume change of  
19 the material will change as these materials are  
20 stressed and strained under a triaxial test.

21 And so -- so -- so the issue is that there was an  
22 argument or a discussion now around what these tests  
23 meant relative to KN -- KN08 and KN09, and if we -- if  
24 we flip to Exhibit 50.003, page 26. In an effort to  
25 sort of look at this relative to KN08 and KN09,  
26 Dr. Boone adopted a -- a particular technique to look

1 at what the transition might be between brittle  
2 behaviour and ductile behaviour and had presented this  
3 figure in his report and -- and primarily utilized a  
4 reference that was provided -- I think it might  
5 actually be on the next -- next page or upper portion,  
6 the Ingram Urai 1999 approach to look at issues around  
7 brittle/ductile transitions.

8         And primarily if you look in this upper figure,  
9 what happened was, is that the -- the approach looks at  
10 the triaxial data and takes the volumetric strain  
11 component of that triaxial data and plots that versus  
12 the effective stress, so the effective stress I'm  
13 pointing to is the 'X' axis, so it's a range of  
14 effective stresses that the testing was conducted at,  
15 and the vertical axis is the volumetric strain that  
16 occurred during the lab tests.

17         And so he plots using a series of data that we had  
18 provided, a public triaxial test data that would exist  
19 inside the AER databases, and based on a position here  
20 where it shows -- where it hits zero, if it -- if the  
21 material shows a behaviour that is contractant, in  
22 other words, under shear, it will actually reduce in  
23 volume, and where it will change to being dilatant or  
24 where it will increase in volume during shear and  
25 defines a -- a transition.

26         The interesting thing is -- about this particular

1 definition from the reference from Ingram is that even  
2 by -- by -- by the author's own admission, that's  
3 referred to as an unconventional definition.

4 So before I -- before I talk to this a little bit  
5 because I want to talk to this lab data issue, is that  
6 these are -- well, actually let me talk to the lab data  
7 first, actually.

8 So -- so in -- in this, I think you will see  
9 somewhere in here that -- yes, down at the very bottom,  
10 you will see that: (as read)

11 The data provided by Dr. Chalaturnyk in  
12 response to the information request is very  
13 useful in assessing this transition for --  
14 for Wabiskaw shales.

15 And I -- while I really -- I do appreciate the  
16 acknowledgement of it being valuable, I would -- I  
17 would suggest that for the question of the hearing and  
18 the question of actually looking at how fluids may  
19 potentially migrate through the confinement strata,  
20 that these may not have been the right kind of tests to  
21 be using. And let me explain that for a second, and  
22 I'll just leave it on this page.

23 So we -- actually, no. Actually for the sake of  
24 that discussion, maybe if we go back to Exhibit 47.002  
25 on page 20. So these are the data, in particular CST3,  
26 CST4, CST5, and so on that was used in that figure for



1 the transition. The reason why these may not be the  
2 most appropriate tests for what is happening  
3 potentially over KN08 and KN09 is that these are what  
4 are referred to as "compression loading tests". These  
5 are triaxial tests in which the samples are loaded  
6 vertically under shear, and the mean effect of stress  
7 in the specimens increases as I shear the specimens.

8 In general, in caprocks immediately above  
9 expanding steam chambers in this sort of lower B1  
10 zones, upper B1s and -- and so on, the stress path is a  
11 compression unloading stress path, and the compression  
12 unloading stress path -- the effect of stress decreases  
13 during shear. So the volumetric response of those  
14 materials is quite different.

15 So now instead of -- instead of increasing  
16 effective stresses during shear that cause the  
17 volumetric behaviour you see in the lower portion of  
18 this program, the stress path that would have come from  
19 the modelling, it would exist somewhere in the  
20 modelling, I haven't seen it, but from experiences with  
21 other projects where we have looked at these issues  
22 around caprock integrity and the behaviour of these  
23 intervals, in general, you will find that stress path  
24 is a compression unloading stress path. So that draws  
25 a little bit into doubt about where that transition  
26 boundary sits.

1           The other thing is, is that in the literature,  
2    recent publications have come out that have shown, you  
3    know, upwards of 35, if not more, ways or descriptions  
4    for calculating the brittle index of these materials.  
5    A substantial number, all the way from strength based  
6    to mineralogically based, includes -- includes the  
7    approach that was used by Dr. Boone, although used a  
8    slightly different part of the reference, and so one of  
9    the other things for -- that I think is relevant to  
10   this confinement strata over KN08 and KN09, is one of  
11   the approaches that was inside the reference that was  
12   used by Dr. Boone but has been used by others,  
13   including -- including ourselves, on a review of  
14   Alberta basin-specific materials, not -- not in other  
15   settings, but specific to Alberta, extremely large  
16   review of the datasets for testing that exist within  
17   the Alberta Energy Regulator database and that review  
18   included Clearwater, Lea Park, unconventional shales,  
19   Wabiskaw, McMurray, with a systematic review of those  
20   test results and the stress states and using an  
21   approach based on where this sits relative to something  
22   called the "Mogi line", which is a -- a well-accepted  
23   technique for looking at brittle and ductile behaviour  
24   in rock mechanics. And in that large review while many  
25   of the formations in Alberta exhibit ductile response,  
26   the Wabiskaw and the McMurray and the Clearwater all

1 resulted in a classification of brittle behaviour.

2       The other part of this -- and it is important, so  
3 I apologize. I'm going to take a couple minutes still  
4 because I do agree with Dr. Boone on this, is something  
5 related -- the brittleness index is related to  
6 something that is referred to as the "overconsolidation  
7 ratio". And the overconsolidation ratio provides a  
8 measure of the maximum -- the ratio of the maximum  
9 stress that a particular horizon has ever seen in its  
10 geological life divided by the current effect of  
11 stress. So in general, in the McMurray region -- the  
12 Athabasca McMurray region, there are estimates of  
13 sediments of -- a thousand metres of sediment overlying  
14 these particular areas that has been eroded.

15       And because the -- the expanse is quite large, the  
16 stress change that will have occurred at depth from a  
17 thousand metres of sediment and you take the unit  
18 weight of that material, you get -- and it -- it -- it  
19 can -- you know, you -- depends on what number you use,  
20 but even if you use 21 kPa per metre, which is the  
21 vertical stress gradient that in general CNRL has used  
22 and other -- other people use, it would suggest that in  
23 the confinement strata the maximum vertical stress that  
24 this material has ever seen is 21 MPa-ish, plus/minus.

25       The current effective stress that's calculated  
26 from the stress distributions adopted by CNRL show that

1 the in situ vertical stress -- current in situ vertical  
2 stress is roughly in the 7 to 7-and-a-half -- let's  
3 say -- yeah, 7 -- maybe it's easier to do the  
4 calculation -- 7 MPa in the middle of the confinement  
5 strata, which means the overconsolidation ratio, which  
6 is 21 divided by 7, is 3. And in a wide body of  
7 literature, including -- including the -- the reference  
8 utilized by Dr. Boone but many other that we can point  
9 to, show that if that overconsolidation ratio is above  
10 2 to 2-and-a-half, then that -- that will be an  
11 indicator of brittle behaviour.

12 So using, you know, several lines of evidence  
13 would suggest that -- that -- that in the -- in the  
14 absence of direct physical measurements in the  
15 confinement strata over KN08 and KN09, that it is -- it  
16 would be likely that the kind of behaviour that would  
17 be seen under the loading of SAGD would exhibit a -- a  
18 brittle response.

19 To -- to turn our attention just a -- at the end  
20 here just to the in situ stress values, if you can turn  
21 to Exhibit 46.002, Tab 5, Figure 7, page 46 of 72.

22 So there was some discussion in the evidence I  
23 provided in trying to sort of look at issues around  
24 what the in situ stresses might be. There was  
25 establishment of -- of appropriate stress gradients,  
26 fracture grade -- minimum stress gradients from DFITS.

1 There were no -- no issues with DFITs. These -- you  
2 know, the kind of analysis conducted by -- by CNRL  
3 on -- on due diligence for DFITs, I think, was --  
4 was -- was quite good. But that wasn't the issue here.  
5 The issue is the confinement strata; it's not the  
6 Clearwater caprocks. There are some issues with having  
7 a stress -- a variation in the McMurray and how you  
8 would model that, but in the confinement strata, this  
9 is the -- this is the data that was interpreted by CNRL  
10 and utilized for their simulation work, and I -- I'm  
11 using the arrow to point to the left-hand plot, and  
12 there are multiple lines in here. The left-hand line  
13 is the yellow line, which is the assumed pore pressure  
14 through the column, including through the confinement  
15 strata and into the McMurray. The pink line is the  
16 interpreted variation in the minimum horizontal stress.  
17 The blue line is the interpretation of the maximum  
18 horizontal stress, and the black line is the  
19 interpretation of the vertical stress distribution.

20 This uses a technique -- and -- and -- and it was  
21 talked about in CNRL reports about 1D mechanical earth  
22 modelling, and you -- you -- you calculate this  
23 variation. And you will see -- and I'm pointing my  
24 mouse to these open circles that lie in the plot that  
25 respond to the locations where DFITs were conducted to  
26 interpret the in situ stress, and these are

1 calibrated -- they're shifted to match those physical  
2 measurements in the field. But what you will see is  
3 that in the McMurray -- the variation in the minimal  
4 horizontal stress is actually reasonably constant.  
5 It -- it doesn't vary a great deal.

6 But if you look up inside the confinement strata,  
7 you can see that because of the variability -- we  
8 chatted before about upscaling, sand shale sequences;  
9 there were comments yesterday about a higher mud  
10 content, Poisson's ratio, vertical stress attracting  
11 and transferring more stress to the horizontal  
12 direction -- that the pink line shows quite a bit of  
13 variability inside the confinement strata.

14 And -- and so if you take a calculation of that  
15 pink line, not a -- not an average gradient -- if  
16 you -- maybe just for the sake of the --  
17 the discussion, if you blow up right here on the --  
18 where it shows the legend but just to the right of the  
19 pink line, anywhere in there, if you blow that right up  
20 enough for us to see dotted lines drawn in there.  
21 So -- yeah. It might -- it's -- it's -- maybe -- yeah.  
22 Thank you. Thank you. That'll work.

23 So you can see where average dotted lines are  
24 chosen for each of these sort of lithologies within the  
25 confinement strata that match to the stress gradient  
26 distribution that we're given in Table 1 that we had

1 shown previously from the modelling study. But what's  
2 important to note when the question is about fluid  
3 migration and potential mechanisms in which those  
4 confinement strata are going to deform under stress  
5 change and pore pressure change is that the variability  
6 in that minimum in situ stress is quite substantial,  
7 and it reflects the heterogeneity. And if you  
8 calculate here in some of these locations where this  
9 minimum horizontal stress minus the yellow line, which  
10 is the pore pressure, these become the -- this -- this  
11  $K_{not}$  that was talked about in the direct evidence,  
12 that this now starts to be in this range of .4 to .6 as  
13 a -- as a way of describing this initial in situ  
14 stress.

15         And -- and in the geomechanical modelling report,  
16 it was stated that -- and there wasn't much data given,  
17 but it was -- there was shear strength data that was  
18 discussed -- said, Well we chose 'C' prime equal to  
19 zero, and -- and the friction angle was 30 degrees.  
20 And so for something like a 30-degrees friction angle  
21 and you calculate this equivalent  $K_{not}$ , that comes to  
22 .33. So at -- at -- at a  $K_{not}$  of .33, the stress  
23 conditions would be touching the failure envelope. And  
24 in these instances here, there are cases where that  
25 initial stress state is at .4, which is -- which is now  
26 saying that the starting stress state is actually

1 almost nearing what you would consider to be the  
2 failure stress state for these materials.

3 The other -- the other part about this -- now, I  
4 know -- I think I had asked that in cross-examination.  
5 I'll leave that.

6 Maybe perhaps if you can switch to my last -- last  
7 comments on in situ stress, which is related to this --  
8 this plot, but Figure 233 --

9 W. MCCLARY: Just --

10 A R. CHALATURNYK: Sorry.

11 W. MCCLARY: Just before we do that,  
12 Dr. Chalaturnyk, I wanted to clarify that the comments  
13 that you were just making in relation to the log are in  
14 relation to the depths of 440 to 460 on that log?

15 A R. CHALATURNYK: Oh, yeah. Sorry. So --

16 W. MCCLARY: For the record.

17 A R. CHALATURNYK: Yeah. For the record. Sorry.  
18 So we can -- if you look -- yes. So it's over the --  
19 for this calculation of the  $K_{not}$ , which is -- is  
20 basically from about 458 -- 458 sort of up through the  
21 sort of entire confinement strata package up -- up  
22 through to the sort of base of the Wab B. And I'm --  
23 I'm using my mouse. So that's about 440, I guess. 440  
24 to 458. It's the variation in stress over what we  
25 would consider to be the confinement strata.

26 W. MCCLARY: Thank you.



1 A R. CHALATURNYK: Yeah.

2 And -- and so Exhibit 01.01, PDF page 67,  
3 Figure 233.

4 So I think this has been shown before, and what  
5 I've -- if you just can scroll down just a little bit.  
6 And this is in reference to just the -- the assumed in  
7 situ stress values, particularly in the confinement  
8 strata, is that there have been conversations put  
9 forward that stresses are -- are regionally consistent.  
10 And so, you know, "regionally consistent" would mean  
11 that the geological framework for these regionally  
12 consistent estimates of in situ stress would -- would  
13 predicate that the geological framework is -- is  
14 similar across those regional distances, and -- and I  
15 think there has been arguments made, even this morning,  
16 in the geological framework that once you are to the  
17 east of KN08 and KN09, that geological lithology is not  
18 the same as it is at KN08 and KN09, yet all of the in  
19 situ stress data that was generated for -- for, in  
20 essence, calibrating the pink line that we saw on the  
21 previous plot come from a -- a -- a region well west --  
22 or east of -- of KN08 and KN09.

23 And if you -- if you can turn -- and sort of the  
24 final slide -- to page 55. And if you just, yeah, can  
25 kind of scroll out so it's the whole thing.

26 So if you -- so in KN08 and KN09, there have been

1 many arguments to this. There will clearly be  
2 discussions and -- and debate about what this  
3 variability looks like. There's been evidence provided  
4 on both sides. But relative to in situ stress, if you  
5 look at the mid-B1 stone -- mudstone isopach -- and if  
6 you switch now to page 56 -- these ranges of isopachs,  
7 erosional surfaces now downcutting and changes to sort  
8 of a channel erosion in the middle of KN08. And if you  
9 switch to the next one, page -- page 57, you know,  
10 these -- this variability, which differentiates itself  
11 from what the interpretation of the geological  
12 framework would have been east of KN06 or -- or where  
13 the DFITs were calculated, I would suggest would --  
14 would suggest the potential that in -- within the  
15 confinement strata there may have been reasons, given  
16 these depositional environments, for changes in that  
17 minimum horizontal stress.

18         So perhaps in summary of time -- if I can find my  
19 little tiny summary page. Hang on a sec. Just to make  
20 sure I get that correct. So while modelling studies  
21 were appropriate for fracture containment and overall  
22 caprock -- overall caprock, the Clearwater formation  
23 upper caprocks were -- were quite sufficient and, in my  
24 opinion, were sufficient, it would be my position that  
25 at the moment the information or the evidence provided  
26 is not sufficiently refined to inform detailed

1 assessments of the behaviour of the heterogenous  
2 confinement strata and the development of potential  
3 fluid migration pathways over the life of the SAGD  
4 project.

5 I think in the absence of KN08- and KN09-specific  
6 core testing, I think uncertainty remains concerning  
7 the potential quantification of brittle/ductile  
8 transition behaviour for the fine-grained zones within  
9 the confinement strata, even though I have even  
10 postulated other methods to define that brittle  
11 behaviour and the variability in the geological  
12 interpretations for the confinement strata above KN08  
13 and KN09 produces, I think, sufficient uncertainty in  
14 the applicability of a regional interpretation of in  
15 situ stress magnitudes, and for the KN08 and KN09  
16 drainage areas, given the importance of understanding  
17 this mechanism of fluid migration, potential  
18 development of fluid migration pathways through this  
19 confinement strata, in particular dominated by the  
20 calculation or determination of the minimum horizontal  
21 in situ stress, I think it's warranted, given the  
22 importance of these conditions, that -- that additional  
23 in situ stress interpretations are established, both  
24 for geomechanical modelling studies that would be  
25 relevant to the behaviour of the confinement strata and  
26 -- and defining the limits for containment.

1           And I should say that at a broad context and final  
2 summary, the -- the part that I think is important in  
3 this discussion or important in the debate around these  
4 mechanisms is that while we -- we can make the point  
5 that the caprock, the proper caprock that really will  
6 hold the SAGD chambers within the subsurface, the  
7 mechanisms that lead to movement of fluids from the  
8 SAGD chambers up through this confinement strata to  
9 immediately below that proper caprock is an important  
10 component of all the SAGD projects in Alberta.  
11 Understanding what those look -- what those mechanisms  
12 are will help inform shallow projects; it will help  
13 inform what factors of safety do mean when it comes to  
14 understanding those mechanisms. And that's why I think  
15 in this context it's important for understanding this  
16 in KN08 and KN09. Thank you.

17 M. RILEY:                               That is then the end of ISH's  
18 direct evidence.

19 COMMISSIONER CHIASSON:   Thank you, Ms. Riley.

20           Thank you to the witnesses.

21           So, Ms. Jamieson, refresh me, then, on how much of  
22 a break you think you might need.

23 J. JAMIESON:                        I'm just looking at the clock.  
24 If we could have 30 minutes, that would be fabulous.  
25 Could we do that?

26 COMMISSIONER CHIASSON:   30 minutes?

1 W. MCCLARY: I think that would -- that  
2 would work for us as well, then, to confer for  
3 questions from the --

4 COMMISSIONER CHIASSON: All right. We will take  
5 30 minutes. We will return back at 2:45, then. Thank  
6 you.

7 Just a reminder to the witness panel that you are  
8 all sworn and/or affirmed, so please do not, during the  
9 break, discuss with your counsel in relation to the  
10 evidence or what you're anticipating in  
11 cross-examination. Thank you.

12 (ADJOURNMENT)

13 COMMISSIONER CHIASSON: You're prepared to proceed,  
14 Ms. Jamieson?

15 J. JAMIESON: I am. Thank you.

16 COMMISSIONER CHIASSON: All right. Go ahead, then,  
17 please.

18 J. Jamieson Cross-examines the ISH Energy Ltd. Witness  
19 Panel

20 Q J. JAMIESON: Good afternoon,  
21 Dr. Chalaturnyk. My set of questions is for you just  
22 to expedite our schedule --

23 A I appreciate. Thank you.

24 Q -- so if you'll humour me. And, of course, I am not a  
25 geomechanical engineer. I have been spending a lot of  
26 time with them lately.

1 A My apologies.

2 Q Yeah. So just bear with me, please. I'll need some  
3 patience.

4 So I'd like to start, if I could, by bringing up  
5 Exhibit 32.10, and this is Tab 6 from Dr. Chalaturnyk's  
6 report, page 13. Yeah -- sorry -- 32.10, yeah.

7 J. JAMIESON: Maybe if you could just expand  
8 it out a bit. I'd just like to -- lines 29 to 33.

9 Q J. JAMIESON: It's just a statement that  
10 you've made, Dr. Chalaturnyk, that we want to follow up  
11 on.

12 So you stated: (as read)

13 While hearing discussions are likely to  
14 resolve geological setting issues, the  
15 presence or non-presence of the mid-B1  
16 mudstone, existing fractures, et cetera, even  
17 the potential that the DFIT in the 9-6 well  
18 was indicative of a westward trend of a  
19 reducing minimal horizontal in situ stress  
20 seems to me to provide sufficient uncertainty  
21 that would warrant "a modern DFIT test" be  
22 conducted in the KN08 and KN09 drainage area.

23 Do you see that quote?

24 A I do, yes. Yeah. Thanks.

25 Q Would you just generally agree that Canadian Natural  
26 has significant experience with DFIT interpretations

1 based on their work?

2 A Absolutely. Yes. I can confirm that. I agree.

3 Q Thank you. Do you think Canadian Natural also has the  
4 technical capability to identify initiation and  
5 propagation of hydraulic fracturing --

6 A Yes.

7 Q -- generally?

8 A Yes.

9 Q Thank you.

10 Okay. If we could please go to Exhibit 15.01,  
11 page 41, paragraph 173. Is it up there? Yeah. Good  
12 stuff. Yeah, as long as that's readable. I'm not sure  
13 how much time you've spent with all the submission  
14 materials, Dr. Chalaturnyk, so in fairness, they are  
15 extensive, so we'll just go through this.

16 A I'll try.

17 Q Are you aware that Canadian Natural's evidence in the  
18 proceeding is that it has started up 146 Kirby north  
19 wells on steam circulation as stated in this paragraph?

20 A Actually, I am, and I heard it in evidence yesterday as  
21 well.

22 Q Thank you.

23 A Yeah.

24 Q Yeah. And if we could, please, same exhibit, go to  
25 Tab 34, which is at page 494, the same document. So if  
26 we can just bear with me. This is a table of the Kirby

1 north maximum bottom-hole pressures applied during  
2 start-up. And would you, please, if you could, state  
3 the maximum start-up bottom-hole pressure gradient for  
4 Well Count Number 2. So we're looking for well name,  
5 Kirby north, KN02-41.

6 A And you just want me to read what the maximum start-up  
7 bottom-hole pressure gradient is?

8 Q Yes.

9 A It says in the table it's 13.7 kPa per metre.

10 Q 13.7. Thank you.

11 And then scrolling down one page, would you please  
12 state the maximum start-up bottom-hole pressure  
13 gradient for Well Number 40, and this would be Kirby  
14 north 03-3I?

15 A I should have opened the file on my laptop. I -- 40 --  
16 sorry.

17 Q Yeah. It's -- no problem. Count 40, Well Name  
18 KN03-3I.

19 A 11.9 kPa per metre.

20 Q 11.9. Thank you.

21 Okay. I can bring this one up, but this is really  
22 from an early report. Maybe we should go there anyway  
23 in the completion. Exhibit 15.01, page 96, Figure 7.  
24 So this would -- I believe is an appendix to the  
25 hearing submission, and it would be Figure 7. Is that  
26 what we have? I should look on here. Okay.



1           So this is an appendix to Dr. Boone's 2020 report.  
2           It's an example of potential hydraulic fracturing  
3           during circulation start-ups. If you can scroll up to  
4           page 87, this is the summary of key findings and what  
5           we find under the first bullet is that out of all of  
6           those start-ups -- and I believe there were 96 at the  
7           time -- but in any event, one of his key findings was  
8           that they found only one well with characteristics that  
9           are indicative of possible fracturing. Do you see  
10          that?

11        A    Yeah. Yes. And I think I recall reading it, so I'm  
12          looking pretty quickly, but I do recall that  
13          conclusion, yes.

14        Q    Sure. So --

15        A    M-hm.

16        Q    And just in the interest of time, that was at the time  
17          of the KN06 proceeding, Canadian Natural had this  
18          experience of 96 --

19        A    Oh, 96.

20        Q    -- wells, and since then we're at 146; right?

21        A    Indeed, yes.

22        Q    Okay. You're with me?

23        A    Yeah, yeah.

24        Q    Now if we could, same exhibit, please move to PDF  
25          page 69, and there should be a Figure 5 there. Yeah.  
26          Scroll down, please, Point i, and there Dr. Boone

1 writes: (as read)

2 Previously 1 in 96 wells are identified to  
3 have likely fractured -- sorry. 1 in 96  
4 wells was identified to have likely fractured  
5 during start-up. With the additional wells  
6 that have since started up, it is now 1 in  
7 146 wells.

8 Do you see that text?

9 A I do, yes.

10 Q Thank you.

11 So do you agree now that there is data other than  
12 DFIT data that can be used to understand stress  
13 variations in the Kirby north area?

14 A No.

15 Q No?

16 A No.

17 Q You disagree completely?

18 A Well -- and I should clarify that because it's a fairly  
19 hard answer.

20 Q It was a hard no?

21 A I apologize. Yes, indeed.

22 Q Please do.

23 A I think in the evidence it provided, although I did go  
24 by it very fast, I think in the evidence that CNRL has  
25 provided around fracture containment within the  
26 McMurray during the start-up of the SAGD process is

1           convincing. I don't -- I didn't have an issue with  
2           that and I -- and I don't even after recalling this  
3           evidence, which I think, to your point of reviewing it  
4           all, is -- is -- is compelling. And -- and the reason  
5           that I'm -- I answered very quickly, which I  
6           apologize -- I shouldn't be quite so blunt -- is that  
7           that -- I didn't see that as being the component of the  
8           in situ stress distribution that was of key interest in  
9           the confinement strata.

10                    So, yes -- no, I -- I thought that -- that in  
11           terms of the work, the operational experience across  
12           sort of all of the asset areas when in the McMurray, in  
13           terms of that process and the convincing numerical  
14           modelling studies that were done by CNRL, you know,  
15           even up at the --

16    Q    M-hm.

17    A    -- temporary MOPs was convincing, so, no, I don't have  
18           a problem.

19    Q    Okay. And I appreciate, you know, given credit for the  
20           work. I actually don't think it's credit for the work  
21           or the diligence that Canadian Natural is looking for.  
22           It's some recognition that there might be some deep  
23           knowledge on stress variations in the Kirby north area.  
24           From all the start-ups from --

25    A    Oh, I see.

26    Q    -- to develop an understanding of stress

1           characterization in the area, that this actual  
2           operational start-up data --

3    A    M-hm.

4    Q    -- is data that can be counted towards understanding  
5           stress variations.

6    A    Yeah, I would agree within the McMurray, yes.

7    Q    Within the McMurray?

8    A    Within the McMurray, yes.  Yeah.

9    Q    All right.  If you'll just give me a moment, please.

10           Okay.  Thank you.  I'm going to -- we're going to  
11           switch out geomechanical engineers just for fun.

12   A    Okay.  Yeah.

13   Q    All right.  All good.  Thank you very much.  Okay.

14           So I'm not sure which exhibit we have.  Yes, if  
15           you could please go to Exhibit 32.10 now.  It's Tab 6,  
16           and this is Dr. Chalaturnyk's report, and if we could  
17           look at page 13 of 31.  It's the same quote.  Yay.  I  
18           recognized it.  So -- I'm a little slow, but I  
19           recognized it.

20           Let's start -- I'm not sure where the words -- it  
21           starts:  (as read)

22           While hearing discussions are likely to  
23           resolve geological setting issues, presence  
24           or non-presence of the mid-B1 mudstone,  
25           existing fractures, et cetera, even the  
26           potential that the DFIT in the 9-6 well was

1           indicative of a westward trend of a reducing  
2           minimal horizontal in situ stress.

3           So that's the sentence we want to focus on.

4           Dr. Chalaturnyk, do you agree that typically shaley or  
5           muddy materials have a higher Poisson's ratio than  
6           sandy materials?

7    A    I think in this class of materials, the answer would be  
8           yes.

9    Q    Yes? Thank you.

10           And do you agree that this difference in elastic  
11           properties typically results in a stress contrast  
12           between a sandy zone and an overlying shady zone?  
13           Sorry. Yeah, shaley zone. That's the word.

14   A    Yeah, and I think we heard that yesterday in some  
15           evidence that Poisson's ratio underloading will result  
16           in differential stress that will be exhibited in a --  
17           in a difference in the stress contrast, yes.

18   Q    Just a moment.

19   A    Yeah. It's okay.

20   Q    Okay. If we could please go back to Exhibit 15.01.  
21           And this would be page 92.

22           Okay. So the figure that you have in front of you  
23           shows DFIT data for multiple wells throughout the  
24           region, so this would be Kirby/Jackfish/Pike, and I  
25           just want to point out before I ask my question, if we  
26           go back -- just scroll one page to page 91. I believe

1           there's a map there.  Yes.  So that would indicate  
2           where the DFIT data is derived from.

3                     Do you agree that this data represents multiple  
4           wells throughout the region and that these wells have  
5           tested multiple zones at times, both McMurray and  
6           overlying muddy or shaley layers?

7   A    Yes.

8   Q    All right.  And if you could scroll back to the figure.  
9           So one more.  Thank you.

10                    So now we're back looking at the stress gradients  
11           by formation from different service providers, and  
12           we've established that's throughout the area.  Do you  
13           agree that in the KN08 and KN09 drainage areas we  
14           should also expect a stress contrast between the  
15           McMurray sand and the muddy confinement strata  
16           consistent with this regional data?

17   A    I'm going to have to apologize that I don't know the  
18           details of each of those particular wells.  Perhaps if  
19           I could ask a clarification before answering your  
20           question.  Is the Wabiskaw that is identified in that  
21           particular horizon in -- in lower B1, upper B1, like,  
22           is it in the middle -- our conversation, I guess, in  
23           this hearing is this confinement strata package, and is  
24           that Wabiskaw, which we're shown sort of -- sort of  
25           uniformly within --

26   Q    M-hm.

1 A -- is it within that confinement strata, or is it -- is  
2 it something else?

3 Q I'll find out --

4 A Could you --

5 Q -- if I can.

6 A -- yeah, if you please.

7 Q These particular geomechanical engineers are quite  
8 certain this is the Wabiskaw A shale, so -- so I  
9 think --

10 A Yeah.

11 Q Yeah.

12 A Okay. No. That's great. No. Thank you. So --

13 Q Okay.

14 A -- the Wabiskaw A shale is the shale that sits just  
15 below the Clearwater and represents what would be  
16 classically defined as the "caprock" --

17 Q M-hm. Correct.

18 A -- for a SAGD project. And I think I also said that I  
19 was convinced by the discussions with CNRL and the  
20 technical events they provided around caprock  
21 integrity, we had -- we had -- there were two parts  
22 that I -- I thought were -- were -- were compelling  
23 in the -- in the -- sort of in the world of SAG -- SAGD  
24 that was -- it was compelling in terms of fracture  
25 containment in the McMurray during start-up, which we  
26 just chatted about, and it was compelling for caprock

1 integrity as overall containment of the SAGD chambers.

2 What -- what -- what I was referring to, I guess,  
3 in the -- in the conversation was -- is the variability  
4 in the in situ stresses interpreted within the  
5 confinement strata, which was indicated by the  
6 variation in the purple line in the interpreted log  
7 response of the variability in the stress which  
8 reflected this in situ stress stiffness contrast that  
9 you asked about previously.

10 So -- so I -- I think from a -- in the regional  
11 interpretation, east of KN08 and KN09 --

12 Q M-hm.

13 A -- absence, I think -- and, again, the hearing -- I  
14 guess in the -- in the body of evidence, geological  
15 structures -- or geological environment will -- will  
16 debate those. In -- in -- in the absence of the  
17 geological heterogeneity that I think exists  
18 differently in KN08 and KN09, to answer your  
19 question -- it's a long answer, I suppose; I apologize,  
20 but -- is that this is -- this would be a regional  
21 interpretation east of KN08 and KN09 for the caprock --

22 Q M-hm.

23 A -- and for McMurray sands and the McMurray shale, which  
24 is the upper -- I'm assuming the upper portion and IHS  
25 of the McMurray, but that's an assumption.

26 Q So let me make sure -- and I do recall your comments



1 earlier about the -- your concerns about the  
2 heterogeneity of the confinement strata.

3 If we can go back to the map. It's one page up.  
4 So I think the point of this map, if you look at the  
5 red star, is they sort of cover the region; right?  
6 We've got some way over to the east, the Jackfish.  
7 We've got the one at KN06. We've got one further south  
8 at 13-20. So -- and then if you'll humour me, please,  
9 if we can scroll back to the other figure. We're not  
10 offering this up to get your opinion on the caprock. I  
11 thought that was quite clear that you made. I  
12 appreciate that. But just the -- the concept, if you  
13 will, that the stress contrast between these general  
14 layers are fairly consistent throughout the region,  
15 that that's what this -- this figure represents.

16 A For the -- for the general region, yes. The  
17 confinement strata lies in the white space between the  
18 McMurray shale and the Wabiskaw, and so there would  
19 need to be a discussion about whether I think the  
20 depositional environment and the geological settings of  
21 KN08 and OK9 [sic] represent some variability in that  
22 white space that exists between those two. And --  
23 and -- and -- and that is seen in other places. You  
24 can have that kind of stress variability, given the  
25 variation of properties in that --

26 Q Right. Understood.

1 A So --

2 Q And your --

3 A So these are -- I think these are valid for -- for east  
4 of that region, yes. Yeah. Or for those horizons,  
5 yes.

6 Q For those horizons. Okay.

7 And just where we started, if you recall, I asked  
8 you if you agree that typically shaley or muddy  
9 materials have a higher Poisson's ratio than sandy  
10 materials. You agreed. And then we talked about how  
11 that difference in elastic properties typically results  
12 in a stress contrast between a sandy zone and overlying  
13 shaley zone. So we're providing this stress gradient  
14 by formation map to show there's actually pretty solid  
15 consistency through the region. And if I understand  
16 your answer, you're -- you're agreeing with that  
17 conceptually, but you're saying you would limit this to  
18 the east. Is that what your evidence is?

19 A I -- it was -- the observation I had provided was that  
20 in what I had reviewed -- I mean, it wasn't my remit to  
21 interpret the geological information. Evidence was  
22 provided yesterday; evidence was provided this morning  
23 that spoke to what I think were cogent arguments around  
24 the uniqueness of the geology in KN08 and KN09 relative  
25 to the east.

26 Q M-hm.

1 A I think evidence was provided this morning of KN01 and  
2 02 and a -- a position of a thick mudstone that was --  
3 was a regional deposition of a thick mudstone that was  
4 absent in -- in KN08 and KN09, amongst all of the other  
5 things, erosional surfaces, erosional channels, and  
6 other things. So -- so long answer is that -- that --  
7 that for these stress distributions for the purposes of  
8 the behaviour in the McMurray and the behaviour for  
9 caprock integrity assessments, absolutely.

10 I'm suggesting that for the -- the question that I  
11 was asked to review the evidence for, which was the  
12 behaviour of the confining strata in particular of the  
13 movement of fluid migration from the SAGD up through  
14 that package to the Wab B gas pools, that -- that was  
15 less certain about what that stress value should be.  
16 Although it was interpreted in the evidence of being --  
17 and I apologize if I get this wrong, but, like, 14.6 I  
18 think was the number or 13.1 in the McMurray stress  
19 contrast --

20 Q That's right.

21 A -- of 1.5. There was some numbers like that.

22 Q Right.

23 A Yes. And so I'm suggesting that given -- given the --  
24 the un -- the absence of specific data in that --  
25 geological differences that exist in KN08 and KN09,  
26 that there was a potential that that horizontal

1 stress -- that minimum horizontal stress could drop to  
2 something less than 14.6.

3 Q Understood.

4 A That was all.

5 Q Thank you.

6 A That was all.

7 Q I think we have one follow-up here.

8 A Sure.

9 Q Yeah. So let's just look here at the stress gradients,  
10 and I want to point out second from the bottom of that  
11 list of wells. It's sort of a turquoise colour, I  
12 believe, but it's the well -- the 2-26 --

13 A Yeah.

14 Q -- -75. So that particular measurement, do you agree  
15 that that -- you might not know this, but that it  
16 represents the mid-B1 mudstone, the regional mudstone?

17 A Oh. Is -- is that what --

18 Q Are you able to --

19 A Is that what's --

20 Q -- tell that from this?

21 A Well, I -- I -- I can see where it sits on there. Is  
22 that -- is that -- does the mid-B1 mud one --  
23 mudstone --

24 Q Or it might be the B1 regional sequence, but it's in  
25 there.

26 A Yes. So that's classified as McMurray shale?

- 1 Q Yes. Within the McMurray shale.
- 2 A Yeah. I -- I -- I don't know the details --
- 3 Q You don't know --
- 4 A -- of 227, but I'll -- no, I'll --
- 5 Q That's fair.
- 6 A No, it's fair. Yeah. Sure. I -- I don't know --
- 7 Q Like, generally speaking --
- 8 A -- subject to the --
- 9 Q -- it would fall in that. We -- we know it's not the  
10 McMurray sands. We know it's not the Wabiskaw. So --
- 11 A Yes.
- 12 Q -- that likely represents a mid-B1 or a regional B1  
13 sequence measurement. Would you agree, just  
14 notionally, that that would make sense?
- 15 A It was -- I think CNRL has already presented evidence  
16 that that was -- on average, was assumed to be 14.6,  
17 which is --
- 18 Q Yeah.
- 19 A -- plus/minus --
- 20 Q I think we're --
- 21 A -- 15.2. I mean, it --
- 22 Q Yeah.
- 23 A Yeah. So 14.6 is what was already submitted.
- 24 Q Right. And I don't think, again, we're offering it up  
25 for the specific numbers, but just to --
- 26 A Oh.

1 Q -- illustrate the stress gradient between a  
2 McMurray shale, you know --

3 A Yeah.

4 Q -- mid-B1 pic --

5 A And the --

6 Q -- versus McMurray sands?

7 A Sands. Yeah.

8 Q That's clearly --

9 A Oh, fair.

10 Q -- clearly a stress -- okay.

11 A Absolutely. I think that's -- I -- I think there was  
12 evidence provided by CNRL for, you know, a range of  
13 SAGD projects in the province, and that tends to be, on  
14 average, the kind of trend directions that you see,  
15 yes.

16 Q All right. Thank you very much, sir.

17 A Yes.

18 Q Okay. We have one more line.

19 A Oh, okay.

20 Q And I have some hesitation in wading into the area of  
21 brittle versus ductile rock --

22 A Oh, no. It's good to --

23 Q -- behaviour.

24 A No. Happy to have the discussion.

25 Q I'm sure it'll be fun. Okay. Here we go.

26 So Exhibit 32.10. Is that where we are? Okay.

1 And then page 8, and this is lines 34 to 36.

2 And this, of course, is your report. I believe  
3 it's the front of your report, the kind of general  
4 summary that you provide. But we have this paragraph  
5 right at the end, and I'm going to draw your attention  
6 to two sentences. The very first one, it reads:  
7 (as read)

8 This class of materials that make up the  
9 confining strata will generally exhibit a  
10 brittle or post-peak strength softening  
11 behaviour with shear deformation, which would  
12 create transmissible pathways for fluid to  
13 migrate between the higher pressure SAGD  
14 chamber with respect to the pressure in the  
15 Wab B gas sands and -- and the gas sands.

16 That's what the sentence says. And then the sentence  
17 at the end of the paragraph reads: (as read)

18 But the implication is that if the confining  
19 strata material above and laterally adjacent  
20 to the growing steam chambers is subjected to  
21 deformations resulting from thermal expansion  
22 of the McMurray reservoir, the brittle  
23 failure will create additional  
24 discontinuities within these materials,  
25 impacting their ability to seal against the  
26 upward flow of fluids.

1 And would this remain your evidence, or would you have  
2 any modifications to those two sentences based on what  
3 you've heard or what Dr. Boone has put in his report?

4 A No. And -- well, I -- I think the -- the -- the  
5 general nature of those statements was that if -- and  
6 that's why it's important. If the failure conditions  
7 in these materials demonstrated a brittle response,  
8 then there was the chance that those failure mechanisms  
9 may create discontinuities that would remain open,  
10 hence the importance of the conversation which -- and I  
11 think was the evidence that Dr. Boone presented in this  
12 discussion between brittle and ductile behaviour.

13 So I think -- I -- I'm not sure I would change it  
14 generically. I'm just saying that this would be the  
15 impact if there was brittle failure, yes.

16 Q Thank you.

17 So I need to go now to Exhibit 50.003, page 29,  
18 and this is Dr. Boone's report. He provided a figure  
19 and -- there it is there. And if we can expand it  
20 maybe just so that the figure showed really well.  
21 Thank you very much. Okay.

22 So this is where Dr. Boone plotted the  
23 approximately -- he approximately plotted the  
24 confinement strata for the KN08/KN09 on this plot. And  
25 I believe you commented on this, and I -- and I missed  
26 this, but it sounded like you referred to Mogi, some



1 type of --

2 A Oh, and -- and -- no, and actually I referred to what's  
3 in the caption of the text, actually. I didn't  
4 reference this in my direct evidence, which I  
5 apologize -- at the time.

6 Q Okay.

7 A But I think what I had referenced is, in fact, a line  
8 that is in Dr. Boone's caption, which -- which  
9 brittleness index, the BRI, is equal to, like, a -- an  
10 unconfined compressive strength of an overconsolidated  
11 material compared to an unconfined compressive strength  
12 of a normally consolidated material.

13 Q Right. Okay.

14 A So we had -- I -- I kind of probably -- I said it in  
15 words, but I didn't actually point to this plot, which  
16 is --

17 Q Oh. I -- I -- okay. But can you just confirm that --  
18 can we use this and what you recognize in Dr. Boone's  
19 report as sort of a generally accepted procedure for  
20 assessing brittleness? Do you concur with that?

21 A It's -- it's one of 35 methods to establish what a  
22 brittleness index is, yes.

23 Q Okay. Well, let's --

24 A Then it is the reference -- Ingram's reference. This  
25 is the technique. There is a --

26 Q You're saying the reference is correct --

1 A Correct.

2 Q -- but you're not -- maybe it's my term "generally  
3 accepted procedure". You're not quite -- you're saying  
4 this is 1 of 35. So you're not really sure that it's  
5 "generally accepted". Is that what you're saying?

6 A There's a -- there's a line about the -- determining --  
7 again, and I apologize if this is -- it tends to become  
8 difficult in this class of materials under sampling and  
9 sampling in an undisturbed form that you can get an  
10 incompressible compressive strength that is -- is not  
11 without its uncertainties.

12 And so the part that I -- I -- in this particular  
13 curve, and I had seen it. There's the blue dot. The  
14 blue dot shows an estimate or an interpretation of  
15 unconfined compressive strength based on an estimation  
16 of the cohesive strength, and an estimate of the depth  
17 and an estimate of what the in situ effect of pressure  
18 is.

19 But I think what -- what I would point out in the  
20 data is that there are two open circles at the bottom  
21 where it says: (as read)

22 The dilatancy transition is unknown.

23 And I would suggest that trying to use the data  
24 anywhere above the 1,000-metre mark, that line  
25 represents a lot of uncertainty. Those open circles  
26 define an unknown dilatancy transition, and the class

1 of materials that are represented by the Wabiskaw are  
2 all in that upper horizon.

3 So -- so, yes, the blue -- the blue dot plots  
4 there, but there's a -- there's a curve fit plotted  
5 by -- by the author, so, yeah.

6 Q If you'll humour me, let's use this plot and see where  
7 it takes us.

8 Do you agree that generally, as this plot shows,  
9 that for a given material with specified unconfined  
10 compressive strength that it will behave brittle at  
11 shallow depths and ductile at deeper depths?

12 A With -- with the caveat --

13 Q M-hm.

14 A -- and we have to define "shallow" and "deep" relative  
15 to the stress history of the material, I -- I had  
16 mentioned that one of the other very significant ways  
17 of defining "brittleness" is -- is related to the  
18 stress history of that material, which is the  
19 overconsolidated versus normally consolidated  
20 behaviour.

21 And so just by even a quick calculation of -- of  
22 the stress history for these materials would suggest  
23 that you were -- we're in a range of brittleness index  
24 that's -- would suggest a risk of dilatancy.

25 Q Thank you. That's fair enough. But I think within  
26 your answer, I actually -- oh my goodness. Okay.

1           So let's try this question: Can you just please  
2 explain for the Panel how the overburdened compression  
3 ratio is determined or calculated?

4   A   So the overconsolidation ratio that I referenced is a  
5 standard term in geotechnical engineering that relates  
6 the preconsolidation stress, which is the maximum  
7 effect of stress that a deposit has ever seen in its  
8 geological history, divided by the current effect --  
9 vertical effect of stress.

10   Q   Okay. Thank you. Just give me a moment, please.

11           All right. So if you have laboratory data for the  
12 strength of the shales, could you -- could you still  
13 rely on the OCR to assess brittleness?

14   A   In fact, it is -- it is a standard lab test that is  
15 generally required to make this measurement. You need  
16 to do a odometer or a one-dimensional compression test  
17 over a range of stresses that moves the material from  
18 its overconsolidated state to its -- okay. Okay.  
19 Sorry. I know you -- the geotechnical engineer. So I  
20 bring a sample to surface, it's unloaded, and when I  
21 take that sample, I put it back in a cell, and I --  
22 what I do is I keep increasing the loads until the  
23 material moves from an overconsolidated behaviour to  
24 what's referred to as a "normally consolidated  
25 behaviour", and the rate at which those deformations  
26 occur change and where that inflection point occurs

1 defines the pre-consolidation stress.

2 Q Okay.

3 A And so now you can determine from that test, generally  
4 as a lab test, once you have that pre-consolidation  
5 stress, it's a measure of what the maximum effect of  
6 stress generally -- I mean, there are nuances to it,  
7 but generally defines that maximum effect of stress.  
8 You can do the calculations that exist in evidence  
9 today for the intervals in the confinement -- to define  
10 the current effective stress, if you divide them, they  
11 will define the overconsolidation ratio.

12 Q Okay.

13 A And I should say there are no lab tests. I didn't see  
14 any lab tests. I -- I don't know if lab tests have  
15 been done in KN08 and KN09, if subsampling of the  
16 lower B1, upper B1 -- I mean, if there is those kinds  
17 of tests have actually been conducted for those  
18 particular materials, I -- I'm willing to stand  
19 corrected.

20 Q Yeah. Fair enough. And we did see that in your  
21 report. I think our question is at a higher conceptual  
22 level than that.

23 A M-hm.

24 Q Taking you back to your general statement that you  
25 made: (as read)

26 This class of materials that make up the

1           confining strata will generally exhibit a  
2           brittle or post-peak strength softening  
3           behaviour with shear deformation which would  
4           create transmissible pathways for fluid.

5           And I think the question that just follows is that --  
6           that "generally exhibit" should have been qualified by  
7           the information that you had stated previously, which  
8           would be depth, the effect of stress rate or state,  
9           that type of thing. That -- that was a blanket  
10          statement that needed some qualification.

11        A    Agreed.

12        Q    Agreed. Okay.

13        A    Agreed.

14        Q    All right. So let's try this one. This is going  
15          back -- same chart; we've got it up here -- and if my  
16          understanding is correct, you mentioned the blue dot,  
17          and the blue dot is about 1 MPa -- is that correct --  
18          or just past?

19        A    Of unconfined compressive strength, yes.

20        Q    Unconfined, yeah.

21        A    Yeah.

22        Q    So do you agree that given the depth of the confinement  
23          strata at KN08 and KN09 of about 450 metres and typical  
24          unconfined compressive strength of McMurray and  
25          Wabiskaw shales, about 1 MPa, that the confinement  
26          strata at KN08 and KN09, as plotted, they should fall

1 in the category of "ductile"?

2 So I can repeat that if you need to, but we want  
3 you to now apply this theory to the depth of KN08 and  
4 KN09 and tell us your conclusion.

5 A So UCS data --

6 Q M-hm.

7 A -- I'm not sure. In fact, I can't recall from  
8 Dr. Boone's report where exactly that came from. If it  
9 came from a correlation with sonic velocities and  
10 mineralogy, I don't know. I didn't see any test  
11 results. I don't know if I've seen unconfined  
12 compressive strength tests, so to go and -- you know,  
13 to go to other Wabiskaw shale A, Clearwater formation  
14 shales and -- and speculate what unconfined compressive  
15 strengths would be at those depths is probably a  
16 little -- would be premature for me. So if we --

17 Q Okay.

18 A But even -- even if we go with that -- I mean, even  
19 if -- let's say there is an -- a difference of an  
20 opinion and it's -- it's not one, but it's one and a  
21 half or it's two, what I'm suggesting is that -- that  
22 for the importance of understanding the migration of  
23 fluids in the confinement strata and making an  
24 assessment a priority at the moment without any  
25 evidence of any material behaviour at KN08 and KN09, I  
26 would suggest that relying on a curve fit to the left

1 of the data where open circles within the depth of  
2 uncertainty for the -- this dilatancy transition thing  
3 is unknown and using that as an explicit definition for  
4 actually becoming an -- all behaviour being  
5 non-dilatant would probably not be the -- the -- the  
6 best way to go.

7 Q Fair enough. So is your evidence you just can't get  
8 there based on the 450-metre depth?

9 A And -- and site-specific information about how those  
10 units would behave within the confinement strata, yes.

11 Q I don't mean to be provocative about this --

12 A That's okay.

13 Q -- and it's -- probably will reflect my lack of  
14 understanding, but --

15 A It's okay.

16 Q -- isn't that what you're doing when you just say, This  
17 is brittle, when -- you know, like, we're -- we're  
18 pointing -- we've got some general principles here in  
19 the sense that "shallow" is generally brittle, "deeper"  
20 is generally ductile, and you're saying even at a depth  
21 of 450 you can't get to the general principle of  
22 ductile that -- but I -- I'm just saying aren't you  
23 doing the opposite by labelling it all "brittle"  
24 without further information?

25 A Oh. Oh, I see where you're getting -- okay. Yeah.

26 No, no. I should be clear about this. No, no. I --



1 I'm not saying that -- that if -- if I go from 450 to  
2 480 to 490 and go to 500 or 600 or whatever the depth  
3 might be that you're not going to go through a  
4 brittle/ductile transition. I -- I didn't say that.

5 Q No, I understand.

6 A I -- I --

7 Q I'm just --

8 A Yeah. So -- so I'm --

9 Q Help me.

10 A -- I'm -- I'm suggesting that there are multiple  
11 ways --

12 Q M-hm.

13 A -- to define brittleness, that in the absence of  
14 specific information at KN08/OK9 makes it a very -- it  
15 makes it a difficult situation to land on a definitive  
16 answer.

17 Q Okay.

18 A That's all. That -- that's all I'm saying, yes.

19 Q I understand that, and I understand that you're  
20 pointing to the complexity. But what you are agreeing  
21 to is the general concept, that, generally speaking,  
22 rocks behave more ductile at depth than shallow?

23 A Well, and I think more important -- and -- and to --  
24 to -- to points that Dr. Boone made in his report, that  
25 if shear occurs in materials that are ductile, then  
26 those -- those discontinuities that are created are

1           likely going to remain closed.  If the material is  
2           brittle and it shears and is dilatant, then those  
3           discontinuities are likely to remain open.

4    Q    Okay.

5    A    And so that -- that is a -- as -- as a concept,  
6           absolutely.

7    Q    Okay.  Thank you.

8    A    Yes.

9    Q    Appreciate that.

10   A    Absolutely.

11   Q    Let's try this one.

12           If you could please bring up Exhibit 47.002,  
13           page 20.

14           And this is, I believe, a response to one of the  
15           Canadian Natural IRs that --

16   A    IRs, yes.

17   Q    You provided this plot, yeah.  You probably recognize  
18           that.

19   A    Yeah.

20   Q    And are these lab tests that you -- that were performed  
21           by you or in your lab?

22   A    Yes.

23   Q    And are the samples taken from the Wab D mudstones from  
24           the Suncor MacKay project?

25   A    Correct.

26   Q    In your report, did you provide the labels "dilation"

1 and "contraction"?

2 A Yes.

3 Q In this context, is "contraction" synonymous with  
4 non-dilatant --

5 A Non-dilatant?

6 Q Dilatant?

7 A Yeah.

8 Q Sorry -- as previously shown; is that correct?

9 A It refers to a -- a reduction in volume as shearing is  
10 occurring in the tests, yes.

11 Q Reduction in volume as shearing is occurring.

12 A Yeah.

13 Q Thank you.

14 A Yeah.

15 Q Okay. So let's look at CST4, which has a confining  
16 stress of 690 kPa?

17 A Yeah.

18 Q And that behaves in a dilatant manner, so it indicates  
19 a risk of open fractures. Would you agree?

20 A In -- within the theory that we had just chatted about,  
21 it -- in the stress-strain curve, it exhibits a brittle  
22 strength softening response, and it's followed by a --  
23 a dilatent volumetric response, yes.

24 Q Okay. Thank you.

25 And what about CST3? You'd agree that that's at  
26 the transition between dilation and non-dilation?

- 1 A From -- yeah. From a -- from stress-strain point of  
2 view, it -- it displays strain-softening behaviour, but  
3 the volumetric behaviour is -- I mean, yeah, marginally  
4 if not just zero; right? It -- it --
- 5 Q Okay.
- 6 A -- it contracts initially and then barely dilates,  
7 yeah.
- 8 Q Would you agree that the CTS -- CST5 sample is  
9 exhibiting non-dilatant behaviour, which, according to  
10 the previous model, means that the fractures are likely  
11 sealed? So sealed fractures?
- 12 A Yeah. Probably very likely in -- in CST3 -- or --  
13 sorry -- CCS5, if-- if -- if we looked at the  
14 samples -- and I think I did show all of the images of  
15 the post-failure condition of the tests likely suggest  
16 that -- yeah, that it would -- it would have been  
17 closed.
- 18 Q Okay.
- 19 A Yeah.
- 20 Q Thank you.
- 21 A Yeah.
- 22 Q CST4, which has a confining stress of 690 kPa; CST3,  
23 1,470 kPa; CST5 has a 1,970 kPa; correct?
- 24 A Correct.
- 25 Q So at the effective -- so at effective stresses above  
26 1,470 kPa, the behaviour is not indicative of open

1 fractures; correct?

2 A Yeah. That's -- yes.

3 Q You agree?

4 A It's -- well, it's -- yeah.

5 Q Thank you.

6 A M-hm.

7 Q If we could please bring up Exhibit 50.003. Is that  
8 what we're in? No. 50.003, page 26, please.

9 Oh, do I have the right -- there's no  
10 page numbers. Okay. So page 26. Yeah.

11 So Dr. Boone provided this chart, and -- which  
12 plots the test versus confining stress at the top and  
13 then illustrates the transition versus depth showing  
14 the stresses at KN08/KN09. You see that?

15 A I do.

16 Q And the initial minimum effective stress in the  
17 confining strata at KN08/KN09 exceeds 4,000 kPa. So  
18 it's clearly in the ductile regime, which one would  
19 expect closed fractures. Do you agree with that?

20 A In the assumed position of the transition that was  
21 interpreted by Dr. Boone, yes.

22 Q Right. You'd agree this isn't even close, meaning  
23 it's -- it's way past the transition at 4,000 kPa?

24 A Indeed. But the stress state within the confinement  
25 strata is actually not represented by the dots shown by  
26 Dr. Boone, as evidenced by the in situ stress estimates

1 provided in the direct evidence I provided.

2 Q Are you able to give us a reference for that, or you're  
3 just saying --

4 A Well, if I would --

5 Q -- generally?

6 A If we would have been able to use slides, I would -- I  
7 would have shown you those calculations, and I'm --  
8 I'm -- I'm happy to -- I don't know -- what is it  
9 called -- no.

10 I'm looking at Ms. Riley. I've been instructed  
11 not to offer undertakings.

12 Q Fair --

13 A I will leave it to Ms. Riley, but, yes, I have the  
14 data, and I have the slides to show the calculations of  
15 what the variation in that minimum effective stress is,  
16 given the stress profile data supplied by CNRL.

17 Q Okay. Fair enough. I think we'll leave it  
18 there since --

19 A Okay.

20 Q -- obviously that information's not on the record.

21 A Yeah.

22 Q And --

23 A Fair enough. Yes.

24 Q -- none of us want to go there, so ...

25 Can you please turn up Exhibit 47.002, page 20, if  
26 you could. And -- page 20, yeah. So -- no. That

1 doesn't look right.

2 So I think this is coming from your report?

3 A Yeah.

4 Q It's Figure 15. You call it "Figure 2", "Changes in  
5 Hydraulic Conductivity and Volumetric Strain with Axle  
6 Strain Number 5". Does that ring a bell in your  
7 report?

8 A Yeah. I'm trying to find --

9 Q It's two graphs, Figure 2.

10 A Oh, Figure -- Figure --

11 Q Just need a page number --

12 A Figure 2?

13 Q Yes.

14 A Figure 2. Figure 2. So -- oh, it was -- well, Figure  
15 2 in the original report was the centrifuge testing.  
16 Are we getting after the centrifuge testing?

17 Q Let's see -- this might be Figure -- I think I'm  
18 quoting the reference. So --

19 A Oh, okay.

20 Q It's Figure 15. This is 11. Maybe keep going down.

21 A Oh, Figure 15.

22 Q I think I was --

23 A Oh, it must be --

24 Q -- referring you to a reference, and that's not right.

25 A Oh. Yeah. I don't think that --

26 Q Right here. We've got it here. Thank you very much.

- 1 A Oh, yes. Yes.
- 2 Q Good job.
- 3 A Yeah.
- 4 Q Okay. Yeah. So can you -- you provided this as an  
5 example of brittle dilatant behaviour; correct?
- 6 A Yeah, just as a -- an example from a public -- or from  
7 a publication. Yes.
- 8 Q Right. And can you just confirm that this test in  
9 particular describes a volcanic pumice tuff --
- 10 A Oh.
- 11 Q -- is that correct?
- 12 A Oh. Oh, yeah. No. It's -- yeah. No.
- 13 Q So it's not a shale?
- 14 A Completely inappropriate for our conversations about  
15 shale, yes. No. This was -- this was supplied to a  
16 response that said, Do you have anything that shows  
17 that there's an increase in permeability with shear?  
18 Yeah. No, no. It's -- this -- this is not for a --  
19 not for a shale and definitely not for the shales  
20 represented by --
- 21 Q Okay.
- 22 A -- our confining strata. Sure. Yes. Absolutely.
- 23 Q I think actually that's part of the question, that we  
24 were looking for you to provide an appropriate example.  
25 Are you --
- 26 A Yeah.



1 Q -- aware of a good example that would show in this  
2 area?

3 A So, again, if -- if -- if we would've been able to use  
4 the slides --

5 Q Oh, okay.

6 A -- I would have shown you a reference of an individual  
7 who did testing on shales utilizing the definitions for  
8 brittle index that we have been establishing and  
9 showing that if the brittle index is above 2 and a  
10 half, the behaviour of those materials will be brittle,  
11 dilatant, and will show permeability increases by  
12 orders of magnitude.

13 Q Okay. Understood. And those ones unfortunately are  
14 not on the record.

15 A They are not.

16 Q Is there any way -- any reason why you didn't provide  
17 it in response to Canadian Natural's information  
18 request specifically requesting pertinent examples?

19 A Oversight and a rookie move on my part. My apologies  
20 to CNRL.

21 Q Okay. So then --

22 A But I can provide it.

23 Q All right. Thank you. Appreciate that.

24 We have reviewed your original report. I don't  
25 think this is on the record either, but it does -- it  
26 does provide the backup or the lab results -- is it

1 specific to this ...

2 Okay. So this is -- maybe I better get this back  
3 up just so you can stay with me. So in your report,  
4 page 20, let's see if we get --

5 A Page 20.

6 Q Oh, this is -- this the reference that's not correct.

7 A Oh. Sorry.

8 Q We want this one, but that's not the page number.

9 A I can ...

10 Q Let's see if this is fair game --

11 A Sure.

12 Q -- Dr. Chalaturnyk, so you have a report. It's called  
13 "Petro-Canada Limited MacKay River Thermal Project  
14 Geomechanics Laboratory Program Clearwater and Wabiskaw  
15 Formations December 7, 2009", and that is the report,  
16 we understand, to have backed up the example that you  
17 did provide in response to the information requests.

18 A Yeah. Just -- I was just going to go to where I think  
19 I listed those -- those references. Hang on. Sorry.  
20 Yeah. Yeah, yeah. Okay.

21 Q So this would be -- I'm going to -- this might be  
22 helpful.

23 A Those -- those reference or my reference to them is  
24 kind of page 12 -- page 12 -- 11, 12 of -- of my IR  
25 response.

26 Q Let's try this and just see if it takes us there.

1 Exhibit -- Exhibit 44.002 --

2 A Okay.

3 Q -- page 74. Yeah. And if you could scroll --

4 A Oh, here we are. Okay. Thank you.

5 Q That's not the response. Hmm ... Let's see if we can  
6 do this.

7 But you had -- you agree with me that you did talk  
8 about the MacKay thermal project results in your -- in  
9 your --

10 A Yeah.

11 Q -- IR response? You recall that, sir?

12 A Yeah, I think I provide basically three -- three sets  
13 of results to demonstrate the brittle response and the  
14 stress strain behaviour that was -- yeah, I think. But  
15 there were two conducted in my lab: one conducted by  
16 Tetra Tech in Edmonton for Wabiskaw A and Wabiskaw D  
17 intervals, yes.

18 Q Exactly. That's what I'm trying to refer to.

19 A Yes. Yes.

20 Q And then you found that that report was assessing or  
21 conducting before and after permeability tests on Wab D  
22 specimens; correct?

23 A They -- they did include -- yes, I think -- I think in  
24 the full reports --

25 Q Yes.

26 A -- there is some permeability testing data, yes.

1 Q Okay. Thank you.

2 And would you agree that that report shows that  
3 there was no permeability increase associated with the  
4 induced shear fractures in either the Wabiskaw or the  
5 Clearwater shales?

6 A It did.

7 Q Yes?

8 A Yes.

9 Q Thank you.

10 You're aware that the Wabiskaw D shale that  
11 you tested and provided evidence of "brittleness" is  
12 the primary caprock for the Suncor MacKay River SAGD  
13 project; correct?

14 A Correct.

15 Q And you're aware that that project has been operating  
16 for more than 20 years?

17 A Correct.

18 Q At the MacKay site, the confining shales would have  
19 been subjected to the thermal expansion of sands that  
20 you express concern about above, correct, in that  
21 report or -- sorry -- that you were suggesting earlier?

22 A So are -- are we moving towards details of these  
23 projects as analogs for KN08 and KN09? Is that -- is  
24 that where we're headed because that might be a little  
25 difficult for me to speak on in detail. I've had, you  
26 know, some passing involvement in those projects. I

1 have not been professionally engaged in analyzing those  
2 projects, so I'm -- it would be a little difficult for  
3 me. Generically, if we want to talk generically.

4 Q I think we are talking generic, and just the concept  
5 that you've held out an example where you're suggesting  
6 that you could get to induced shear fracture of those  
7 shales, and yet we actually have an operating SAGD  
8 project for 20 years --

9 A M-hm.

10 Q -- that -- that just isn't the case?

11 A Yeah.

12 Q That has not occurred?

13 A Yeah. And I think if you read the details of the IR  
14 response, the IR response from CNRL asked, You made a  
15 claim about brittle behaviour, what -- what evidence or  
16 experience have you had in your -- in your life that  
17 shows that, in fact, you could get this kind of stress  
18 strain response that is -- is strain softening or  
19 demonstrates a brittle response?

20 I -- I -- I didn't supply the data for a  
21 wide-reaching conclusion of KN08 and KN09. They -- it  
22 was -- it was meant specifically to CNRL's direct  
23 question that says, You said "brittle": What evidence  
24 do you have in your experience that shows that it's  
25 brittle for this class of materials? That's all I  
26 have.

1 I -- again, I will say that if -- if -- if there  
2 is data of core testing specifically from KN08 and KN09  
3 in this confinement strata under this condition, I --  
4 I'll sit corrected.

5 Q For sure.

6 A Fair enough.

7 Q Understood. Yeah.

8 A Yeah.

9 Q I think what we were just trying to get at is you're  
10 sort of claiming brittleness over here in an  
11 established caprock that has clearly been containing  
12 steam for the past 20 years, so just -- it would  
13 suggest that you're -- you know, that you're applying a  
14 theory that's just not being proven in practice.

15 A The reason I'm hesitating is that your question stated  
16 specifically "held steam", and it is difficult for me  
17 to comment on direct experience in those field projects  
18 that demonstrates the movement of pressure beyond that  
19 horizon. And I don't think I'm in a position to be  
20 able to talk about that in detail, but your comment or  
21 your question specifically was steam containment, which  
22 is by definition a vapour phase and high temperature  
23 and so on, as everybody knows. But -- but that's not  
24 necessarily a germane conversation around how the  
25 confinement strata at KN08 and KN09 are going to behave  
26 over the lifetime of the project. It's -- I -- I had

1 thought about this when thinking about CNRL and the  
2 evidence that was provided that if steam as a vapour  
3 phase arrived in the Wabiskee -- Wabiskaw B pool, we  
4 would have other serious issues to be talking about.

5 But that's not -- in my mind, when I reviewed the  
6 evidence was not what the germane question was about.  
7 The -- the question was fluid migration and in the  
8 range of descriptions that have been provided: steam,  
9 condensed steam, reaction products, and so on, but the  
10 fluid migration from the SAGD up through the  
11 confinement strata to the Wab B. So, yes, I know  
12 you're asking me to -- to speak to the issue of steam  
13 containment in a shallow SAGD project like the MacKay  
14 River, but there -- it would be difficult at the moment  
15 for us to get into the conversation about what that  
16 means relative to how fluid pressures and other such  
17 processes would occur in the -- in the -- in the  
18 overlying zones.

19 Q Yeah. Understood.

20 A That's a long answer. I apologize.

21 Q That's okay.

22 A I guess I find it very difficult to be able to give you  
23 the answer that I think you're looking for because it's  
24 a very complex situation involving monitoring data,  
25 surveillance data, and -- and other things that have  
26 happened that -- that make it difficult for me to, I

1 think, give you the answer you're looking for.

2 Q I think -- I'll just boil it right down. My last two  
3 simple questions. We know -- you don't have any  
4 evidence to suggest that at Fort McKay after 20 years  
5 that that caprock, which you have characterized as  
6 "brittle", is not containing the steam. And I'm  
7 specifically using the "steam".

8 A Steam. Yeah. No, I --

9 Q You agree. You have no evidence?

10 A I do not.

11 Q And are you aware, sir, that the wording of Hearing  
12 Issue 1 actually is "steam"? I understand your client  
13 is concerned about other --

14 A No, I --

15 Q -- issues, but the wording of Hearing Issue 1 is  
16 "steam"; correct?

17 A Yeah, sorry. And I apologize because I had migrated to  
18 the language that was used by the AER in their IRs to  
19 CNRL which spoke specifically to fluid migration from  
20 the SAGD chambers up through the confinement strata, so  
21 I apologize.

22 Q Fair enough.

23 A But I did use --

24 Q That's a good point.

25 A I did use AER language.

26 Q Fair enough.



1           If you'll just give me one moment, we'll just  
2 confer and see if we're finished.

3           Thank you very much. I think we're done with  
4 that -- that line of questioning, and we'll just hold  
5 on and wait for our turn for the rest of you tomorrow.

6   A   Thank you.

7   Q   Thank you very much.

8           COMMISSIONER CHIASSON: Thank you. All right. So we  
9 do have some questions from the AER. So please  
10 proceed, Ms. Peddlesden.

11           The Alberta Energy Regulator Counsel Questions the ISH  
12 Energy Ltd. Witness Panel

13   Q   S. PEDDLESDEN:           Good afternoon. So I am  
14 Ms. Peddlesden, and I'm here with the Alberta Energy  
15 Regulator, and I just had a few follow-up questions.

16           I'm looking at the practical value of a DFIT. Is  
17 the critique ISH provides of Canadian Natural's  
18 geomechanical model still as relevant if the KN08 and  
19 KN09 steam chambers are contained as Canadian Natural  
20 claims, the steam chamber will be based upon what has  
21 been defined in the submissions as the confinement  
22 strata made up of the six co-relatable units in varying  
23 thicknesses?

24   A   R. CHALATURNYK:           I think the component of the  
25 discussion that's happened relative to your question is  
26 a conclusion based on stress contrasts and the

1 submission of geomechanical modelling that is based on  
2 the initial assumptions of what those in situ stress  
3 states are, and the repercussions, I guess, or if the  
4 consequences, I suppose is maybe a better way, is that  
5 if the horizontal stresses that are -- have been  
6 regionally estimated are transferred to the confinement  
7 strata and given the geological heterogeneities that  
8 exist in KN08 and KN09 result in a lower horizontal  
9 stress, you know, I -- I can't -- I argue there were  
10 some interpretations of some other values, but if it's  
11 lower, then -- then I think the consequences for the  
12 question change.

13 It -- it -- it -- lower stresses will result in  
14 deformations having a larger impact on the -- on the  
15 integrity of those zones and will have a larger impact  
16 on the ability to contain the fluid movement and to be  
17 able to lower stresses will change the outcomes of the  
18 geomechanical modelling.

19 So, yes, I would say that if there is the  
20 potential, given the geological environment, that there  
21 is an uncertainty or a lower horizontal minimum stress  
22 that, yes, it may change the outcome.

23 Q Okay. And now I'll ask for Exhibit 46.002 at PDF  
24 page 70 to 71. Great. Figures 30 to 31.

25 I just wanted you to identify which variables of  
26 Canadian Natural's geomechanical model ISH expects

1 would change with the data of a more proximal DFIT to  
2 the KN08 and KN09.

3 A So relative to Figure 30 and Figure 31. Is -- is  
4 that -- is that correct?

5 Q Not necessarily.

6 A Oh.

7 Q Just if we had a more proximal diagnostic fracture  
8 injection test.

9 A Oh, I see. Okay. So --

10 Q As suggested.

11 A So -- so clearly in the -- in the evidence I had  
12 provided, you know, I had recognized the expertise and  
13 experience of Mr. Walters in conducting these kinds of  
14 simulations. That -- that's -- that wasn't at all in  
15 question. When it comes to results like this, there  
16 has been the interpretation that based on regional --  
17 regional characterization or regional interpretation of  
18 the stress distributions, that the stress contrast in  
19 the -- specifically shown in this one -- let's pick the  
20 lower -- the lower B1 is 13.7 kPa per metre. Mid-B1 --  
21 I will leave it to the geologists to have the  
22 discussion around the heterogeneity of the presence or  
23 non-presence of mid-B1.

24 But if you pick 13.7, it is -- it is correct in --  
25 in the position by CNRL that that stress contrast under  
26 the short-term conditions, 24 hours of injection, is

1 sufficient to contain the fracture -- vertically  
2 growing fracture within the McMurray; correct? If you  
3 look at this data.

4 So the question becomes if the regional  
5 interpretation doesn't reflect the geological  
6 heterogeneities that exist within KN08 and KN09, which  
7 have been spoken at -- at length in the hearing, result  
8 in the stress contrast from 13.7 going to 13.1, not  
9 even as low as -- as what was interpreted in another  
10 place but drops to 13.1 or -- or even lower locally,  
11 then there's a potential for that fracture -- vertical  
12 fracture growth to propagate well into the confinement  
13 strata.

14 I am -- and I think I -- in -- in questioning with  
15 CNRL, I -- I -- I -- I -- I didn't see any evidence to  
16 suggest that that becomes a risk for caprock integrity,  
17 and there's a difference. It's not a risk for caprock  
18 integrity. This is about the behaviour of the  
19 confinement strata in sealing against the migration of  
20 fluids out of the SAGD chamber into the Wab B gas pool  
21 over the life of SAGD.

22 So, yeah, if -- if -- if -- if -- if those  
23 horizontal stress estimates drops, then -- then you  
24 will have the potential for the fracture to grow  
25 vertically up into the confinement strata.

26 Q And what I'm trying to explore with you is what value

1 or certainty would the Regulator gain from a DFIT test  
2 more proximal? Which parameters can you identify?  
3 Obviously you identified --  
4 A Yeah. Yeah.  
5 Q -- that 13.1 might be more --  
6 A Okay. And -- and -- so you --  
7 Q -- conservative --  
8 A So I -- so you would like me to kind of speak --  
9 Q The value.  
10 A -- a value statement on --  
11 Q Is it going --  
12 A -- on behalf of AER or -- or -- or just --  
13 Q No. Just --  
14 A -- my opinion --  
15 Q -- like, why -- why would it guide --  
16 A Oh, okay.  
17 Q -- our approval MOP? Which parameters do you  
18 anticipate would change with a more proximal DFIT test?  
19 Can it identify the brittle or ductile behaviour of the  
20 confinement strata? I'm not concerned about the  
21 caprock as you had said.  
22 A Oh, okay.  
23 Q That's fair.  
24 A No. I -- well, there are a few of the issues we  
25 chatted about in terms of the behaviour of the -- you  
26 know, the mud zones and the sand zones within the

1 confinement strata. Understanding what that initial  
2 stress state is, if it varies, helps better understand  
3 how the confinement strata is going to respond to SAGD  
4 pore pressures and temperatures. So the value of the  
5 DFIT locally or proximally to KN08 and KN09 from --  
6 from the point of view of -- of the confinement strata  
7 would provide confidence that if you confirmed that the  
8 horizontal -- minimum horizontal stress was in line  
9 with -- with these regional estimates, then that would  
10 confirm that -- that -- that, in fact, the confinement  
11 strata will behave as proposed.

12 If the value is lower, then you -- you stand the  
13 chance that the predicted behaviour will result in  
14 fluid migration through the confinement strata into the  
15 overlying zones such as the Wab B gas pools.

16 And so that's -- that's -- that's a -- that's a  
17 particular end result that's a part of the discussions  
18 at the hearing, but I would suggest in the -- in my  
19 final statement that -- regarding SAGD projects, per  
20 se, that it -- that it -- that understanding what those  
21 mechanisms are and ensuring that we understand better  
22 what those mechanisms are moving through the  
23 confinement strata helps us better understand what our  
24 caprock integrity risks are. I mean, so -- so minimum  
25 horizontal stress is inherent in any of those  
26 discussions.

- 1 Q Are you referring to in situ stress or --
- 2 A Yeah.
- 3 Q -- is it --
- 4 A The -- the -- in the -- in the language or the terms  
5 and stuff, Sh min, the -- the minimum stress -- in this  
6 particular case, the minimum stress happens to be the  
7 horizontal, but -- and in -- and most of this has been  
8 determined by the DFIT. So it's the minimum horizontal  
9 stress.
- 10 Q Thank you.
- 11 A Yes.
- 12 Q And is it ISH's position that a DFIT would reveal  
13 further information on the ductility of the confinement  
14 strata?
- 15 A No, not necessarily. No.
- 16 Q Now, if I could get Exhibit 32.02.
- 17 Hold on. I'm just going to confer.
- 18 As far as the range of values you may anticipate  
19 for -- from the DFIT model, what is your position on  
20 the sensitivity analysis that's already been applied in  
21 the Canadian Natural geomechanical model?
- 22 A Can -- I've -- don't have the exhibit number.
- 23 Q 32.02.
- 24 A No, no.
- 25 Q No?
- 26 A Well, actually, let me see if it's -- it's the --

1 the -- you might -- you might have it in my slide deck.  
2 It's the second-last one that showed the stress  
3 profile, and I apologize that I don't -- to -- to  
4 answer your question -- sorry. This might help with  
5 it.

6 Q This is helpful.

7 A Yeah. Just to help with that question.

8 Q Yeah. I appreciate it.

9 A Yeah. Yeah, yeah. It's -- we'll see how fast -- see  
10 who can -- who can win the race faster. It's the in  
11 situ stress, and it is -- oh, no, that's the DFITs.  
12 No. No, no, no. I mixed up all of these documents,  
13 and I apologize. Oh, for God's sake. Ah,  
14 Exhibit 46 -- 46.002, Tab 5, Figure 7, page 46 -- PDF  
15 page 46 of 72.

16 So I think this might -- this -- this uncertainty  
17 level -- so I had -- I had indirect -- I had pointed  
18 out that in the confinement strata there have been  
19 estimates of the -- of variation in the minimum stress  
20 gradient indicated by the dotted lines. So we had  
21 blown in -- we had -- we had -- yeah. We had gone in.  
22 And so -- so in the kind of numbers that we've been  
23 talking about that we see in the tables, those gradient  
24 values are the values interpreted by fitting those pink  
25 straight lines in there that are not representative of  
26 the variability in the horizontal stress that's been



1 interpreted from continuous logs as a part of CNRL's  
2 interpretation of their mechanical earth model.

3 So when you -- when you say about -- so I guess  
4 the impact, I guess if you like, is that that  
5 variability, theoretically, would still exist. And  
6 there were sensitivity studies that I -- I think  
7 Mr. Walters might have shown -- and, again, I'm going  
8 to apologize if I've get the -- the numbers wrong. He  
9 took the stress gradient in the lower B1 and the stress  
10 gradient in the McMurray and shifted them down -- and  
11 shifted them both down by equal amount. I'll have to  
12 find the things, but that was a part of the  
13 sensitivity. He said, Well, listen, we'll test it, and  
14 we'll shift the things down. But -- but it's the  
15 dotted lines that shifted, not the solid pink variation  
16 in the interpreted variation in the minimum horizontal  
17 stress.

18 So the implications are that if that variation  
19 still remains within the confinement strata, that that  
20 variation may push the actual local minimum stress to a  
21 point that actually will not resist fracture  
22 propagation. That's the implication.

23 Does that -- does that help? Sorry. I didn't  
24 know if that would help --

25 Q It does help.

26 A -- in terms of your question.

1 Q But the DFIT would not identify the brittleness?

2 A Ah, okay. You're getting at the value of the DFIT. So  
3 the DFIT value --

4 Q Yes.

5 A -- in this piece of work, which is a key, standard  
6 workflow -- I mean, Mr. Walters is an expert at this.  
7 This has not been in question. Those interpretations  
8 of the variations in  $S_h$  min, the minimum horizontal  
9 stress, have to be calibrated or typically calibrated  
10 to the DFIT number, which is the open circles in this  
11 plot.

12 Q So that brings me to: Would the new DFIT --

13 A Yes.

14 Q -- in a proximal location to the proposed drainage  
15 boxes significantly change the  $S_h$  min curve, in your  
16 opinion?

17 A Yeah. So if the DFIT results in a reinterpretation of  
18 what that minimum stress is at any particular depth and  
19 it's lower than that open circle that exists within the  
20 confinement strata, the whole curve shifts to the left.

21 Q Right.

22 A And that has impacts on -- on the -- on the containment  
23 characteristics of the confinement strata. So the  
24 value is that in order to calibrate this data, if the  
25 new DFIT shifts that number to the left, the whole  
26 curve shifts to the left.

1 Q And how much variation are you anticipating?

2 A Oh.

3 Q What's your position?

4 A I -- I -- I don't know. I -- I think there was  
5 pushback -- again, I think in my report there was some  
6 conversation around the low confidence of the  
7 interpretation of the confinement strata DFIT in the  
8 9-6 well, which is the closest. I think, you know,  
9 it's off to the east of -- of -- of KN06. And, you  
10 know, there were experts in -- in CNRL that analyzed  
11 the data. There are -- there are ways to do it, the --  
12 the response of the pressures, the volume injected, and  
13 so on, and there was a low confidence limit given to  
14 that estimate, and so it was disregarded.

15 The -- the -- in the same well, there were other  
16 DFITs conducted in the Clearwater for caprock integrity  
17 assessment, and in the -- I don't know if it was in  
18 the -- but there were other -- yeah -- in the McMurray,  
19 which are the open circles that you see here -- and  
20 even though it was the same operation, those were  
21 deemed to be valid.

22 So all I had pointed out at the time is that  
23 the -- the interpreted much lower  $S_h$  min in that test  
24 in the confinement strata may have suggested some  
25 uncertainty in what those estimates are for the minimum  
26 stress.

1           But I think, you know, that -- it wasn't based on  
2 my interpretation. It was just looking at the  
3 behaviour and looking at the consequences for the  
4 confinement strata in KN08 that I -- I'd -- I'd made  
5 that observation.

6           So the uncertainty part, I -- I -- I probably  
7 haven't looked at the data enough to be able to offer  
8 a -- a -- a solid conclusion to you. Sorry.

9   Q   And now we'll turn to Exhibit 32.02, page 10 at  
10 paragraph 22. I'll just read it out loud so --  
11 (as read)

12           ISH has not and does not seek an order  
13 preventing CNRL from developing the bitumen  
14 resources. ISH is asking that the conditions  
15 of approval recognize the unique geology  
16 underlying KN08 and KN09 and include  
17 appropriate measures to mitigate the  
18 concomitant risk.

19           Speak to that. What conditions are you looking for  
20 specifically within your expertise? Oh, I didn't mean  
21 to scare you.

22   A   I think this is at the point when I do not have the --  
23 can't speak on behalf of ISH.

24   Q   It's only because you're leaving early --

25   A   Yeah, I know.

26   Q   -- that I put it to you.

1 A So maybe that -- perhaps I don't know -- I think I can  
2 turn it over to the chair.

3 Q No, you don't have to.

4 A Oh, okay.

5 Q It's not our issue yet.

6 A Oh, okay.

7 Q Yeah. No.

8 A I -- I'd be --

9 Q I just wanted to ask you before you departed.

10 A Yeah. That would be a little probably beyond my remit.

11 Q That's fair.

12 A Sorry.

13 Q That's fair.

14 So in a similar vein, before I let -- let this  
15 drop, if the Sh min is indeed lowered, what mitigation  
16 strategy would you propose? It's kind of the same  
17 question. Like, what condition would help mitigate  
18 risk of breakthrough of the confinement strata?

19 A Good question. That's a -- that's a great question,  
20 actually. I think in my mind -- and -- and I spoke to  
21 it generically about even the importance for us in --  
22 in the -- in the -- in the SAGD projects and the -- and  
23 the technical people involved in SAGD projects is about  
24 better understanding what the potential is for these  
25 fluid migration pathways, if or if they do not occur,  
26 you know, what happens to pore pressures and -- and so

1 on.

2           So in some ways I'm not -- it really is in  
3           constraining those values helps us better understand  
4           how that confinement strata would behave, and from a --  
5           I suppose from an ISH perspective, it helps them better  
6           understand what that potential risk profile looks like  
7           for the -- over the life of the SAGD project for -- for  
8           fluids migrating to the Wab B gas pool. But I would  
9           suggest in -- in -- in terms of even your earlier  
10          question sort of on the -- from a perspective of, say,  
11          if you like, an AER in ensuring subsurface containment  
12          and subsurface assurance issues is that, you know, even  
13          if you look to projects that have -- have -- have  
14          failed, Jocelyn, others, whatever, it has to have  
15          started with fluid migration from the SAGD chamber  
16          moving through these intervening layers to some upper  
17          interval that has now failed and moved and -- and --  
18          and moved to the surface. So a better understanding of  
19          how that interval behaves provides knowledge, if you --  
20          like, for a whole range of SAGD projects who are -- who  
21          are actually dealing with the containment side even as  
22          you move shallower in the column. If we better  
23          understand that, we better understand where we sit  
24          relative to factors of safety.

25                 So I would say that that's the reason why  
26          refinement of that kind of information at KN08 and KN09

1 beyond the potential risk of -- of contamination in the  
2 Wab B gas pool also has much larger value-added  
3 contributions to the industry.

4 Q Thank you for that. My questions are concluded.

5 A Thank you.

6 COMMISSIONER CHIASSON: So thank you for that. The  
7 Hearing Panel has no questions --

8 A Oh, okay.

9 COMMISSIONER CHIASSON: -- for you, Dr. Chalaturnyk.

10 A Thank you.

11 COMMISSIONER CHIASSON: So I think Ms. Peddlesden  
12 probably covered off what we may have been wondering  
13 about, as well as the cross-examination. So thank you  
14 very much.

15 At this point, Ms. Jamieson, we do have time in  
16 the day if you are inclined to continue your  
17 cross-examination; however, if you would prefer -- if  
18 you would prefer to leave it till tomorrow morning,  
19 then we can close off for the day as well.

20 J. JAMIESON: If I could just have a moment  
21 to confer.

22 COMMISSIONER CHIASSON: Absolutely.

23 J. JAMIESON: I'll see what that might look  
24 like. Thank you.

25 COMMISSIONER CHIASSON: Actually, Ms. Jamieson,  
26 because this may be relevant in your conferring, I

1 should mention that if we were to continue, we do need  
2 to take at least a break to allow our court reporters  
3 to switch over.

4 J. JAMIESON: Yeah. Thank you. I  
5 appreciate that. I'm going to try to get a sense of it  
6 and to see where that would take us.

7 COMMISSIONER CHIASSON: Okay. Yeah.

8 J. JAMIESON: Just so we're not staying  
9 late.

10 COMMISSIONER CHIASSON: Okay. Thank you.

11 J. JAMIESON: Okay. Thank you.

12 Commissioner Chiasson, we think if it works for  
13 the Panel, that we would like to stop here. We'd be  
14 prepared to come back, finish off in the morning. But  
15 just because of how this has unfolded we're just not  
16 quite ready to go right now, and I couldn't give you a  
17 sense of how much time we're going to need.

18 COMMISSIONER CHIASSON: No. Thank you. We appreciate  
19 that. And I don't think that's a problem otherwise.

20 Any concerns, Ms. Riley, in terms of that?

21 M. RILEY: I certainly don't have a  
22 concern with stopping today. I would just like to  
23 confirm that Dr. Chalaturnyk is then no longer under  
24 oath and released --

25 COMMISSIONER CHIASSON: Yes.

26 M. RILEY: -- and excused.



1 COMMISSIONER CHIASSON: No. No. That was -- that was  
2 going to be my -- that was going to be my next job.

3 So let's do that, then. We will close for today.  
4 The usual reminders to remember to take all your  
5 belongings.

6 So, Dr. Chalaturnyk, thank you very much. You are  
7 released, which is, like, not parole. You're free and  
8 clear. The rest of the witness panel, we would remind  
9 you that you are still under oath and affirmed, so  
10 please do not discuss with your counsel overnight or  
11 that -- and we will see you back tomorrow.

12 (WITNESSES STANDS DOWN)

13 COMMISSIONER CHIASSON: And, to confirm, we will  
14 restart again tomorrow at 9:00 and anticipate running  
15 through the rest of the hearing, including final  
16 argument. So thank you all. I hope everyone enjoys  
17 having a little bit of earlier time today. I suspect  
18 we will. And that -- And thank you, all. We will see  
19 you tomorrow morning.

20

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21 PROCEEDINGS ADJOURNED UNTIL 9:00 AM, FEBRUARY 9, 2024

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1 CERTIFICATE OF TRANSCRIPT:

2

3 We, Sandie Murphy and Sandra Burns, certify that  
4 the foregoing pages are a complete and accurate  
5 transcript of the proceedings, taken down by us in  
6 shorthand and transcribed from our shorthand notes to  
7 the best of our skill and ability.

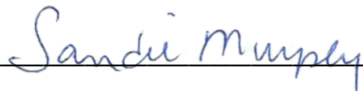
8 Dated at the City of Calgary, Province of Alberta,  
9 this 8th day of February 2024.

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Sandie Murphy, CSR(A)

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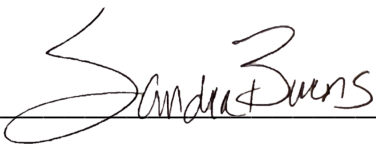
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Sandra Burns, CSR(A), RPR, CRR

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