

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)

AER PROCEEDING

VOLUME 2

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February 7, 2024

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1 Proceedings taken at Govier Hall, Calgary, Alberta

2

3 February 7, 2024 Morning Session

4

5 Cindy Chiasson Panel Chair

6 Brian Zaitlin Panel Member

7 Meg Barker Panel Member

8

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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 9:00 AM)

8 COMMISSIONER CHIASSON: Good morning, and welcome
9 back to Day 2 of this proceeding. So before we start,
10 a couple of reminders: One, just to remind everyone in
11 the room that the hearing is being video cast on the
12 internet. So anyone in the hearing room may show up on
13 the video cast, so if you have any concerns, please
14 approach Mr. Lung, Mr. McClary, or Ms. Peddlesden.

15 The second thing that I want to remind -- and I
16 want to remind everyone who is using a mic in here, the
17 Panel -- we found yesterday over the course of the day
18 that we were having challenges with hearing, so --
19 hearing people. So as I mentioned yesterday, the mics
20 are very moveable, very adjustable. It seems to work
21 best if you can get the mic close in to you. I also
22 encourage people to use their loud projection voices.
23 My kids are used to me referring to it as my "mom
24 voice", but I know not everyone here is a mom, so --
25 but I encourage you to project as well. It just makes
26 it a little easier for us because we have discovered

1 the speakers in the room here are not oriented towards
2 the Hearing Panel, oddly enough, so just that reminder.

3 So other than that today -- and I've got it
4 right -- it came to me during the night -- I wanted to
5 acknowledge that we have Anastasia Stanislavski from
6 hearing services here. I apologize. I had a brain
7 blip last -- yesterday in relation to doing that;
8 otherwise, we have got largely the same folks.

9 And are there any matters before we proceed? No.
10 Okay. Otherwise, we are back to cross-examination of
11 Canadian Natural's panel by ISH. So, Ms. Riley, we are
12 over to you, and right now we're currently scheduled
13 for a break about 10:30, but you let us know when -- if
14 that -- that -- as you go along if that fits
15 conveniently with where you are at, please.

16 DEVIN OLLENBERGER, THOMAS BOONE, LENNON ROCHE,
17 MARC SCRIMSHAW, Previously Affirmed.
18 GERARD IANNATONE, JASON LAVIGNE, SCOTT SVERDAHL,
19 DALE WALTERS, XIANG WANG, PETER THOMSEN, SCOTT BARLAND,
20 Previously Sworn

21 M. Riley Cross-examines the Canadian Natural Resources
22 Limited Witness Panel

23 M. RILEY: Good morning, Panel. I'm
24 going to try and move this microphone for a moment and
25 see how things work out for us.

26 COMMISSIONER CHIASSON: Thank you. We appreciate --

1 we appreciate the efforts.

2 M. RILEY: Let's see. Okay. I think
3 this works.

4 COMMISSIONER CHIASSON: You're sounding good so far.

5 M. RILEY: Excellent. Good morning. We
6 will then proceed with our cross-examination of the
7 CNRL panel, and I would like to begin with a reference,
8 please, to Exhibit 50.02, PDF page 33, paragraph 113.

9 Yesterday, when we started, I mentioned to
10 Mr. Iannattone that there was references to several
11 industry examples which CNRL rejected. Mr. Iannattone
12 could not remember which of these examples I was
13 talking about, so I promised to come back today with a
14 reference for him, and specifically, then, it is this
15 reference that we see in paragraph 113.

16 Q MS. RILEY: And the question that I have
17 is: If you reject the examples provided by Aardwolf
18 and you offer none of your own, how do you know that
19 what you're proposing is safe?

20 A G. IANNATTONI: Commissioner Chiasson, we'd
21 just like to conference on this one for a minute,
22 please.

23 COMMISSIONER CHIASSON: Okay. Go ahead.

24 A G. IANNATTONI: Could I request a
25 clarification on the question. Is it regarding -- what
26 exactly is it regarding? Is it regarding safety or

1 steam breakthroughs, or could you please clarify.

2 Q M. RILEY: It is, in fact, both.

3 A So it's regarding safety?

4 Q Safety and steam breakthrough.

5 A So steam breakthrough through the caprock and steam
6 release on surface?

7 Q My apologies. Could you repeat that?

8 A Sorry. What's your definition of "safety"?

9 Q I think in the broadest sense possible, the impact on
10 GOB, any risk to the environment, people, property.

11 A Thank you.

12 A P. THOMSEN: Good morning. I think
13 there -- I think there could be a misunderstanding as
14 far as Ms. Riley's comment about rejection of the
15 examples. I would like to start with speaking to the
16 Cenovus/Wabiskaw pressure example, and CNRL does not
17 reject this. I think there are important learnings
18 from this finding.

19 So in December 2012, Cenovus was drilling a strat
20 well for the purpose of recovering a McMurray
21 post-steam core. This well is 103/11-15 76-6 W-4.
22 When this well was being drilled, it encountered
23 elevated pressures in the Wabiskaw D bitumen saturated
24 sands, and a pressure of 6,500 kPa was subsequently
25 recorded, and this was unexpected. And Cenovus has
26 investigated this. They have submitted several

1 applications on this topic. Their findings were that
2 this is due to overburdened heat losses from the
3 underlying steam chamber, and there was an undrained
4 thermal expansion of this bitumen in the Wabiskaw D.

5 So with respect to what are the learnings for CNRL
6 and for the KN08 and KN09, overburdened heat losses
7 will inevitably occur. They are -- they occur with all
8 SAGD projects, and it occurs through conduction.
9 Conduction is a slow process. It has a temperature
10 diffusion coefficient on the order of E minus 6 to
11 E minus 7 metres squared per second. And just for
12 interest, that is about 6 to 7 orders of magnitude
13 slower than, let's say, pressure diffusion in the
14 McMurray bottom water.

15 The Cenovus example had 6 metres of muddy facies
16 in between the top of the steam chamber and the
17 Wabiskaw D bitumen saturated sands. In -- in KN08 and
18 KN09, we have perhaps 10 to 12 metres, so there is
19 going to be less heating or much slower heating of the
20 Wabiskaw D bitumen saturated sands.

21 I'd like to quote Cenovus Application Number
22 1766940, and on page 5 of that application, Cenovus has
23 written: (as read)

24 Note that Cenovus expects no vertical gravity
25 drainage in the Wabiskaw member due to
26 laminations that occur throughout the zone.

1 So Canadian Natural appreciates this example being
2 brought forward. It effectively shows hydraulic
3 isolation of the confinement strata portion in the
4 upper McMurray -- in the muddy facies in the upper
5 McMurray, and, in effect, this confinement strata has
6 been pressure tested, and there was a large pressure
7 difference between the Wabiskaw D bitumen saturated
8 sands and the underlying steam chamber, and this would
9 be several thousand of kPa of differential pressure.
10 Yeah. So that's all we have to say on the -- or that's
11 the update as far as the Cenovus example.

12 I'd like to hand it over now to either
13 Mr. Sverdahl or Mr. Lavigne to talk to the -- the
14 Surmont example and the findings from them.

15 A J. LAVIGNE: In the Surmont example,
16 referenced in the Aardwolf report, it was mentioned
17 that it appeared that steam had gotten through a
18 1-metre thick mudstone, and -- and the term
19 "breakthrough" was applied to that example. However,
20 in the D 54 of that example, it could be seen that the
21 mudstone in question appeared to actually be a 1-metre
22 thick class. There were small breccia pieces at the
23 base and at the top of that class. And so in that one
24 well -- could we bring this up?

25 A S. SVERDAHL: Exhibit 50-003, page 71,
26 please.

1 A MR. LAVIGNE: Thank you.

2 So in this example -- so in this example it
3 appears like steam has broken through this seemingly
4 continuous mudstone. As you can see in the RST log in
5 the upper right, when, in fact, looking at the core
6 photo in the centre, you can see small mudstone chips
7 at both the top and the base of -- of this 1-metre
8 thick mudstone. And the more reasonable geological
9 interpretation is that this is a single mudstone clast
10 that -- this is on the order of a metre thick, and it
11 forms a part of a breccia. And so when you look at the
12 log in the lower left, you can see the small deflection
13 as the gamma tool responds to this, but this particular
14 example would not have lateral extent, and that is why
15 steam moved around this particular clast as opposed to
16 breaking through it vertically.

17 So this is not -- this is not applicable to the
18 analysis of, say, a regional mudstone of 1-metre
19 thickness. This is a small clast that over time steam
20 is able to move around. And -- sorry. And this is
21 within the McMurray formation, within the reservoir
22 component.

23 A T. BOONE: Could I add a comment? So,
24 you know, I'm going to say that there isn't anything
25 particularly special about the problem here. I mean
26 there's shales and mudstones that are capping

1 essentially what is a steam flood zone.

2 And steam flooding has been going on for 70 or
3 80 years now. It's -- most of it was done in
4 California before it moved up here, and now we -- and
5 SAGD is what I would say is a mature process here now.
6 So, I mean, we're all informed by 80 years of
7 experience where there have been some cases of steam
8 breaking through the caprock or the confining strata,
9 but they're relatively few and particularly when you're
10 at -- at the low -- the pressures that SAGD is normally
11 operated here.

12 So the fact that there's no examples of steam
13 breakthrough that -- that we can cite here that are
14 specifically -- says, Oh, you don't have -- you have
15 steam breaking through the type of caprock that we
16 exactly have here, is just a statement that the
17 industry has determined how to work -- how to, you
18 know, design these projects and implement them so that
19 you don't have breakthrough.

20 Q MS. RILEY: Would you agree that part of
21 the reason we don't see these exact examples is because
22 there is adequate monitoring?

23 A T. BOONE: No, I wouldn't agree with
24 that. There -- you know, in general SAGD projects
25 initially were heavily monitored and, you know, what's
26 happened is more recently there's less monitoring, but

1 that's because it's becoming a -- a mature process.
2 And as an example of that, the D 54s don't require
3 companies to report their observation well data
4 anymore. So apparently the AER believes that -- that
5 the process has matured as well, and it's not as
6 important as it was in the past to share that
7 monitoring data.

8 Q And then a further follow-up question regarding the
9 Cenovus example: I believe the terminology used was
10 that there are learnings for CNRL, and I was just
11 wondering how you incorporate those learnings into your
12 monitoring conditions.

13 A P. THOMSEN: Okay. And the learning that I
14 was referring to was the learning as far as showing a
15 pressure difference between the bitumen saturated
16 Wabiskaw D sands and the underlying steam chamber, and
17 so that learning is that there is hydraulic isolation,
18 and it is required in order to have this pressure
19 buildup. So as far as learnings on surveillance are
20 monitoring, I'm not aware of a -- of a relevant finding
21 for that.

22 Q I will then move on, and I would request that we go to
23 Exhibit 50.003, Tab 19, at page 64. I would request
24 CNRL's panel to look at this map, and then if we could
25 go to the next page at Tab 20, this is apparently the
26 gas structural cross-section that informs this map; is

1 that correct?

2 A S. SVERDAHL: That is correct.

3 Q This map does not look the same as other maps of the
4 gas structural cross-section; is that correct?

5 A The difference in this map is the mapping that was
6 provided in our submission was -- was just for the
7 Kirby Mannville II pool.

8 Q So, to be clear, this section here, this is the new --
9 the new portion of the map?

10 A Yes. We added that portion.

11 Q When did you obtain these logs in Tab 20?

12 A Just give me a moment.

13 I just have information on the AA/11-2 well that
14 was drilled in 2008 and the one you see 4-12 well was
15 in 2018. The remaining well, I do not know exactly the
16 rig release date at this moment, but I can check on
17 that.

18 Q I would appreciate it if you would tell us what that
19 date was. And even if you can't give us an exact date,
20 I would be interested to know whether it was before or
21 after the application was filed?

22 A Most likely before the application.

23 Q Can we accept that it was before the application unless
24 you advise us otherwise through the course of this
25 proceeding?

26 A Yes.

1 COMMISSIONER CHIASSON: Do you want an undertaking on
2 that, Ms. Riley?

3 M. RILEY: If the understanding is that
4 it was before the application was filed and we
5 understand that if we don't hear anything by the end of
6 the day, then I do not need an undertaking. If CNRL
7 would rather give an undertaking, then I -- I will take
8 one.

9 COMMISSIONER CHIASSON: Perhaps we'll make a note of
10 that, Mr. McClary, and we'll circle back by end of day,
11 just to check in on that.

12 M. RILEY: Thank you.

13 COMMISSIONER CHIASSON: Thank you.

14 Q M. RILEY: If the data was available
15 before you filed the application, why did you not map
16 that section?

17 A S. SVERDAHL: To be clear, as stated, we
18 provided our mapping on the Kirby Upper Mannville II
19 pool.

20 Q Thank you.

21 I would then like to go to Exhibit 01.01. It's
22 PDF page 18. It is Figure 18. And what this is is a
23 map of the Kirby north approved and proposed McMurray
24 formation drainage boxes; correct?

25 A Correct.

26 Q We note that the KN24 and 25 drainage boxes is not

1 depicted on this map. Is that because it's not a
2 McMurray formation map or drainage box?

3 A Those drainage boxes are Wabiskaw D.

4 Q Can we then go to Exhibit 20 at 02, page 92. Do you
5 agree that the orange on this map is the Wabiskaw D
6 bitumen?

7 A That is a map of the SAGD pay for the Wabiskaw D.

8 Q And do you note that here we don't see the KN24 and 25
9 drainage boxes?

10 A They are not on this map.

11 Q Do you also agree that this map purports to show both
12 drainage boxes, approved and proposed?

13 A It shows the approved McMurray drainage boxes.

14 Q I'll ask you to have a look at your legend here. It
15 only says "drainage boxes (approved)".

16 A I am clarifying that it is only the McMurray drainage
17 boxes that are approved.

18 Q Very well.

19 Is it possible for you to indicate -- and I will
20 have to give you the mouse -- where the KN24 and KN25
21 drainage boxes are?

22 A Roughly in this area here.

23 Q So adjacent to KN09 and KN08?

24 A Correct.

25 Q Do you know when the KN24 and KN25 drainage boxes were
26 approved?

1 A I will have to confer with my regulatory correspondent
2 here.

3 Subject to check, we believe the -- those boxes
4 were approved in 2014.

5 Q The date we have is March 21, 2022.

6 A The 2022 approval was just for the surface pads.

7 Q Okay. The point being that at the time this map was
8 filed, KN24 and KN25 was approved?

9 A Correct.

10 Q I will then ask to go onto Exhibit 01.01 at page 35.
11 This is the SAGD pay isopach. We know from CNRL's
12 evidence that there is Wabiskaw D bitumen. I assume
13 it's not mapped here because it does not meet the
14 cutoff?

15 A This is a McMurray map, and it wasn't on this map
16 because it wasn't part of the drainage boxes that we
17 were proposing to develop.

18 Q If we then go to Exhibit 20.2 at Tab 4, page 92 again.
19 Where you've indicated that KN24 and KN25 is, do you
20 agree that operations there will result in additional
21 heat in that vicinity?

22 A In which vicinity?

23 Q Just north of KN09.

24 A Over time there would likely be some conductive heating
25 in that small portion of the northern -- northeastern
26 portion of the KN09 drainage box into the Wabiskaw D

1 conductive heating.

2 Q I will move on, and, as promised, I still have one or
3 two questions on GCMS, and I am back to the statement
4 that was made yesterday that if oil concentrations were
5 not able to equilibrate over geological time, that
6 steam will be able to migrate through these lower
7 permability -- permeability zones. I hope you caught
8 that. That was quite painful.

9 A S. BARLAND: Yes, I did.

10 Q Can you describe for me what the mechanism of
11 hydrocarbon degradation over 40 million years is
12 compared to the process of fluid movement over 25 years
13 of SAGD?

14 A So over geologic time, the oil would have -- originally
15 the McMurray was completely water wet, and then it
16 would have been slightly buried and -- and the
17 sediments would have been charged from lower zones off
18 to the west that would have moved updip into the
19 McMurray formation, so generally charges from the top
20 down. And as it's charging, all -- because the
21 McMurray wasn't buried deep enough to kill the bacteria
22 or to sterilize the reservoir, those bacteria, both
23 anaerobic and aerobic, are still there and would have
24 used that incoming hydrocarbon, the oil to live. So
25 they're basically breaking bonds to get their food,
26 breaking carbon -- carbon bonds.

1 Q And how does that compare to the fluid movement over
2 25 years of SAGD development?

3 A Over geologic time it would have been a slower process.
4 I believe during SAGD we would still expect to see the
5 same barriers or -- or baffles as described by the
6 concentration profiles, but the fluid below or the
7 fluid that the steam actually interacts with would have
8 changed from a solid to more of a liquid, and we would
9 produce that.

10 Q Isn't SAGD a process that is driven by delta P as
11 opposed to concentration gradients?

12 A SAGD is more of a gravity process. It's not really
13 driven by delta P.

14 Q Can you tell me, based on GCMS data, if we have these
15 two very distinct processes, how can you conclude that
16 SAGD will not do what geological time has not done?

17 A We're using the barriers or baffles identified by GCMS
18 as a proxy for what the SAGD process will do. We've
19 got several industry partners as well as analogs that
20 I've been involved with, and the observation well data
21 in Jackfish would -- would corroborate that evidence.

22 Q I am then finally moving on from GCMS, and I am moving
23 on to FMI. I would like us to go to Exhibit 01.01 on
24 page 13. 13 -- sorry -- one, three.

25 This is a table of CNRL's consultation with ISH,
26 and we've heard some evidence about the steps that CNRL

1 has taken to consult. I would like us to look at that
2 very first table and pretty much the second sentence:
3 (as read)

4 Canadian Natural will not provide the
5 requested microresistivity logs, or image
6 logs, as the core photos provided in Canadian
7 Natural's view is sufficient to provide a
8 comprehensive geological interpretation of
9 the McMurray reservoir and overlaying
10 confinement strata intervals.

11 So CNRL is telling ISH, You can't get the image logs
12 because the core is enough to inform a comprehensive
13 geological interpretation.

14 My first question is: Does that mean that CNRL
15 did not consider the FMI information at its disposal to
16 determine whether there were fractures or not?

17 A G. IANNATONE: I would say that at this point
18 in time, this was the -- I guess this was recorded in
19 the application. I do believe that we're making
20 reference to preapplication, and I would say that
21 Canadian Natural would view the core information as the
22 primary measured data and the FMI information as more
23 interpretive -- interpretive and more secondary, and so
24 we were trying -- I believe at the time we were trying
25 to aid ISH to seeing the conclusions that -- that we
26 see in -- that we see that there is no issues found in

1 the core, which is the hardcore -- pardon the pun --
2 primary data.

3 Q The request, however, was for image logs, and the
4 response is, You don't need image logs because you can
5 do a comprehensive geological interpretation without
6 them. Do you agree that that is what that says?

7 A That's what that says, yes.

8 Q My next follow-up question is: At what stage does CNRL
9 obtain its FMI data? Broadly speaking -- I don't need
10 a specific example -- when do we get FMI data?

11 A S. SVERDAHL: We run FMI logs as part of
12 drilling strat wells.

13 Q What we can take from that is that I see there's --

14 A Just one moment, please.

15 Just to -- just to supplement that last statement,
16 we -- we also core a significant amount of our strat
17 wells and use the FMI logs to conform -- confirm what
18 we're seeing on that core data. We don't run core on
19 every log or every strat well, but it's another tool,
20 the FMI log, to confirm our -- our integrated approach
21 of interpreting what we're observing in the subsurface.

22 Q The only point I was trying to get at is we obtain FMI
23 data at the time of drilling. It doesn't happen after
24 that?

25 A The logs are run as part of the drilling of the well.

26 Q So it is safe to say that all of the FMI data that CNRL

1 has it had at its disposal, and one would believe in a
2 usable format at the time this application was filed,
3 other than, of course, the new wells that was drilled
4 in between?

5 A G. IANNATONE: That's correct.

6 Q I would then like to go to Exhibit 50.003, Tab 10,
7 page 55. And I would like us to look at this header.
8 I don't know if you will be able to see it. Perhaps we
9 can make it bigger. I promise that wasn't I.

10 Do you agree that this is a Schlumberger log or
11 report?

12 A S. SVERDAHL: That log was run by
13 Schlumberger. That is correct.

14 Q If we can then just go to the inscription on this log.
15 Do you agree that it was not ISH who identified that
16 fracture. It was, in fact, the interpretation of
17 Schlumberger?

18 A Yes.

19 Q I would then like to go to Exhibit 15.01, paragraph 113.
20 MR. LUNG: Sorry, Ms. Riley. What page
21 number?

22 M. RILEY: Sorry. I just realized I did
23 not tell you. Let me see if I can find 113 for you.
24 It is page -- page 27.

25 A G. IANNATONE: Ms. Riley, if you allow me, I
26 would like to go back to the previous question and

1 provide an additional response.

2 Q I will be hard-pressed to refuse you. Please do.

3 A Oh, okay. Thank you.

4 Yeah. I just wanted to bring up that in Draft
5 Directive 23, I think it was that -- I don't have the
6 exact section. I think it's 4.2, but in there it
7 states that the applicant must make reasonable efforts
8 to -- to address stakeholder concerns, and I guess what
9 I would say is in providing the core data Canadian
10 Natural thought they were making a reasonable effort.
11 It does not state in Directive 23 that all the data
12 that you have in your possession, either confidential
13 or non-confidential, needs to be supplied. Thank you.

14 Q If we can then return back to 15.01, and we're looking
15 at paragraph 113. Here CNRL tells us that they were
16 14 fractures identified on image logs and various
17 formations in which they saw them. My question on that
18 is: Are there any consequences for -- for these -- for
19 these fractures that exist, for instance, in the
20 Clearwater B and in the Wab B?

21 A S. SVERDAHL: We would conclude this is a
22 minor amount of fracturing, and there would be no
23 significant consequences of these fractures being
24 present.

25 Q So what we see here is fractures above and below the
26 confinement strata but not in the confinement strata;

1 is that correct?

2 A Correct.

3 Q Could you explain the geological process that would
4 result in fractures above and below but not in the
5 confinement strata?

6 A J. LAVIGNE: First of all, it's worth
7 pointing out, as we discussed, the differences between
8 fractures identified in core and fractures identified
9 in image logs. Image logs are run over the entire
10 interval. The coring is -- is done over the reservoir
11 units in the confinement strata. We don't core the
12 entire well in -- in all of the holes. And so we do an
13 analysis of fractures in those units. There are
14 fractures to be known in all of the regional shales
15 above. The point being made is that it's of -- they're
16 very minor, and in other places, especially in areas to
17 the east where there's a significant amount of salt
18 dissolution, there can be quite extensive faults and
19 fractures in some of those overlying units that in the
20 Kirby north area would -- would form part of the
21 caprock interval.

22 There are also fractures observed in the Paleozoic
23 in the underlying limestones. Those fractures are
24 typically very ol and mostly healed. So we don't
25 actually feel that -- we don't actually feel that
26 those -- those lower fractures or the overlying ones

1 are -- it's -- it's not surprising that we see a very
2 low density of fractures in the overlying caprock
3 shales or in the underlying Paleozoic the deposits
4 within the McMurray and Wabiskaw that form both the
5 reservoirs and the confinement strata were not
6 fractured in -- in the same way.

7 Q That was very interesting, but my question was: What
8 the geologic process would be that would lead to this?

9 A The shales have a different rheology and -- and rock
10 strength than the -- than the bitumen sandstones, and
11 so they're -- they're more prone to fracturing. But
12 the point is that two fractures within a very large
13 thick caprock section is -- is not a significant amount
14 of fracturing.

15 Q I would then like to move on to Exhibit 15.01,
16 page 195. I would like for us to zoom in on the first
17 2 metres of -- of that image. Are we at maximum
18 resolution? Perhaps a little bit smaller so we can see
19 the first 2 metres, please. Like that is good.

20 My question is: Can you tell me from this image
21 whether there is a fracture or a bed in the top of this
22 image, and as a part of that answer, could another
23 interpreter or the AER make any determination from this
24 image?

25 A X. WANG: Actually, this looks like a --
26 looks like static. The one way the interpreter

1 interpret the image, we usually can play the contrast
2 of the colour wrap. We can go to dynamic, and then we
3 can play with. For this particular image, I will say
4 you may not see the details, but one interpreter
5 actually doing the work, we can see more than that.

6 Q Certainly, sir. You've essentially answered two of my
7 follow-up questions and that was that we use this image
8 to do our interpretation and that you use a dynamically
9 normalized image in your interpretation, and I assume
10 the answer to that was yes?

11 A Well, that's just the routine for every interpreter.
12 We both see the dynamic and the static, and we play
13 with -- with the contrast of the resistivity, so we can
14 see more than that.

15 Q So given that CNRL did not use this image for its
16 interpretation, is it fair to say that there is further
17 detail that does not form part of this application?

18 A No. I will say no. Because once you got the DLIS this
19 file, you got to the software. You can play with it.
20 This just a one displacement.

21 Q So -- so from your evidence, I take it that you need
22 the DLIS file to actually do this interpretation?

23 A Yes.

24 A S. SVERDAHL: I would add that we were not
25 requested for the digital data.

26 Q You, in fact, were, but we will get to that.

1 If we could then go to Exhibit 50.003, Tab 18.
2 It's page 63. I'm going to ask you to expand the
3 image, focus on the middle of the page until we can see
4 any of the two bars as the only image on the screen.
5 If you can keep going, that's good; if you can't keep
6 going, that's also good. Excellent.

7 First question: Can you read the depth for me?

8 A The depth on this image is -- is blurry; however, you
9 can, if you zoom back out and reference it to the log
10 on the left of this image, get a good indication where
11 this is.

12 Q Is this what the image looked like when you did your
13 interpretations?

14 A X. WANG: Actually, this is just a Tiff
15 or JPEG file of a screenshot --

16 THE COURT REPORTER: A what file?

17 A X. WANG: A JPEG or Tiff file of the --
18 of the actual image. Some -- sometimes the resolution
19 is worse than you actually looking at the screen, when
20 you do the interpretation. That's where the comment,
21 right? This is just a displacement of one of the
22 pictures -- image.

23 Q M. RILEY: So if this was all that you
24 got, would you be able to do a good job of interpreting
25 this?

26 A This is a misunderstanding. We do not interpret the

1 image log on the page's sides 'cause this shranked
2 several thousand metre -- hundred metres into one page.
3 We -- we do not do that.

4 Q So to expect someone else to try and interpret this and
5 given only this would be unfair?

6 A I don't think any interpreter, professional
7 interpreter, will interpret it from the page size.

8 Q So from the information that CNRL put on the record,
9 neither ISH or the AER could actually use these images
10 to do an interpretation?

11 A Well, the --

12 A S. SVERDAHL: This slide was created in the
13 reply submission to tell the story that we've drilled a
14 well through an area of expected differential
15 compaction. It wasn't meant as a figure to interpret
16 from.

17 Q If we could then move on to Exhibit 15.01, Tab 25.
18 It's page 340. My apologies. It's obviously not
19 page 340. Let's have a look. It is, in fact,
20 page 339.

21 M. RILEY: Could we increase the image?
22 I would like the yellow block to be in the centre of
23 the screen and as large as you can make it.

24 Q M. RILEY: I would like to draw your
25 attention to this feature here and this feature here.
26 What are the sigmoidal features that I've indicated?

1 A X. WANG: Okay. That's -- we call it
2 diagonal -- two marks. So usually you can see on the
3 image log at least two sets that come from the side
4 to -- so within each set you can see that they're
5 roughly parallel. They're straight lines. And when
6 they intersect, you don't see the curvature of the
7 fracture -- see. So you can see multiple -- actually,
8 if you follow the trend and you can see the multiple
9 part of that. That's quite common, and -- oh, what
10 happened? Okay. So you can see actually -- when you
11 see this kind of features, you need to stand back to
12 zoom out and not just the 1 metre or half metre.
13 You -- you can see the trend start from up right corner
14 here. You can go from here, and there are some -- some
15 trend here, and for the other set, you can see the
16 marks -- the two marks go through there, and it goes
17 through there. They result from the hole spiral. So
18 it's two marks. It's kind of artifacts we see quite
19 common on the image log.

20 Q May I have the mouse back? Because I think we are
21 misunderstanding each other about which area I'm
22 referring to. I am specifically talking about this
23 mark here and this mark here. It's -- is it your
24 interpretation that these are two logs?

25 A Yeah. As I said, if you trace that, you can see
26 clearly the trend go over there and that there is a

1 parallel mark just nearby what you point out. So
2 that's not fracture. That's just a diagonal two marks.

3 Q Is it possible that these are not two marks, but that
4 is where the image log is stretched or there was a
5 failure of speed correction?

6 A No. I think that's -- that's a common features on the
7 image log 'cause we're not interpreted that as picture,
8 and you're not -- you're not going to cherry-picking,
9 say, I want to -- this mark and this mark.

10 Q Then, still on the same image, can you see the white
11 feature? Let me just find it on the screen. Yeah.
12 Can you see the white feature?

13 A I can see it. That's also common. For most two marks,
14 they are conductive. On the image log, they're dark
15 straight marks. But sometimes you also see the
16 resistive, which is a white, is also common. So the
17 white is -- the dark mark is because the -- the more --
18 relatively more conduct mark with the smear by the
19 tool, and the resistivity mark is usually just a
20 partial. It's not really continues like the dark mark.
21 But that caused by the two scratch from more resistive
22 layer, and they move on. So we see that.

23 Q I assume that that will be your same answer for the
24 white mark here and the white mark here?

25 A Where?

26 Q So it is the -- the last one I pointed to you was here.

1 A Okay.

2 Q And the other one I was pointing at you is here.

3 A Okay. I -- so on the image log like that, we only can
4 see it's more resistive. But when we line up with
5 gamma ray and density and we know is that cemented or
6 not. So that went quite easy, actually, when we
7 interpret it.

8 Q That concludes my questions on FMI.

9 A S. SVERDAHL: I wanted to add that this --
10 this example is within the Wabiskaw B and not the
11 confinement strata.

12 Q Noted.

13 If we can then go to Exhibit 15.01, PDF page 28,
14 paragraph 108.

15 I apologize. It does not look like 15.01 is
16 paragraph 108 on page 28. Let me find you the right
17 page reference.

18 Ah, I see. I was -- it's page 26.

19 In this paragraph, CNRL says that it has reviewed
20 all of its core and all of its image logs data and it
21 has not identified any fractures within the confinement
22 strata units. The question is: Did you look at
23 information that you did not file?

24 A Yes.

25 Q I can provide you with references if I need to, but
26 since the application was filed, 27 new wells were

1 drilled; is that correct? We can look at them. The
2 one is Exhibit 01.01 at page 28.

3 A There were 11 wells since the application of the
4 hearing. I believe -- actually, I do have to check.
5 But there -- there were definitely wells that were
6 drilled from the application to the hearing submission.

7 Q We have it as 16 wells drilled in this -- in this
8 exhibit and then a further 11 drilled in another
9 exhibit. The point is at least 27 -- can you still
10 hear me?

11 A Yeah.

12 Q The point is at least 27 wells were drilled in the
13 meantime. You had, in other words, 27 opportunities to
14 do a DFIT if you wanted to but elected not to?

15 A G. IANNATONE: We'll just take a huddle here.

16 A P. THOMSEN: I understand the question to
17 be with all the wells that we've drilled since filing
18 the application, why did we not conduct a DFIT.

19 So the -- the value with conducting DFITs is to
20 determine principal in situ stress, and that can be
21 used for either leveraging some geomechanical effects
22 for a resource recovery process and/or for caprock
23 integrity or -- or confinement strata integrity. In
24 the absence of significant structural features, we
25 expect the horizontal stresses within a stratigraphic
26 unit to be quite consistent. There are four reasons

1 that I presented on yesterday as far as why the stress
2 characterization is adequate for the proposed
3 operations, the first being in situ stresses tend to be
4 regionally consistent; the second one being the
5 reasonably present mud-prone strata such as the
6 regional B1 sequence have similar elastic properties,
7 and this is a driver of horizontal stresses; the third
8 one being for the Kirby north field data of starting up
9 146 horizontal wells, we don't see variable or low
10 fracture pressures; and the fourth one being that I'd
11 previously mentioned we don't have significant
12 structural features such as a karst.

13 Additional DFITs do increase costs, depending on
14 if it was using an existing cased well or a new
15 wellbore. Could be between 375 to -- \$375,000 to
16 \$1,075,000. And with what has been requested is a
17 temporary MOP or the purpose of starting up
18 circulation; this is for a short duration and a small
19 volume, and it doesn't warrant the additional DFIT data
20 acquisition. And there's also a concept of
21 proportionality, and the resource or the cost of
22 additional safeguards should not be disproportionate to
23 the risk reduction achieved.

24 And, with this, it's unlikely to change our
25 requested MOPs, and that is why we did not conduct
26 additional DFIT.

1 Q I just want to make sure that I understood you
2 correctly. You said that there were no significant
3 geological features at KN08 and KN09 that would
4 indicate that another DFIT is necessary?

5 A Correct.

6 Q I would then like to refer you to Exhibit 01.01 on
7 page 55. This is the area where CNRL maps that the
8 mid-B1 mudstone is absent, and that is right -- right
9 at KN09. Do you think that is significant?

10 A No, I do not believe that is significant.

11 Q And then if you can --

12 A It is the --

13 Q Sorry.

14 A And the reason for that is the -- the DFIT that's been
15 used to characterize the minimum stress in -- in the B1
16 really tested the regional B1 sequence. And so it's
17 the -- it's the mud-prone nature of the regional B1
18 sequence that's the key, and it isn't specifically the
19 'X' centimetres or -- or metre of a mid-B1 mudstone
20 that's -- that's key. So the -- the important reason
21 is what was tested was the regional B1 sequence.

22 And so in the -- in the well that has been
23 discussed, CNRL -- Canadian Natural presented on
24 yesterday that did not have a -- a mid-B1 mudstone, it
25 was replaced by a -- quite a muddy tidal channel --

26 Q I apologize, but I cannot hear you.

1 A Was it just the last sentence or ...

2 Q If you could roll back about two sentences, that would
3 be good.

4 A So the -- the stress characterization is for the
5 regional B1 sequence, and in the well that Canadian
6 Natural presented on yesterday, subject to check, I
7 think it's 1-3 -- yeah, it's the 1-3 example where the
8 mid-B1 mudstone was not present. It was replaced by
9 quite a muddy tidal channel facies. And so, overall,
10 the regional B1 sequence in that well has quite a -- a
11 high mud content.

12 Q If we go to the next page, that is page 56, and that is
13 where CNRL maps that the A2 mudstone is absent, and I
14 assume that is also irrelevant?

15 A J. LAVIGNE: Where -- as discussed
16 yesterday, where the A2 mudstone has been removed,
17 other confinement strata still exist in that location,
18 including the Wabiskaw B -- 'D' -- pardon me -- the
19 Wabiskaw D non-reservoir, the -- the basal upper
20 Wabiskaw D heterolithic unit, and the Wabiskaw C. So
21 the concept of confinement strata is that even if
22 individual units have been removed, they work together
23 in tandem to provide confinement.

24 Q And so my follow-up question to that will then be is:
25 If we have different strata in different sections,
26 would they operate differently under stress?

1 A P. THOMSEN: What I've been -- what I was
2 trying to communicate earlier with a response is that
3 the regional B1 sequence is -- is present over all of
4 the KN08 and KN09 drainage boxes, and it is
5 dominated -- or it -- it has a high mud content. And
6 so we expect the -- the minimum stress within the
7 regional B1 sequence to be representative over the
8 entire KN08 and KN09 drainage boxes.

9 Q That is, except for that one well where we don't have
10 the mid-B1?

11 A The one well -- 1-3, without a -- the mid -- mid-B1
12 mudstone, has still the lower B1 and the upper B1, and
13 these are mud-prone strata. And, overall, the -- the
14 minimum stress gradient for that regional B1 sequence
15 is representative.

16 Q If we can then go to Exhibit 15.1, page 29,
17 paragraph 122. Sorry. Just on page 29. It's just --
18 it's gone over the page. If we could scroll down to
19 page 29.

20 There, pretty much second line from the top, we --
21 CNRL says: (as read)

22 The KN09 and KN09 drainage boxes are directly
23 adjacent to the KN06 and are considered to be
24 in the same depositional and structural
25 setting with each other.

26 And then Canadian Natural goes on to conclude that:

1 (as read)

2 Because these drainage boxes are geologically
3 equivalent, the same monitoring that was
4 allowed for at KN06 should be applied in KN08
5 and KN09.

6 Is that correct?

7 A D. OLLENBERGER: Yes, that's correct.

8 Q If we then go to Exhibit 20.2, page 59. There's -- in
9 the preamble, we see that ISH says that: (as read)
10 ISH is of the view that KN06 is not
11 geologically equivalent to KN08 and KN09.

12 And we see CNRL's response that it disagrees with ISH
13 and reiterates that KN08 and KN09 is similar to KN06;
14 is that correct?

15 A J. LAVIGNE: Broadly speaking, the
16 stratigraphy between the two adjacent pads is the same.
17 Both have post-B2 incision reservoirs. They're
18 overlaid by the regional lower and upper B1 sequence,
19 separated by the mid-B1 mudstone. Both are overlain by
20 the regional A2 sequence.

21 As stated in our direct evidence yesterday, over
22 the KN08 and 9 boxes, Wabiskaw D incision has removed
23 the upper parts. We've provided maps that we just
24 looked at that showed where the A2 regional mudstone
25 had been removed. The Wabiskaw D incision does not cut
26 down through the lower B1 sequence, and the mid-B1

1 mudstone is present over the majority of the KN08/9
2 pads with the exception of the 100/1-3 wells that we
3 have discussed in some detail. And where the
4 Wabiskaw -- so it is geologically equivalent. In fact,
5 in the KN06 proceedings, we discussed how the A2
6 mudstone had been removed in one well over that pad,
7 and the KN08 and 9 drainage boxes are immediately to
8 the west where the Wabiskaw D incision is deeper. So
9 geologically they are the same. The difference is the
10 amount of incision at Wabiskaw D level.

11 Q If we can then go to Exhibit 50.002 at page 8,
12 paragraph 21 -- sorry -- page 8, paragraph 21.

13 There in the first line we see Canadian Natural
14 recognizes that there are differences in the geological
15 strata present in KN08 and KN09 compared to KN06 and
16 that those differences are relevant to this proceeding.
17 Could you explain this paragraph?

18 A I believe my previous answer did explain that. The
19 difference is the magnitude of Wabiskaw D incision over
20 the KN08 and 9 drainage boxes as opposed to the KN06
21 box. They are not different. They just differ in
22 magnitude.

23 Q So it is your evidence that despite these strata
24 differing in magnitude, their stress response will be
25 exactly the same?

26 A P. THOMSEN: The -- the stresses within the

1 regional B1 sequence where it is present will be the
2 same. And if I could add to that, the higher mud
3 content of a strata, it leads to a higher Poisson's
4 ratio, which leads to more vertical stress transfer
5 from the vertical stress to horizontal stresses. And
6 there are also some components of the -- the stiffness
7 as well.

8 So the difference in elastic properties between
9 mud and sand ends up with there being a reliable stress
10 contrast between the underlying McMurray post-B2
11 reservoir sand and the muddy -- the mud-prone strata.
12 And we -- we focused on the regional B1 sequence for a
13 number of things on the geomechanics evaluations, but
14 really high mud content strata are going to have higher
15 horizontal stresses. And Canadian Natural is -- is
16 highly confident that we have a stress contrast between
17 the post-B2 reservoir sand and the regional B1 sequence
18 of -- or at least 005 kPa per metre. Our
19 characterization points to a stress contrast, the
20 minimum stress gradients of 1.5 kPa per metre.

21 Q If we go to Exhibit 20.02 at page 12. My apologies. I
22 am struggling with the reference, so I'm going to move
23 on. Then I'll come back to this very shortly.

24 If we can go to Exhibit 43.02 at page 5. So it is
25 43.02 at page 5. Pardon me. I'm scrolling.

26 The second paragraph from the top. You mention

1 the Wabiskaw D facies, and you include them in your
2 confinement strata for KN08 and KN09. The question is:
3 Why did you not include them in your confinement strata
4 in the KN06 hearing?

5 A J. LAVIGNE: As we mentioned, the magnitude
6 of the Wabiskaw D incision is -- is greater over KN08
7 and KN09. And when assessing confinement strata or
8 geological positioning, it's important to look beyond
9 the boxes. And so we look at the units in a more
10 regional sense, and we have looked beyond the KN08 and
11 9 boxes.

12 The reason why these two units were not introduced
13 in the KN06 proceedings is that they didn't occur in
14 the thicknesses and mappability that they do over the
15 KN08 and 9 boxes. That's directly a function of the
16 magnitude of the Wabiskaw D incision. So over the KN06
17 box in one well in the northwest corner, the -- the
18 magnitude of the Wabiskaw D incision was very small.
19 And so it -- it -- those units weren't differentiated
20 and broken out.

21 Also over the majority of the KN06 box, the A2
22 mudstone was present, and -- and as we demonstrated in
23 those proceedings, the mid-B1 mudstone was also
24 present. And as we had two regional mudstones, we
25 didn't feel the need to discuss a very thin deposit
26 over KN06 and considering that part of our confinement

1 strata. But as those units are thicker over the KN08
2 and 9 drainage boxes, we -- we feel -- and as
3 demonstrated yesterday, over the KN08 and 9 drainage
4 boxes, those two units hold back gas caps, and so they
5 are very relevant in the discussion of confinement
6 strata there.

7 Q If we can then move on to Exhibit 15.01, page 10,
8 paragraph 31.

9 More or less in the middle of the paragraph,
10 you -- you mention that the original gas over bitumen
11 decision, or the GOB decision, concluded that
12 Wabiskaw C could not act as a local seal; is that
13 correct?

14 A That -- that was the board's conclusion. I might add
15 at the time of the original GOB decisions there were
16 very few wells that penetrated into the Wabiskaw C.
17 And because of the lack of information, the variable
18 amounts of bioturbation, and the presence -- the
19 presence of calcites, the -- the board at the time
20 decided to rule that the Wabiskaw C was not considered
21 a -- a regional barrier.

22 Since that time, we've acquired a lot more well
23 information, and we have observed gas caps trapped
24 beneath it, and so we feel that it does have -- it does
25 have some regional -- at least over the scale of the --
26 of the drainage boxes in question, the Wab C does

1 appear to have some capacity for sealing.

2 Q And that is what you say in paragraph 93 on page 22 of
3 this same exhibit?

4 A I -- I'd have to see it. I'm not sure.

5 Q I'm sure we're going to show it to you in a moment. If
6 we could just scroll down to paragraph 93, please.

7 That is your conclusion that -- that here, the
8 Wabiskaw C does act as a barrier or a local seal?

9 A I would say the gas caps observed off pad are the
10 strongest evidence that it's a seal.

11 Q The properties of the Wabiskaw C here, is it different
12 from the properties that the AER considered when they
13 issued the GOB order?

14 A I think we have more extensive data in the Wabiskaw C
15 now than they did. The unit is the same.

16 Q Has CNRL approached the AER with this data and
17 suggested that the GOB order should be reviewed and
18 varied as the Wabiskaw C apparently acts as a seal?

19 A May we just have a moment, please.

20 No. We have not approached the AER with that.

21 M. RILEY: I see it is now 22 minutes
22 past 10. The next section that I need to go into will
23 take longer than eight minutes. Might I request that
24 we take the break now and then perhaps return a bit
25 earlier.

26 COMMISSIONER CHIASSON: Thank you. We can do that.

1 So let us break now, and we will return at, let's say,
2 20 to 11, so 10:40, and we'll proceed from there.
3 Thank you.

4 (ADJOURNMENT)

5 COMMISSIONER CHIASSON: So before you start again,
6 Ms. Riley, I'll just let you know -- Mr. Lung advised
7 me this morning that it's advisable that we go no later
8 than 12:15 because of room arrangements that we have
9 for lunch on terms of when we need to be out of that
10 room. So just in terms of giving you a -- giving you
11 a -- giving you a time window.

12 M. RILEY: Thank you. And we will do our
13 best.

14 My apologies. I just have to scroll in my notes
15 to where I left off.

16 COMMISSIONER CHIASSON: We'll just -- we are just
17 waiting for Ms. Peddlesden. Oh, okay.

18 All right. Please proceed, Ms. Riley.

19 M. RILEY: If we could bring up
20 Exhibit 15.01, Tab 8, at page 194. And if we could
21 scroll down to where the Wabiskaw B1 is identified, the
22 mudstone specifically. Right there. Thank you.

23 Q M. RILEY: My first question is on this
24 exhibit. How do I see the mid-B1 you're -- if your
25 identifying line wasn't there, how do I see it?

26 A J. LAVIGNE: I'm sorry. Could you

1 please -- which well is this? Sorry.

2 Q If you could just scroll up. I believe it is --

3 A Yeah.

4 Q -- the 5-34, but ...

5 A Okay. When we identify units, we use a stratigraphic
6 datum which restores units to the horizontal. As --
7 restores them to the way that they were deposited
8 horizontally. And so we use regional markers in
9 offsetting wells, and we correlate -- we correlate that
10 way. So it's finding -- it's finding the level -- the
11 horizontal in this well that's the same as in other
12 wells.

13 Q So if I were to look at this log, I wouldn't be able to
14 see the B1 mudstone from just this log?

15 A I think you'd have -- I think you'd -- you wouldn't
16 want to look at wells in isolation. I think you would
17 want to look at them next to adjacent wells to make the
18 correlation.

19 Q And what do we do when there are no closely adjacent
20 wells?

21 A I would suggest that over the boxes there -- there are
22 close spacing of wells.

23 Q If we could then go to Exhibit 15.1, Tab 8, on
24 page 196. If we could just scroll down to the B1
25 again.

26 So if neither of these wells show specifically

1 that there is a mid-B1 mudstone, how do we -- what do
2 we do?

3 A We -- we integrate with other wells. No one well is
4 used in isolation. This correlates to other wells,
5 other wells that have core, and so we -- we never just
6 use one well. We always correlate to other wells.

7 Q So if we go to the next one on page 200 of the same
8 exhibit, we can scroll down again, and we see again,
9 really, if it was not for your line, there's no
10 difference between just at the top and just at the
11 bottom of the line. That was the case in the previous
12 three that I've showed you, so I struggle to see if we
13 are correlating wells.

14 A I don't struggle to see that. Again, we correlate
15 it -- so in this particular well, you can see the A2
16 mudstone, which is a regional unit which gives us a
17 paleohorizontal quite close to the interval that we're
18 trying to understand, and so we can datum down from
19 that to see where the mid-B1 mudstone should look.

20 We -- as we've mentioned, the lower B1 regional
21 sequence and the upper B1 regional sequence are very
22 heterolithic, and they -- they have differences in
23 sandstones and mudstones, which affects the gamma ray
24 signature. And there is also thin-bed effects where
25 the gamma tool has a certain resolution, and it has
26 difficulty identifying thin-bed effects.

1 So, again, that's why we -- we use an integrated
2 approach of other -- other offsetting wells so that we
3 can identify where in a particular well this -- this
4 particular horizon is.

5 Q So in this case you saw the A2 and then extrapolated
6 from there where the B1 is?

7 A In this particular case, yes.

8 Now, in areas of the north -- the north edge of
9 the KN08 box and over the KN09 box, the A2 mudstone is
10 not present, and so in that case we would go up to,
11 say, the top of the Wabiskaw, and we would work our way
12 down to -- to find this particular level.

13 Q If we go to Exhibit 15.01, where I believe we already
14 are at, page 18, paragraph 68. There the last sentence
15 on the page, the mid-B1 mudstone is highly correlatable
16 in wireline logs. From what we've just seen, that
17 doesn't seem so easy, as you suggest?

18 A Well, I think that we have a lot of experience over the
19 entire Kirby north area. I might point out that the
20 mid-B1 mudstone is a regional unit that's correlatable
21 over hundreds of square kilometres. So I think that
22 having seen this in several hundred wells, we have a
23 pretty good idea as to where to look, even though there
24 are some differences in the lithologies expressed in
25 the underlying lower B1 regional sequence, the
26 overlying upper B1 regional sequence, those differences

1 can cause some difficulties in -- in understand --
2 interpreting that, but, again, we don't look at any
3 single well in -- in isolation. We apply it over a
4 broad area.

5 Q Is that what you were getting at in para -- in
6 Exhibit 50.02, page 14, paragraph 43?

7 A Yes. What we were saying in that paragraph was that
8 just making gamma ray API cutoffs is not sufficient
9 for -- for identifying that feature, and that's --
10 that's substantiated by seeing the mid-B1 mudstone in
11 cores where that log signature is -- also does not, for
12 example, hit 105 API cutoff.

13 Q So you didn't really see it in -- in the logs. You saw
14 it in the cores?

15 A No. We don't use either in isolation. We use both.
16 We use cores -- so just -- and touching on something
17 that we discussed earlier, every well we drill has an
18 image log. A subset of those wells are additionally
19 cored, and so -- and all wells have gamma -- the basic
20 suite of gamma resistivity logs, and so we use both.
21 Some wells have all three of those; some wells don't,
22 and so by leveraging what we've seen in other wells,
23 then we can make a coherent story.

24 Q Good. Let's go to Exhibit 050.003, Tab 6, page 51.
25 Much smaller, please.

26 So here we have -- I'm going to call them

1 "tables", for lack of a better word, and am I correct
2 when I say -- could you just scroll down a bit,
3 please -- that this second image, or table, is an
4 interpretation of the first?

5 A Yeah. Could -- could we please reduce just a little
6 bit more, please, so we can see the full context of the
7 figure? Thank you. That's -- that's enough.

8 So in the -- in the up -- yeah. So this is a
9 seismic image that has wells projected upon it that
10 is -- that is out of view in the upper right, and the
11 interpretations on seismic are substantiated with the
12 well logs as well, and so, yes, in the centre is an
13 interpretation of the seismic, but you'll notice it's
14 also driven by the well logs.

15 Q And I understand that it is difficult to see, but this
16 interpretation includes the log and the seismic from
17 the 10103 well?

18 A Yes.

19 Q So if we look at the second -- is it a figure, or is it
20 a table? I'm not sure. I'm going to call it "figure".
21 If we look at the second figure, this green is where
22 you say it's the mid-B1 mud -- well, the B1 region, and
23 then the dashed line is the mid-B1 mudstone?

24 A Yes, that's correct.

25 Q So if this includes the 1-3 where we now know that
26 there is no mid-B1, where does this line break up to

1 show that?

2 A There's a -- the dashed line there, if you can zoom in,
3 I see the well there. There's a core -- there's a
4 fining upward sequence around the middle of the
5 diagram.

6 Q Would it help you to have the mouse?

7 A Oh, sure. This is the 100/1-3 well right here, and so
8 there's a fining upward sequence at the -- in the
9 upper B1 that we've been discussing.

10 Q But the dashed line that shows the mid-B1 mudstone
11 doesn't break off there?

12 A Yeah. The dashed line is -- is a correlation through
13 the section. As we've discussed, there -- there's a
14 very small hole in the mid-B1 there as we discussed in
15 the well yesterday.

16 Q ISH's evidence will be that the mid-B1 cannot be seen
17 on the seismic and on the logs. If that is correct, do
18 you agree that the dashed line is an arbitrary line
19 with no support from any specific data?

20 A Oh, it's supported by the well data. For example, if
21 you look to the well -- two wells to the left, you can
22 see a very strong break between the lower B1 sequence
23 and the upper-B1 sequence. And so because the mid-B1
24 mudstone doesn't have a direct seismic indicator, it's
25 obviously extrapolated through here, and it's
26 extrapolated through regions where we don't have well

1 control as well.

2 A S. SVERDAHL: I would like to add as well --
3 if I could just grab the mouse, Mr. Lavigne -- that B1
4 mudstone is not a resolvable reflector by the seismic
5 here, but we can infer areas where it is not present,
6 such as where I'm pointing here. This is where the
7 Wabiskaw D channel system cuts down, and we can project
8 this interpretation of the mid-B1 against this
9 reflector here and make conclusions as to where the
10 mid-B1 mudstone is not present.

11 Q If we could then go to Exhibit 050.003 -- we're already
12 there -- and if we can go to page 20. You can just
13 stop it right there.

14 This is from Dr. Boone's report, and there under
15 the "lack of continuity of a mudstone", he agrees that
16 "mudstones are commonly discontinuous". What is
17 Dr. Boone's response to that?

18 A T. BOONE: You know, that's just a
19 general statement that any facies can be discontinuous.

20 Q We have had various discussions -- or we heard, at
21 least, various discussions between VMI and V shale.
22 V shale is a very particular number based on a gamma
23 ray cutoff in your interpretive logs; is that correct?

24 A J. LAVIGNE: V shale is not --

25 A S. BARLAND: Sorry. So V shale or volume
26 of shale is not always based on gamma rays. Sometimes

1 it's based on density neutron log separation as well.
2 So we can have high radioactivity sands that actually
3 look muddy on just purely the gamma ray logs. So quite
4 often it's based on gamma ray, but not always.

5 Q My follow-up question was: As we understand it,
6 there's various formulas that you can use to calculate
7 V shale. Which one did you use?

8 A We would have used a combination of both because in the
9 general Kirby north area, sometimes there will be hot
10 sands associated with the reservoir too. So it would
11 have been based on the petrophysicist's -- after a
12 petrophysicist's analysis.

13 Q Moving on from that --

14 A Sorry. Just -- just to be clear, the hot -- hot sands
15 are radioactive sands, so they have heavier minerals
16 that contain natural radioactivity like a shale would.

17 Q CNRL's evidence is that gas comes from -- evolves from
18 the bitumen phase. If gas evolution began slowly at
19 the top, why does the presence of a gradient through
20 the McMurray down to the Wabiskaw convince you that
21 there is isolation?

22 A G. IANNATTONE: Please repeat the question.
23 Thanks.

24 Q Certainly. CNRL's evidence is that gas evolves from
25 the bitumen phase. If gas evolution began slowly at
26 the top, why does the presence of a gradient through

1 the McMurray down to the Wabiskaw convince you that
2 there is isolation? Sorry. I think those two should
3 probably be turned around. The point is if there's a
4 gradient, if there's a pressure difference between the
5 zones and gas evolution begins at the top by slow
6 degradation, why is the gradient evidence of isolation?

7 A T. BOONE: I'm sorry. Are you referring
8 to GCMS gradient? I mean, what --

9 Q No. I'm referring to pressure.

10 A G. IANNATONE: We'll take a huddle here.

11 A T. BOONE: Sorry. Are you referring to
12 the figure that I had in my report with the pressure
13 gradient?

14 Q Yes.

15 A And so maybe we should bring that up, please, if we
16 can.

17 Q Can you put your hands on it?

18 A And I can find that if you'd like.

19 A P. THOMSEN: It's -- I think it's 50.003.
20 Exhibit 50.003 --

21 A T. BOONE: I know it's the first report,
22 but I can find that. It's Exhibit 15.01, and I believe
23 it's PDF page 60.

24 A G. IANNATONE: Okay. Please repeat the
25 question one more time.

26 Q CNRL's evidence is that gas evolves from the bitumen

1 phase. If gas evolution begins slowly at the top, why
2 does the presence of a gradient convince you that there
3 is isolation?

4 A Just to be clear, which bitumen phase are you referring
5 to, the bitumen in the Wabiskaw B or the McMurray
6 bitumen or the Wabiskaw B bitumen?

7 Q Is your suggestion that gas evolves differently in the
8 different zones? So in 'B', gas will evolve from
9 bitumen, but in 'D' it won't?

10 A No. I just -- I'm assuming you're talking about the
11 bitumen in the Wabiskaw B. I just wanted confirmation
12 of that.

13 Q The question relates to a gradient through the zones.

14 A T. BOONE: Maybe I will try and explain
15 this chart here. So there's -- there is -- down in the
16 McMurray, there's a pressure gradient, and that's the
17 water gradient. And what normally -- if you're looking
18 for discontinuity between zones, meaning over geologic
19 time -- there's a pressure separation -- you plot the
20 two gradients and then -- between the zones, and you
21 see if they overlap. And so if all the points fell on
22 that -- that hydraulic gradient there, that would at
23 least say that there -- at somewhere -- and it may be
24 well off structure, not immediately there, that they're
25 connected. Okay. So maybe they've got bottom water
26 somewhere that connects these zones, but maybe they're

1 connected through the column there as well.

2 But in this case if you plot that gradient and the
3 pressures between the two zones don't fall on the same
4 line, that's evidence that they're discontinuous and
5 that there's a pressure break or barrier between them.

6 Now, if you start to -- if you have gas on top of
7 bitumen and you start to produce that gas, gas will
8 evolve out of that bitumen -- and you're right. It
9 will start at the top of the bitumen, and the pressure
10 will work its way down through that bitumen, and the
11 gas will evolve out of it and move upwards into the
12 gas. So I'm -- I'm -- it's a bit of a disconnect
13 between your question there -- I realize that -- but
14 I'm -- I'm struggling to understand it, to be honest.

15 Q No. Thank you. You've been very helpful.

16 If we can then go on to Exhibit 15.01, PDF
17 page 16, paragraph 2.

18 So here we see CNRL says that the isopach of the
19 confinement strata is 3.8 metres to 14.3 metres. Do
20 you agree?

21 A Yes.

22 Q And then if we go to page 61 of this same exhibit under
23 the geology, the second line from the bottom of the
24 first paragraph, we see Dr. Boone saying that the
25 isopach is 2.46 to 14.32 metres; is that correct?

26 A J. LAVIGNE: That's what it shows.

1 Q And then if we go to Exhibit 50.03 on page 9. This is
2 from Dr. Boone's second report. And if we look there
3 in the geography and the stratigraphy -- I'd hope you
4 can see it, but there's a total confinement strata
5 thickness of 13 to 30 metres. And then comes my
6 question this morning when we spoke about the muddy
7 'D', you mentioned that there's 10 to 12 metres of
8 muddy 'D' over these -- over these strata. So I -- I
9 struggle if the total isopach, which is now 'B', 'C',
10 and 'D', is 2, how did we get to 10 to 12 metres of
11 muddy 'D'?

12 A G. IANNATTONI: We'll just huddle here for a
13 minute.

14 A T. BOONE: Let me just explain my part of
15 it there. The 13 to 30 metres -- so, you know, as a
16 reservoir engineer, I was focused on the total
17 thickness, not just the confinement strata that are
18 listed in the table, which are -- are sort of zones
19 within the total package of the confinement strata.
20 And so that confinement strata does contain zones that
21 have lower mud contents that -- that are not barriers
22 per se that were included in the table that was
23 provided by CNRL. But as a reservoir engineer, it's
24 important because steam has to work its way through
25 that, and all that rock has to be heated, and it's also
26 a barrier to conduction between the Wabiskaw B and the

1 SAGD zone. So the total thickness is important.

2 And so I asked the -- the geoscientists at CNRL to
3 provide me the total thickness from the top of the
4 post-B2 reservoir to the base of the Wabiskaw B, and
5 that's what those numbers are. And that would include
6 sections of that confinement strata that wouldn't be
7 barriers to steam. But in order for steam to get
8 through them, they would have to be heated as -- you
9 know, by the steam as it migrates through, which all
10 takes time. Okay.

11 The -- the other number may be -- and I -- and
12 I -- maybe that came from an earlier table, those
13 little numbers; they're just -- there's a minor
14 difference between the -- the final confinement strata
15 thickness numbers that the geologists have been
16 reporting, and I -- I apologize for that.

17 A G. IANNATONE: Ms. Riley, can you repeat the
18 second part of the question?

19 Q My question -- there was only, in fact, one part -- or
20 there was three references and then one question. This
21 morning we spoke about the muddy Wabiskaw D, and you
22 mentioned that it is 10 to 12 metres thick over KN08
23 and KN09. If we look at those references, then we have
24 a total confinement strata that is at times less than
25 that -- significantly less than that.

26 A P. THOMSEN: This morning I mentioned the

1 10 to 12 metres, and that was in the context of the
2 Cenovus example of undrained thermal expansion and a
3 pressure increase in the Wab D -- the Wab delta sand.
4 And the 10 to 12 metre that I was referencing is
5 referring to distance -- or thickness from the top of
6 the post-B2 reservoir to the base of the Wab D delta
7 sand. And there are a number of other items being
8 referenced here, and those would include confinement
9 strata above the Wab D delta sand.

10 Q If we could then move on to Exhibit 01.01 at page 67.

11 This is a stratigraphic cross-section through the
12 DFIT wells, and these are the DFITs that CNRL relies
13 on; is that correct?

14 A That is correct.

15 Q If we then go and look at Exhibit 15.01, Tab 5,
16 page 108 -- sorry -- page 108.

17 This is the stratigraphy of KN08 and KN09. And I
18 appreciate that this will be difficult. If we could
19 perhaps go back to the DFIT of the -- or the DFIT
20 stratigraphy, page 67, 01.01. If we look at this
21 stratigraphy, do you agree that there is an A2
22 mudstone?

23 A J. LAVIGNE: Yes. The A2 mudstone is
24 present in those wells.

25 Q And then if we flip back to the 15.01 and we look, then
26 the A2 is not present through the full stratigraphy; is

1 that correct?

2 A The A2 has been removed in the second well from the
3 left by Wabiskaw D incision. That's correct.

4 Q If we flip back to the 01.01, could you compare the
5 Wabiskaw B shape that we see there with the one on
6 15.01? Are they the same?

7 A I'm -- I'm sorry. Did you say the 'B'?

8 Q 'B', yes.

9 A The 'B'.

10 Q So look at the Wabiskaw B here, and then compare it to
11 the Wabiskaw 'B' that we see in the stratigraphy for
12 KN08 and KN09. Perhaps it will be -- I'll leave it to
13 CNRL's panel to tell you how to flip so that they can
14 see.

15 A The -- in this particular cross-section, the Wabiskaw B
16 is not present in the well on the far right from the
17 Jackfish area. Now, if we toggle back to the previous
18 figure, the Wabiskaw B is present in orange that covers
19 the entire section.

20 Q So these two are not alike or the same?

21 A These are -- these are different cross-sections from
22 different areas. So the -- the Wabiskaw B is not
23 identical over the entire basin. It's -- it's
24 locally -- in this section, it's continuous. And in
25 the other -- in the previous well log section that we
26 were looking at, it is continuous over the local Kirby

1 north area in the three wells on the left; and the
2 other well, it's beyond the depositional limit of the
3 Wabiskaw B, where it's encased in the regional Wabiskaw
4 shale.

5 Q Then for my last geology question, if we can -- well,
6 I -- do we have the transcript on the record I think is
7 the question? I would like to go to page 56 of the
8 transcript, line 16 to 18.

9 It's page 56. We don't have a 56.

10 I'm going to try and ask you the question, and if
11 you disagree with my quote, then please tell me, and we
12 will do more work to try and find the reference.

13 You've said that: (as read)

14 An analysis of overlying confinement strata
15 is critical.

16 A I'm sorry. Are you referring to a specific quote in
17 this? I'm just scanning it and trying to see that.

18 Q Line 16. 16 going on 17.

19 A Yes, I would agree with that statement.

20 Q My question is: Especially in KN09 there is a very
21 significant portion that does not have any well
22 control. If this is so critical, why did you not drill
23 more wells?

24 A S. SVERDAHL: Right now we are at AER
25 requirements for well density for KN09. We will
26 consider drilling more wells to evaluate the reservoir

1 at a later time. What -- we are at current delineation
2 requirements.

3 Q Very well. Even though we don't have that big zone in
4 the middle, we -- we just don't know anything?

5 A G. IANNATTONI: Excuse me. Could you pull up
6 an exhibit that shows this big zone in the middle where
7 we don't know anything, please?

8 Q Can we go to Exhibit 01.01, page 56. If we could then
9 please just enlarge the image.

10 Do you agree that we see a well to the left side
11 of the KN09 box?

12 Can I have the mouse? Then I can perhaps show.

13 So we see a well here, and then we see no wells
14 until here.

15 A S. SVERDAHL: I'd like to correct that.

16 There is one well in 12-2, which is under the 'N'.

17 Q What do you estimate the distance is between those
18 wells?

19 A About 3, 400 metres between those wells, including the
20 well I pointed out under the 'N'. Yeah. My apologies.
21 About 600 metres or so.

22 Q Very well.

23 Moving on, then, to the next section of my
24 questions. If we go look at Exhibit 50.002, page 6,
25 paragraph 14. The second-to-last line says: (as read)

26 Canadian Natural is concerned about the

1 declining pressure.

2 Is that correct? This is in the 10-1 well.

3 A G. IANNATONE: That's correct.

4 Q If we can then go to Exhibit 32.02 at page 34. I think
5 I have the wrong exhibit here. If we can go to
6 Exhibit 15.01 at page 34. My apologies.

7 If we look at paragraph 143, this is where CNRL
8 tells us about the investigation reporting to the 10-1
9 and that they've submitted it to the AER on May 18,
10 2021. Remember that date.

11 If we then go to Tab 29 in the same document,
12 page 350. This is the -- this is the report; right?
13 This is the report that was submitted in May. And I
14 would like to pause there.

15 It is CNRL's contention that we don't need to
16 worry about the 10-1 well because there was this full
17 investigation into it, the report was submitted to the
18 AER, and the AER was satisfied; there's nothing further
19 to be done here?

20 A G. IANNATONE: CNRL agrees that the integrity
21 of the 10-1 well is -- is good, and it also agrees that
22 the data that it's been measuring is valid.

23 Q If we could then scroll down -- my apologies. Let me
24 just find you a page reference.

25 If we go to page 358. So in May, CNRL says at
26 current -- if you could just scroll down. After one

1 year of buildup pressure is now higher than when it was
2 first measured; correct?

3 A That's correct, yeah.

4 Q So this is what the AER has when it makes its decision
5 in August, that there's nothing to be concerned about
6 in the 10-1 well? There was no update to this report
7 between May and August?

8 A There was no update to the report, no.

9 Q If we can then go to Exhibit 15.01, page 358. And my
10 apologies. If we can go to 43.02. It's not -- sorry.
11 Hang on. My apologies. It is 15.01, 43, page 43 --
12 483. My apologies.

13 Here we have a -- a time line of events produced
14 by CNRL, and here we see that the pressure has been
15 declining since March 2021. So when CNRL provided the
16 report to the AER in May of 2021, the pressure was
17 already declining, but it didn't tell the AER that?

18 A That's correct, yes.

19 Q And it also didn't update its report before the AER
20 gave its decision in August 2021?

21 A Sorry. I missed the question. Could you please repeat
22 that last part.

23 Q You said that you did not update the report before the
24 decision in August 2021; correct?

25 A No, we did not update the report.

26 So the history here of this gauge was the -- that

1 we saw a very evident pressure buildup that is
2 reflected in, you know, Point 7 and 8 on this plot.
3 Clearly in Canadian Natural's opinion, that is a
4 valve-closing event, but that's only Canadian Natural's
5 opinion. And then at the time we saw a nice buildup,
6 so we thought, Yeah, this is all good -- very good. It
7 looks like in 9 -- Point Number 9, yeah, we pulled the
8 gauges to do the investigative work, the chat log, the
9 casing integrity-type work. We ran the gauges back in.
10 And the date you're referencing was which point?

11 Q I was not referencing the -- the graph at all.

12 My point was: In May 2021, CNRL produces a
13 report, tells the AER the pressure is high. Despite
14 knowing that from March pressure has been declining, it
15 does not update its report and leaves the AER to make a
16 decision in August without telling the AER that the
17 pressure is, in fact, declining?

18 A D. OLLENBERGER: As you can see, up until
19 Point 9, which is in March, the pressure's very flat.
20 So up to that point there was no established pressure
21 decline observed. So I believe that the contents at
22 the time of the report that was sent to the AER remains
23 valid.

24 Q Sure. And then from there it decreases, but there's no
25 update to the port.

26 My point is this: CNRL says it's concerned about

1 this pressure decrease, but it does nothing about it;
2 it does not tell the AER about it?

3 A The intent of the conditions on the 10-1 are with
4 respect to reporting any potential concerns with flow
5 behind casing or any impacts from SAGD operations.
6 Seeing as the KN06 pad had not began steaming
7 operations until May of 2023, there was no evidence of
8 any sort of communication, and therefore there was no
9 expected need to communicate that to the AER.

10 Q If we then move on to Exhibit 01.01, page 41. What is
11 the -- in -- in this graph, what is the distance
12 between the injector and the SAGD top? So if we look
13 at your heel, for instance, what is the distance
14 between the injector and the SAGD top?

15 A S. BARLAND: Looking at it, I believe it's
16 about 6 metres.

17 Q 6 metres. Okay.

18 How long does it take for a steam chamber to reach
19 the top of a reservoir?

20 A Depends on the actual conformance of that well pair.
21 Generally it's in a matter of months, usually, if the
22 sand is very clean and -- and conformance is good.

23 Q What is the distance between the top of the SAGD
24 reservoir and the Wabiskaw D bitumen?

25 A Probably around 10, depending on which well you look
26 at, 10 to 12.

1 Q Then if we look at your map there at the bottom with
2 your proposed heels, do you agree that where those
3 proposed heels are there will be a concentration of
4 heat?

5 A D. OLLENBERGER: I would say no more than any
6 other portion of the horizontal.

7 Q How long do you think it will take for the heat to
8 reach the Wabiskaw D bitumen?

9 A P. THOMSEN: We don't have a prediction
10 included in the record to answer this question. If we
11 could review the -- the PNX and temperature logs that
12 were included in Tab 12 -- I just need to pull up a
13 reference for this, and we could show some field data
14 for that approximate distance. Just one moment while
15 we pull up the reference for this.

16 A M. SCRIMSHAW: Exhibit 15.01, Tab 12. It's
17 at PDF page 224.

18 A P. THOMSEN: If we could zoom in, please,
19 on the left-hand pair of red and green images to --
20 around the area above that 200 degrees C annotation,
21 please. And if we could scroll down. Okay. Great.
22 If we could keep on scrolling down, please.

23 So some of my colleagues are saying a -- a
24 15 metre would be appropriate based off of that
25 previous cross-section we were looking at. So if we
26 went up 15 metres from that McMurray non-reservoir base

1 or the -- the top of the post-B2 reservoir -- just give
2 me a second as I work my way up here. I think that'd
3 be about a 50 to 60 degrees Celsius after four years of
4 operation in this example. That's subject to check
5 with actually getting the measurement on this, but ...

6 Q Does CNRL acknowledge that conductive heating is a
7 productive -- production mechanism?

8 A Could you repeat the question, please?

9 Q Does CNRL acknowledge conductive heating as a
10 production mechanism?

11 A There is some oil that's mobilized via conduction with
12 SAGD.

13 Q So in Exhibit 50 -- is that your final answer? Can I
14 proceed?

15 A Please proceed.

16 Q In Exhibit 50.002, paragraph 116 on page 34, you agree
17 that conductive heating implies that there's a heat
18 transfer; correct?

19 A Correct. Conductive heating is heat transfer.

20 Q Did CNRL include production from conductively heated
21 bitumen in their application?

22 A D. OLLENBERGER: Can you please clarify the
23 context?

24 Q So you've been very clear that this application is for
25 McMurray bitumen only. Conductive heating can result
26 in production of Wabiskaw D bitumen. Did you include

1 that in your application?

2 A G. IANNATONE: Just one second, please.

3 Thank you.

4 A D. OLLENBERGER: Could you just repeat the
5 question one more time, please?

6 Q CNRL said that they are applying for production from
7 the McMurray formation. The question is: If it is
8 possible to produce Wabiskaw D bitumen through the
9 process of conductive heating, did you include that in
10 your application?

11 A We did not include any production from the Wabiskaw D
12 in our application, and we feel that such production
13 would be highly unlikely.

14 Q If we then go to Exhibit 50.003 at page 7. In that
15 paragraph that is numbered "1" on the side, more or
16 less in the middle of the paragraph after the word
17 "Figure 3": (as read)

18 Conductive heating of the confinement strata
19 will inevitably occur ...

20 And then there is the explanation of how it will work,
21 and then at the bottom of that paragraph: (as read)

22 To the extent that this does occur, it will
23 result in higher volumes of bitumen
24 production and more optimal exploitation of
25 the total resource.

26 So we have the statement that it will inevitably happen

1 and that will result in further exploitation, which
2 does not form part of your application.

3 A T. BOONE: So you're -- that's out of my
4 report; right? And now the confinement strata consists
5 of McMurray and Wabiskaw. And so it -- it would be
6 very specific to the location, you know, how much
7 production occurred out of the confinement strata
8 and -- and which zone it came out of, but, you know,
9 inevitably you can't stop conduction. I mean, once the
10 steam hits the top of the reservoir, it's there for ten
11 years and conduction continues to occur, and once --
12 once any bitumen up there is mobilized, it's heated.

13 Now, the -- the good thing is you get a little bit
14 of oil out of that; right? And the -- one of the
15 reasons SAGD has worked really well is steam actually
16 stops at the top of the reservoir. If steam kept going
17 up there and heated up all this low-quality reservoir,
18 you'd see your steam-to-oil ratios incline -- or, you
19 know, shoot up -- increase significantly, and the whole
20 process would become, you know, less economic for
21 everyone. But fortunately, I mean, steam has been
22 contained to the good sands, and -- and the net result
23 has been -- you know, most projects have very good and
24 very consistent steam-to-oil ratios with SAGD.

25 Q So we inevitably get this conductive heating. We
26 inevitably get this production from the Wabiskaw D. My

1 question is: How will you know --

2 A G. IANNATTONI: No.

3 A T. BOONE: I didn't --

4 A G. IANNATTONI: Excuse me.

5 A T. BOONE: -- say that. I said from the
6 confinement strata there. And it depends on the
7 permeability. Okay? And -- and it's not necessarily
8 the Wabiskaw D. I didn't look at -- to see if there
9 were barriers between -- and I think generally there
10 are barriers between the Wabiskaw D and the McMurray
11 formation steam chambers.

12 Q If we can then move on to Exhibit 50.002,
13 paragraph 123, on page 35.

14 This refers to an overpressure event; correct?

15 A G. IANNATTONI: I think this is that Cenovus
16 example that we talked to earlier this morning.

17 Q In your opinion, if -- if there was a thermal expansion
18 in the Wabiskaw D, what kind of pressure could that
19 generate?

20 A Are you referring now to the KN08, KN09 drainage boxes?

21 Q Correct. If there was a similar event as in this
22 example, what kind of pressure are we looking at?
23 Could it reach 6.5 as in the Cenovus example?

24 A P. THOMSEN: We have not included a
25 prediction or a model of this within the record to
26 bring up. What we can answer this question with is the

1 Cenovus example had temperatures of up to 150 degrees C
2 in the Wabiskaw D sand, and with the example that we
3 were just looking at, 15 metres above, we were looking
4 at temperatures around 50 to 60 degrees Celsius. So we
5 would have lower temperatures.

6 A G. IANNATONE: I think to answer your
7 question is we don't have a prediction or a model that
8 predicts the pressure in the Wabiskaw D over the KN08
9 and KN09 drainage boxes due to conductive heating.

10 Q Very well. Do you agree that steam most often rises to
11 the top of a reservoir and that the overlying strata is
12 heated over time by conduction from the top of the
13 steam chamber?

14 A P. THOMSEN: Overburdened heat losses will
15 occur via conduction. And what was the second part of
16 the question?

17 Q Do you agree that steam most often rises to the top of
18 the reservoir and that the overlying strata is heated
19 over time by the conduction from the top of the steam
20 chamber?

21 A Just one moment.

22 So our steam chamber development may reach the top
23 of the post-B2 reservoir. In some instances, there are
24 mud beds that can impair the rise of the steam chamber,
25 and so in some portions of our development, the steam
26 chamber will -- will not reach the top of the post-B2

1 reservoir.

2 Q I am, in the interest of time, going to skip over a
3 couple of questions, and I'm going to jump to the Long
4 Lake example of CNRL. It's, I believe, in the
5 transcripts on page 117. I believe lines 24 to 26,
6 page 117.

7 So here CNRL referenced the Long Lake Pads 14 and
8 15, and you used it as an example of SAGD operations
9 which have an MOP, where the hydrostatic head of the
10 water is near the seismic scale faults in the caprock,
11 and you suggest that Long Lake is an example where this
12 type of operation was conducted safely; correct?

13 A The purpose for communicating this was this is an area
14 where there is a potential concern about shear failure
15 of the faults through the caprock, and I don't know
16 specifically how far those faults extend within the
17 caprock, but it was an area of concern.

18 Q Did you know that Long Lake has 18 observation wells in
19 Pads 14 and 15?

20 A Could you repeat the question, please?

21 Q Did you know -- did you know that Long Lake has
22 18 observation wells in Pads 14 and 15?

23 A I do not know the number of observation wells.

24 Q I am then going to jump further to the geomechanics
25 topic. I am referring to Exhibit 46.02 at Tab 5,
26 page 32. It's the geomechanical modelling report. And

1 I'm going to have to ask you for a little bit of help
2 because I only have the acronym here, and I do not, in
3 fact, know what it stands for, "SSL"?

4 A D. WALTERS: I can speak to that. It -- it
5 stands for shear stress level.

6 Q Thank you very much.

7 Can you confirm that in the modelling output you
8 used in computing the SSL it is dependent on the
9 properties that have been assumed for each of the main
10 zones in the modelling?

11 A Yes, that's correct. It depends on the shear strength
12 properties we assign to each of those materials.

13 Q Can you show me in your report where you assigned those
14 properties?

15 A So the Table 1 in the report -- which was corrected, so
16 that's on page -- PDF page 43 -- this table lists the
17 different zones that were included in the model and
18 some of the inputs. The shear strength properties
19 themselves, there was -- was -- were discussed in the
20 text below that table, so two paragraphs down. The
21 paragraph starts: (as read)

22 Shear strength of the mudstones and
23 mud-dominated confinement strata ...

24 Q Do you agree that the properties that were assumed for
25 each of those zones was assumed for a homogenous
26 material?

1 A So the properties assumed for those zones were assumed
2 to be at a post-peak or a residual-strength state and
3 so that accounts for the potential for there to be
4 shear fractures within the materials and is a
5 conservative approach. There were -- there was lab
6 data that was also presented that shows the shear
7 strength of intact mudstone from the area, and the
8 properties that we assumed for the modelling was much
9 lower than those properties. So we used a conservative
10 estimate, but we assumed that for the entire zones, so
11 homogenous through that zone.

12 Q And we know from the geological evidence that these
13 zones here are not homogenous. They are, in fact,
14 heterogenous?

15 A That's correct. However, this -- this modelling
16 approach and modelling workflow is much like SAGD.
17 It's something that's very well established and very
18 mature. The first caprock integrity work project that
19 I worked on was in 2002 when the SAGD commercial
20 projects were beginning, and since then I've conducted
21 over 30-plus caprock integrity studies on commercial
22 SAGD projects. It's typical that they don't have the
23 same characterization of the geomechanical material
24 properties in the caprock that you would of the
25 reservoir properties that have been discussed by
26 geology.

1 Q To be clear, we don't take issue with your approach.
2 We just doubt whether it actually answers the questions
3 that this Panel needs to answer.

4 A The modelling approach that we take is first developed
5 from a risk perspective. So as you heard in the direct
6 evidence, a lot of the characterization for KN08 and
7 09 -- a lot of work has been put into looking for risks
8 that could be a risk for containment, which is
9 eventually what the caprock integrity study would look
10 to evaluate over the operational history. So the
11 models that are then developed, which this is an
12 example of that we've just talked about, are fit for
13 purpose based on the risks that have been identified.
14 And geologically, there were very few risks and very
15 low risk identified for containment, as has been
16 discussed, with respect to faults and fractures. The
17 operating conditions are relatively low risk as well in
18 terms of operating pressures and volumes injected at
19 the start-up pressures. So associated with that, the
20 inputs that were used were conservative to analyze
21 caprock integrity, and it was felt representative --
22 reasonably representative to confirm that we have a
23 low-risk operation, and I believe it showed that.

24 Q Do you acknowledge that we don't, in fact, have your
25 model on the record? All we have is your report?

26 A That is correct. This modelling report is on the

1 record.

2 Q Could you show us in your report where the maximum
3 confinement strata uplift appears?

4 A The uplift or the deformations, the vertical
5 deformations are not shown in the report. Just summary
6 plots of the stress levels which are a result of that
7 deformation. The pressure and temperature results that
8 induce that deformation, they are all shown in the
9 report.

10 Q Could you show us the deformations in your report or
11 the predictions for deformation in your report?

12 A No. Not in the report. If you would like, I could
13 provide those deformations or deformation plots.

14 Q The problem that I have is that I have no further
15 opportunity to file further evidence or do anything
16 with that information.

17 I'm going to stop it here because I'm running
18 rapidly out of time, and I'm going to hand it over to
19 Mr. McLeod.

20 Mr. McLeod Cross-examines the Canadian Natural
21 Resources Limited Witness Panel

22 Q A. MCLEOD: Can everyone hear me?
23 Excellent.

24 All right. So I'm going to start with
25 Exhibit 50.03 at page 3. Now, Dr. , at the top here
26 you say that you re-affirm the conclusions from your

1 initial report, which I believe is in Exhibit 15.01.

2 Do you agree with that?

3 A T. BOONE: Yes.

4 Q Okay. And you would also agree that in Exhibit 15.0 --
5 yeah, 15.01, you had recommended a temporary MOP of
6 6,600 kilopascals; right?

7 A I -- that was being recommended or being proposed by
8 CNRL, and -- and I supported it.

9 Q And so when you say that you re-affirmed the
10 conclusions in your initial report that a temporary MOP
11 of 6,600 kilopascals is acceptable, you've actually
12 changed that recommendation now, haven't you?

13 A I don't believe so, but maybe you could point me to it
14 if I --

15 Q Sure.

16 A -- had a misstatement there.

17 Q Yeah. In -- under Issue 3 there, you say it is your
18 assessment that it's reasonable to permit an MOP of
19 6,600 kilopascals as requested by CNRL for the purpose
20 of starting up the SAGD wells. And then you go on to
21 say in Issue 4 that it: (as read)

22 Is my assessment that solvent injection
23 during start-up phase, as requested by CNRL
24 in Exhibit 15.1, page 47, paragraph 199,
25 should be allowed with a pressure limit of
26 5,500 kilopascals equal to the MOP without

1 the allowance for a higher temporary MOP.

2 So I'm a little bit confused about what -- the
3 temporary MOP that you recommend.

4 A Sure. And -- and I -- I recognize that there's been a
5 bunch of, you know, confusion. There's different
6 numbers floating around there; right? So the temporary
7 MOP of 6,600 kPa applies to the start-up of the wells.
8 And so this is when they're initially trying to get the
9 wells circulating. And so that's in the very first few
10 days or few weeks of operations. And -- and the
11 challenge, then, is just to get steam circulating
12 because you have this pressure head of water in the
13 well, and you have to overcome that, and you have to
14 overcome your -- your pressures in your flow lines to
15 the plant and whatever else. So that's very early on.

16 And so then what happens is you get the wells
17 circulating, and that temporary MOP of 6,600 kPa
18 doesn't apply. Okay? Once they're up and running -- I
19 mean, there is a period where it -- as Peter said
20 yesterday, maybe things -- you know, there's a
21 shutdown, and you need to apply it again.

22 Q So it's --

23 A But the --

24 Q It's not just at the start, then. It's -- it's any
25 time that you have to restart the --

26 A Well there --

1 Q -- the wells?

2 A There's a limit on the time period there, but -- so --

3 Q What is that time limit?

4 A I -- I'm going to refer to Mr. Thomsen.

5 A P. THOMSEN: Canadian Natural has modified
6 its requests, as presented yesterday, to a maximum
7 continuous time of 24 hours for use of bottom-hold
8 pressures above 5,500 kPa and below the requested
9 temporary MOP of 6,600 kPa.

10 A T. BOONE: And -- and so, again, I'll
11 just say now that's during steam injection only. So
12 during solvent injection, which is referred to in
13 Issue 4, I think the proposal has always been that the
14 pressure limit would be the -- the MOP itself, which
15 was originally in the application 6,000 kPa and now has
16 been reduced to 5,500 kPa.

17 Q So you're suggesting, then, that the temporary MOP
18 would only apply to the times prior to the injection of
19 solvent?

20 A D. OLLENBERGER: As I stated yesterday, solvent
21 injection will be subject to the long-term MOP of
22 5,500 kPa.

23 Q Right. And so when -- when are we going to see the --
24 the exceedance to 6,600 kPa? Is that before or after
25 injection of solvent?

26 A It would typically be before injection of solvent.

1 Under very rare circumstances, there would potentially
2 be a case after an extended shut-in that we would need
3 to recirculate the wells. Due to the heat that would
4 be stored in the wellbore, we would not expect to need
5 to use the temporary MOP at that time.

6 Q But you've requested to have that temporary MOP extend
7 beyond just the start-up of these wells?

8 A I don't think that we did do that. Any time that
9 there's solvent in the well being injected, we would
10 not exceed the long-term MOP of 5,500 kPa.

11 Q I think you might have missed my question. My question
12 was whether you intended to exceed the 5,500 kilopascal
13 MOP at any time aside from at the start-up of these
14 wells.

15 A As we've stated in our submission, it's very likely
16 that in early SAGD all the injected hydrocarbon would
17 be produced back out of the wells; therefore, if we
18 ever did have to recirculate the wells, it's expected
19 there would be no hydrocarbon downhole. There may be
20 instances where we would have to recirculate the wells.
21 If such times occurred and we could not unload the
22 wells below the long-term MOP of 5,500 kPa, we may
23 proceed to use the temporary MOP; however, this
24 situation is very highly unlikely to occur.

25 Q And, sir, where in your application was that request
26 for a temporary MOP for recirculation events?

1 A I think that's covered under the umbrella of -- that we
2 will not exceed the temporary -- temporary MOP for more
3 than 24 continuous hours or 14 nonconsecutive dates. I
4 believe those 14 nonconsecutive days would cover that
5 time period.

6 Q But at any time during the life of the project you
7 might need that exceedance?

8 A Potentially, but I would say it's very highly unlikely.
9 Once the wells are on SAGD and the near wellbore area
10 has been conductively heated, unloading the wells
11 becomes much, much easier, and therefore we'd not
12 anticipate to need to use that MO -- temporary MOP to
13 unload the wells and re-establish circulation.

14 And in our experience, that has never had to
15 occur. We've never had to use the temporary MOP again
16 to re-establish circulation in any of our well pairs.

17 Q Now, Dr. Boone, was it CNRL that suggested to you that
18 there should be a temporary MOP of 6,600 kilopascals,
19 or did you reach that conclusion on your own?

20 A T. BOONE: So there was -- well, when I
21 first got involved in KN06, that hearing, the temporary
22 MOP was part of that and -- and was approved for KN06.

23 Also, if you look in the D 86, the directive for
24 shallow SAGD projects, there's a specific section in
25 there on exceedance of the MOP -- temporary exceedance
26 of the MOPs, and it's commonly granted to most

1 companies in industry, and there's a procedure there --
2 in there for asking for permission to temporary --
3 temporarily exceed the MOP. So it's --

4 Q So CNRL --

5 A -- common --

6 Q CNRL --

7 A I didn't suggest it, but it's --

8 Q Okay.

9 A -- it's common practice.

10 Q So CNRL suggested to you that it wanted a -- a
11 temporary exceedance of the MOP up to 6,600
12 kilopascals, and then you concluded in your report that
13 that was the appropriate temporary MOP?

14 A I concluded that 6,600 was reasonable, yes.

15 Q Very good.

16 We'll turn to Exhibit 50.003 at page 22. Can we
17 go back to 21? Sorry. I apologize. It is on 22.

18 So there, Dr. Boone, you indicate that there's
19 no -- or -- or the risk that you're -- you're
20 considering is -- is whether steam containing no
21 reaction products might escape containment. Can you
22 tell us why it is that you concluded that there would
23 in no circumstances be any reaction products in that
24 steam?

25 A Sure. So this is early on in -- generally early on in
26 the process that you're starting up the well, and there

1 isn't a large steam chamber developed yet that would
2 contain reaction products. So that -- that's one
3 point.

4 But the real key point is if you're going to
5 inject steam -- and the risk here is that you do it
6 above fracture pressure and that fracture rises up into
7 the overlying strata, the steam that you're injecting
8 which has no reaction products because it comes from
9 the plant flows into the fracture, it's at high
10 pressure, there's some leaking off into the formation,
11 and -- and the only possibility is that some of that
12 injected steam makes it up into the strata. But
13 there's -- there's no potential for reaction products
14 to flow into that fracture. Okay? The fracture is at
15 the high pressure, and it's -- it's injected steam, and
16 it has no reaction products in it.

17 Q All right. Thank you.

18 I'm going to turn you now to Exhibit 20.02 at
19 page 70. 70, seven zero. Sorry. Thank you.

20 So from CNRL's response here, is it correct for
21 ISH to understand that it's CNRL's position that
22 bitumen-saturated zones are confinement strata?

23 A D. OLLENBERGER: Sorry. To clarify, are you
24 questioning whether or not we're implying the bitumen
25 surrounding our SAGD well pairs is confining strata?

26 Q I'm trying to ascertain whether it is CNRL's position

1 that bitumen-saturated zones act as a -- or are
2 confinement strata.

3 A One moment, please.

4 Generally be the mud content of our facies that
5 would be what we would use to determine confining
6 strata. Bitumen at low temperatures would impede flow
7 of fluids. There might be some water mobility in cold
8 bitumen. However, we wouldn't typically classify
9 highly saturated bitumen zones that are heated as
10 confinement strata.

11 Q Thank you.

12 COMMISSIONER CHIASSON: Mr. McLeod, just to give you a
13 heads-up, I'd mentioned previously that we have a --
14 need to have a hard stop at 12:15 because of the
15 availability of the room that we have for lunch, so
16 just to -- to give you an early warning.

17 A. MCLEOD: Yeah. And perhaps this may be
18 a good time to take a break. I do think that I am
19 going to have to continue for a little bit after lunch
20 just --

21 COMMISSIONER CHIASSON: Fair enough.

22 A. MCLEOD: -- due to the length of some
23 of the answers that we've been getting, which we
24 appreciate.

25 COMMISSIONER CHIASSON: Yes. No. We realize that
26 because our time was off yesterday.

1 So, Ms. Jamieson.

2 J. JAMIESON: Thank you.

3 Mr. Sverdahl, earlier this morning you were asked
4 about three wells, and you were asked to provide the
5 date they were drilled. You were able to give the date
6 of two of those wells but not the third, and you had
7 committed to bringing that information. Do you have it
8 now or ...

9 A S. SVERDAHL: Yes. It's -- that third well
10 was drilled in February of 2012.

11 J. JAMIESON: Very good. Thank you very
12 much.

13 COMMISSIONER CHIASSON: Okay. Great. Thank you. So
14 I'm assuming that, with that, we don't need to check
15 back end of day. You're satisfied with that,
16 Ms. Riley?

17 M. RILEY: Yes. Thank you. And an
18 undertaking has been avoided.

19 COMMISSIONER CHIASSON: Thank you. Thank you, all.

20 All right. So we will break now, and we will look
21 to return back, let's say, at ten past 1. Thank you.

22

23 PROCEEDINGS ADJOURNED UNTIL 1:10 PM

24

25

26

1 Proceedings taken at Govier Hall, Calgary, Alberta

2

3 February 7, 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 1:14 PM)

8 COMMISSIONER CHIASSON: Could we get the door to the
9 foyer closed, please.

10 Thank you. So, Mr. McLeod, you're ready to
11 continue?

12 A. MCLEOD: I am ready.

13 COMMISSIONER CHIASSON: Okay. Please go ahead.

14 A. MCLEOD: Everyone can hear me okay?
15 Excellent.

16 DEVIN OLLENBERGER, THOMAS BOONE, LENNON ROCHE,

17 MARC SCRIMSHAW, Previously Affirmed.

18 GERARD IANNATTONE, JASON LAVIGNE, SCOTT SVERDAHL,

19 DALE WALTERS, XIANG WANG, PETER THOMSEN, SCOTT BARLAND,
20 Previously Sworn

21 A. McLeod Cross-examines the Canadian Natural Resources
22 Limited Witness Panel

23 Q A. MCLEOD: All right. I'll start by
24 bringing up Exhibit 50.02 at page 54. All right. All
25 right. So at paragraph 202 Canadian Natural says that
26 it agrees with ISH that the solvent assist start-up

1 technology is still in the development stage. After
2 testing at KN01 to 08 with positive results scaling
3 this technology up to pad scale at the KN08 and 09 pads
4 is naturally the next step in the technology
5 development process.

6 And so my question is: What have been the steps
7 that CNRL has taken to go from one well with less than
8 100 metres cubed injected of solvent to a pad scale
9 test with 350 metres cubed per well with, as I
10 understand it, up to 24 SAGD well pairs on KN08?

11 A D. OLLENBERGER: Yes, I guess just to clarify,
12 obviously, Canadian Natural has applied to conduct this
13 test on a pad scale. That does not necessarily mean
14 that we will plan on conducting hydrocarbon-assisted
15 start-up on every well pair. More than likely it will
16 be every second well pair perchance, and, secondly, we
17 did do an additional trial at Jackfish for
18 hydrocarbon-assisted start-up, and as far as the
19 volumes that we've requested, as we've listed, the
20 wells on KN08 and KN09 will be longer in length, can be
21 longer in length as applied compared to KN01 Well
22 Pair 8, and therefore we're asking for additional
23 flexibility on the injected volumes.

24 Q Now, I'm no engineer, but it seems to me that doing
25 every other well pair with the solvent assist must be
26 aimed at determining what -- what the differences are

1 between using solvent and not using solvent. Am I
2 right?

3 A Yes. It would be used to intentionally develop
4 analogs.

5 Q So why is it that CNRL has not applied to use solvent
6 assist on every other well?

7 A We haven't yet drilled the wells and therefore
8 selecting candidates at this time would be premature.

9 Q But CNRL didn't give any indication in its application
10 or subsequently filed materials that it intended on
11 doing anything other than using the solvent assist for
12 every well pair on KN08 and KN09?

13 A Yes, that's correct. I mean, it is just for the intent
14 of being able to maintain operational flexibility. You
15 know, CNRL would like to reserve the right to inject on
16 every well pair.

17 Q All right. And in terms of the -- the hydrocarbon that
18 CNRL intends to use for the purpose of the solvent
19 assist start-up, in some places I see that CNRL has
20 referred to it as -- as xylene and other places as
21 xylene diluent. What is it that CNRL intends on using
22 as the solvent?

23 A I would characterize it as a xylene diluent blend.

24 Q And do you have any detail on -- on the composition of
25 that or the ratios of xylene and diluent, or ...

26 A Just one moment, please.

1 I would say we don't yet have the specific
2 composition locked down ahead of the test. Xylene is a
3 more expensive product than diluent, and 100 percent
4 diluent may cause asphaltene deposition. So therefore
5 we would look to do some further tests potentially to
6 determine the optimum ratio at KN08 and KN09.

7 Q All right. I'll now turn to Exhibit 40.01. And I'm
8 looking for Tab 8 there. All right. So we'll maybe
9 scroll down to the "Working Experience" there. And
10 maybe just go down a little bit further so we have 2016
11 to present. Thank you.

12 Dr. Boone, I've had a look over your résumé, which
13 is now displayed on -- on the screen, and I notice that
14 you worked for ExxonMobil and Imperial Oil for quite a
15 while and -- and did some work with -- with SAGD. But
16 I don't see anywhere on your résumé where you have
17 worked a lot in -- in developing solvent-assists SAGD
18 projects, yet you've commented quite extensively on the
19 solvents at start-up. Can you provide your comments on
20 that?

21 A T. BOONE: Sure. Why don't we go to the
22 listing of my published papers.

23 Q Sure. If we can just scroll down.

24 A Like, the second one there? "An Integrated Technology
25 Program for Solvent-Based Recovery", and I believe you
26 guys included that as one of your aids for cross, and

1 that describes four or five different solvent projects
2 that when I was manager for research at Imperial Oil's
3 research lab here our major focus was solvent
4 technologies, and so I -- I have a lot of experience
5 with solvent.

6 Q Okay. So maybe we'll turn to AQ Number 1, Tab 2. And
7 we'll turn to page 12.

8 Now, Dr. Boone, this is the paper that we were
9 just talking about in -- in your résumé, and I think it
10 was published around 2011; is that right?

11 A Yes.

12 Q Okay. And about halfway down the page on -- on the
13 page that's on the screen here, you and your co-authors
14 wrote that: (as read)

15 A fundamental learning from a long history of
16 pilots at Cold Lake is it is always much more
17 difficult to reliably interpret field results
18 than as is anticipating in the planning stage
19 or can be directly ascertained from
20 simulation models.

21 Would you agree that that is applicable to field tests
22 generally?

23 A Yes. I'd say that's generally true.

24 Q And then later on in that same page, if we can just
25 scroll down -- sorry -- starting at "Another Learning",
26 you and your co-authors wrote that: (as read)

1 Another learning from experiences that pilots
2 are rarely confined to the planned or design
3 pilot conformance area.

4 Would you agree that that is applicable to the -- the
5 pad scale test that CNRL is now proposing?

6 A Well, I think you need to -- so the pad scale test that
7 CNRL is proposing is in the very early start-up phase,
8 and they're injecting solvent, and I think you heard
9 previously with the intent of keeping it within
10 3 metres of the wellbore. And so in this case, I mean,
11 it is very localized around the well, and -- and
12 there's really no possibility that -- that one well is
13 going to communicate with another.

14 This paper focuses on recovery processes, and
15 that's, you know, a much longer term. We're going to
16 be injecting much larger volumes of solvent, and the
17 steam chambers have grown to the point where they're
18 connecting between wells, and there's a lot of
19 possibility for fluids moving from one well to the
20 other well.

21 Q Okay. So you're saying, then, that this is one of
22 those rare cases where a pilot will be confined to the
23 planned or designed pilot area?

24 A Yeah, and I -- I -- you know, this is -- these are
25 pretty small-scale trials. I'm not -- I don't know
26 whether they would really be qualified as a pilot used

1 in the sense of this paper.

2 Q Okay. Now, you go on there to say: (as read)

3 Additionally facility operations are
4 typically more variable and complex than is
5 anticipated at the planning stage.

6 Recognizing these challenges, high-quality
7 production fluid measurements were performed,
8 not only at the wells where solvent was
9 injected, but also at all adjacent steam-only
10 wells.

11 You'll agree that the -- the idea that facility
12 operations are more variable and complex than is -- is
13 normally planned is true?

14 A Definitely, yes.

15 Q And that would apply to the development of these two
16 pads as well? It will be more complex than it is on
17 paper?

18 A G. IANNATONE: If I could take this one, Tom.
19 We do not have any solvent-related facilities for the
20 solvent start-up.

21 Q Okay.

22 A It should be thought of as a stimulation to the
23 wellbore, so we inject the solvent, we produce it back,
24 we create some reservoir voidage, and essentially
25 that's the end of it. There's -- it's very simple,
26 quick to do; probably, you know, within a few days of

1 the injection, the solvent's been produced back so
2 there is no impact at all on surface facilities.

3 Q And I'm just going to turn to page 14 of that exhibit.
4 And, sir, you'd agree, Dr. Boone, that with the
5 statement that the transition from a successful pilot
6 phase through to completion of a successful first
7 commercial application is also commonly more difficult
8 than anticipated?

9 A T. BOONE: Yes.

10 Q And you'd agree with me that we haven't yet had a --
11 or, rather, CNRL hasn't yet had a successful pilot
12 phase for the -- as a start-up?

13 A I haven't reviewed the data that they had on SA
14 start-up.

15 A G. IANNATONE: I would agree they haven't had
16 a successful start-up phase yet. That, in fact, is the
17 purpose of wanting to trial it here at KN08 and KN09 so
18 we can advance the technology.

19 Yeah -- sorry -- my colleague here corrected me.
20 He said that we've had success in the execution, not
21 necessarily in the results, right. So we're -- that's
22 why we're continuing to pilot. We're trying to see if
23 we can get this technology to work subsurface.

24 Q But essentially -- and as you've -- or CNRL mentions at
25 paragraph 202 of Exhibit 50.002, the intention is -- is
26 to scale the technology up to pad scale; in other

1 words, do a commercial scale, not to merely test it.

2 A Yes. That's the intention.

3 Q All right. I'm going to turn to Exhibit 01.01 at
4 page 77. Now, this was the first plot plan that CNRL
5 submitted in -- in conjunction with this application.
6 Now, I'm wondering if -- if the witness panel can point
7 to where on -- on this plot plan there is any equipment
8 to complete the solvent-assist start-up?

9 A Just one moment please, thanks.

10 A L. ROCHE: So, yeah, there will be
11 nothing specific on this plot tied to that. Like
12 Mr. Iannattone said, we come in and do solvent-assisted
13 start-up. We bring in third-party pumping, and we pump
14 them down the wells and maintain our pressure
15 limitations, but as far as flowback, we just use the
16 existing facilities.

17 Q Okay. And -- and I'm going to turn you now to page 315
18 of this same exhibit -- sorry -- 316 it must be.

19 All right. So this is the plot plan that CNRL
20 provided in response to one of the SIRs from the AER.
21 Can you tell me is -- is this the -- the pad that CNRL
22 plans to build on KN08?

23 A D. OLLENBERGER: This is a typical plot plan
24 for a SAGD pad. Subject to the number of well pairs
25 and final design, it could be altered.

26 Q And you wouldn't be able to point, then, anywhere on

1 that plot plan to any sort of equipment that might
2 monitor the injection or return of solvents?

3 A This pad would be equipped with the typical SAGD
4 monitoring.

5 Q And I suppose that would be the typical SAGD monitoring
6 that was customary as of the date this was issued for
7 implementation on May 17th, 2018?

8 A I believe that could be correct. Canadian Natural has
9 not proposed any additional monitoring for hydrocarbon
10 start-up.

11 Q Thank you.

12 All right. We'll turn now to the thermal
13 compatibility of wells, and in that respect, I will
14 turn to Exhibit 50.002 at page 57. Now on -- in
15 paragraph 214, we have Canadian Natural's proposal with
16 respect to the 10-2 well: (as read)

17 ... to pull out existing equipment, remove
18 the packer assembly, patch the Wabiskaw B
19 perforations, cement from plug back to
20 15 metres above the Wabiskaw member [and so
21 on].

22 So I'll ask you to just briefly read that and keep it
23 in mind, and then I'll ask that we turn to
24 Exhibit 50.003 at page 249. And -- and here we have
25 the visual representation of the planned workover for
26 the 10-2 well, and -- and it appears to me that there

1 might be a little bit of a discrepancy between what was
2 written in -- in paragraph 214, which was that CNRL
3 would pull out existing equipment, remove the packer
4 assembly, and patch the Wabiskaw B perforations to, in
5 this proposed plan, indicating that CNRL will pull
6 existing equipment, drill out the plug, patch the
7 Wabiskaw B perfs and so on. So I'm just wondering if
8 you could comment on those differences and what the
9 intended plan is?

10 A L. ROCHE: Sorry. Just repeat that
11 again. The variances?

12 Q Yes. So at paragraph 214 CNRL says that it intends to
13 pull out existing equipment, remove the packer
14 assembly, patch the Wabiskaw B perforations, and so on,
15 and then in Tab 33, CNRL says that it will pull
16 existing equipment, drill out the plug, patch the
17 Wabiskaw B perfs. And so the discrepancy that I'm
18 seeing there and, you know, I'm no -- no reservoir
19 engineer, but the discrepancy I'm seeing is that
20 there's pull existing equipment in para 214 and remove
21 the packer assembly, whereas on the visual
22 representation it talks about drilling out the plug,
23 and my impression is that those are different things?

24 A Yeah, so I think -- so the first one, pulling out the
25 existing, we would go in, and we'd pull out the
26 existing packer and the coils, and then we would go in

1 and set a patch. So the drilling out the plug is more
2 part of our commitment to reestablish production after
3 the GOB order is lifted.

4 Q Oh, I understand. Okay.

5 So it was just that this proposed plan isn't quite
6 in the order of intended operations?

7 A That would be correct.

8 Q Okay. And -- and is it fair to say that based on just
9 this diagram and just paragraph 214, that there's not
10 enough detail at this point to I guess send out a -- a
11 completions crew to do the workover?

12 A Based on this, no. We have detailed programs that we
13 would share with ISH before executing any operations.

14 Q Perfect. I'm next going to turn to Exhibit 32.02 at
15 page 27. And can we just scroll down to para 92.

16 So CNRL has proposed that no wellbore intervention
17 would be required in the 12---34 well because
18 continuous monitoring has been restored there, and at
19 the time of ISH's submission it -- it agreed with
20 that -- that view. But I'm wondering if -- if that
21 monitoring well at 12---34 if it's actually approved to
22 be a monitoring well at this point?

23 A D. OLLENBERGER: The requirement of the 12---34
24 well to be a monitoring well has been removed from our
25 approval.

26 Q And so would it be CNRL's intention then to apply for

1 approval for 12-34 to be a monitoring well?

2 A Sorry. Can you please repeat your question?

3 Q Sure. Sorry. The question is: If -- if the approval
4 for 12-34 being a monitoring well has been removed,
5 would CNRL reapply for that approval?

6 A The monitoring condition of 12-34 now would be more
7 with respect to the thermal compatibility component,
8 not as an observation well in and of itself. The 12-34
9 was originally an aquifer monitoring well.

10 Q Thank you.

11 I'm going to now turn to Exhibit 43.002 at
12 page 21, and we'll just scroll down there a little bit
13 to the response. Sorry.

14 So CNRL, at the response, about two-thirds of the
15 way down the screen there, says: (as read)

16 In the unlikely event of any type of casing
17 breach in the overlying formations of the
18 12-34 well, hydrostatic flow path would be
19 created between the McMurray and breached
20 upper zone and reservoir fluid transfer would
21 be experienced. Canadian Natural has
22 installed a gauge that measures pressure and
23 temperature which is continuously monitored
24 for a transient response in the data. If any
25 out-of-zone casing breach occurs, the
26 pressure gauge will record a change in

1 pressure which would indicate a flow path is
2 present. Temperature trends will also be
3 monitored, which would indicate fluids
4 flowing past the gauge. Pressure and
5 temperature data will be used concurrently to
6 detect a casing failure.

7 Now, Dr. Boone had confirmed that he had not:

8 (as read)

9 ... assessed issues associated with pathways
10 that may involve the wellbores [in his first
11 report.

12 And had indicated as well in his first report that:

13 (as read)

14 While tens of kilopascal pressure changes can
15 be resolved by the gauges, it would be very
16 difficult to differentiate from the ongoing
17 pressure changes.

18 So my question is: What is CNRL going to do in the
19 event of a casing breach?

20 A P. THOMSEN: We just need to discuss.

21 Can you just repeat the question once more,
22 please?

23 Q Sure. The question was: What is CNRL going to do in
24 the event of a casing failure?

25 A So in the event of a casing failure and if there was --
26 if there was a casing failure connected to a zone with

1 a different pressure and cross-flow started to occur in
2 the well, we would measure a pressure change associated
3 with that cross-flow, and the response would be to kill
4 the well. And it would be relatively simple to use
5 fluid with -- like, water has a high enough density to
6 be able to control the well, and then we would put
7 together a plan to address the casing failure.

8 Q And if, in the course of that casing failure, there was
9 hydrostatic flow created between the McMurray and
10 breached the upper zone, what would CNRL do to
11 remediate that occurrence?

12 A We would likely zonally abandon the monitoring
13 interval. There are other options that could also be
14 considered, but that's the likely course of action.

15 Q CNRL hasn't done a risk assessment, though, to -- to
16 consider what the appropriate mitigations would be
17 there?

18 A Canadian Natural has significant experience with
19 monitoring wellbore integrity. We are continuously
20 monitoring wells with steam injection and have
21 experience with -- with casing failures occurring at
22 various times of thermal operations. So CNRL --
23 Canadian Natural has a response procedure for
24 high-pressure well kills for thermal assets and that
25 can deal with bottom-hole pressure that is far in
26 excess of the KN08 and KN09 setting.

1 Q I'm going to turn now to Exhibit 50.002 at page 59, and
2 I'm looking at paragraph 219.

3 Mr. Iannattone, CNRL will acknowledge that ISH's
4 consent to proceeding with the workover proposals is
5 subject to negotiation and execution of an agreement
6 detailing the respective parties' obligations and
7 rights?

8 A G. IANNATTONI: Right. I think we're just
9 quoting what they had in their IR response here.

10 Q Okay. And CNRL acknowledges that that is going to be a
11 necessary step in the process to do these workovers?

12 A I believe so. That has been the step, I think, that
13 we've taken in the past.

14 Q Thank you.

15 A. MCLEOD: Now, just for the -- the
16 Commissioners' knowledge, I believe I've got maybe 10
17 or 15 minutes more of questions, and we should be able
18 to burn through those relatively quickly.

19 COMMISSIONER CHIASSON: Thank you for that update.

20 Q A. MCLEOD: All right. So if I can have
21 the transcript brought up at page 135.

22 Now, Mr. Ollenberger, I'll have you review lines 3
23 through 6 of the transcript.

24 A D. OLLENBERGER: I've reviewed them.

25 Q And so you'll agree that it was your evidence that a
26 20-year delay should be anticipated before CNRL and ISH

1 would be able to produce the gas resource that is
2 subject to the GOB order?

3 A Yes.

4 Q And as a result of that conclusion, you think that the
5 discount of 10 percent per annum for 20 years should be
6 applied to the present value of future cash flows?

7 A That is the assessment we conducted.

8 Q That was the assessment that CNRL conducted or
9 Mr. Ollenberger?

10 A We used the 10 percent discounting, correct.

11 Q But was it Mr. Ollenberger who did the -- the --
12 applied the discount formula, or who was it?

13 A I was leading a team that conducted the discounting.

14 Q Okay. Then perhaps I'll direct this question to you.
15 You're not an economist or an accountant or an auditor?

16 A Correct.

17 Q Okay. And can you tell us how CNRL has reported its
18 portion of the gas asset on its balance sheet? Has it
19 applied the same discount based on the delay in
20 production of 20 years?

21 A It's my understanding that the Kirby Upper Mannville II
22 gas pool is not on our reserve books.

23 Q You haven't recorded it on your reserves at all?

24 A Subject to check, I believe because it's shut in, it
25 would not be considered proven reserves.

26 Q Can I get an undertaking for you to review CNRL's

1 records to confirm whether the gas resource under the
2 Upper Mannville II pool is -- is on the reserves, and
3 if so, the value that it's recorded at?

4 A Yes.

5 A G. IANNATTONI: I think we can check to see if
6 it's on our reserves. With respect to the value, I'm
7 not sure that that's relevant here because -- anyways,
8 I don't believe it's on our reserves, but I'm not
9 committing to the value at this point in time.

10 Q Well, sir, I would suggest to
11 you that given that CNRL takes a position that the
12 evaluation that ISH has assigned to its gas resource is
13 wrong, that it only -- it would be fair that CNRL tells
14 us how it values the same gas resource.

15 A I wouldn't say that Canadian Natural is saying that
16 ISH's valuation is wrong. All we're saying is that --
17 and maybe what we should do is pull up that IR question
18 where Canadian Natural asked ISH a series of questions
19 so that we could better understand how they came to
20 their value, and I -- I have the number here.

21 Q I mean, the -- the value that ISH came to was accepted
22 by CNRL subject to this 20-year discount?

23 A That's -- that's correct. We've used their values, and
24 we just discounted them because it was unclear to us
25 what their values meant because the only reference to
26 timing there is it said that it had an effective date

1 of January 1st, 2024. There's no detail, even though
2 we asked for it, in terms of when did the production
3 start and some other questions. So we're making -- we
4 just don't know. We just don't know. So we -- that
5 was our approach.

6 But going back, we typically don't publicly
7 disclose reserves and values of reserves at this minute
8 detailed level. We will confirm if we have reserves
9 booked or not, and we'll report -- report back, but I
10 don't think it's our corporate policy to talk about
11 what kind of value we have in a public forum about our
12 reserves, unless we want to move this part of the
13 hearing into a confidential portion, but I'm certain --
14 certainly wouldn't support that.

15 COMMISSIONER CHIASSON: Is it confidential to speak
16 to, if it's on your reserve report, the method that you
17 would use for assessing future value?

18 A G. IANNATONE: No.

19 COMMISSIONER CHIASSON: Because it seems to me that
20 that's what -- if I understand correctly, Mr. McLeod,
21 that that's what you're getting at, is what's the
22 methodology that they would use.

23 A. MCLEOD: Yeah. That's correct. I am
24 getting at what is the methodology, yeah.

25 A G. IANNATONE: Yeah.

26 COMMISSIONER CHIASSON: Because I think the Panel

1 would be interested in that information.

2 A G. IANNATTONI: Okay. Yeah. No. Methodology
3 is fine. The exact dollar value is not, so ...

4 Q A. MCLEOD: And --

5 COMMISSIONER CHIASSON: So just so that we're clear,
6 then, for the undertaking, so it's that CNRL will check
7 to assess whether or not their interest in the gas in
8 the upper -- the Kirby Upper Mannville II pool is on
9 its reserve reports and, if so, what's the methodology
10 that it's used for determining the future value.

11 A. MCLEOD: For determining the present
12 value.

13 COMMISSIONER CHIASSON: Present value. Okay. Thank
14 you. And future value or --

15 A. MCLEOD: I mean, the -- the future
16 value can derived from the present value --

17 COMMISSIONER CHIASSON: Okay.

18 A. MCLEOD: -- based on the discount. So
19 I'm only concerned about the present value.

20 COMMISSIONER CHIASSON: Okay.

21 A. MCLEOD: Yeah.

22 COMMISSIONER CHIASSON: Thank you.

23 Got that, Mr. McClary? Lovely. Thank you.

24 UNDERTAKING 1 - For Canadian Natural

25 Resources Limited to check and assess whether

26 or not their interest in the gas in the Kirby

1 Upper Mannville II pool is on its reserve
2 reports and, if so, advise the methodology it
3 used for determining the present value
4 (Fulfilled on Page 405)

5 Q A. MCLEOD: Now, one further question on
6 that --

7 A G. IANNATONE: Sorry, Commissioner Chiasson.
8 In terms of timing, those reserves are in another group
9 that we don't look after, so is it okay if we report
10 back by noon tomorrow?

11 COMMISSIONER CHIASSON: That -- that should work fine.
12 I think we will have to see once that comes back in
13 terms of whether or not ISH may have a need to explore
14 any further on that.

15 A. MCLEOD: Yeah.

16 COMMISSIONER CHIASSON: We'll be open to looking at
17 that --

18 A. MCLEOD: Yes.

19 COMMISSIONER CHIASSON: -- that timing.

20 A. MCLEOD: Yeah. That -- that's
21 agreeable.

22 COMMISSIONER CHIASSON: Okay.

23 A. MCLEOD: Subject to the ability for ISH
24 to potentially question on it.

25 COMMISSIONER CHIASSON: All right. Thank you.

26 Q A. MCLEOD: Now, one final question on

1 that -- and I understand that CNRL likely has a very
2 robust accounting program for its -- its proven
3 reserves, and so my -- my question is: For proven
4 reserves, what is the effective date that is used for
5 the valuation of the present value of a proven
6 resource?

7 A G. IANNATONE: Is that proven producing
8 reserves or proven undeveloped preserves?

9 Q Both.

10 A That is our annual year-end date, so typically
11 December 31st of the prior year.

12 Q Perfect. Thank you.

13 Next I'm going to turn to Exhibit 50.002 at
14 page 44.

15 Now, here I see on the -- the fourth row of this
16 table that CNRL estimates the cost of a DFIT on KN08 or
17 9 as \$1,075,000. If we turn to page 53 of this same
18 exhibit, in paragraph 197, CNRL says that the cost of
19 DFITs on three intervals over the KN08 and KN09
20 drainage areas would be approximately \$375,000. You'd
21 agree with me the difference between those two is the
22 cost of drilling a well?

23 A D. OLLENBERGER: Yes. The 1 point -- sorry --
24 the 1 million 75 -- I'm having trouble with the system
25 here. The 1,075,000 total cost estimate is 375,000 for
26 the DFIT execution itself and 700,000 for a cased hole

1 strat.

2 Q And in its latest submission, CNRL has already agreed
3 to drill an additional gas monitoring well in KN09;
4 right?

5 A A future well, yes.

6 Q So it's not actually accurate, then, to suggest that a
7 DFIT would cost over a million dollars?

8 A I believe it will still cost over a million dollars all
9 in.

10 Q But you're going to be drilling a well anyways. You're
11 going to spend that \$700,000 either way, so the added
12 cost to the DFIT is only \$375,000.

13 A I would say that if that future well on KN09 was in an
14 ideal location to conduct a DFIT, which we're not
15 currently certain, that it potentially could be used
16 for a DFIT and then converted to a monitoring well.

17 Q All right. So if you've overestimated the -- the cost
18 for the DFIT, fair to say that you might have also
19 overestimated the time delay that might occur as a
20 result of conducting a DFIT?

21 A G. IANNATONE: So -- so, first of all,
22 obviously that we only have winter access here; right?
23 So we have to drill a well and we have to conduct a
24 DFIT in the same winter season. That is easier said
25 than done. A good example is this winter, for example,
26 where we had record highs in January, so we couldn't

1 even move drilling rigs in to start our strat program
2 until later on in the month of January. So there's no
3 guarantees.

4 I guess, more importantly, we don't think that an
5 additional DFIT is going to change our requested MOPs,
6 but -- so we just can't -- we just don't know if it's
7 going to be a time delay or not.

8 Further, what we do with the information once
9 we can -- if we did do an additional DFIT, what would
10 we do with the information? We'd have to either
11 reapply, reaffirming our MOPs, and is that process open
12 to consultation? If it is, all bets are off in terms
13 of timing. So we cannot sit here today and say that
14 doing an additional DFIT would not delay the project.

15 Q All right, sir.

16 A And I think one of the points that I made is that
17 before we commit to drilling a pad, we pretty much have
18 to have certainty that we can execute under our
19 conditions. So until we have that, the corporation
20 will not commit.

21 A T. BOONE: Sorry. Can I just add one
22 comment here? I see on paragraph 197 it refers to my
23 risk assessment and the maximum consequence being less
24 than \$1 million. But -- but the DFIT specifically
25 refers to Risk Number 2 where the maximum consequence
26 was a hundred thousand dollars or less. So if -- if

1 you're just -- we need to read that correctly. So
2 that's why the DFIT being much more costly than the
3 consequence itself makes it not justifiable.

4 A G. IANNOTTONE: Yeah. The last --

5 Q Based on your assessment of -- of the -- of the risk,
6 which was based on information that was conveyed to you
7 by CNRL; right?

8 A T. BOONE: No. I -- I assessed the risk
9 of fluids migrating during start-up into the Wabiskaw B
10 gas zone myself.

11 A G. IANNATONE: I would like to add an
12 additional point that was brought up by my colleague.
13 The other prerequisite for DFIT is -- is that we need a
14 vertical wellbore. Most of our strat wells are
15 deviated. So likely we'd have to plan and design a new
16 wellbore.

17 Q All right, sir. My last question for you -- if I heard
18 you correctly there, you said that it was unnecessary
19 to do a DFIT because regardless of the results, your
20 MOP is not going to change. So CNRL is -- is going to
21 take new information and not change its position?

22 A P. THOMSEN: Canadian Natural will use all
23 information available with the -- the assessment and
24 the future operations. Previously I'd mentioned
25 proportionality, and when you consider the use of the
26 temporary MOP, it really is for the first time -- to

1 initiate its potential use for the first time to
2 initiate circulation, and if it was used, it would
3 likely be for a couple hours with a -- with a volume
4 that's well under 180 cubic metres. And so even if
5 there was some unlikely result of having a -- a reduced
6 stress, yes, we would -- we would continue to request
7 and justify the temporary MOP of 6,600 kPa for a
8 start-up, and that's in part it's such a short duration
9 and a small volume that's injected.

10 A G. IANNATONE: The -- the last point, as --
11 as we've said, we've lowered our long-term MOP from
12 6,000 kPa to 5,500 kPa, and that is a mitigation, and
13 that is a -- an additional reason why we don't feel
14 that an additional DFIT is -- is required because
15 we've -- we've modified our request.

16 Q Thank you.

17 A. MCLEOD: Subject to questions on the
18 undertaking that was given, those are my questions this
19 afternoon, Commissioner Chiasson.

20 COMMISSIONER CHIASSON: Thank you, Mr. McLeod.

21 So you look like you're about to say something,
22 Ms. Riley. No?

23 M. RILEY: Absolutely not.

24 COMMISSIONER CHIASSON: Okay. Thank you.

25 All right. So what we would do next is -- what
26 would be next on our schedule is questions from the AER

1 staff and Panel. We will take a short break just
2 because we need to check in with our team, so -- but we
3 anticipate it being no longer than ten minutes, if
4 that. So we will break and be back shortly.

5 (ADJOURNMENT)

6 COMMISSIONER CHIASSON: Okay. Thank you for your
7 patience. So, witness panel, what we will do is we
8 will be starting with -- Mr. McClary and Ms. Peddlesden
9 will be directing questions to you that have been
10 formulated by the staff team who are supporting the
11 Hearing Panel. Once they are finished with those
12 questions, then the Commissioners, the Hearing Panel,
13 we may have questions for you as well, so just so that
14 you know it's proceeding.

15 So Mr. McClary is going to kick things off.

16 W. MCCLARY: Thank you, Commissioner
17 Chiasson.

18 Alberta Energy Regulator Legal Counsel Questions the
19 Canadian Natural Resources Limited Witness Panel

20 Q W. MCCLARY: As Commissioner Chiasson has
21 said, my name is Will McClary. I'm legal counsel here
22 at the Alberta Energy Regulator, and I'm going to be
23 asking a few questions today on the subject of the
24 Fustic papers and the gas chromatography mass
25 spectometry -- thank you -- or what I will call it,
26 thankfully, for the rest of the afternoon "GCMS data",

1 and I want to explore that a little bit because we had
2 some questions.

3 We might do a bit of shuffling on this bench just
4 because we don't have enough room here to accommodate
5 our subject-matter experts who are helping us with the
6 questioning, so I apologize in advance if that's
7 disruptive. We'll try to do it quietly, but once I'm
8 done my questions, we'll get a few more SMEs up here,
9 and Ms. Peddlesden will continue with the questioning.

10 So I pose this to the entire witness panel, and
11 you can identify who is best suited to respond and we
12 can proceed from there, but the general understanding
13 that we have at this point is that the Fustic paper
14 from 2011 that was submitted at Exhibit 43.002, I
15 believe it's Tab 7A, forms the basis of CNRL's
16 interpretation of the GCMS data that's been presented
17 so far.

18 So to the witness panel, I guess, is that correct?
19 And then who is best suited to answer further questions
20 on the subject?

21 A S. SVERDAHL: Mr. Barland is the best to
22 take that.

23 Q Thanks.

24 Mr. Barland; is that correct?

25 A S. BARLAND: Yes. So most of the industry
26 usage of GCMS in the oil sands reservoirs is based on

1 those fundamental or pioneering papers on -- on the use
2 of the analysis of oil compounds and the -- plotting
3 them versus depth.

4 Q Thanks. Now, when you say "oil compounds", what do you
5 mean?

6 A So crude oil or bitumen is made up of multiple
7 different hydrocarbon compound classes, and what we do
8 is some certain members of those oil compounds and then
9 plot them versus depth to determine their gradients.

10 Q Thanks. So my understanding from having reviewed --
11 and I guess -- sorry -- also going back, and I will
12 slow down, I promise, reporters. Going back, you
13 referred to two papers, I believe, or "papers" plural.
14 Is there another paper in addition to the Fustic 2011
15 paper?

16 A There is also the Fustic 2013 paper that was submitted
17 as well in the IRs from the AER to CNRL.

18 Q Thanks. And that's -- you're correct there; that's
19 Fustic 2013. I'll refer to it as -- and it's
20 Exhibit 43.002, Tab 7B.

21 So in addition to those two papers, are there any
22 other papers that CNRL relies on or any other kind of
23 scientific methodologies described elsewhere that would
24 be relevant to our consideration of the analysis?

25 A No. I don't think so. I think the gist of it is
26 contained in the Fustic. I would add, though, that

1 that's been over ten years since both of those papers
2 were published, and our sampling density as well as the
3 probable interpretations of barriers and baffles may
4 have been influenced by real-world industry knowledge
5 from our own other producing assets as well since then.

6 Q Thanks. So my understanding, then, of that evidence is
7 that you're saying there's -- there are subsequent --
8 subsequent experience that CNRL has had in this area of
9 interpreting GCMS data that supplements the -- what's
10 presented in Fustic 2011 and Fustic 2013?

11 A Correct.

12 Q Thanks. That's helpful.

13 Have you presented kind of the basis for that
14 analysis to us anywhere in the materials?

15 A So in the reply submission -- I can't remember what the
16 exhibit number is. I can get that.

17 Q I believe it's 50. Five zero.

18 A Yes. Yeah. There is one example that I -- I brought
19 in from CNRL's Jackfish project. This was -- I used to
20 work at Devon Canada, and we did a -- we did a CSBG
21 technical conference presentation in 2019 that was
22 published as well, and that case study on the use of
23 GCMS -- this one example was from that -- from that
24 technical conference presentation.

25 Q Okay. But the underlying principle, I guess, from
26 Fustic 2011 and 2013, is that still sound?

1 A Yes.

2 Q And, in general, I guess, the description of the Fustic
3 papers of that method -- which we'll go into a little
4 bit more in detail in a moment -- that is still
5 generally sound; it's not contradicted or anything?

6 A Not to my knowledge.

7 Q Okay. Now, if I could please pull up, I guess,
8 Exhibit 43.002, Tab 7A or page 147 of the PDF. Just,
9 yeah, the next page there, please, and then a little
10 bit further down, please, there's a paragraph that
11 begins -- or contains the phrase: (as read)

12 The continuity of biodegradation-susceptible
13 aromatic hydrocarbon concentrations.

14 W. MCCLARY: It's the fourth line in the
15 second paragraph. If you could just maybe highlight
16 that for Mr. Barland with the cursor or select it.

17 A Yeah. They just made it a little bigger.

18 Q W. MCCLARY: So this is the abstract for
19 the paper. Can you -- can you see it? I can read it
20 as well if you prefer.

21 A (as read)

22 Continuity of biodegradation-susceptible
23 aromatic hydrocarbon concentrations measured
24 through vertical profiles of a reservoir were
25 used to determine siltstone-prone intervals
26 observed in log and core acted as barriers or

1 baffles to fluid flow over geologic time.

2 Q And then the next sentence is: (as read)

3 Integration of the bitumen molecular
4 composition data with geological
5 cross-sections fosters predictions of the
6 lateral extent of the identified barriers.

7 Is that -- that's what we're talking about?

8 A Yeah.

9 Q And now is that a fairly good summary of the Fustic
10 method, the 2011 Fustic method?

11 A I would say so, yes.

12 Q Is there any kind of important supplement to that that
13 we would want to add based on the intervening years?

14 A I would -- I would say the only thing I would add to
15 that would be our interpretations of some of the
16 forward-stepping or upwards-increasing steps in the --
17 in the geochemical or the oil-compound concentration
18 profiles. So the paper -- or the presentation that I
19 referred to earlier that I did at a previous company
20 examined these forward-stepping changes,
21 upward-increasing changes, and found that they were
22 barriers to steam as well.

23 Q Okay. So, I mean, we can get into that in a bit more
24 detail in a moment, but just to confirm, when you say
25 "upward increasing", you mean that the relevant
26 concentration of the polycyclic aromatic hydrocarbons,

1 or PAHs, that are being measured in this method is
2 increasing --

3 A As you go up.

4 Q -- as you go up as opposed to going down, which is
5 what's described by Fustic?

6 A Yes. Correct.

7 Q So now that -- I think that response to a question that
8 was raised yesterday about the direction of different
9 offsets?

10 A Yes.

11 Q And I intend to explore that in a bit more detail later
12 on, but there was a phrase you used yesterday that I
13 wanted to check in on and ask you about, and I believe
14 it was the "equilibration of compounds over geologic
15 time".

16 A Yes.

17 Q Could you explain a little bit more in depth what you
18 mean by that?

19 A So as the oil charges the reservoir, it's light. As it
20 biodegrades, it becomes heavier and heavier, so there
21 are buoyancy effects as the oil degrades. It also
22 creates biogenic methane and so that will rise to the
23 top of the reservoir through the oil and/or bitumen and
24 all aid in its movement. So if you have a very
25 connected column or a very easily mixed column of
26 hydrocarbons or slowly degrading -- biodegrading

1 bitumen, that mixing process will create that diffusion
2 across barriers or baffles. If you don't see that or
3 you see two separate curves, that means there was
4 something in between them that prevented that mixing.

5 Q Now, when you say "mixing", can you explain a bit more
6 in detail what you mean by "mixing"? Is it your
7 evidence that the -- the compounds themselves would
8 diffuse across the zone or, you know, we're talking
9 about molecules within substances -- like, what is
10 mixing? What is equilibrating in this?

11 A So, yes, it's molecules slowly diffusing.

12 Q And so if you could imagine a theoretical bitumen
13 molecule that's at one point in the zone, is it your
14 evidence, then, that that molecule would move -- or not
15 a molecule, like a small amount of bitumen?

16 A Portion.

17 Q A portion of it?

18 A If the buoyancy or changes in oil/water contact may
19 force it there, yes, it could. This is very slow,
20 though. This is very slow.

21 W. MCCLARY: So if we could pull up please
22 Exhibit 43.002 at Tab 7B or PDF page 196 or -- sorry --
23 page 203. 203. And now about midway through the left
24 side -- stop there, please.

25 Under "Reservoir Charging" and "In-reservoir Fluid
26 Mixing" -- maybe actually just scroll down a little bit

1 more, please. There that's the paragraph I'm looking
2 at.

3 Q W. MCCLARY: And now, Mr. Barland, could
4 you please read that for us?

5 A Under the "Reservoir Charging" and "Fluid Mixing".

6 Q Yeah. Is that large enough? Or I could read it as
7 well if it's easier.

8 A (as read)

9 Fluids in petroleum reservoirs are constantly
10 mixing with a tendency to attain equilibrium
11 [from several different papers].

12 Biodegradation or physical leaking results in
13 some fluid components being removed from the
14 reservoir, whereas other components such as
15 methane and CO2 are generated in the
16 reservoir as byproducts of biodegradation.

17 [Again, more quotes from different papers]

18 These processes are poorly documented in
19 studies dealing with the Athabasca oil sands
20 deposits, but it's clear that mixing times
21 with their viscous fluids may exceed
22 reservoir age.

23 Q Does that contradict what you just told me about
24 bitumen moving or molecules moving within bitumen in
25 the reservoir to reach equilibrium over geologic time?

26 A So -- so I think that actually confirms it.

1 Q Can you explain how?

2 A So if fluids are constantly mixing with a tendency to
3 attain equilibrium, that's what I was describing.

4 Q Sorry. I mean the last sentence of that paragraph in
5 which it says that: (as read)

6 The processes are poorly documented in
7 studies dealing with Athabasca oil sands
8 deposits, but it's clear that mixing times
9 with these viscous fluids may exceed
10 reservoir age.

11 A I don't know that it -- it discounts that entirely. I
12 would say that the reservoir age in the -- in the
13 McMurray formation that we're looking at here is
14 probably in excess of a hundred million years. The oil
15 would have charged it afterward. Being -- being
16 "poorly documented" means that they're, you know, they
17 could be right or they could be wrong.

18 Q I'm really specifically looking at the part of the
19 phrase where it says: (as read)

20 But it is clear that mixing times with these
21 viscous fluids may exceed reservoir age.

22 I'm trying to understand whether that contradicts the
23 idea that -- that there is mixing as suggested by the
24 concept of equilibration of the chemical compounds.

25 A Okay. So what I -- what I would say or respond to that
26 with is that the fluid was not always as viscous as it

1 is currently. The process of biodegradation is still
2 occurring today in the -- in the reservoir as well as
3 an outcrop in the McMurray formation north of Fort
4 McMurray. So anywhere you have -- anywhere you have an
5 oil/water contact still, you would still have that
6 bacteria because the -- the sediments haven't been
7 sterilized; they haven't been buried greater -- to
8 greater than 80 degrees Celsius.

9 So it -- it's still an ongoing process because the
10 oil initially charged at light API levels; the mixing
11 would have been easier then. So mixing now, yes, very,
12 very difficult to mix bitumen, but when the oil was
13 charging, it wasn't bitumen. It slowly was converted
14 to that.

15 Q Understood. Thanks. That does clear that up for us.

16 Now, I guess taking the -- the combination of the
17 two papers, Fustic 2011 and 2013, my understanding of
18 the papers is that, you know, they've -- they've
19 conducted the GCMS analysis on the number of wells and
20 identified a whole bunch of compounds that are relevant
21 and interesting for the assessment that they're trying
22 to conduct. Broadly speaking, the compounds that we're
23 interested in for the purpose of the analysis conducted
24 on the wells for this hearing relates to polycyclic
25 aromatic hydrocarbons; correct?

26 A Yes.

1 Q And based on, again, those papers, it -- it seems as
2 though there are some PAHs that are susceptible to
3 biodegradation at a greater rate or, you know,
4 over slow -- like, shorter time periods, we'll say,
5 than other PAHs; is that correct?

6 A Yes.

7 Q And in Fustic 2013, they identify a number of PAHs
8 which act almost -- that are, I guess, effectively for
9 their analysis not as susceptible to the biodegradation
10 and therefore show a consistent concentration in a
11 vertical profile?

12 A Yes. Yeah. So they would -- they would be a straight
13 up-and-down line. Usually those are the heavier ends.
14 You can think of -- you can think of the oil over the
15 biodegraded bitumen as the food of the bacteria.
16 That's essentially what it is. And if there was a
17 party underground, the first thing to go would be the
18 chips and the pop and the really tasty stuff; the last
19 thing to go would be the broccoli. The heaviest ends,
20 that's the broccoli.

21 Q And in this case, my understanding is the subset of
22 PAHs that we're interested in, the chips and pop, are
23 kind of carbon molecules that are slapped on to these
24 PAHs?

25 A Absolutely.

26 Q And the broccoli --

1 A And the easiest bonds to break.

2 Q Yeah. The broccoli is the -- the leftover kind of base
3 PAH itself --

4 A Yes.

5 Q -- that gets eaten last?

6 A The -- the longer chain ring carbon structures.

7 Q And then if we're extending that analogy, would it be
8 consistent to say that these -- these other markers
9 that showed a consistent profile through -- through a
10 certain formation that don't show a -- or a curve of
11 biodegradation, those are kind of like something you
12 wouldn't even think about eating at the party?

13 A That could be your shoe.

14 Q Yeah. Somebody's shoe. Thanks.

15 So now are there different shoes?

16 A Oh, yes. Yes.

17 Q And do those shoes tell us anything about the oil?

18 A So -- so the longer chain, bigger molecules that are
19 harder for the bacteria to -- to biodegrade or to eat,
20 sometimes you will -- you will use them to determine
21 oil providence. You can -- you can also use different
22 ratios of -- of certain longer chain ones, like
23 9 versus 1 methylphenanthrene to determine
24 biodegradation index. That's a -- that's a commonly
25 discussed result in both Fustic papers.

26 Yeah. Pristane/phytane ratios determine oil

1 providence usually. That's kind of one that's commonly
2 used in both of these papers. So the longer chain ones
3 do have their uses, generally not -- because they don't
4 move as you plot them with depth, it's not useful for
5 determining barriers and baffles. So you have to move
6 to a shorter chain or -- or lower atomic weight
7 molecules that you can actually observe change with
8 depth to determine those barriers and baffles.

9 Q Thanks. Now, going back to the shoe analogy, as it
10 were --

11 A Okay.

12 Q -- I believe you said at the beginning of your answer
13 just there that the shoe print, we'll say, can
14 determine providence or can be associated with
15 providence of the oil; is that correct?

16 A Yes.

17 Q Would there be any other anticipated chemical
18 differences between oil with different shoe prints or
19 that has different providence?

20 A Yeah. There -- there probably is. Again, I think some
21 of what's discussed in both papers discusses that a
22 little bit. In general that's probably not as -- as
23 useful to a working geologist or determining barriers
24 and baffles than the -- than the molecules that -- that
25 you can observe the barriers and baffles in.

26 Q Thank you. So --

1 A Sorry. The compound classes, I guess.

2 Q Thanks. Sorry for stepping on you there.

3 Just to confirm, though, then, it wouldn't be the
4 case -- or feel free to correct me, but it would not be
5 the case that oil with a different shoe print might
6 affect the interpretation of the -- you know, what gets
7 eaten first, whether it's the pop or chips, or the
8 curve that we see in response to the concentration of
9 the PAHs that do biodegrade?

10 A So, yeah, I suppose I should clarify a little bit. If
11 there were multiple charge events of differing -- at
12 differing times of different providence, that might
13 obscure things. We generally don't see that or the --
14 the Fustic papers, along with a few other examples of
15 papers from, say, Dr. Jennifer Adams or Dr. Barry
16 Bennett do not see that in the McMurray or the
17 Mannville group as a whole. In general, Wabiskaw oil
18 providence looks like McMurray oil providence.

19 Q So did you look for it in this case? Like, did you
20 take the samples that you would be able to tell what
21 the shoe prints are for the -- the oil through the
22 column?

23 A Yes. All of that gets output from the -- from the mass
24 spec spreadsheet we get of -- of every aromatic
25 hydrocarbon individually and then some to plot. I have
26 looked at MAS versus TAS or the tricyclic terpanes

1 versus the pentacyclic terpanes, and the providences
2 look very similar.

3 Q For the wells in question for this hearing, you've
4 looked at -- you've conducted the analysis or plotted
5 the shoe prints -- and I'm sorry that I'm not going to
6 be able to say which terpanes they are, but you plotted
7 the shoe prints --

8 A Yeah.

9 Q -- for all of the wells in question?

10 A I would -- probably five of the six.

11 Q Okay. And are those plots anywhere in the materials?

12 A No. We didn't submit any of those plots.

13 Q Is there a reason why?

14 A They don't show anything in terms of barriers and
15 baffles. So I didn't feel like they were relevant
16 or -- or useful.

17 Q Thanks. I think that about does it for the shoe print
18 discussion. Now, I'd like to move over to the pop and
19 chips and eventually get to the broccoli.

20 W. MCCLARY: So if we could go, please,
21 to -- still keeping in Exhibit 43.02 and go to
22 page 177, please.

23 Q W. MCCLARY: So I'll save you having to
24 look across the room, and I'll just read this out, and
25 the word we're looking for is: (as read)

26 Anaerobic biodegradation occurs within the

1 oil/water transition zone.

2 So I think it might be ... It's about halfway through
3 the paragraph under that -- with -- under the heading
4 "Bitumen Quality Characterization".

5 A Okay.

6 Q And it says: (as read)

7 Anaerobic biodegradation occurs within the
8 oil/water transition zone where diffusion of
9 biodegradable hydrocarbon components through
10 the oil column to the active biodegradation
11 zone is responsible for observed vertical
12 compositional gradients.

13 Now, can you describe for me please what a vertical
14 compositional gradient is that you're looking for in
15 this analysis?

16 A So that's exactly what -- what the plots describe in
17 all of the submitted GCMS plots of CNRL's or of -- of
18 ISH's experts as well show that vertical compositional
19 gradient. So generally the -- the most -- or the least
20 biodegradation occurs at the -- closer to the top of
21 the reservoir, and the most occurs near the oil/water
22 contact.

23 Q Thanks. Now, when it says "gradient", what exactly are
24 you looking for to establish a gradient?

25 A That change versus depth, right. So lots up here, less
26 down here near the oil/water contact.

1 Q And now when you're trying to establish a gradient for
2 your analysis, you know, you've just described two
3 points on a plot. Do you -- how many points do you
4 need? Like, what are you looking for in terms of
5 establishing a trend or a gradient or a curve?

6 A So -- so in general you always need three points to
7 make a line, minimum, right? So we would -- we
8 endeavour to take a sample every -- probably
9 75 centimetres to 2 metres. If we -- if we think
10 there's nothing to sample, there's no facies change or
11 something we're interested in, we -- we might increase
12 that sample density just a little bit or -- sorry --
13 decrease that sample density. So we'd go to a sample
14 every 2-and-a-half metres. But by and large a lot of
15 the Fustic paper -- and, you know, that was pioneering
16 work 12, 13 years ago. They go -- they sample every 4,
17 4-and-a-half metres, so our sample density has
18 increased just because we're looking for small --
19 smaller changes sometimes, especially in areas that
20 have more mud, so you -- you just have less bitumen to
21 sample sometimes.

22 Q Thanks. And when you say "sampling", what exactly are
23 you sampling?

24 A So we sample the core. We actually take a -- a spoon
25 or a garden trowel, and you physically carve a little
26 piece out of the core as clean as you can get it and

1 put it in a Ziploc bag and off it goes to Schlumberger.

2 Q That answers that question. I was going to say --
3 because yesterday you referred to Schlumberger as
4 running the analysis, but it is, in fact, CNRL that
5 collects that sample?

6 A We -- yes. We -- we would go and collect it, or the
7 coring lab that we're -- core analysis lab sometimes
8 will take our samples on brand-new cores.

9 Q Thanks. I'm going to explore that a little bit more in
10 detail after we talk about the papers, we'll get
11 through that, but thanks for that.

12 W. MCCLARY: Now, if we could go to
13 page 180, please, in the same document, and it's in the
14 left column, about halfway down. And I'm looking for
15 the "biodegraded reservoirs". Oh, yeah. 180. There.
16 You can stop there. Thanks.

17 A Yeah.

18 Q W. MCCLARY: And the statement is:
19 (as read)

20 In biodegraded reservoirs such as those in
21 the Athabasca oil sands, the systematic
22 removal of more biodegradation-susceptible
23 compounds of the oil/water contact creates
24 downward decreasing concentration gradients
25 in an oil column.

26 And then I believe it goes on later on this page to say

1 "the susceptibility" -- is that in the same paragraph?

2 A Yeah, I think it is.

3 Q Yeah. (as read)

4 The susceptibility of alkylnaphthalenes to
5 biodegradation decreased in the order:
6 methylnaphthalene, C1N; dimethylnaphthalene,
7 C2N; trimethylnaphthalene, C3N;
8 tetramethylnaphthalene, C4N --

9 THE COURT REPORTER: Mr. McClary, you are going
10 very fast. We are not scientists.

11 W. MCCLARY: I'll continue. I promise --
12 well, no promises, but I hope that's the last time I
13 have to do that.

14 Q W. MCCLARY: (as read)

15 -- leading to the conclusion that the
16 comparison of their concentrations can be
17 used for relative biodegradation assessment.

18 And then it notes a bit about the subscript
19 representing the carbon changes, and those carbon
20 changes we discussed, that's the pop and chips kind
21 of -- that's what the bacteria will latch on to?

22 A Yeah.

23 Q But what I'm picking up from this is that there are a
24 number of PAHs that one could plot and also a number of
25 different ways that one could plot them when trying to
26 establish the gradient that's being discussed.

1 A Yes.

2 Q So in the initial submission that we received from
3 CNRL, there was, I believe -- like, one chosen molecule
4 in this IR response, which we'll get into a little bit
5 later. We -- we asked you to -- to graph it a little
6 bit differently and include multiple compounds.

7 A Yes.

8 Q Can you speak to CNRL's analysis and why it is that the
9 decision was made to present data in the initial way
10 versus other ways?

11 A So in the initial way, the compound class that seems to
12 pick up barriers and baffles or seems to establish the
13 most reliable concentration gradients with depth in
14 the -- in the Kirby/Jackfish/Pike areas of the southern
15 Athabasca reservoirs, we found that the phenanthrene
16 group generally seems to plot the most reliably and
17 consistently to -- to identify those gradients. So
18 that's what was presented by and large in the -- in the
19 first submission.

20 We -- we just didn't want to complicate it; right?
21 Here -- here's the one group that we feel strongly
22 works the best, so that's what we're going to present.

23 I will -- I will say plotting all three different
24 ways on all six wells showed very, very similar zones
25 or layers of resistance or barrier/baffle, whatever you
26 want to call it. There was no difference in those

1 depths.

2 Q So then what I'm understanding is that you did conduct
3 the analysis, and you plotted the other PAHs that --

4 A Yes.

5 Q -- you know, Fustic identifies or may be relevant, but
6 for the sake of simplicity, that -- that data was
7 omitted from the initial submission?

8 A Yeah. We -- we have plots of the naphthalene group,
9 the ethyl dibenzothiophene group, phenanthrene group,
10 styrenes, methyl dibenzothiophenes -- all kinds of
11 different compound classes. The ones that we really
12 trust in -- in this area are the phenanthrenes.

13 Q Thanks. That -- that -- that helps a lot.

14 And when you are -- so when you're doing your
15 sample collection at the intervals you identified from
16 the core as we discussed, those samples are sent for
17 GCMS analysis, and there's the whole slew of the
18 different points, and then you conduct the analysis on
19 a number of those points but present the one that you
20 think is most representative. That's the --

21 A Well, we do -- we do the analysis on -- on every point.
22 So every depth point -- every sample gets the same
23 analysis. We just plot certain compound groups that we
24 feel like -- are the most effective at determining
25 barriers and baffles, and the one that we trust the
26 most generally in the Athabasca area is the

1 phenanthrene. So that's what we -- that's what we
2 showed.

3 Q Where does that trust come from?

4 A What we -- what we looked for initially -- so I started
5 working on -- on GCMS in 2013 in -- in the Pike area,
6 and we plotted everything. We plotted every compound
7 class we could look -- we could think of within the
8 spreadsheets that Schlumberger -- or Gusher at the time
9 would have -- would have submitted for us or -- or
10 analyzed for us. And the four or five different ones
11 that jumped out were the naphthalene group, the methyl
12 and ethyl dibenzothiophenes, the phenanthrenes, and the
13 styrenes. The styrenes generally are those longer
14 chain hydrocarbons that don't biodegrade much, so those
15 ones don't help us nearly as much. The phenanthrenes
16 and the C2DBTs or the ethyl dibenzothiophenes -- sorry
17 if I'm going too fast -- those ones were the more
18 consistent ones in the Jackfish/Pike area, and after
19 doing -- I'd probably say I've looked at 140 different
20 wells in -- in that southern Athabasca area, and it's
21 based on my -- on my experience looking at them.

22 Q Thanks.

23 And, again, when you're -- when you're
24 conducting -- you're gathering quite a bit of data;
25 right? There's all -- like, GCMS gives you --

26 A Yeah. The --

1 Q -- quite a bit of data --

2 A -- the spreadsheets got thousands of columns.

3 Q Yeah. Again, you're looking for -- would it be fair to
4 describe it as a "curve"? Like, is that a fair
5 assessment?

6 A In our reservoir sands, yes. If we get a -- if we get
7 a very uniform curve with no flat spots or breaks or
8 jump backs or -- sorry -- back steps, that's what we're
9 looking for, yes.

10 Q And in assessing whether something forms a curve, I'm
11 assuming you're trying to gather as much data as you
12 can; right? Like -- like -- or you're trying to have
13 as many data points that conform with that curve as you
14 can?

15 A Yeah. Depending on cost too. It's still -- these --
16 these cost 6 to \$800 a sample too, so you can't -- you
17 don't want to do too little, but too many is -- is --
18 is overkill; right?

19 Q Yeah. What does it tell you if it doesn't form a
20 curve?

21 A That tells you your reservoir is very unconnected and
22 you shouldn't put a well pair there or drill a pad
23 there.

24 Q Thanks.

25 Now, if we could scroll down a little bit on that
26 same page, we could see the examples. And maybe it's

1 better if you walk us through these. Are you familiar
2 with the three kinds of descriptions here?

3 A Yes.

4 Q Can you maybe walk us through -- this is Figure 4A, B,
5 and C from Fustic 2011.

6 A So these -- these -- yeah. These are -- these are
7 generalized curves with -- with, you know, eight
8 samples in each, just -- just kind of cartoon showed --
9 or cartoon shown. And the first -- the --
10 or -- sorry -- Figure A in Figure 4 is a -- this is
11 what we would look for in our reservoir. If we found
12 this every time, we would say, This is great; put --
13 put a well pair here. Figure B is a "maybe", depending
14 on the overall thickness of the lower -- the lower kind
15 of connected curve there. And then Figure C is "we
16 never want to do that". I -- we -- I would walk away
17 from that reservoir immediately.

18 Q And -- sorry -- that's a reservoir analysis; right?

19 A So both Fustic papers generally only sampled really
20 well-connected sands or very, very clean sands.
21 There -- there isn't much -- there isn't too many
22 samples from a much muddier type of reservoir in -- in
23 both papers.

24 Q Now, if you were trying to find a reservoir that had a
25 barrier above it, which of the patterns would you be
26 looking for?

1 A The third one, 'C'.

2 Q Right.

3 A Although I would say our subsequent operational
4 knowledge or examining wells that are on producing pads
5 would say if that -- if that upper row of -- or the
6 upper curve of four samples was moved off far to the
7 left in comparison to the lower four samples, we would
8 also consider that not a good result -- sorry -- to the
9 right.

10 Q Sorry. And when you say "not a good result",
11 scientifically and geologically, what is that?

12 A In terms of reservoir connectivity. We would say if --
13 so that -- that column up there, if that moved off to
14 the right quite a ways, we would say that's something
15 we want to avoid as well with our well pairs. If we
16 were looking for a barrier, that would be another good
17 example of one in our -- in my opinion.

18 Q And do you have any -- I guess, like, a geochemical
19 explanation as to why that -- the shift in Figure 4C of
20 the top four sample points forming that grade and if
21 it's shifted off to the right, why that would indicate
22 a baffle or a barrier?

23 A So in the Fustic papers, in both of them, they mention
24 those forward shifts or the forward upward increasing
25 shifts are due to low permeability, low porosity, areas
26 where fluid was difficult to mix. In my -- in my

1 understanding or in my operational experience, that
2 means something that is impacting your reservoir
3 connectivity. That would be where steam would stop as
4 well.

5 Q And I guess interpreting that back to -- to a geology,
6 what would that be indicative of?

7 A A barrier.

8 Q And, again --

9 A Or, at minimum, a baffle.

10 Q And the premise for that would be, just so I'm
11 understanding this, that the -- there's a barrier to
12 the mixing present between the two --

13 A Correct.

14 Q -- that's resulting?

15 And that's the geochemical explanation for the --

16 A So --

17 Q -- the --

18 A The smooth slope in 'A' and the slightly less smooth
19 in 'B' means connected. The break or the -- the back
20 step in 'C' means disconnected. A forward step of a
21 similar amount after -- after looking at many, many
22 wells and having some calibration data in terms of
23 observation temperature logs or reservoir saturation
24 tool temperature logs, we see this -- that
25 forward-stepping example be a problem in our reservoirs
26 as well.

1 Q Problem in your reservoirs. But have you seen it
2 equate to a barrier or baffle as well in practice?

3 A Yes.

4 Q And is that evidence on the record anywhere?

5 A That would be the one -- the example that I showed from
6 the Jackfish -- my -- my technical presentation that
7 was at the CSBG in 2019.

8 Q Thanks.

9 So then I guess if I'm conceptualizing this, the
10 evidence effectively is saying any discontinuity
11 between curves that are observed in the data,
12 regardless of the direction, in CNRL's view, based on
13 Fustic 2011 and '13 as well as your presentation, you
14 know, that -- that gives us an indication of a barrier
15 or a baffle? That's --

16 A That would be my assessment.

17 Q Thanks.

18 Now I'd like to turn to the evidence -- or the
19 actual plots that were submitted. It's just a little
20 further down in the same document. It begins -- it's
21 Tab 7C at PDF 244. So this is the -- this was an
22 information request response submitted by CNRL;
23 correct?

24 A Yes.

25 Q And this -- you'll see at the bottom of the slide it
26 says "Plotted After Fowler Figure 1"?

1 A Yes.

2 Q And I believe if you scroll up one page -- oh, too far.
3 243. You'll see that this is the Fustic figures?

4 A Yes.

5 Q So do these tell us anything different than what was
6 presented initially from CNRL?

7 A I don't believe so. In the Fustic example, they're
8 plotting the -- or the -- they start always plotting
9 the methylphenanthrene class of compounds and the C2P,
10 which is the dimethyl or ethylphenanthrenes. And what
11 we plotted was the entire group of phenanthrenes in our
12 first submission, and then Dr. -- Dr. Fowler in -- in
13 the -- in the ISH submission plotted the naphthalenes,
14 the dibenzothiophenes, and the phenanthrenes all
15 together in one plot.

16 Q Now --

17 A So that -- that was your second --

18 Q Yeah.

19 A -- slide there.

20 Q So would there be any reason to doubt the conclusions
21 if a response is seen in one PAH and not another or
22 to ...

23 A I would say you might think about questioning things
24 or -- or replotting or maybe going back and doing
25 another few samples, but I -- to my knowledge, we
26 didn't actually see that in these -- the behaviours or

1 the trends where the same -- plotting the
2 methylphenanthrenes, the dimethyl and
3 ethylphenanthrenes like this example, or the full
4 compounds of phenanthrenes such as CNRL and Dr. Fowler
5 did, as well as the naphthalenes or the
6 dibenzothiophenes.

7 Now, there -- there -- there may be small changes
8 compound class to compound class, but the overall
9 trends, I believe, look very similar.

10 Q So, again, it's just a choice as to how you present the
11 data what -- which compound you choose to plot?

12 A Well, yes and no. In -- in general, the -- I would say
13 the trends would always be the same, but you -- you
14 always want to look for something that moves with depth
15 so that it creates that gradient towards the oil/water
16 contact. So that tells you about the biodegradation.
17 If you plotted the styrenes in these wells, which I
18 have, they're almost vertical. So it just doesn't tell
19 you what -- what your -- it doesn't tell you anything
20 you paid for.

21 Q And then is it always the case that your biodegradation
22 results in a profile of a decrease in the subject PAH
23 as you go deeper?

24 A No. Not always. The closer you get to an oil/water
25 contact or a paleo oil/water contact, that always does.
26 If you say -- say you had something that was surrounded

1 by two aquitards or aquicludes and was completely
2 separated from the upper or lower zone, that one may --
3 may have a -- a -- a forward shift. But to my -- well,
4 it -- it doesn't happen in these ones. It -- it -- you
5 know, we generally do decrease toward the current
6 oil/water contact, which would've -- would be just
7 below the lowest sample in any of these plots.

8 Q Thanks.

9 And I'm just looking at the slide that we have up
10 right now, again, PDF 243, and you can see between
11 about 225 metres of subsea depth --

12 A Yeah.

13 Q -- and 220, it appears that there's an increase in the
14 C2P concentration with depth. So what's going on?

15 A Sorry. Can you make that just a little bigger, the --
16 the figure on the --

17 Q Yeah. If we could just go -- zoom in just above the
18 red line on that.

19 A Yeah. Okay. Yeah. So -- so both classes are -- are
20 doing the same thing there. That would be -- it looks
21 like an 80 to 100 microgram per gram concentration
22 increase right around the level of the mid-B1 mudstone.

23 Q Yeah. And, I mean, if you draw -- if you were to draw
24 a line from the -- just looking at the blue -- the blue
25 points, if you were to draw a line between the
26 concentrations present at about 226 metres of depth

1 down to 217 and a half, we'll say, like, the -- the
2 line that intersects with the mid-B1 mudstone or the
3 point that intersects, that would appear to -- to
4 create a curve between 230 -- or between 225 and two --
5 217 and a half or so. So, you know, is that the type
6 of data that we're looking for to establish a curve, or
7 do we need something more than that?

8 A No. I -- I think that's what you would do, although in
9 general, it's more connect the dots than try to draw
10 the curve. Where you see the flat spots or the jumps
11 back and forth, that's where you would say, There must
12 be something in this part of the -- of the strata that
13 is causing compartmentalization. And in general, in
14 this -- in the zone you're looking at, we've got a lot
15 of back steps going up. So as you're looking from the
16 bottom -- from the lower part of that zone up, we --
17 we're seeing a couple of forward steps and a lot of
18 back steps, which, to me, says a lot of
19 compartmentalization in that general depth interval.

20 Q When you say "compartmentalization", what does that
21 mean in geochemical terms and -- and also in -- in
22 terms of the geology?

23 A So -- so I would say in geochemical terms it doesn't
24 really mean anything. It's -- it's more reservoir
25 compartmentalization, or the little bits of sand that
26 we sampled in those muddier sections are their own

1 little compartments. Each -- each sample looks like
2 it's moving back and back and back further, suggesting
3 this little thing was its own compartment, separated
4 from the ones above and below, and then the next one
5 was, and then the next one was, until you -- until
6 you're almost fully biodegraded in those classes just
7 at the top of the Wabiskaw -- or the Wabiskaw D
8 non-reservoir unit pic there on the -- with the black
9 line at 225 or so.

10 Q Thanks.

11 And if you were trying to establish trend based on
12 these data points, would you -- what would your
13 conclusion be about the depths here between about 235
14 and 217 and a half again? Is -- are -- is there a
15 trend?

16 A There really isn't. You could make three or four
17 different trends which says that those are -- it's a
18 very compartmentalized interval over that described
19 depth top and base.

20 Q So now going back -- and if we could zoom out just a
21 little bit, please, and maybe scroll down.

22 Going back to Fustic, then, does this correspond
23 to anything that we found in Fustic about the signature
24 of a baffle or a barrier?

25 A This would correspond exactly to that figure -- or --
26 Figure 4 letter 'C' diagram that -- in the cartoon.

1 Q So if I recall correctly, Figure 4C showed two separate
2 trends, one trend in the zone above and then a trend in
3 the zone below?

4 A So you've got that moving back.

5 Q So is it your evidence, then, that the -- the trend in
6 the zone above here is that there is no gradient, or
7 there is no profile of the degradation with depth?

8 A There -- there's a backward stepping profile in
9 general, and then we have a little bit of a forward
10 step as you cross above the Wabiskaw C and into the --
11 into the Wabiskaw B. Yeah. So multiple barriers
12 would -- would create a non-profile like -- like this
13 that suggests a lot of compartmentalization between the
14 samples at those depths.

15 Q But, again, if we're trying to establish a gradient, as
16 we discussed, you'd probably need more than a single
17 point fluctuating in each direction; right?

18 A Well, yes. But the -- the strongest gradient there is
19 between the -- in the upper B1, so above the mid-B1
20 mudstone towards the Wabiskaw D. Those are all back
21 stepping toward the -- toward the lowest concentration
22 in the Wabiskaw D non-reservoir.

23 Q Okay. So just to confirm, the top four points in this
24 graph, in your view, form the gradient that's being
25 compared here?

26 A No. About 215 to -- sorry -- yeah. Two -- 217 and a

1 half to -- to 224 would be a nice -- would be -- would
2 be a gradient that would suggest that compartment was
3 on its own. I wonder if I could get the mouse just to
4 show you --

5 Q Yeah. By --

6 A -- and everybody else.

7 Q Yeah. That would be very helpful, actually. Thank
8 you. And if you need a break at all, let me know.

9 A No. I'm okay.

10 So -- so just -- just to clarify, down here we
11 have a very nice gradient where -- where I'm -- where
12 I'm pointing with the little hand. And then up here,
13 this is -- this would be a gradient that -- not really
14 described by Fustic because he didn't -- they didn't
15 sample much -- you know, muddier intervals like this.
16 But each of those stepping backs would say it -- in
17 general, it -- you want to have a gradient go like this
18 if it's a connected reservoir; right? Like this stuff
19 down here. Each of these stepping back suggests that
20 this is a -- its own little compartment, and then
21 there -- there are multiple -- multiple segregated
22 zones within this larger zone.

23 And then as we go up -- up above, we could say
24 that just at the base of the Wabiskaw D, you start to
25 get -- or -- sorry -- Wabiskaw B, you start to get this
26 again, although there are only two points there. In

1 general, you would say -- in my assessment of this well
2 especially, you would say there's a nice connected
3 reservoir below, and then we start to see these
4 segregations or points that step back toward a -- each
5 of these would've had their own paleo water contact,
6 and -- and that little bit of bitumen would have
7 biograded on its own.

8 Q Thanks.

9 And then there's -- there's a point around
10 227-and-a-half metres that looks like it's the highest
11 concentration on this graph of the blue --

12 A Right there?

13 Q -- diamond.

14 What's the story there?

15 A So that one could be an isolated compartment as well
16 that did not actually have much water to get rid of.
17 So the -- the bacteria live on water; right? You --
18 you -- well, they live on the energy they get from the
19 hydrocarbons, as well as they also need nitrogen
20 phosphate -- other nutrients to live. So if there
21 isn't very much water there to begin with or that water
22 was expelled quickly, the biodegradation ceases. So
23 that would have been another little compartment as
24 well.

25 Q Thanks.

26 And then just -- just going back, the -- the paper

1 you reference that you presented -- or the presentation
2 and maybe there was a paper associated, is that --

3 A No, just the presentation.

4 Q Is it in our record? Is it in evidence?

5 A Not the whole thing, just the excerpt that I added --

6 Q Just the one --

7 A -- to describe the forward stepping or the --

8 Q Okay.

9 A -- steam -- steam being a barrier not always at a back
10 step in the -- in the reservoir gradients.

11 Q And has anyone else looked at that? Like, have you had
12 any peer review on it, or has anyone --

13 A Yeah. We -- we actually presented it at that -- at the
14 CSBG technical conference. It -- it is not
15 peer-reviewed. The -- the CSBG presentations are
16 reviewed by the chair of the -- of the -- part of the
17 conference that you present in, but I don't believe
18 they're technically peer-reviewed.

19 Q Thanks.

20 Now, going to the -- I guess one more kind of
21 conceptual question before I move into a little bit of
22 a nitty-gritty type of area. How -- how completely can
23 this analysis be applied? Because it seems like the --
24 the conversation that's happened so far is that if the
25 graphical data tracks with Fustic, then that suggests
26 there is a baffle or a barrier. If the data is

1 inconsistent, does that demonstrate the absence of a
2 baffle or a barrier as well?

3 A So CNRL relies on more than just the GCMS. The GCMS is
4 a corroboration piece of data or an additional piece of
5 data. We don't -- we don't core every well, as well as
6 we don't GCMS every single core we -- we take. We
7 would always rely on our geologic principles and
8 correlations from well logs from that core facies as
9 well as 3D seismic interpretations married to those
10 well logs and core data as well. So we're trying to
11 help ourselves be a little bit predictive with the
12 GCMS.

13 Q So all that to say that the GCMS is sort of a help, not
14 hurt, in terms of identifying the presence of a baffle
15 or a barrier?

16 A I would agree, yes.

17 Q Thanks.

18 And is there any, then, susceptibility to a bit of
19 a confirmation bias, or do you have checks and balances
20 on that?

21 A Yes. We actually try to calibrate the GCMS with the
22 obs wells that we have in -- in Kirby south, Jackfish.
23 We haven't got any on -- obs wells currently in Kirby
24 north, but we're hoping to.

25 Q Sorry. When you say --

26 A Or monitoring wells. So we're -- we're using those to

1 calibrate our interpretation or our understanding of
2 the GCMS, saying, Did steam stop at this location that
3 was predicted, or did it actually get past it?

4 Q So that calibration you could also refer to maybe as
5 ground truthing or --

6 A Correct.

7 Q And is any of that information before us?

8 A In the example I provided from Jackfish, yes.

9 Q Okay.

10 A That is a ground truth piece of data. We also compare
11 it with 4D -- against our 4D results and RST log
12 results, although the -- the -- the one example that I
13 did present in -- in the technical presentation is --
14 is not from Kirby north; it is from Jackfish.

15 Q Thanks. Give me a moment to confer here.

16 Thanks. Moving into the nitty-gritty.

17 A All right.

18 Q I used to do a lot of groundwater sampling, and it's
19 really difficult to do that when it's minus 30 and
20 you've got nitrile gloves on. Led me to think that
21 sometimes sampling methodology can lead to bad results.
22 Is there any concern about methodology between when you
23 spoon the bitumen out of the core -- or when you, I
24 guess, gather the core from the well and when you spoon
25 it out and put it in a bag and send it to Schlumberger
26 that would lead to uncertainty in these results?

1 A So I -- I don't want to say "never", but it's probably
2 really rare. The reason why GCMS works is that these
3 are non-volatile molecules; they don't evaporate like
4 the very, very light hydrocarbon ends. Like, if you
5 pour gasoline on the ground, you can smell it; right?
6 That -- that's volatilization of that hydrocarbon.
7 These do not. So the reason why they're present in
8 cores and -- and don't require major special handling
9 is because they're tough and -- and they don't gas off
10 really easily.

11 Q Now, I think -- go ahead.

12 A Sorry. Schlumberger -- I attended a -- a technical
13 presentation by Schlumberger where they did a -- they
14 did the exact same GCMS analysis from a twinned well
15 that was -- one was cored over 50 years ago, one was
16 cored 6 months ago, and the trends themselves were the
17 same. Some of the absolute concentrations were a
18 little bit lower in the oldest well, but that was their
19 sales pitch to say, Look, you can do this on cores that
20 have been sitting around or cores that you just take
21 fresh, and you're going to get data you can rely on.

22 Q Now, I believe there's a reference in Fustic 2011 about
23 the vintage of the core. So is that to say that the
24 recent developments have negated the comment about
25 trying to get fresh core for this analysis?

26 A So I would say the fresher the better always, but I

1 don't think that going back a few years and -- and
2 utilizing a core that you have stored somewhere sitting
3 on the shelf is -- negates any validity of the data.

4 Q So then if there are outlying data points that present
5 themselves to you during your analysis, how do you
6 treat those? Is it your inclination to disregard them
7 or to -- to try and associate a geochemical and
8 geological explanation for an outlier?

9 A So I -- I would say the latter. We would -- we don't
10 disregard them. We would actually talk to the lab and
11 see if there is anything wrong with the machine, if it
12 hadn't been cleaned recently or something like that.
13 They do do repeat analyses [sic] on every well. So
14 they'll pick a single sample or -- or two samples and
15 do a repeat analysis to ensure it's within tolerances.
16 We get those. We don't plot them, but we get them.
17 And if they look like they're very close in absolute
18 concentration for the classes we're plotting, we would
19 go ahead with the data then.

20 Q Thanks.

21 And then before the data goes to the lab, is there
22 any susceptibility to the -- to the -- like, the
23 sampling method, like the spooning of the oil out of
24 the core, like, if you get some sand in there
25 accidentally or if you get something else?

26 A So you -- you're literally spooning the

1 bitumen-saturated sand. So the sand goes with it.

2 Q And do those samples have varying concentrations of
3 sand?

4 A I'm -- I'm sure they do. It all depends on the spot
5 you're sampling. A -- a finer grain sand, you would
6 probably have more grains along with it. A very, very
7 coarse grain sand that has large pores you would
8 probably have a little bit more oil than -- than sand
9 grains.

10 The method of extracting the oil from the sand
11 grains is cold. It involves no solvent. They press it
12 out, so under very -- under high pressures. So you're
13 ensured a clean representative oil sample.

14 Also the amount that they actually need to run
15 through the machine is very, very small, and we
16 generally give a more than 50-gram total sample weight,
17 so there's plenty of sample to go around to do a repeat
18 check or to validate if -- if there was a question
19 about a data point.

20 Q And that all happens at the lab?

21 A Yes.

22 Q And I assume they provide a report of their results
23 with respect to quality assurance and quality control?

24 A Yeah. With every -- with every output there's a QA/QC.

25 Q And there's parameters within which they operate that
26 they, you know, provide the service within a certain

1 number of -- like, a -- kind of certain error bars on
2 their results?

3 A Yes, there is.

4 Q And so do we have those error bars in evidence?

5 A I -- I think they were submitted with the --

6 Q With the confidential --

7 A -- with the confidential data, yes.

8 Q Thank you.

9 If you give me a moment, I need to confer, but I
10 think that might be everything I've got for you.

11 A Thanks.

12 Q That's it for me. Thank you very much.

13 COMMISSIONER CHIASSON: Thank you.

14 So the Panel needs a short break. Court
15 reporters, how are -- how are you doing? Or I'm
16 assuming perhaps the witness panel could also use --
17 let's -- let's break for 15 minutes now, and that way
18 that gives everyone a chance to tend to what needs --
19 needs to and whether that's a walk or otherwise. So we
20 will come back at 3:40.

21 (ADJOURNMENT)

22 COMMISSIONER CHIASSON: So thank you, all. Hopefully
23 everyone benefitted from the break as much as the Panel
24 did. We will pass it over now to Ms. Peddlesden to
25 continue with questions.

26 Q S. PEDDLESDEN: Good afternoon. So I'll be

1 asking questions about lateral continuity to start
2 with.

3 S. PEDDLESSEN: Ms. Wheaton, if you could put
4 Exhibit 32.03 at page 5.

5 Q S. PEDDLESSEN: We've noticed that Canadian
6 Natural has interpreted the mid-B1 mudstone as a marine
7 regional mudstone, and we wanted to look more closely
8 at this particular sample. This is a submission from
9 ISH, but we just wanted to identify which well --
10 well -- this is 1-3 -- and if Canadian Natural could
11 speak to where the green vertical arrow -- and speak to
12 the variation within the sample on display.

13 A J. LAVIGNE: The area within the -- between
14 the green arrows is the mid-B1 mudstone. It has some
15 variability. It is a marine flooding surface. It does
16 contain some silt. It is bioturbated by a very small
17 low diversity suite of trace fossils, but there --
18 there is a bunch of compositional variation within it.

19 Q All right. And to be more specific -- would you happen
20 to be able to get the mouse where you could point?

21 A Sure.

22 Q I'm not sure where it is right now.

23 A Yeah. We have it.

24 Q I appreciate that.

25 A Yeah.

26 Q Thank you.

1 All right. So if we start at the top and just
2 work your way down, and if you could speak to the
3 bioturbation and the change in colour --

4 A Sure.

5 Q -- and then the bioturbation, please.

6 A Sure. Would you mind if I started from the bottom and
7 worked up?

8 Q You can do that. That's fine. Thank you.

9 A It's a -- it's a geology thing.

10 So -- sorry. So starting at the bottom, there's a
11 sharp surface, and you'll notice there's a slight
12 difference in the colour here. I would also like to
13 point out that this core is a little bit desiccated
14 from being in storage, and so sometimes after a period
15 of time they don't look quite as good as they do when
16 they're fresh. But within the -- within the mid-B1
17 mudstone, there are -- for the most part, it's -- it's
18 mud, but if -- if you can follow my cursor up a little
19 bit, I'm sort of halfway now, and you can see some
20 small silt-filled burrows in -- in the mud, and then
21 above it you'll see that there's a darker few
22 centimetre-thick unit that has a bit of a higher
23 organic component. And then as we go into the top of
24 the -- of the unit, there's -- there's also a little
25 bit of bioturbation and a bit of silt mixed in.

26 And Canadian Natural has been fairly conservative

1 with what we call the mid-B1 mudstone. Right at the
2 very top of this green arrow where there's an
3 appreciable silt and even some fine-grained sand that
4 has bitumen in it, also bioturbated -- there's some
5 nice paleoficus burrows and things here -- but we've
6 tended to pick the -- the more mudstone-dominated
7 portion when we apply isopach maps of the mid-B1
8 mudstone, and we would say that where we start picking
9 up appreciable sand or silt and the bioturbation
10 increases in both size and intensity, that's what we
11 would say is now the regional upper B1 sequence.

12 Q All right. Thank you.

13 I'd like to turn to Exhibit 43.121, and this comes
14 from Well 1AB-07-02. If you could expand it where the
15 annotations are in red on the mid-B1 mudstone for this
16 well. And if you want to start from the bottom, but --

17 A Sure.

18 Q -- just give a geological interpretation of this core
19 sample, please.

20 A Okay. So I'll start at the very bottom, in the bottom
21 right of the core photo, and perhaps for the Panel's
22 orientation, the -- in these core samples that are
23 turned on their side, the bottom right is the bottom,
24 and then we'll go up vertically through the series of
25 cores so that the top of the cored sequence shown is in
26 the upper left. So we'll work our way through --

1 through this.

2 These lower two tubes are the lower B1 regional
3 sequence, and you can see that they -- they contain --
4 it's -- it's very muddy here, but it does contain sands
5 with some small burrows in them. And then near the top
6 of the lower B1 sequence, not present in every well,
7 but we can see that there is -- we're developing a
8 paleosol at the top. So that's a fossil soil, and it's
9 capped with a coal.

10 And -- and so what that represents, the lower B1
11 sequence, is a -- is a tidal flat sequence, and the
12 coaly portion that you observe at the top of that
13 sequence represents a period where the tidal flat had
14 built its way up to sea level, and so you'd have a
15 coastal salt marsh develop along the side.

16 Now, where the -- yeah. No. Where the red line
17 is, you can see that it's kind of distorted, jumbled up
18 a bit. That's a transgressive surface of erosion at
19 the top of the -- the coal. And so in that case, the
20 coal has armoured the lower B1 sequence. And during
21 transgressive erosion, you can see there are pieces of
22 coal that have been ripped up and churned and
23 incorporated into the lower deposits of the -- of the
24 mid-B1 mudstone. And by the time you get to this point
25 that I'm highlighting, the mid-B1 mudstone is -- looks
26 very similar in character to the previous well, still

1 having bits of coaly material incorporated. And up
2 around this level, we start to pick up some of the
3 bioturbation, the silty small burrows and some very
4 distal storm beds that have put -- put little sand
5 lenses into the marine environment.

6 And then by the -- where the red line is here,
7 we're into something that more approximates the
8 upper -- the regional upper B1 sequence.

9 Q And further to that point, does Canadian Natural
10 classify mid-B1 mudstone, as it appears to in this
11 particular sample, as bioturbated and non-bioturbated?

12 A I would say that the bioturbation in it is quite
13 variable. Many very shaley or muddy rocks are
14 extensively bioturbated, but it's not always visible,
15 and it's -- often when you see the appreciable silt
16 content like I'm showing here just below 470 metres,
17 it's with the incorporation of that silt that you get
18 an indication of how bioturbated the unit might be.

19 Q All right. So would you consider the mid-B1 mudstone
20 to consist of two distinct facies characterizing it?

21 A I would say that it's -- it would be very difficult to
22 map those two distinct facies. I would perhaps say
23 instead that the mid-B1 mudstone has -- has variable
24 character.

25 Q And speaking towards lateral continuity, when you say
26 it has "variable character", what, in your opinion,

1 would be the best location to sample the character of
2 the mid-B1 mudstone where there's a disagreement
3 between the parties overtop of Drainage Box KN09?
4 Where would you recommend putting a sample, if you were
5 going to take a core sample and drill a well? Sorry.

6 A Oh, if we were going to take a core sample.

7 Q If you were going to drill a new well.

8 A I think when you look at the area of the Wabiskaw --
9 where the Wabiskaw D has cut deepest along this centre
10 part of that axis, that's the place where it's cut the
11 deepest, and that's the place where you would look
12 to -- to sample or test the presence of the mid-B1
13 mudstone.

14 Q I appreciate your opinion on that.

15 Previously you described the turbated part as
16 potentially the regional upper B1?

17 A Yes.

18 Q In your opinion, is this annotation potentially in the
19 wrong spot marking the top, or is it just an
20 interpretive --

21 A It's -- it's a little bit interpretive, and sometimes
22 the -- sometimes the contact can be kind of
23 gradational, and so some people perhaps would pick it
24 back here at about 470, where you first start seeing
25 coarser grain sand, and the issue with that is, of
26 course, then right above it where my cursor is right

1 over the O-N-E of mudstone, it's very similar in
2 character to the silty bioturbated deposits below. And
3 so -- so it's -- in this well, it's sort of been picked
4 where the -- the silt and sand component seems to be
5 more dominant.

6 Q So further to that, if you could comment on the
7 possible genesis and lateral continuity of the
8 non-bioturbated mudstone facies and how that would
9 influence the lateral continuity of such beds. I could
10 put up a different picture for you to speak to. It
11 might be more helpful.

12 A Perhaps. And while you're doing it, could you please
13 repeat the last part of what you asked.

14 Q Yeah. Yeah. I will. Okay. So if we could put up
15 Exhibit 43.076.

16 A Okay.

17 Q All right. So this is Well 05-02, and if we look at
18 the annotated mid-B1 mudstone in the top right
19 corner --

20 S. PEDDLESDEN: Ms. Wheaton, if you could zoom
21 in on the top right.

22 Q S. PEDDLESDEN: -- and just speak to the
23 bioturbation and the lateral continuity.

24 A Okay. Coming out of the top of the lower B1 in the
25 tube second from the top, there -- right at 469 where
26 my cursor is, there's a sharp erosive surface there

1 where we start depositing mud, and we can see a bunch
2 of very small, sand-filled burrows in -- in this area
3 at the end of that tube. And then as we come up to the
4 top portion labelled the "mid-B1 mudstone", again it
5 looks like we can see perhaps some coaly ripups, and
6 there's some very small, possibly chondrites-like
7 burrows in the darker shales of the mid-B1 mudstone.

8 Now, this -- the red line at the top of it is --
9 is -- this is the base of the upper regional B1
10 sequence, which is also a shallower tidal flat. And so
11 what you can see right here where my cursor is, you can
12 see some rooting and some overprinting on the -- on the
13 mid-B1 mudstone. And this represents a small
14 inconformity where the lower B1 tidal sequence was
15 flooded over by the mid-B1 mudstone, and then
16 subsequently the upper regional B1 sequence prograded
17 over the top. That's a very shallow setting, and so
18 we've overprinted some roots on the upper part of the
19 mudstone.

20 Q I'm just going to confer as far as further questions.
21 Thank you.

22 Okay. I do have one more question. Is it
23 possible that the bioturbated component of what has
24 been defined as the mid-B1 mudstone could be part of
25 the upper B1 regional -- oh, pardon me. I'm getting
26 corrected. I will ask you in a second.

1 So could it be part of the lower B1 and not part
2 of the mid-B1? And the previous slide would be more
3 indicative of that.

4 A Right.

5 S. PEDDLESSEN: If you could put
6 Exhibit 43.121 back up. I appreciate it, Ms. Wheaton.
7 Thanks.

8 A Sorry. Is this the one --

9 Q S. PEDDLESSEN: This is the one where you can
10 see the bioturbations quite distinctly --

11 A Yeah. Okay.

12 Q -- and the difference.

13 A Yeah. So I think I understand the question. The
14 bioturbation -- the bioturbate character in the mid-B1
15 mudstone with the small, silty-looking burrows is
16 different than the bioturbate character in these
17 underlying lower B1 regional sequence mudstones, which
18 have a fair posity [sic] of burrowing. If we could go
19 back, perhaps, to the exhibit that we were just on, if
20 that would be possible.

21 Q Yes. That was --

22 A So I just want to differentiate between the relatively
23 non-burrowed character of these particular lower B1
24 regional muds versus the silty bioturbated ones within
25 the mid-B1 mudstone just to make that a bit of a
26 contrast, and then if we could please go back to the --

1 Q 43.76? Oh, was it this one that you were referring to?

2 A No. I'm sorry. The other core photo we were just
3 looking at.

4 Q That one is actually Exhibit 43.76. 43.076.

5 Mr. Lavigne, I've been corrected on my question,
6 so --

7 A Okay.

8 Q -- thank you for your patience. I'm just going to give
9 you the real question. I just had it upside down.

10 So the question is: The non-bioturbated facies,
11 could that be part of the lower B1 mudstone? So the
12 opposite of what I said. I was looking at the
13 turbated; I'm looking at the turbated and where you
14 think it fits.

15 A I'm very sorry. Could you repeat that one more time?
16 I just want to make sure I have it.

17 Q Okay. This is actually 43.76. Its much more clear in
18 43.121.

19 S. PEDDLESDEN: If you could put that one back
20 up, Ms. Wheaton. Yeah, this one.

21 Q S. PEDDLESDEN: Here I had asked you if the
22 turbated part would be better categorized with the top.
23 That was an error. What I meant to ask you to opine on
24 was if the non-turbated could possibly be classified as
25 the lower B1, not the mid-B1 mudstone.

26 A Right. In this particular case, I would say no simply

1 because the -- the mid-B1 mudstone as interpreted here
2 sits above this transgressive surface of erosion and it
3 does display the character that we -- we see in the
4 mid-B1 mudstone. That being said, however, both the
5 lower regional 1 -- B1 sequence and the upper regional
6 B1 sequence are highly variable in terms of their
7 sedimentary character, and it -- it can make it
8 difficult sometimes to actually pick it, and in some
9 cases you end up picking something that's quite thin as
10 the mid-B1 mudstone. That's why we look at offsetting
11 wells, and we try -- we come from stratigraphic datum,
12 and we try to -- try to see at that stratigraphic level
13 what the -- what the differences are.

14 It's fair to say that it's -- it's recognized as a
15 unit. It is mappable. The sedimentary character is --
16 is not perhaps completely unique to -- to a deposit,
17 and so part of -- part of our interpretation and the
18 way we map that surface is to compare to offsetting
19 wells so that we make sure we're looking at the same
20 horizon, but it -- it is very fair to say that it's --
21 it's -- it's variable in its character.

22 Q Thank you.

23 Dr. Boone, my next questions are also on lateral
24 continuity, but they're directed to your expert report,
25 your supplemental report.

26 S. PEDDLESDEN: So specifically, Ms. Wheaton,

1 if you can put up Exhibit 50.03 at page 13. And we'll
2 be discussing page 13 and 16 in detail.

3 A T. BOONE: Okay.

4 Q S. PEDDLESSEN: Okay. Just starting with
5 page 13, are the vertical permeability values for
6 Facies F1 to F6 provided in Table A1 from the sources
7 listed, which are on this article as Gotawala and Gates
8 and Murtaza and Dehghanpour?

9 A So those two sources there, they don't provide vertical
10 permeability, right.

11 Q Okay.

12 A What they do provide is the steam rise rate in clean
13 sands, essentially, so an analog in this case. And I
14 would have to check which that -- which analog it is.
15 I think it's written there.

16 And so I assume the 2,000 millidarcies' based on
17 typical for regional -- you know, the -- the good clean
18 sands in the Athabasca.

19 Q Thank you.

20 A And consulting with some geoscientists, they said it
21 might be a little bit higher.

22 Q And for the F5 facies, how did you come to the Number 1
23 microdarcies?

24 A For the F5 facies, I really assigned it a 1 millidarcy,
25 although I thought that was very conservative. If I go
26 into the literature, there's a lot of evidence of

1 measurements of less than 1 millidarcy and even
2 hundredths of a millidarcy in, you know, hundred
3 percent shales or muds.

4 Q Particularly which muds were you basing the -- the
5 values on?

6 A I wasn't basing it on -- particularly on any specific
7 mud.

8 Q Okay.

9 A I mean, it's -- it's sort of general.

10 Q Okay.

11 A And -- and now the interim permeabilities there,
12 there's another chart there. Did you want to go to
13 that, the one on the next page based on some
14 micromodelling?

15 Q Yeah. That would be great, yeah.

16 A So let's talk about that. So, you know, the -- if
17 you're going to do reservoir modelling of facies like
18 this -- and this is the challenge for doing any
19 reservoir modelling of steam moving up through the
20 confinement, is how do you capture all these fine bits,
21 okay, that are -- that you can look at them, and you
22 can see there's tens to many tens in -- in a metre.
23 And so the standard way to do that is to do
24 micromodelling. And so that is -- you create a
25 simulation model on something that's, like, a metre
26 cubed. And I -- I -- I think in that subtitle on that

1 figure, it describes that, the -- the size of the
2 models.

3 Q Right. And how did you get your values for this
4 diagram?

5 A So that's not my work. That's taken from a paper by
6 the Clayton Deutsche group out of the University of
7 Alberta that are sort of the experts in that area, and
8 it seemed to be pertinent, so I included it here. And
9 you can see that -- that, you know, in this section
10 here, they -- they modelled things like muddy his, and
11 they typically got very low vertical permeabilities;
12 right?

13 And so when I compare that to my table, I'd say
14 the table -- I have higher numbers of vertical
15 permeabilities, and that -- that was intentional that
16 it -- that it be conservative.

17 Q Could you confirm that the Wabiskaw D upper
18 heterolithic unit and the Wabiskaw C are both given the
19 F5 facies as their values for your model?

20 A I -- I would say that's generally true, but you can
21 look -- you know, I only applied it to the four cases
22 that are included --

23 Q Right.

24 A -- in my report, and it -- and it's visual mud index.
25 So it wasn't done specifically on a -- on a facies
26 basis.

1 Q Okay. Yeah. That was the next question, is what was
2 it based on, the visual mud?

3 A But that -- that's the standard that's sort of used
4 in -- in industry that's, you know, been found to be
5 reasonably predictive of where you get good SAGD pay.
6 But I'm -- I'm taking those same facies and reversing
7 it and saying, Let's -- let's try and use this to model
8 the -- the confinement strata.

9 Q Okay.

10 S. PEDDLESSEN: Ms. Wheaton, can you take us
11 to page 16.

12 Q S. PEDDLESSEN: And, Dr. Boone, can you talk
13 about intervals of similar lithology? Can there be
14 intervals of similar lithology deposited in a range of
15 depositional settings?

16 A T. BOONE: I -- I -- I would say yes, but
17 you're -- you're getting outside my area of expertise.
18 I would consult with my geologist friends on that.

19 Q And then could you speak to the distribution of the
20 same or similar lithology in, for example, a deltaic
21 meandering channel or an estuary setting and how that
22 may be of different lateral extent or continuity?

23 A Again, you're -- you're out of my expertise.

24 Q Oh, absolutely. Yeah. Canadian Natural, you can
25 answer.

26 Mr. Lavigne.

1 A J. LAVIGNE: Could I please bring up a
2 figure?

3 Q Oh, yes. Yes.

4 A Exhibit 43.002, PDF page 26. Thank you. If we could
5 maybe just reduce that a little bit so we could see the
6 whole slide, please. Thank you.

7 So visual mud index is sort of a 1D point that you
8 would use in core. And to your question, yes,
9 different depositional settings can have the same
10 visual mud index. And so one of the differences -- the
11 McMurray formation point bar shown in the bottom half
12 of the slide show continuous mudstone beds over -- that
13 can be mapped for tens, even over a hundred metres
14 in -- in well-studied outcrops.

15 The -- the -- the deposits of the Wabiskaw D
16 non-reservoir unit and the basal upper Wabiskaw D unit
17 are more like the top two panels where there are --
18 there are flasers and wavy beds of mud with -- with
19 interbedded sands.

20 And in -- when we look at the diagram in the top
21 centre, what happens is we have a dominance of mudstone
22 versus sandstones, and the -- sorry. I'm just looking
23 for a figure. And in that case, individual mudstones
24 for -- may not have the same lateral extents that we
25 would think of in point bars. And that's typically why
26 we think about and look at the Wabiskaw D quite

1 differently than the McMurray.

2 If I could -- if I could please ask to go forward
3 to Slide 30 of the same presentation, please. This is
4 a modern example from an estuary in Europe. And just
5 to orient the Panel, in -- in the lower right you can
6 see some sort of sand dunes that -- thank you. You can
7 see some dunes across the bottom of this estuary. And
8 what -- what has happened with side-scan sonar, the
9 bottom of this channel was imaged, and right where my
10 cursor is dragging in the centre of these red circles,
11 you can see -- you can see a slight discontinuity, and
12 that's a fluid mud caused from the way mudstones
13 deposit in estuaries. That's very different than the
14 way mudstones deposit in rivers. And so in this
15 particular case, the -- the mudstones that -- that are
16 being seen here are on the order of 1 metre thick.

17 Now, that being said, they're very high -- they
18 have a high volume of water in them. And so in the
19 rock record, when they compact, they'll be much thinner
20 than that. But what this shows is how mudstones can be
21 deposited in -- in -- interbedded with sandstones, and
22 that describes the nature of that flaser-type bedding
23 that we see.

24 Now, if I could please ask to go to the next slide
25 in this same document. Thank you.

26 This is another scanning profile, and you can see

1 the scale of this, and what's -- these deposits --
2 these laminated deposits that I'm tracing out here with
3 fairly horizontal beds, that's a deposit of fluid muds
4 that's draped all of the sand dunes along the bottom of
5 the estuary. And in this case, if you notice the scale
6 in the lower left here is 100 metres. So what this has
7 deposited is a deposit of mudstone beds that is on the
8 order of a metre thick over perhaps 900 metres to a
9 kilometre as a fairly continuous deposit.

10 So while the mudstone distribution of individual
11 mudstone beds within the Wabiskaw D -- individually
12 they are smaller, but as an aggregate of deposits in
13 high visual mud index deposits, they can be mapped over
14 fairly large areas.

15 Q Thank you.

16 Back to Dr. Boone. With your calculations, you
17 were relying on homogeneous confinement strata, I
18 believe? Can you speak to that?

19 A T. BOONE: Homogeneous at what -- sorry.
20 Homogeneous at what scale? So, you know, clearly
21 they're heterolithic at the visual mud index scale.
22 And so, you know, it's being classified into units, but
23 there's no assumption of it being homogeneous. The --

24 Q Okay.

25 A -- the condition is that it's a heterolithic unit and
26 that --

1 Q Okay.

2 A -- that if steam was going to rise through it, you
3 know, especially where there's a lot of mud, it's a --
4 it's a very torturous path.

5 Q Right.

6 A And -- and the other key point there is it's not just
7 steam rising up; it's -- bitumen has to drain down that
8 same pathway. And if it becomes a torturous pathway,
9 that's a slow process, which is why steam rise becomes
10 very slow.

11 Q Okay. And when you submitted your calculations, could
12 their validity be reduced based upon a lack of lateral
13 continuity?

14 A You know, definitely. If -- if, for example, there was
15 a channel that was sand filled that cut through those
16 facies and was, you know, between the wells or -- or
17 you drilled it, then that would be potentially an
18 issue.

19 Like -- now, there's -- there's a lot of
20 low-quality facies in -- in all the wells over these
21 drainage boxes, so it -- it -- that seems unlikely. It
22 seems that the channels that are there are mud-filled
23 and -- and impermeable, but the geo -- my geoscience
24 friends there might want to elaborate on that more.

25 Q That's okay.

26 Are you aware -- in your opinion, could the

1 bioturbation increase or decrease the vertical
2 permeability for the steam to rise?

3 A In -- I'm not aware of any case where bioturbation of a
4 shale has made it permeable to steam, okay, in that --
5 for that to happen, would the -- the bioturbation would
6 have to be filled with sand, and it would have to be
7 connected through the whole section. Now, that
8 possibly can happen, and maybe there's examples out
9 there. But the thicker the section you get, the more
10 unlikely it is that bioturbation will -- will provide
11 pathways for steam.

12 Q And did the model consider variable bioturbation?

13 A No. It's -- it's a visual mud index --

14 Q Right.

15 A -- just as you see there.

16 Q And as far as how the visual mud index for the Facies 1
17 to 6 scheme is calculated, you spoke to using typical
18 numbers that you would see in literature and picking
19 the 1 microdarcy as a conservative one. Is that --

20 A For the --

21 Q -- the correct --

22 A -- permeabilities associated --

23 Q -- permeability?

24 A -- with them. The -- the visual mud index, that --
25 that chart of those facies is from Suncor MacKay,
26 and -- and a lot of other people have reproduced it.

1 Q Right. So do you know if it was created with digital
2 software, or is it variable between geologists
3 performing the work?

4 A My -- I mean, in my experience, it's geologists looking
5 at it and -- and visually making a determination.

6 Q Thank you.

7 Okay. So we'll be moving to the next topic, which
8 is monitoring.

9 S. PEDDLESSEN: Ms. Wheaton, if you could put
10 up Exhibit 15.01, PDF page 106 of 505, and this is the
11 Wabiskaw net gas isopach.

12 Q S. PEDDLESSEN: So similar question that we
13 had put to Mr. Lavigne, when you look at this map and
14 you look at particularly the KN09 drainage area, where
15 would Canadian Natural recommend putting a monitoring
16 well and provide supporting reasons?

17 A G. IANNATONE: Okay. I'm going to try and
18 answer this one.

19 We have plans to drill a strat well that's
20 slightly to the northeast of the KN09 box. And so in
21 those plans to drill that strat well, we would case it
22 and make it available as a Wabiskaw B gas monitoring
23 well.

24 Q And have you considered putting the sampling well in an
25 area that has thicker gas pay?

26 A I don't know exactly -- the exact location, but I would

1 guess -- or maybe Mr. Sverdahl knows it, but it would
2 be in that -- not the darkest red, but it would be
3 likely in that -- the next reddest colour. And I'm not
4 sure what that contour is, but it might be 2 metres.

5 A S. SVERDAHL: Yeah. It would be in that
6 range. We have tried to optimize it as -- as much as
7 we can to make sure we're going through what we're
8 interpreting Wabiskaw B gas.

9 Q And then how will the gas sampling be submitted? In
10 your latest reply submission, you had mentioned
11 providing a gas sampling of the Kirby Upper
12 Mannville II gas pool prior to production. How about a
13 frequency after that? What would you think would be
14 reasonable to notice any anomalies in the Kirby area --
15 Kirby north Wabiskaw B?

16 A G. IANNATTONE: Okay. Just to clarify, so
17 we're talking about gas sampling, and you're talking
18 about gas sampling after the GOB gas resource is
19 allowed to produce?

20 Q Right.

21 A Okay.

22 Q Yes.

23 A So I believe, as typical in gas operations, that as the
24 gas is produced there is a frequency of normal gas
25 sampling. I'm not a hundred percent sure what that is,
26 if it's monthly or annually. It probably depends a lot

1 on the type of gas, but -- so what I'm trying to say is
2 there's a natural process that gas samples would be
3 taken and analyzed on a frequent basis.

4 Q I might be confused. Are you talking about the gas
5 sample from the Wabiskaw B, the monitoring gas sample?

6 A No. No. I'm talk -- so -- okay.

7 Q Right.

8 A So just to be clear --

9 Q Yeah. I think we're talking about two different --

10 A Just to be clear, when we talk about gas sampling,
11 we're not necessarily talking about the gas monitoring
12 wells.

13 Q Right.

14 A It could come from other wells. And so --

15 Q Right. Okay. I --

16 A -- after --

17 Q I wanted you to speak to sampling of the monitoring
18 well. In the reply submission, there was
19 acknowledgement of getting a baseline gas sample --

20 A Right.

21 Q -- by Canadian Natural --

22 A So -- so I guess I would say we haven't necessarily
23 decided -- okay. You're talking about the baseline --
24 baseline sample now?

25 Q Yes.

26 A Baseline not -- okay.

1 Q Baseline sample --

2 A Let's go to the baseline.

3 Q -- of the Wabiskaw B --

4 A Yeah.

5 Q -- gas reserve.

6 A Right. Right. So first --

7 Q Yeah.

8 A -- of all, there's four wells that are available, I
9 guess, in the Kirby Upper Mannville II gas pool, and
10 all of them are GOBed. So, first of all, we'd have to
11 apply for a GOB waiver to get permission to -- to
12 sample. Then we would select, I believe, one of the
13 four wells, probably the most convenient one where
14 either, you know, it could be an access issue or it
15 could be a mechanical issue downhole, but we would like
16 to select the most convenient one. And we would have
17 to produce the well for some period of time just to
18 clear the wellbore from the gas that's been sitting
19 there for decades, and we would sample one of those
20 four wells. And that would provide the baseline.

21 Q And if you were required to submit gas sampling on an
22 interval basis, would you be able to submit it to the
23 AER in an Annual Directive 54 report?

24 A Yes, we could do that, but -- one moment, please.

25 Okay. Excuse me. Yeah. So our plan would be to
26 collect the baseline sampling now, once, right, and

1 collect it again prior to the GOB gas production coming
2 back on. So that could be years later to see if
3 there's been any contamination over the period. We
4 were not committing to an interval of baseline gas
5 sampling over the years.

6 Q All right. Moving on to maximum operating pressures.
7 S. PEDDLESSEN: So for this question, if we
8 could have Exhibit 15.01, Ms. Wheaton, at PDF page 32,
9 paragraph 135.

10 Q S. PEDDLESSEN: All right. So we have here
11 start-up, mitigation, 5,500 kPa rather than the MOP of
12 6,000, adopting the recommendation, and we've spoken
13 about this already. Long-term MOP of 6,000 kPa and
14 then the 6,600 for the 24-hour start-up. So my
15 question is: Provide the technical basis for the
16 proposed long-term MOP, maximum operating pressure, of
17 5,500 kPa at KN08 and KN09.

18 A P. THOMSEN: Could you clarify? Are you
19 referring to the modified long-term maximum operating
20 pressure of 5,500 in the reply submission?

21 Q Yes.

22 A Okay.

23 Q Just why it was changed to 5,500. Just confirming the
24 technical reasons. The application was 6,000, so --

25 A There -- there isn't a really solid technical
26 justification for reducing it. I mean, the evaluation

1 supported the use of a long-term MOP of 6,000 kPa.

2 Q All right. So do you foresee any potential technical
3 concerns with this change in your application?

4 A Just a moment, please.

5 Okay. So with the modification to the long-term
6 MOP, there -- there is some minor risk reduction
7 associated with that, and associated with that is
8 there -- there could be some increased operational
9 downtime associated with a reduced long-term MOP for
10 upset conditions. We'd mentioned --

11 Q Power outages?

12 A Interruptions.

13 Q Steam?

14 A Potential -- potential for scale plugging inside a
15 well. So ...

16 Q Scale what? Pardon?

17 A Scale plugging inside a wall.

18 Q Okay. Thank you.

19 All right. Moving on to the geomechanical model,
20 if we could get Exhibit 46.002, PDF page 43 displayed.

21 All right. So here we have the model, but as
22 pointed out earlier this morning or afternoon -- it's
23 been quite a day -- we didn't really understand
24 Canadian Natural's assumptions or input parameters for
25 the analysis, so we're just going to explore that a
26 little bit. Describe the geomechanical lab testing

1 conditions.

2 A D. WALTERS: So the -- so there was a
3 figure in the report that showed some lab testing for
4 mudstones. So those were triaxial tests conducted in a
5 lab, so standard triaxial tests at different effective
6 confined stresses, and that gave some information about
7 the elastic properties and the shear strength.

8 For the sand itself for the McMurray, analog data
9 was used based on UTF public data, so -- and that's
10 been used in other projects in the past as well. And
11 there's a paper reference, I believe, at the bottom of
12 the page.

13 Q Which formation were the samples taken from for the
14 model, or were they assumed to be McMurray sand or ...

15 A The samples were actually taken from the Clearwater and
16 the Wabiskaw shales, so the -- the main caprock for the
17 mudstone testing.

18 Q Okay.

19 A Yeah. And the McMurray data was taken from McMurray
20 sand.

21 Q Okay. I'll just confer with Baohong.

22 Okay. Canadian Natural, did the tested samples
23 have the same elastic properties and strength as the
24 confinement strata found -- or contoured and estimated
25 to be found in the KN08 and KN09 drainage area?

26 A Yeah, so no samples from the confinement strata were

1 actually tested in the lab. So we did do some log
2 comparisons to check the gamma ray, which is a measure
3 of the V shale that's been talked about earlier today,
4 and it was comparable to the mudstones that were tested
5 but not exact, and so not exactly the same mudstone.

6 But those -- those -- because that data was
7 available and -- and relevant because it was close --
8 regionally close to this area, that was used to guide.
9 And then, as was described in the report, a
10 conservative assumption for the shear strength, then,
11 of that -- those mudstone layers was assumed to add a
12 layer of conservatism.

13 Q All right. Describe the stress range used to determine
14 the Young's modulus.

15 A So the -- the Young's modulus values in the table that
16 were used, so the 500 MPa is -- that number was based
17 more on experience and would be representative of
18 mudstones over an effective stress -- stress range of
19 500 kPa to 2, 2-and-a-half -- 2,500 kPa. And then
20 the -- there was, as mentioned, a sensitivity done with
21 a stiffer value assigned to the mudstones to do some
22 sensitivity, and the range of those effective stresses
23 was from 2,500 up to 9,500 kPa. So it covered quite a
24 large range.

25 Q And what are the range of effective stresses observed
26 in your model results?

1 A So the -- the initial effective stress is approximately
2 4,500 kPa. And so in areas where the operating
3 pressure was increasing, that could potentially go down
4 to 2,500 kPa, and it potentially could increase as well
5 with the heating and the stress changes associated with
6 heating.

7 Q And is that the pore pressure? That's the effective
8 stress in the pores, or is that separate?

9 A The effective stress is the total stress minus the pore
10 pressure. So --

11 Q Oh, thank you.

12 A Yeah. So as the pore pressure increases with your
13 operating pressure, then the effective stress would
14 decrease.

15 Q Thank you.

16 A Yeah.

17 Q I appreciate that.

18 And then which model are your results based upon?

19 A How do you mean, which -- "which model"?

20 Q We noticed in your submission it had 500 MPa to
21 1.3 gigapascal, and then just as you were speaking you
22 mentioned a range in the effective stresses, 4,500 to
23 9,500. So I'll just confer on how to --

24 A I think that cleared -- that clears it up. So the --
25 the model that was presented in terms of the results
26 was based on that tabular data, so it was the 500 MPa

1 stiffness for the mudstone layers and then an
2 elastoplastic model for the sand.

3 Q And it was based on the confinement unit that you had
4 mentioned earlier?

5 A The confinement stresses, correct.

6 Q Oh, sorry. I meant the confinement strata.

7 Okay. So the effective stress is based on which
8 confinement unit, as in the mid-B1, the lower B1?
9 That's the confinement unit we're hoping you can
10 identify.

11 A Yeah. So the -- the main focus of the shear stress
12 level was the mid-B1 mudstone in -- in the long-term
13 SAGD model. So -- so that was sort of the -- the layer
14 that was focused on in terms of plotting across
15 the model and through time -- and monitoring through
16 time.

17 Q The mid-B1?

18 A The mid-B1 mudstone.

19 Q Okay.

20 A Yeah. And -- but the entire B1 sequence was included
21 in the long-term model.

22 And then in the -- in the fracture models, there
23 was a slightly different treatment where the entire B1
24 sequence was assigned properties associated with the
25 stress gradients.

26 Q And by the entire strata, you mean all the identified

1 strata from CNRL -- -- pardon me -- Canadian Natural,
2 the six that worked together? Okay.

3 A Yeah.

4 Q And then, finally, provide the thermal expansion
5 coefficient used for the McMurray post-B reservoir and
6 confinement strata?

7 A Yeah. So the -- the linear thermal expansion
8 coefficient that was used was 1 E to the minus 5,
9 100 degrees Celsius. And that's a value that, again,
10 we have a lot of experience using and matching surface
11 eve [phonetic] data from other projects. We did run
12 some sensitivities with higher thermal expansion
13 coefficient as well, but the 1 E to the minus 5 is our
14 best estimate of our representative thermal expansion
15 coefficient.

16 Q Yeah. And then you found those coefficients would be
17 representative of the McMurray sands and confinement
18 strata that you would find in the KN08 and KN09?

19 A Yes.

20 Q Thanks.

21 Okay. So there's a bit more on geomechanical.
22 This is Exhibit 46.002, same exhibit, but at page 71
23 and 72.

24 S. PEDDLESDEN: If you could scroll down,
25 there's a helpful table coming up. Oh, probably the
26 next page. 71, 72. That's the table. Thank you,

1 Ms. Wheaton.

2 Q S. PEDDLESSEN: All right. Based on the
3 current models, provide the calculated maximum SSL and
4 TSL, so the shear and the tensile, for other mudstones
5 and non-reservoir and heterolithic strata that Canadian
6 Natural will rely upon as confinement strata in the
7 absence of A2 mudstone and mid-B1 mudstone.

8 A So -- yeah. So this table is representative of the
9 mid-B1 mudstone, and so you can see the number is
10 tabulated there. I guess to get you the exact numbers,
11 I'd probably have to take it away and come back.

12 Q That's okay. We were more so just exploring if you had
13 conducted a sensitivity analysis and if you had assumed
14 that the mid-B1 mudstone was present with lateral
15 continuity.

16 A So the -- several conservative assumptions were made in
17 the modelling again to try and investigate some of the
18 risk of containment. So the -- in general I would say
19 these numbers are representative of the lower B1 and
20 the entire B1 sequence in that it's a mud-dominated
21 sequence, as has been talked about previously.
22 However, in -- in the long-term model, the initial
23 stresses that were assigned to the lower B1 and the
24 upper B1 were lower values to be conservative, and
25 therefore the shear stress level and the tensile stress
26 level were higher than these values. But the -- some

1 of work that we did, specifically the log analysis,
2 shows quite nicely that the mud content that's been
3 identified by geology shows up in the log in terms of
4 gamma ray and also shows up when you calculate elastic
5 properties from the log for the entire B1 sequence. So
6 it gives us some justification for applying these
7 values to the entire B1 sequence from a confinement
8 strata integrity point of view.

9 So I guess the short answer is we'd say these
10 were -- these are applicable to the entire B1 sequence.
11 And then, as was asked, that's for the base case or
12 that table of values that were -- were documented.
13 Several sensitivities were investigated with, you know,
14 higher thermal expansion and some variations -- other
15 variations that may cause more uplift or may cause more
16 stress change in the caprock, like the higher
17 stiffness, and all those values, the shear stress level
18 and the tensile stress level were well below 1. So
19 although we investigated some very conservative low
20 cases, there was no case that looked to -- to be
21 problematic.

22 Q Thank you.

23 If you could now discuss potential impacts that
24 natural fractures and faults, if they exist, may have
25 on the rock strength.

26 A So the mudstone, as we discussed, was assigned a shear

1 strength lower than the mudstone data that was
2 presented. So it was assigned a cohesion of zero and a
3 friction angle of 30 degrees, and that was done to --
4 even though the characterization shows, you know, very
5 small amount of fractures or no fractures in those
6 units, to make a conservative assumption that there
7 could be fractures in those units, and so that
8 frictional strength assigned then accounts for the
9 potential of having fractures present.

10 And -- however, for faults, potentially faults
11 because if -- especially if they were seismic -- seen
12 on seismic, then there's some significant deformation
13 on them. Faults would typically have even a lower
14 shear strength, but we've identified no faults on
15 seismic, so that suggests if there were any faults,
16 their subseismic scale, very small offsets, and
17 therefore the shear strength, we wouldn't expect to see
18 a significant difference lower than this conservative
19 assumption already made.

20 So from that perspective, we feel this is a
21 reasonable assessment, and although there is some
22 uncertainty in it because the evaluation shows the risk
23 is so low of any problem with confinement strata
24 integrity, we feel it covers and is adequate to
25 describe the situation.

26 Q Even in the potential absence of the A2 mudstone, which

1 we all agree is absent. How about in the potential
2 absence of the mid-B1 mudstone? Is it still a
3 conservative, in your opinion, model?

4 A Yeah. I think from the log data that we have, it shows
5 consistent high mud content behaviour of the B1. So
6 although it's not a -- necessarily a marine shale
7 with -- with lateral continuity over large distances,
8 the high mud content then would give it geomechanical
9 properties and strength closer to the muddy behaviour
10 that we've assigned it.

11 Q Okay. And correct me if I'm wrong, Canadian Natural --
12 I seem to remember the seismic data was accurate to
13 within 7 to 8 metres. Is that --

14 A S. SVERDAHL: Yes. That's our estimate --

15 Q Okay.

16 A -- of the resolution of the seismic data.

17 Q I don't have a pinpoint, so thank you.

18 All right. You're off the hook on geomechanical.
19 Thank you for providing that background.

20 We'll now look at thermal compatibility, which is
21 Issue 5. Oh, I apologize. I should have conferred
22 before I let you go, Mr. Walters.

23 All right. Back to the geomechanical model.
24 Discuss how potential variations in the minimum in situ
25 stress of the confining strata may affect the predicted
26 SSL and TSL.

1 A So the -- both -- both of those parameters are affected
2 by your assumption on the initial stress date. So
3 there were some sensitivities that we ran as was
4 documented for the fracturing risk but for the long
5 term as well, and so if you assumed a smaller or a
6 lower-stress gradient than what we assumed based on our
7 DFIT testing, then it would increase the initial shear
8 stress level and/or tensile stress level.

9 So, for instance, in that table that's in front of
10 you, you know, potential -- instead of 0.36, it might
11 increase to 0.46 to start, and that's if you would
12 maybe decrease the stress gradients by 1 kPa per metre.
13 So that sensitivity is run, but then the incremental
14 changes through the life of the operations would be the
15 same. So they would all shift, then, by those values,
16 and -- and they would all shift by the same amount
17 because nowhere through the history of the model did we
18 encounter any shear failure. So there was no, then,
19 complex stress or strain behaviour that would then
20 cause something other than a linear shift to those
21 values.

22 Q And then provide the minimum in situ stress and the
23 predicted SSL and TSL based upon that.

24 A So for that sensitivity -- so we looked both going
25 lower and going higher, but on the low end, so instead
26 of the 13.1 kPa per metre, let's say, for the McMurray

1 sand --

2 Q Right.

3 A -- and then the 14.6 kPa per metre that we would have
4 for the mudstones, they -- I initialized it with
5 12.1 kPa per metre and 13.6. So similar stress
6 contrast but dropped the numbers by that 1 kPa per
7 metre, and the pressures remain the same.

8 Q Thank you. I'm just going to confer if you're done.

9 All right. We're going to move on to thermal
10 compatibility. You're clear, Mr. Walters. Thanks for
11 that.

12 Thermal compatibility was Issue 5 that we're
13 addressing at this hearing. I would like to see
14 Exhibit 50.002, PDF page 56. And we're looking at
15 paragraph 211 to 212, so it will be pages 56 and 57.
16 Perfect. All right. So we start with 10-34 well. In
17 the revised workover plan submitted in Canadian
18 Natural's reply, there was a plan to knock the
19 permanent bridge plug to the seller and equip the well
20 with continuous downhole surface readout pressure and
21 temperature monitoring.

22 Is Canadian Natural planning to place thermal
23 cement inside 114.3-millimetre production casing across
24 the non-completed McMurray formation in Well 10-34 as
25 it is required in Section 5.4.2 to 125 of Directive 20?

26 A L. ROCHE: As of right now, the plan was

1 not to put -- was only put cement across the McMurray
2 formation as it is a monitoring well. So right now we
3 weren't planning to cement the 114 ml.

4 Q So 10-34 is going to be used as a monitoring well?

5 A Yeah. We've committed to making that Wabiskaw B gas
6 monitoring well.

7 Q How deep does 10-34 go?

8 A It's got a total depth of 500 metres.

9 Q So it goes right down into the McMurray formation?

10 A It encounters the McMurray, yes.

11 Q So where are you putting the monitoring on 10-34?

12 A We have existing perforations in the Wabiskaw A from
13 435 to 438.5, and we would be aiming to set it 1 metre
14 above that.

15 Q And then what's the plan from 438 to 500?

16 A It would be remaining open.

17 Q Why would you choose not to abandon the bottom leg with
18 thermal cement? What's the future plan?

19 A The future plan here, eventually post-GOB, would be to
20 return it to production, but as far as cementing it,
21 that's an option.

22 Q All right.

23 A Okay.

24 Q Are you aware of the current casing in Well 10-34?

25 A Yes. It's J55.

26 Q And how about the connections?

1 A They're, like, the standard API 8 rounds, so it would
2 be non-thermally compatible as per our protocol.

3 Q Right. And they're not compatible to Directive 20 for
4 a thermal area?

5 A So as my colleagues just mentioned to me one option
6 that we would leave -- use to keep the well
7 open -- sorry -- is to have the ability to do
8 temperature logs, R, C, P, and X logs for monitoring
9 SAGD chamber growth.

10 Q So you're proposing potential monitoring deeper in the
11 10-34, deeper than the 4-38 plus 1 metre?

12 A Those are done on an annual or a biannual basis.

13 Q And how do you propose to deal with the non-thermal
14 capability? Are you going to be monitoring the steam
15 chamber growth and whether or not it gets close to
16 Well 10-34?

17 A We'll have the surface readouts in there. We'll have
18 the pressure data at Wabiskaw, and we'll also have the
19 temperature, and as I just mentioned, we will be using
20 it for PNX logging, which is an annual or biannual
21 basis, but it gives us temperature in the wellbore.

22 Q And you predicted my next question. Thank you. Okay.

23 All right. One more question on thermal
24 compatibility. I'd now like to have Exhibit 50.002 --
25 is that the one we're on? Yeah. So it's just the same
26 area, basically. Paragraphs 211 to 218. Here we have

1 Canadian Natural is planning to remediate the thermal
2 non-compatibility issues related to Wells 12-34, 10-34,
3 10-2, and 10-3. The concern would be the thermal
4 compatibility.

5 And the question is: Does Canadian Natural plan
6 to conduct cement bond logs verifying if there is
7 adequate isolation behind intermediate casing above the
8 McMurray formation to ensure isolation to surface
9 casing? So from the intermediate casing above the
10 McMurray formation to the surface casing in the
11 existing cased wells located within the drainage area
12 of Pads KN08 and KN09.

13 A That is not in our plans right now. On the one well
14 that we are looking to abandon, as per Directive 20, we
15 will be using cement retainers on those wells. As far
16 as the other ones --

17 Q How does that address behind the casing, like, on
18 the ...

19 A It doesn't. Can you repeat that.

20 Q Oh. Just if you're planning on abandoning it with
21 thermal cement, is that going to come back to surface?
22 Like, are you going to know all the way around or
23 should -- like, would a cement bond log confirm whether
24 or not there were any integrity issues of communication
25 between zones?

26 A A cement bond log would definitely confirm if we have a

1 strong cement bond, but we do not have any cement bond
2 logs on these wells specifically.

3 Q So then how would you represent to the Regulator that
4 you do have well integrity and that we don't have to be
5 concerned with communication?

6 A So all four of the subject wells that were identified
7 in our thermal compatibility study do have thermal
8 cement initially placed in it, so that is, I guess, the
9 driver, plus we'll have monitoring throughout KN08 and
10 KN09.

11 Q And the monitoring would have a drop in pressure that
12 would let you know there might be communication between
13 zones, or what would the monitoring reveal?

14 A The monitoring would reveal if we were to have a
15 communication into the Wabiskaw B.

16 Q And then how timely would it be to report it to the
17 Regulator if you did see an anomaly?

18 A Similar to the bottom water in our scheme approval, I
19 would probably look at 30 days with a plan to remediate
20 in 60 days.

21 Q Okay. Yeah. No further questions. Thank you for your
22 time, and thanks for answering those. The Panel will
23 have their own concerns and questions, so thank you.

24 The Alberta Energy Regulator Panel Questions the
25 Canadian Natural Resources Limited Witness Panel

26 COMMISSIONER CHIASSON: Thank you, Ms. Peddlesden.

1 The Panel does have some questions for the witness
2 panel. So we'll start off with Commissioner Zaitlin.

3 Q COMMISSIONER ZAITLIN: Thank you very much. I just
4 have two sets of questions to ask. One will be for a
5 tag team with Mr. Lavigne and Dr. Boone, if possible.

6 Mr. Lavigne, you showed a number of examples of
7 the various isopach maps by stratigraphic unit that
8 basically shows the distribution of the different
9 stratigraphic units across KN08 and KN09. You showed
10 various cores showing the range of facies. Basically
11 what this together shows is highlighting the
12 heterogeneity of the containment strata in those
13 drainage boxes, specifically in terms of thickness
14 across the area. Dr. Boone put forward in his -- in
15 his data showed data associated with the steam rate
16 rise methodology.

17 So the question I have first is: Is that data put
18 together in any way in terms of a reservoir model that
19 shows the 3D distribution of the different reservoir
20 facies and units across the area showing the -- that
21 heterogeneity?

22 A J. LAVIGNE: Sorry, Commissioner Zaitlin.
23 Canadian Natural has conducted a preliminary geomodel
24 that was not ready in time for these proceedings. It
25 is standard practice that we make 3D models over our
26 McMurray assets, so ...

1 Q So where you are now, does it show significant
2 heterogeneity across those boxes?

3 A Yeah, the models --

4 A S. BARLAND: Hi, Commissioner Zaitlin. So
5 I was involved with some of the model building or
6 preliminary stages of model building and the low
7 permeabilities in the heterogenous confinement strata
8 units are quite well represented in the current version
9 of the 3D model, although it is in a preliminary state.
10 I would say it represents or closely corresponds to the
11 higher numbered F4/F5 facies that Dr. Boone had
12 described and -- and shown you guys earlier today.

13 Q So to follow up on that, are there certain areas in the
14 KN08 and KN09 boxes that would preferentially be at --
15 be at risk for earlier breakthrough because of specific
16 facies distribution in -- in those boxes?

17 A Yeah. So we're just in the very early stages of -- of
18 trying a few cases of simulation on that model. No
19 indications as of yet for steam breakthrough. Again,
20 scenario building and running the actual predictive
21 history match or the forecast history match is in its
22 early stages.

23 Q Just to follow up on that, though, do you think this
24 model, when it's built, would be able to help highlight
25 where the best position of the monitoring wells should
26 be?

1 A Any -- any model has uncertainty, so using it to
2 predict a single 7-inch position for a monitoring well
3 may be more than a -- than a model can -- can guarantee
4 to do. It may help inform that decision, but I would
5 say it's probably too much to say, Yes, it's going to
6 depict the right spot.

7 Q Following on, on a second --

8 A Sorry, Commissioner Zaitlin. I'm just wondering, is it
9 the gas monitoring well you're -- you're asking about?

10 Q I'm asking more about how the distribution of
11 containment facies will be effective across the area
12 spatially to make sure that there's no upward movement
13 of steam that may or may not happen and may or may not
14 go into the Kirby pool.

15 A Okay. So not a specific well, but identifying areas of
16 potential better spots to place one --

17 Q That's right.

18 A -- if needed?

19 Q Northeast corner, northwest corner, that type of thing.

20 A Excuse me one more second.

21 Q Sure.

22 A I think -- I think we'll leave it there if you're -- if
23 that does answer your question. I would say the
24 variability is -- is hard to predict, although once we
25 get to that stage, it could be informative.

26 Q Fair enough.

1 For Mr. Lavigne, you talked about the 1-3-75-9-W4
2 well and the identification of that well having a tidal
3 creek that cut out the B1 mudstone. What was the
4 dimensions that you used -- that you thought occurred
5 with those tidal creeks and how many other wells, if
6 any, actually intersected similar facies at the B1
7 level?

8 A J. LAVIGNE: I'm just going to pull up an
9 exhibit quickly, if I may.

10 Q Yes. Of course.

11 A Could I please pull up Exhibit 050.003, page 52.

12 Thank you. Sorry, Commissioner Zaitlin. Your
13 question was the -- the scale of this feature and have
14 we seen it elsewhere?

15 Q That is correct, yes.

16 A Okay. This is the -- while both the regional lower B1
17 sequence and the regional upper B1 sequence are quite
18 variable in lithologies and -- and do contain some
19 sandier deposits that would be interpreted as tidal
20 channels, this is the example that we -- this is the
21 only example we've seen directly on the pad regionally,
22 away from these pads we have seen small features like
23 this. In fact, in the KN06 area, there is a small
24 feature like this as well that seems to be confined to
25 the parasequence that doesn't have a significant
26 downcutting.

1 As far as scale, in the three-well cross-section
2 in the centre -- top centre of this figure, these wells
3 are about 215 metres apart, and so it -- it's very --
4 it's very well constrained aerially. We can't
5 correlate it to any of the offsetting wells.

6 I'd like to invite my colleague Mr. Sverdahl to
7 speak on seismic.

8 A S. SVERDAHL: Yeah. Just to add we have
9 looked substantially at the seismic at this well doing
10 time splices or special decomposition slices, coherency
11 as well. Unfortunately the feature is too thin and/or
12 does not have enough reflectivity to pick up very well
13 as a geomorphological feature that we can map or see at
14 this well. So, unfortunately, we're not able to
15 determine the -- the size, the aerial extent of this --
16 this feature at this well.

17 Q Would there be any -- is there the potential for having
18 any other channel-form-like bodies like this cutting
19 through potential containment strata in any other of
20 the Wabiskaw units?

21 A J. LAVIGNE: Based on our understanding,
22 and our -- sorry. I'm just trying to pull up one more
23 figure.

24 Q No problem.

25 A My apologies.

26 Could we please pull up Exhibit 043.002, page 29.

1 Thank you.

2 Commissioner Zaitlin, you asked specifically about
3 the Wabiskaw. So for context, in the lower left of
4 this figure, there's a map, and the Wabiskaw sandstone
5 trend is shown in orange in that southwest/northeast
6 orientation, and so this model slice was -- was
7 submitted to try to explain the mudstone-rich facies
8 associated with the Wabiskaw. And as mentioned
9 earlier, the incision at the base of the Wabiskaw D
10 thins to the south and rises, and so this figure was
11 included to try to contextualize the two Wabiskaw D
12 confinement strata over the KN08 and 9 pads to the
13 south.

14 Based on our understanding from having examined
15 cores and seismic of this Wabiskaw D sandstone body,
16 we -- we don't -- we feel like this tidal bar has been
17 vertically accreting and is draped with these mudstone
18 facies on the side. In contrast to Strobl and Shields
19 earlier core work, the occurrence of high-angle
20 cross-bedded facies is volumetrically very, very small
21 and the breccia component as well in the sands is very,
22 very small based on probably about 50 more strat wells
23 since that earlier work was compiled, and so we don't
24 see much evidence of channelization in those non -- in
25 those mudstone-rich non-reservoir facies and haven't
26 observed any channelization in any of the cores or

1 wells that we've drilled.

2 Q Okay, thank you. I'll pass it over to Commissioner
3 Chiasson.

4 COMMISSIONER CHIASSON: Thank you, Commissioner
5 Zaitlin.

6 Commissioner Barker has a question.

7 COMMISSIONER BARKER: Thank you, ma'am.

8 Q COMMISSIONER BARKER: I just have a quick question
9 for Mr. Thomsen. I just wanted to clarify -- or
10 clarify my understanding of what you had mentioned in
11 response to one of the questions from Ms. Peddlesden.
12 She had asked you if there were any technical concerns
13 with the change to operating MOP in your applications
14 with the change in operating pressure to -- to 5,500
15 kPa. And I thought I heard you mention that there was
16 a minor risk reduction, but then you had mentioned that
17 there could be some increase in operational downtime
18 and a potential for scale plugging.

19 So I didn't know if the risk reduction was related
20 to those things because that sounds like a risk
21 increase to me, but I wondered if I'm muddling up what
22 you had said.

23 A P. THOMSEN: The risk reduction is with
24 respect to ISH's concerns about steam communication
25 with the Wab B gas.

26 Q Okay.

1 A And so that minor risk reduction is with respect to the
2 confinement strata integrity.

3 The -- in a sense, I mean, the consequence of this
4 is there is less operational flexibility for the SAGD
5 operations, and we would not expect this change in the
6 long-term maximum operating pressure to have any impact
7 on scale precipitation, so that's just -- it's an
8 example of a type of unplanned event that can occur
9 with SAGD well operation.

10 Q Okay. So -- so lowering the maximum operating pressure
11 would not have the potential for a scale plugging or
12 increased downtime?

13 A No, they're independent.

14 Q They're independent. Okay. Okay.

15 So the technical concerns you don't have any real
16 technical concerns with regard to lowering the --
17 reducing the -- the operating MOP?

18 A I don't have any technical concerns as far as
19 confinement strata integrity. There are some -- if you
20 can just give me a moment, I just want to confer with
21 my production colleague.

22 Q Yeah. Sure.

23 A Okay. So the reduced operational flexibility has to do
24 with pressures that we can apply to the well and some
25 upset operating conditions, and so, for example, if
26 there was scale precipitation inside a well, inside a

1 tubing, or inside the liner, and we needed to do a
2 stimulation to dissolve some of that scale, it would
3 reduce the pressure that we could inject an acid at,
4 let's say.

5 Does that answer your question?

6 Q It does, yeah. Thanks. So -- yes, that's clear for
7 me. Thank you very much.

8 COMMISSIONER BARKER: Thank you.

9 Q COMMISSIONER CHIASSON: So I have questions on a
10 couple of topics, and I was going to say I'll go with
11 the first one, which is actually likely a set of
12 questions, and I can't point to a particular person
13 because this arises out of what we heard yesterday in
14 evidence, and we heard various different terminologies
15 used in relation to time. And so I'm wanting to just
16 get some clarity around that to understand whether all
17 these different terms we've heard are meaning the same
18 thing or not, and then I have some follow-up on that.

19 So part of it, I think -- and initially,
20 Mr. Lavigne, you had talked about CNRL's definition for
21 barriers and baffles and you mentioned that CNRL's
22 definition for a barrier was that it was not --
23 something that was not permeable to steam over the life
24 of operations. And then you referred to the life of
25 operations again but also made reference to life of the
26 KN08 and KN09 pads and life of the drainage boxes. And

1 then later on I think both Dr. Boone and Mr. Barland
2 made reference to lifetime of drainage boxes, and so
3 I'm wondering, are those all the same thing?

4 A J. LAVIGNE: So, firstly, just for
5 clarification, the definition of barrier and baffle
6 that we used was actually out of the Fustic paper,
7 which -- which was presented in a KN06 decision report
8 and so we -- for continuity, we decided to follow
9 those -- those same definitions.

10 So sort of to this second part of your question,
11 the -- over the life of the boxes or pads or
12 operations -- I think we're all meaning the same
13 thing -- over, say, the 20 years or 25 years of SAGD
14 operations on those pads.

15 I'll invite any of my colleagues to correct me.

16 A G. IANNATONE: I was just going to say I
17 think we've had various numbers in -- in the life of a
18 pad definition or drainage box. I think it was as low
19 as 10 or 15 years and maybe as high as 20. I think
20 what we're talking about is typical. Like, we have a
21 lot of drainage boxes that go beyond 20 years, and we
22 have, you know, others that are shorter, 10. So, like,
23 we have the whole spectrum. So that's why, you know,
24 the definition of a typical life span of a drainage box
25 is -- it's not an exact number. It's a thumb wag.

26 Q Okay.

1 A It's a range.

2 Q Yeah. So that's -- that's part of what I was wanting
3 to understand is with all these terms, are we all
4 talking about the same thing in terms of after this
5 when the Panel sits down to look at it, are we
6 comparing apples to apples and not apples to oranges,
7 to be quite frank.

8 So then, similarly, because Mr. Ollenberger talked
9 about 20-year delay in relation to valuation of the gas
10 resource and talked about on the assumption that the
11 pool would not be able to produce until the bitumen
12 resources at the Pads KN08 and KN09 are completed. So,
13 again, is that the -- is that the same thing in terms
14 of -- when you're talking about that type of timeline
15 and the resources being completed, same thing as
16 lifetime of the operations, lifetime of the well pad or
17 of the drainage boxes?

18 A D. OLLENBERGER: Yes. The 20 years is with
19 respect to what would be considered probably a normal
20 operating life span of a SAGD pad, but of these pads
21 specifically, not necessarily any future pads.

22 I guess just to clarify also, there is a probably
23 high likelihood or strong likelihood that KN08 and KN09
24 will not necessarily start steaming operations at the
25 exact same time.

26 Q Okay. And just in the broad range -- and I understand

1 what you say about being a thumb wag or whatever, but
2 we've got 10 to 15 years, up to 20 years; I may have
3 seen something when I was looking at the transcripts
4 that had mentioned 25. So are we looking 10 to 20? Is
5 there -- are there goalposts, like, broad goalposts
6 that you can point out to us, or does it depend on
7 who's talking about what?

8 A I think probably the difficulty arises from -- though
9 Dr. Boone did say that SAGD is an established
10 technology, and that is true, there's not yet, to my
11 knowledge, a SAGD pad -- definitely I don't think at
12 CNRL or Canadian Natural -- that has reached its final
13 life. And so I think that's where it's relatively hard
14 for us to nail down one number there. We're using 20
15 because I think at our Jackfish asset we have our A pad
16 that is over 20 years of life span and still producing
17 today.

18 Q Okay. So enough about -- talking about timelines,
19 then. We'll move on to my second question.

20 COMMISSIONER CHIASSON: And so for this, Ms. Wheaton,
21 could we pull up -- let me just get the document number
22 right. So 50.002, PDF 44, and I'm interested in
23 Table 5 on that -- on that page.

24 Q COMMISSIONER CHIASSON: So this is the table with the
25 cost estimates, and to some extent some of Mr. McLeod's
26 questions crept into where -- where I was looking to go

1 with it because he asked earlier today in relation to
2 the DFIT estimate, and Mr. Thomsen had referred to this
3 morning in terms of DFIT could cost a range from
4 375,000 to 1 million plus, and we see that it's the --
5 the 1 million figure here. And so I'm interested in
6 understanding in relation to this, and I don't know
7 whether anyone on the witness panel was who prepared
8 this table or not, but in terms of understanding, with
9 these various estimated costs both for ISH requests and
10 CNRL commitments, are these all subject to ranges in
11 terms of a high and a low possibility? Let's start
12 with that.

13 A Yes. I mean, these are estimates. Obviously there's
14 not budgeted numbers. Any work in the KN08 and KN09
15 area we have -- as Mr. Iannattone mentioned, we need
16 certainty on development before we can proceed with
17 developing our assets. So there's always, you know, a
18 time component and inflationary pressures that could
19 change these costs. I think these are generalization
20 costs. There are probably ways to have these costs be
21 reduced. There's probably also ways that these costs,
22 as often happen in the oil and gas industry, could go
23 well above these costs.

24 Q And so then how -- can you talk about how you settled
25 on costs -- the costs, then, in terms of if there's a
26 high and a low? What -- what got picked? Where --

1 where -- what's --

2 A We used our best reasonable estimates today.

3 Q Okay. All right. And so then I guess just -- and so
4 that's for both the ISH estimates and the CNRL
5 estimates there. So I'm a little interested, then, in
6 terms of -- as well because you mentioned in terms of
7 potential for cost savings, that type of thing, and the
8 other one that -- that catches my eye significantly is
9 essentially if we look at the first row running across
10 under the grey about ISH request for minimum one
11 observation well per pad, which you would assume, then,
12 would be two pads, and it's saying 2.4 million. And
13 next to it you've got CNRL commitment in terms of
14 converting -- converting wells, which would appear to
15 come out to 995,000. And so I'm just looking to
16 understand that a bit better because here you're
17 talking about more wells, and I realize it's
18 conversion, but that -- you know, 2.4 million seems to
19 me to be a significantly higher number.

20 A Yes. So in ISH's submission, they did give an example
21 of what they thought was a sufficient observation well
22 where I believe they described a full SAGD observation
23 well with external cemented gauges and thermocouples.
24 Those wells are our most costly wells, and we would not
25 have any existing today that would be able to provide
26 the data that ISH requested. So that is where the

1 large number of the \$1.2 million per well does come
2 from.

3 When you look at our estimated costs for the CNRL
4 commitment, that's where we would convert the 10-34
5 well plus adding surface equipment for what's estimated
6 at \$115,000 -- sorry -- yes, \$115,000. Further, we
7 said we have the existing 100/1-3, which is a standing
8 cased well, so there's no additional cost to drill that
9 well. To convert that well and add surface equipment,
10 that would be where we would be able to go in and hang
11 a gauge and perforate and monitor the Wabiskaw B gas.
12 That would be an additional \$90,000 as estimated.

13 And then if you assume that we needed to go to
14 KN09 and provide a new standing cased well for \$700,000
15 approximately and then convert that well for the
16 previous mentioned \$90,000, that is how we add up to
17 the \$995,000.

18 Q Okay. And just -- just -- perhaps I misunderstood the
19 submission that CNRL filed on January 23rd, so the
20 reply submission because my understanding was that the
21 suggestion was on the future gas monitoring well on the
22 KN09 that that would be a conversion out of a -- out of
23 a stratigraphic well or out of a -- any number of
24 stratigraphic wells that you would be planning to -- to
25 do over the KN09 -- the KN09 area?

26 A Yes --

1 Q Am I wrong?

2 A -- that's correct. It would be a new well.

3 Q Okay. So this is taking into account the brand-new
4 cost for that well that you would be planning to drill
5 anyway otherwise for -- for -- for stratigraphic
6 purposes?

7 A Potentially. We would not necessarily be leaving it as
8 a standing cased well, so there is additional expense
9 to that. And I guess the point would -- being that in
10 our submission we felt that the existing 100/1-3 well
11 and 10-1 well do provide sufficient monitoring.

12 So, yes, if we wanted to be, again, reducing
13 costs, you could in theory say we were going to convert
14 an OSC well that was not going to be cased, and there
15 would be some additional savings if you applied that
16 full value.

17 Q Okay. Thank you. That was what I was looking to now,
18 and --

19 COMMISSIONER CHIASSON: You're good?

20 Okay. So that is it for the Panel's questions.

21 So now, Ms. Jamieson, I guess we're looking to you
22 as to whether or not Canadian Natural is looking to do
23 redirect?

24 J. JAMIESON: Yes. So I am -- good
25 afternoon, Commissioners. I am very keenly aware that
26 I am between -- my questions are between everybody

1 going home after a very long day. So -- but I would
2 like to do -- I think I can be done in 10 to
3 12 minutes, provided my panel cooperates. So I would
4 propose to -- if you can allow me, I would really like
5 to get it done, and then the panel can be released for
6 the evening.

7 G. IANNATONE: Yeah. Ms. Jamieson, we have
8 the undertaking -- the answer to the undertaking as
9 well.

10 J. JAMIESON: Yes. That can come back in
11 tomorrow, though; correct?

12 G. IANNATONE: We --

13 J. JAMIESON: I think --

14 G. IANNATONE: We have the answer tonight, if
15 you want it.

16 J. JAMIESON: Oh, you have it right now?
17 Okay.

18 G. IANNATONE: Yeah, we have it. So it'll
19 take 30 seconds, I believe.

20 J. JAMIESON: Why don't we start there.
21 That's great.

22 G. IANNATONE: Okay. So I think the
23 undertaking was -- the question was: Does Canadian
24 Natural have any reserves currently booked to the Kirby
25 Upper Mannville II gas pool? And the answer to that
26 question is: No, we do not have any proven or probable

1 reserves booked to that pool. The reason we don't have
2 reserves is because under the co-key [phonetic] -- the
3 rules is that we don't have line of sight to the
4 regulatory approval. So although -- although the
5 reserves will be produced at some future point in time,
6 we can't predict when. So no reserves, no value.

7 (UNDERTAKING 1 FULFILLED)

8 COMMISSIONER CHIASSON: Okay. Thank you.

9 ISH, anything that -- that you'd have out of that?
10 Because I know we did -- you did indicate that you'd
11 closed off your questions, subject to anything that
12 might arise out of the undertaking.

13 M. RILEY: My apologies. If we could
14 please consult.

15 COMMISSIONER CHIASSON: Okay. All right. Let us
16 know, please.

17 M. RILEY: To confirm, ISH has nothing
18 further.

19 COMMISSIONER CHIASSON: Thank you very much.

20 All right, Ms. Jamieson. Let's proceed with your
21 redirect, then.

22 J. Jamieson Re-examines the Canadian Natural Resources
23 Limited Witness Panel

24 Q J. JAMIESON: Okay. Good afternoon, panel.

25 Dr. Boone, I'm going to start with you. You
26 received a number of questions from Mr. McLeod --

1 that's ISH's legal counsel -- I believe -- well, mostly
2 yesterday -- a little bit today -- regarding your
3 qualifications to provide the different parts of your
4 assessment on the hearing issues. Can you very briefly
5 speak to why you are qualified to provide the
6 assessment that you did in terms of your professional
7 credentials and experience?

8 A T. BOONE: Sure. So my original PhD
9 thesis was in the area of rock mechanics, but it was
10 actually fracture propagation in pore elastic
11 materials. It was sponsored by Schlumberger. So I
12 developed a fair bit of expertise in fracture mechanics
13 and geomechanics at that time.

14 I -- I subsequently moved to Imperial Oil's
15 research lab, where I was mostly working in
16 steam-induced fracturing. We had some containment
17 issues at the time, so I spent considerable part of my
18 career working caprock integrity, potential fluid
19 losses outside of zone for various problems and
20 developed monitoring techniques that were applied in
21 the oil sands industry.

22 And then I started doing a lot of work in pilots.
23 I was running the pilot program, so drilling different
24 wells, doing types of recovery processes. I evolved
25 into becoming a reservoir engineer.

26 Spent some time in Houston doing reservoir

1 simulation and in Norway as well doing reservoir
2 simulation, drilling wells, that type of thing. Came
3 back. I was the research manager for Imperial Oil, oil
4 sands recovery research is what we called it, but at
5 the time we were mostly working on solvent processes,
6 SAGD for -- solvent-assisted SAGD for the Athabasca.
7 We were modelling it in the lab, running pilots at Cold
8 Lake but also other solvent processes for Cold Lake.

9 And then after that role, I -- I moved on to work
10 for ExxonMobil as the senior EOR reservoir engineer
11 worldwide, so I went around the world looking at
12 various projects and --

13 Q And in all of that time, have you provided other risk
14 assessments like the one that you provided on these
15 hearing issues?

16 A Risk assessments within Imperial Oil in particular
17 is -- I'm going to say it's a daily process. So at the
18 research lab every project that we have, we did risk
19 assessments. For everything in the field, we did risk
20 assessments. I mean, one good example is for the
21 Nabiye project. We encountered -- well, CNRL had some
22 issues north of us. Just as we were going to -- to go
23 drill up the project, we convened a large team of
24 experts, or I should say a modest team of experts, five
25 or six of us, evaluated the caprock integrity, and
26 based on our risk assessment, added four or five more

1 wells to the program at the last minute, which wasn't
2 well received by everyone but technically was certainly
3 justified.

4 Q The risk assessments that you're talking about, do they
5 include using the APEGA guide and model that you have
6 provided in your report?

7 A Similar. I would say the process was the same. I use
8 the APEGA guide, and, of course, working for Imperial
9 Oil, every company has its own risk assessment process.
10 So they're all somewhat different but fundamentally
11 they're the same.

12 Q Thank you.

13 You were also asked about whether you had any
14 other clients other than Canadian Natural during the
15 past year. If the question had been posed the last
16 five to ten years, what would your consulting practice
17 have looked like? How would you have responded?

18 A Since I retired? I have done some consulting for a
19 geomechanical company. I've done another hearing like
20 this for another company. I was hired in a patent
21 infringement lawsuit related to SAGD in in-fill wells
22 that took a year and a half. I was the -- the
23 non-infringement expert.

24 Q Okay. You also received a number of questions with
25 respect to how you had sourced the information and --
26 that you relied on in your report, which included

1 receiving information and data from various Canadian
2 Natural personnel.

3 So the question is: Can you just briefly review
4 your methodology for collecting and analyzing the
5 information and data?

6 A At the high level -- so I went and looked at reports
7 and papers and things out there that -- that recommend
8 how to assess caprock, and generally they say you're
9 going to end up with a qualitative answer. It's
10 geology. You're never going to be able to definitively
11 say, No, this is a hundred percent going to seal
12 whatever material you're trying to seal, whether it's
13 CO2, steam, or waste.

14 And so generally the recommendations are, you
15 know, develop a list of all the factors that might
16 apply and assess them all. And that's things like --
17 and that's why I had that table at the beginning. So
18 do you have enough core wells in the area to make a
19 reasonable assessment? Do you have enough wells for
20 FMI, that sort of thing? What other evidence is out
21 there?

22 So what I tried to do was take a comprehensive
23 approach like that. I also looked at the AER
24 directives and that guided some of the choices of the
25 parameters I looked at. And then CNRL sort of more or
26 less gave me open access to talk to anyone in their

1 organization and seek out data that I thought was
2 appropriate and needed to be considered.

3 Q And during that process, which included contact with
4 Canadian Natural staff, how did you maintain your
5 independence?

6 A I -- you know, I didn't ever think it was a problem
7 maintaining my independence. I'm -- I am independent.
8 These are my conclusions. I recognize that, and I need
9 to own them, and, you know, I -- I -- those are my
10 professional opinions that I have provided in the
11 reports.

12 Q Thank you, Dr. Boone.

13 Mr. Sverdahl, yesterday you were asked a question
14 about whether faults or fractures can be seen on
15 seismic. I think it came up again this afternoon, and
16 you did acknowledge that small faults and fractures
17 cannot be seen on seismic, so "subseismic", we heard
18 that term as well.

19 Can you briefly confirm, please, that if small
20 faults and fractures cannot be seen on seismic, what is
21 Canadian Natural's workflow for identifying small
22 faults and fractures?

23 A S. SVERDAHL: We review all -- all other
24 data such as core data and image logs to understand if
25 there's fractures or fracture intensity within the
26 areas that were --

1 Q Sorry. I'm going to stop you because can you just
2 bring your mic closer to you. You're soft spoken and
3 it's just -- speak right in there. Thank you.

4 A Yeah. Our primary method of understanding if there's
5 faults and fractures -- small-scale faults or fractures
6 is to review all of our core data, all of our image log
7 data. We also look at the seismic in context of areas
8 where we see things like sags from differential
9 compaction, and we test those areas as appropriately
10 with strat wells and run them, either core and/or image
11 logs, through those features. So we investigate areas
12 where we believe there could be fractures or faults
13 that aren't necessarily detectible on the seismic but
14 we know they may exist. They're in the areas of
15 greater differential compaction. So, yeah, it's an
16 integrated workflow to understand where they -- they
17 may be, and we -- we test these features as necessary
18 with getting more direct geological data.

19 Q Thank you. Last question: Mr. Lavigne, so Canadian
20 Natural was asked a series of questions at the end of
21 yesterday, actually, regarding -- and then I believe
22 AER legal counsel came back to it, but it had to do
23 with Canadian Natural's use of, first, third party
24 analyzing GCMS data using Schlumberger's lab. Do you
25 recall that set of questions?

26 A J. LAVIGNE: Yes.

1 Q Okay. The question for you: Can you please clarify
2 Canadian Natural's workflow for integrating GCMS data
3 into its confinement strata interpretation.

4 A Firstly, at the sampling level, Canadian Natural
5 strategically picked samples in cores to test
6 stratigraphic units that we have correlated to other
7 wells, and -- and then we apply industry standard
8 display techniques and plot it consistently with --
9 sorry.

10 Sorry. So the GCMS, to reiterate, is -- it's one
11 part of a much bigger workflow, and so we've mapped
12 units, we assess logs, and, as I mentioned, we pick
13 stratigraphic surfaces that we try to -- that we want
14 to test; particularly in the reservoirs, we're very
15 concerned about steam rise. There's tremendous
16 economic implications for barriers and baffles within
17 the reservoir. So we start to -- we start there and
18 then -- and then we apply the sampling up through the
19 confinement strata to test the longer-term containment,
20 but we -- we have a third-party vendor conduct the
21 actual analysis, but then we have the expertise
22 in-house that -- that we use industry standard
23 techniques to plot and analyze the data, but it's
24 always layered back to our stratigraphic foundation.

25 Q Thank you.

26 I see Mr. Sverdahl. Do you have something to add?

1 A S. SVERDAHL: I think Mr. Lavigne covered
2 most of it. Like he said, we do all of our mapping,
3 you know, based on -- on the available well log data,
4 core data, image log data. We integrate surfaces as we
5 can with seismic, and we layer on the GCMS data to all
6 of our other vast geological understanding. The
7 analysis for the GCMS data, the lab analysis, is done
8 by Schlumberger in-house, and we do the interpretation
9 of that lab data that is provided to us and layer that
10 into our -- our geological models of both the reservoir
11 understanding and the confinement strata.

12 J. JAMIESON: Thank you, Commissioner
13 Chiasson. Those are all my questions. Thank you.

14 COMMISSIONER CHIASSON: Thank you, Ms. Jamieson.

15 So at this point, and I'm just going to ask you
16 gentlemen not to all jump up, but as a witness panel
17 you are -- are released, so we are done with you there,
18 but because I do have a couple of closing comments, and
19 that it would be easier if you wait 'til we close it
20 off for the day.

21 So I realize we are clearly -- clearly behind and
22 that we were -- we were scheduled initially in the
23 schedule for ISH to start direct evidence today. I'm
24 assuming that you would prefer to leave that 'til
25 tomorrow morning and start off with your -- with your
26 direct tomorrow morning.

1 M. RILEY: Certainly, yes.

2 COMMISSIONER CHIASSON: Yes. Okay. And we're well
3 aware that the concern is that Dr. Chalaturnyk has --
4 has timing restrictions in terms of that he's not
5 available on Friday, so we need to ensure that
6 cross-examination in relation to any of his evidence
7 from both CNRL and any questions that we have from the
8 AER occurs tomorrow. So we will make sure that that
9 happens.

10 Is -- and so I guess I'm just testing in terms of
11 from the parties' perspective, is there a desire to
12 start earlier than 9:00 tomorrow or to look at how --
13 how we can adjust the day as it goes along?

14 And -- sorry -- I guess in that, I should check
15 and make sure if our court reporters would be available
16 earlier if that was an option. Yes. Okay. I'm seeing
17 a nod yes from them, but ...

18 M. RILEY: I don't want to be difficult,
19 but earlier is not really a possibility for us because
20 we have panel members with children and some
21 obligations early in the morning.

22 COMMISSIONER CHIASSON: That's absolutely
23 understandable. So that's not -- that's not a problem.
24 We just thought it was something that -- that we would
25 test.

26 So that's -- that's fine. We will start -- we

1 will start at 9, and we will look to -- look to see, I
2 guess, how -- how the day flows. I guess I would test
3 with both parties in terms of -- so clearly today we
4 ran a little later than planned. Is there the
5 flexibility there in terms of running -- because right
6 now what we had projected for tomorrow was 'til just
7 before 5:00. Is there the flexibility or the interest
8 in terms of running a little longer tomorrow if need
9 be?

10 M. RILEY: We will make arrangements to
11 make that possible if we need to.

12 COMMISSIONER CHIASSON: Okay.

13 M. RILEY: We will also overnight review
14 the evidence we intended to present and see if there
15 isn't some time economics to be gained.

16 COMMISSIONER CHIASSON: Thank you. We appreciate
17 that, but we don't want to put the squeeze on you
18 otherwise because we -- we recognize that things
19 have -- things have a way of growing generally, aside
20 from what -- what you have got, so thank you.

21 So we'll be -- we'll be alive to that tomorrow.
22 So we will confirm that we resume tomorrow morning back
23 here at 9:00. As we reminded everyone yesterday, the
24 rooms here are not secure. I am assuming that the
25 breakout rooms are not secure, so please make sure that
26 you take all your belongings with you 'til tomorrow,

1 and thank you all for your participation today and,
2 gentlemen, for your patience sitting in those seats
3 for -- for -- for two days. We appreciate it.

4 And actually also we would like to provide the
5 feedback to everyone. Thank you for making the effort
6 to use the microphones today and speak clearly. It
7 made a big difference for us. So thank you so much.

8 (WITNESSES STAND DOWN)

9 _____
10 PROCEEDINGS ADJOURNED UNTIL 9:00 AM, FEBRUARY 8, 2024

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1 CERTIFICATE OF TRANSCRIPT:

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3 We, Sandie Murphy and Sandra Burns, certify that
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6 shorthand and transcribed from our shorthand notes to
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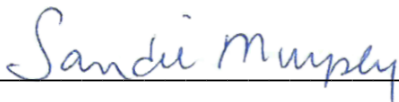
8 Dated at the City of Calgary, Province of Alberta,
9 this 7th day of February 2024.

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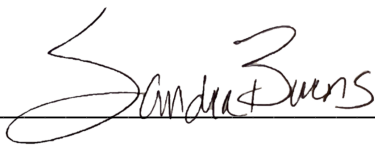
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