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 1

Calgary, Alberta

February 6, 2024

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(PROCEEDINGS COMMENCED AT 9:17 AM)

Opening Remarks

COMMISSIONER CHIASSON: So a question before we start. Are we standardly leaving the door open to the foyer there? I suspect it would be a noise distraction. Thank you.

Good morning, and welcome to Govier Hall. Thank you for attending to participate in and observe the hearing in Proceeding 430. My name is Cindy Chiasson, and I am the hearing commissioner chairing this hearing. The other Panel Members are on my right, Meg Barker and on my left Dr. Brian Zaitlin.

COMMISSIONER ZAITLIN: We ask that the parties refer to us as "Commissioner Chiasson", "Commissioner Barker", and "Commissioner Zaitlin", and that you refrain from using the term "Madam Chair".

My colleagues and I respectfully acknowledge that we are holding this proceeding on the traditional territories of peoples of Treaty 7 region in southern Alberta, which includes the Siksika, Piikani, and

Tsuut'ina Nation and the Stoney Nakoda Nation, which includes the Chiniki, Bearspaw, and Wesley First Nation, Mohkinstsis, also known as the City of Calgary, is also home to Metis Nation of Alberta Region 3.

I want to introduce the AER staff who are assisting the panel in this proceeding. Please identify yourself when I read your names.

So we have Will McClary and Shannon Peddlesden of the law branch, when I read your names.

Andrew Lung, the hearing coordinator for this proceeding. The technical staff assisting the Panel are Susan Harbidge, Maksim Xhaferllari, Felix Chiang, Scott Botterill, Baohong Yang, and Elwyn Galloway.

Additional staff supporting the hearing may change throughout the week. This morning we have Denise Parsons and Fahad Hamdan from hearing services, and do we have Anastasia there as well?

And, Anastasia, I apologize because I remember your maiden name but not your married name. So I will correct that when I have a chance to look. The hearing panel and all the AER staff in the hearing room are wearing name tags whether they are assisting in the proceeding or observing participating. If you have questions about this proceeding, please approach the staff supporting the hearing for assistance.

Communications with the Hearing Panel must be on

the record; therefore, don't speak to Panel Members unless it is part of the hearing. We're not trying to be unfriendly, but, to be fair and transparent to the hearing parties, all communication with us must be on the record. We appreciate everyone's understanding and respect on this request.

In addition to AER staff, we have court reporters to transcribe the proceeding. We ask the hearing parties to be mindful of speaking slowly and not interrupting or talking over each other for the court reporter's benefit.

Video of the hearing is being live streamed through a link on the AER's website. We do not keep a record of videocast, and the video is not an official transcript. The court reporter will prepare the only official transcript of this hearing. To any viewers who are observing the video cast, we advise that recording or rebroadcasting of hearing audio or video is strictly prohibited, and the same applies to anyone here in the room.

As well, we would advise for anyone in the room that there is the possibility because you are video casting that may show up on the video, so if you have concerns please speak to hearing staff.

Mr. Lung, please tell us the safety procedures as well as the particulars of this proceeding and the

publication of the notice of hearing.

A. LUNG: Thank you, Commissioner Chiasson. In case there is a building alarm, listen for directions and ask -- to evacuate turn left as you evacuate Govier Hall and proceed down the stairs. The muster point is in the lobby of the Eau Claire Tower, which is across the street to the west of us.

In the event of a medical emergency, call 9-1-1 and then alert an AER employee, who will notify building security. The first aid kits, defibrillator, and first aid extinguisher can be found by the sink in the foyer area that you came in.

The fire phone on this floor is located right outside of the elevator lobby. Ms. Harbidge, in the back row, is trained in first aid.

An AER employee will be present to assist anyone who requires support to evacuate should there be an emergency. For other emergencies, please alert any AER staff. Please note that Govier Hall is the only AER room on this floor, all other conference rooms are private, and if not booked for your use, please don't use it.

The subject of today's proceeding is Application 1936092. On March 11, 2022, the AER received Application 1936092 from Canadian Natural Resources Limited under Section 13(1) of the Oil Sands

Conservation Act and Directive 23, oil sands project applications to amend Commercial Scheme Approval Number 11475.

The amendment is for Pads KN08 and KN09 within -- or with the addition of two SAGD drainage boxes. The statement of concern from ISH Energy Limited was received on April 8th, 2022.

The AER determined that the application should be set down for a hearing on May 1st, 2023. The notice of hearing and notice of scheduling of hearing are Exhibits 2.01 and 51.001 respectfully and were distributed directly to all parties.

The materials filed for the hearing have been marked as exhibits. The parties were sent a copy of the most recent exhibit list on February 1st, 2024. That's all, Chiasson Commissioner.

COMMISSIONER CHIASSON: Thank you, Mr. Lung.

We will now register the hearing participants. Please speak clearly and not too quickly into the microphone so the court reporters can hear you and for the video webcast. State your name for the record, spell your surname for the court reporter, and confirm the party you are representing.

And this piece here is applicable for the whole hearing. Technical limitations only allow five microphones to be live at any one time, and you'll see

we've got a multiplicity of them here. So please mute your microphone when you are finished speaking.

Who is representing the applicant, Canadian Natural Resources Limited?

J. JAMIESON: Good morning, Commissioner Chiasson. My name is JoAnn Jamieson. Jamieson is spelt J-A-M-I-E-S-O-N, and I am here representing Canadian Natural Resources Limited as the applicant in this application.

I do want to clarify, if I could, that seated here at the table with me are two corporate representatives. I can introduce those just for the record. So there's no co-counsel, but Maude Ramsay, spelled R-A-M-S-A-Y, is regulatory manager for Canadian Natural Resources Limited. And seated beside Ms. Ramsay is Mr. Gerard Iannattone -- Iannattone, and he is vice president of Athabasca Oil Sands for Canadian Natural. Iannattone is spelled I-A-N-N-A-T-T-O-N-E. Yes, correct. I believe those are all our comments. Thank you.

COMMISSIONER CHIASSON: Thank you, Ms. Jamieson. Who is representing ISH Energy Ltd.

M. RILEY: Good morning. My name is Marlé Riley, R-I-L-E-Y, and with me I have Andrew McLeod, McLeod, M-C-L-E-O-D, and we are counsel for ISH Energy. Thank you.

COMMISSIONER CHIASSON: Thank you.

So, Ms. Jamieson and Ms. Riley, I'm going to mention right now, if you're able to either adjust the mics to come a little closer to you or speak a little louder, 'cause I can say right now I was not hearing you as clearly as -- as I might have hoped. So thank you.

So I will now explain the procedures for this hearing. The Panel expects all hearing participants and observers to be respectful and civil throughout this proceeding. According to Section 21 of the Alberta Energy Regulator Rules of Practice, all witnesses must give evidence under oath or affirmation. The court reporters will provide for this when witnesses come forward to give evidence. All witnesses who are sworn or affirmed are not allowed to discuss evidence amongst themselves or with counsel or others during breaks until such time they are released by the Panel.

Please note that we will not be qualifying expert witnesses in this hearing. Having said that, it will be open to each party to argue what weight we should give a witness's evidence based on that witness's qualifications or other relevant factors.

During this hearing exhibits will be referred to and displayed on the screens in this room. To assist all participants, we ask counsel and witnesses to

identify each document they refer to by its exhibit number, then the relevant PDF page number within the document, and the paragraph or line number, if applicable.

Please pause after giving an exhibit number to give our staff time to find the relevant exhibit and then confirm that the exhibit that you requested is being displayed. It is not our staff's responsibility to guess about the exhibit if your reference is incorrect.

We will be following the order of presentation set out in the AER Rules of Practice. First, I will ask Canadian Natural to come forward and present its direct evidence. Canadian Natural has been allocated through mid-afternoon today to present its direct evidence; following which, ISH will begin cross-examination of Canadian Natural's witnesses. We plan to wrap up Day 1 of the hearing at 4:35 PM.

On Wednesday, ISH will complete its cross-examination followed by any questions for Canadian Natural's witnesses by AER staff and the Panel. After this, Canadian Natural may redirect. This is scheduled to take us to mid-afternoon on Wednesday. After a break, ISH will begin its direct evidence, and we plan to wrap up Day 2 of the hearing around 5:05 PM. On Thursday, ISH will complete its

direct evidence followed by the start of Canadian Natural's cross-examination. We plan to conclude Day 3 of the hearing at 4:50 PM.

On Friday morning, Canadian Natural will complete its cross-examination of ISH's witnesses and AER staff and the Panel may also question ISH. Following that, ISH may redirect and Canadian Natural may present rebuttal evidence. There will then be ISH's cross-examination of Canadian Natural on rebuttal if needed and questions by AER staff and the Panel for Canadian Natural on rebuttal, if needed.

After a break we will hear closing argument first from Canadian Natural and then from ISH. Our plan is to conclude the hearing around 5 PM on Friday.

After the hearing has concluded, we expect to issue the hearing decision within 90 days.

Please note that the Panel Members may be taking notes throughout the hearing. Even though we may not be making direct eye contact with you at all times, please understand that we are listening to what you are saying.

We request that the parties remain in the hearing room throughout the proceedings to maintain procedural fairness and in consideration of those giving their presentations. Should any of the parties require a break during the proceedings, please let me or hearing

services staff know. We have breaks planned for each morning and afternoon as well as a hour lunch break every day.

We ask that everyone present in the room ensure that your electronic devices, including telephones and computers, are set to "silent" mode through the hearing. If you must take or make a call and cannot do so at a break, please step out of Govier Hall to do so, and by "out of Govier Hall", I mean out into the hallway outside of the foyer because the sound carries.

As I mentioned before, recording or transmission of this hearing, other than the official transcript and AER videocast, are not permitted.

In our review of the exhibits filed in this proceeding, the Panel notes that there appears to have been a narrowing and focusing of the parties' position on some hearing issues. The parties can assist us by identifying matters that are not in dispute between them. In those circumstances, we strongly encourage the parties to focus their direct evidence, cross-examination, and argument on those matters that are still in contention.

So I understand that we have two preliminary matters to deal with. The Panel we have before us -- there's the question of materials that CNRL sought to file yesterday morning, and the Panel plans to deal

with that first, and then we have a motion that was to adjourn that was filed by ISH this morning and depending on the -- and the Panel will look to address that after it has dealt with the first piece on the material sought to be filed by CNRL.

So, Ms. Jamieson, if you would like to proceed and tell the Panel a bit about this material that CNRL has sought to -- to file.

J. JAMIESON: Is this better audio if I move it forward?

COMMISSIONER CHIASSON: Yes. Thank you.

Submissions by J. Jamieson

J. JAMIESON: Yes. Thank you, Commissioner Chiasson.

So I'll just provide a little bit of context. The material that's in question right now is Canadian Natural's direct evidence presentation, and what we did was we put together an opening statement, and there's extensive technical evidence that's been filed in this proceeding, so the idea was to put forward a PowerPoint presentation that Canadian Natural witnesses could, you know, move through and provide both their opening comments as well a review of the technical evidence, and that was the idea.

We -- of course, the Panel would be aware that Canadian Natural's KN06 application went through a

similar full hearing process -- that one was online during COVID -- but we filed a very similar direct evidence PowerPoint presentation. There was no issue there. We filed it, gave it. There was no issue, and so we were attempting to do a very similar thing here.

With respect to timing, there was a couple of things. We did reach out to Mr. Lung to request a -- just a sense of timing when the direct evidence presentation would need to be filed. We were advised at least 24 hours prior to, and that's what we attempted to do. So it was, of course, the weekend. We filed first thing Monday morning.

The -- in terms of the content of the material, we heard from Ms. Peddlesden late yesterday, just some concerns about the content of the direct evidence presentation, and she pointed out a couple, sort of, rules that we needed to be aware of. One was in terms of when we were presenting material in the slide deck to make sure that we had sourced the exhibit number, and we had done that by far for the majority of the information; however, there were a couple of places where we had combined sort of maps and figures on one slide, and so we had to go back and review and make sure we had identified, you know, both exhibits where that information -- there's no new evidence being filed, no new data, no new interpretations. It was

just trying to present this very complicated technical evidence in a way that could be consumed in a three-hour block, you know, by the Panel.

And the other thing that we had done -- again, we hadn't -- we had reached out, again, to Mr. Lung, but we hadn't yet received confirmation about whether or not there would be a laser pointer. If we had -- you know, because we didn't know whether there would be a laser pointer, we had included some, you know, colour and shading. Also there's some, you know, arrows on some of the slides and also, you know, just visual cues to sort of help the reader follow the talking points of the witnesses. So that's what we had done. We thought we were onside the rules by doing that, but given Ms. Peddlesden's correspondence, we did quickly -- the team has spent the last six to eight hours going back through making sure that there are exhibit numbers for each of the figures and maps, anything that we sort of combined on one slide to make sure that it could be tracked and -- back to the record.

We did remove anything that was sort of unique or outside, like, that we had -- like, visual markers that we had superimposed, with a few exceptions. There was some, you know, very light shading on a couple of images. We made that darker, that kind of thing. We also bolded.

So we have confirmation now that there is a mouse available that the witnesses can point to things on the slide. So we removed as much of that as we thought was, you know, practical. We have filed a revised presentation this morning. We're prepared to proceed, if that's acceptable to the Panel. We're also prepared -- the witnesses tell me that they're -- if they can't have their visual, their direct evidence, that they'll proceed by just, you know, reviewing and going through their talking points which they prepared, so if it really is a -- is a problem.

The question of new evidence -- I'll just speak to that, because we are aware of the rule in the -- AER's Rules of Practice about not filing new documentary evidence. There was no attempt to do that. It really was just to try to communicate very complicated technical evidence that's already been filed. We have reviewed it. We don't believe there's anything new there that can't be sourced from the record. And so the material is with the hearing coordinator, I believe, at this point. But that's really our request, if we could please proceed with this revised presentation.

COMMISSIONER CHIASSON: So my understanding is that this is not a simple few-pages opening statement, that we have a slide deck that CNRL's present -- planning --

suggesting to present about 154 slides.
J. JAMIESON: Yes.
COMMISSIONER CHIASSON: Which is a fairly substantial matter, and if there's no new evidence, can you explain to the Panel why this could not have been provided on January -- January 23rd when CNRL -- CNRL's deadline was for filing -- filing its reply submission?
J. JAMIESON: Well, I think that just simply can be explained by time constraints. I mean, we were very focused on getting the reply submission in, which in itself was an extensive document. That was two weeks ago, and so then the -- the -- our witness panel went right into preparing their direct evidence.

I -- you know, my counsel to them -- because, in my experience, coming into a hearing with your direct evidence or your opening statement is standard, and like I say, for the KN06 proceeding, we did that in the form of the PowerPoint and because there's so much technical evidence, but it has literally taken two weeks to prepare that PowerPoint as well as the speaking points because, of course, it's a review of literally hundreds of pages of technical evidence.
COMMISSIONER CHIASSON: And that's not something that could have been a heads-up given to both ISH and the Panel.
J. JAMIESON: Yeah. I appreciate your

point, and, believe me, in hindsight that's exactly what we were -- what we would have done. We did not believe we were presenting anything new or novel. It's just a summary of Canadian Natural's technical evidence. The actual opening comments, I think, are less than ten slides, and then it goes into the five hearing issues as well as Dr. Boone's independent assessment, and, you know, that's -- I have no other explanation. That's the time it took to put that together.

COMMISSIONER CHIASSON: Okay. Thank you, Ms. Jamieson.

We would like to hear from Ms. Riley now. And, Ms. Riley, what we would like to hear from is not in relation to your motion. At this point we would like to hear in relation to what CNRL is seeking to put on the record.

Submissions by M. Riley

M. RILEY: Certainly. Thank you.

The problem that we have, in the first place, is I understand that this morning at 20 to 8, this new updated slide deck was -- was sent by email. I was not favoured with that email. I learned about that when I met with my -- with my client. Apparently it was sent to co-counsel, but I did not receive it, and I was not with him this morning.

So as we stand here, I have not even seen this new slide deck. The purpose of the 24 hours is to allow us to verify what is on that slide deck to go to the record, to compare what is there, to see if we have any concerns, anything that we need to tell the -- the Panel. We do not have that opportunity.

What is proposed now is that the slide deck be filed, and while we're listening to the evidence, we have to go to the record, see what is there, see if there is anything we want to cross-examine on, and that is wholly unfair and not within the rules.

There's been quite a bit of mention about what happened in the KN06 hearing. In KN06 it was a virtual hearing. The directors made provision for the filing of an opening statement. This directive in this hearing does not provide for that.

Ms. Jamieson also mentioned that it took two weeks to prepare. If they -- CNRL had two weeks to prepare the slide deck, surely ISH should be allowed a little bit more than an hour to have a look as well. We object to the filing of this document, and we submit that it should not be allowed at this late -- this time.

COMMISSIONER CHIASSON: Thank you, Ms. Riley.

Thank you. We're going to take a short break, and the Panel is going to step out to discuss.

(ADJOURNMENT)

Decision

COMMISSIONER CHIASSON: Thank you all for your patience. Actually, before we get going, just a reminder from the panelists again -- and I would point out to counsel you can pick up the mic and move it around. So adjust it on the dais. We need you to have it close to you so that it's -- so that it's coming through. So we'll do that.

Thank you, everyone, for your patience. The Panel has discussed, and we have determined -- we heard reference to two documents, one that CNRL filed yesterday and a revised one that they produced this morning. Neither of -- we have decided that neither of those documents will be allowed, and we've taken into consideration in making that determination the fairness to ISH in relation to how it would affect them in terms of managing -- managing in this proceeding and the lack of preparation time. CNRL has indicated to us that they are prepared to proceed without the document.

And the Panel would like to note that we appreciate that there was reference made by both parties to the 397 proceeding and that such matter was allowed in the 397 proceeding. We would point out, one, the 397 proceeding was a fully electronic hearing -- the first electronic hearing that the AER

had held because of COVID -- this is not -- and also that the 397 proceeding is not binding on this Panel or on this proceeding, and, in that vein, we would remind the parties that nothing that was on the record in 397 is automatically part of this proceedings, materials, or record. So if either party is looking to incorporate and make reference to -- or want us to consider any materials that were live in 397, those are not on our -- those -- unless they've been filed by parties, they're not on our record, and you can govern yourselves accordingly in relation to that.

So, in that vein, we will mention that we are open to allowing CNRL to adjust before seating their witness panel. What we want to do is move on to -- we also have before us a motion from ISH this morning to adjourn. So what we want to do is move on to that.

So, Ms. Riley.

Submissions by M. Riley

M. RILEY: Thank you.

The motion by ISH engages the AER jurisdiction to make orders in respect of its own procedure to instruct parties to file further material and to adjourn matters on any terms that the Panel may deem fit. I want to be clear that before we received this presentation from CNRL that has now not been allowed to be filed we had no intention of seeking an adjournment. ISH had

prepared its submissions based on the record.

A great deal of the concerns that ISH has, and as a part of the basis of the application for adjournment, was the prejudice that stemmed from this presentation, which arguably now may be cured because the presentation is not allowed on the record; however, that does not resolve the problem.

What we saw in that presentation is that there is further information available specifically on the modelling that is not before the AER. It also appeared to ISH from that presentation that CNRL has changed its interpretation that is extremely relevant to the Panel and to the hearing issues.

The AER cannot be expected to make a decision in the vacuum of all relevant information. Specifically, ISH's problem is this: When we approach the geomechanical evidence, it was on the basis that there is nothing before the AER regarding deformation. Then we received the response to the AER's information request and the modelling again, and we had another look. Nothing in the information requests filed or responses filed dealt with the deformation issue. It is a standard model you used for caprock integrity, but it did not answer the actual issue before this Panel, and that relates to the underlying strata and what would happen to those strata while SAGD operations are

underway.

In Slide 116, we saw new information regarding the modelling, relevant information, and information that would -- would change ISH's experts' views and would also result in further questions being asked by ISH's experts. To this end, that is why ISH does not just want an adjournment. ISH is also applying for further procedural direction. ISH is requesting that the technical experts meet so that we can determine exactly where the -- this alignment between ISH and CNRL is so that we can have a focused hearing on just the issues that are still in dispute.

It's clear from the presentation that there is more to be seen yet and more to be said. And in the public interest, all of the relevant information should be before the Panel before the Panel makes a decision.

Another issue that appeared from this presentation that was not allowed is the issue of CNRL's ever-changing ask. For instance -- and you see that from our model -- or from our motion -- CNRL indicated that they seek a maximum operating pressure of five thousand five -- no -- sorry -- not MOP, a standard operating pressure of 5,500.

But if you look at ninety -- Slide 96, their work is still being done at 6 ,000 kPa. So it's not clear to ISH what exactly CNRL wants, and that makes it very

difficult to prepare for a hearing and to know what case to meet.

CNRL will complain about prejudice if this hearing is adjourned. We have two responses to that. Any prejudice that CNRL suffers will be financial -- and they have indicated that financial harm is not something the AER should care about -- and they are the author of their own misfortune. They have decided to file further -- well, attempted to file further evidence on the eve of this hearing. Had we not known about this further information, well, we don't know what we don't know, but now that we know about it, this allowing CNRL to file it does not make that information go away, and that is why ISH is seeking the adjournment, the directives for a technical meeting further evidence, and then ancillary relief.

Those are my submissions. I don't know if there's any questions.

COMMISSIONER CHIASSON: Yes, there are.

So my understanding is, from what Ms. Jamieson told us earlier, that what we disallowed had no new evidence, so what we're looking to proceed on today is all the material that's been on the record. You made reference to geomechanical modelling, the rest of it. We've had an extensive procedure in this proceeding, including extensive information requests, the last of

which were filed, I believe, three weeks ago. Why weren't we hearing concerns about this three weeks ago, Ms. Marlé -- Ms. Riley?

M. RILEY: We indicated that in our motion. We had a look at it. We saw that -- well, there's still no information about deformation. So from that, we take it that CNRL is not concerned about deformation, which is ISH's concern. We prepared for this hearing on the basis that that work was simply not done. It's not ISH's application; it's CNRL's, so CNRL has to convince this Panel that there is no concerns.

Now we know that there is a whole host of information that we've simply not been privy to.

COMMISSIONER CHIASSON: Which my understanding is not on our record.

M. RILEY: Indeed.

COMMISSIONER CHIASSON: So are you suggesting, then, that we need to adjourn this proceeding and reopen?

M. RILEY: Indeed that is -- that is the request. That is why we --

COMMISSIONER CHIASSON: And --

M. RILEY: -- ask that the -- and I will file the further information that there be a technical meeting of the experts and that there be further evidence filed.

COMMISSIONER CHIASSON: I have to say I'm struggling a

little bit with the concept of why this is something that is a concern that's only coming to us the morning of the hearing when we've had extensive exchanges between the parties.

M. RILEY: Well, the process did not allow for ISH to make any further submissions or ask any further questions of CNRL after the filing of their information responses, and, as I said, we had a look at what they filed, decided, Well, if we were to do anything more, it will result in an adjournment, and given that this work that we now see wasn't done, we would proceed on that basis.

COMMISSIONER CHIASSON: And -- sorry. But when would -- when would enough be enough?

M. RILEY: Once all of the information underlying CNRL's geomechanical modelling is on the record and before the Panel.

COMMISSIONER CHIASSON: So you've mentioned about deformation. Isn't that what's covered in the video evidence that was filed by ISH?

M. RILEY: It is ISH -- ISH's interpretation, yes.

COMMISSIONER CHIASSON: Okay. Just a moment. Okay. Thank you.

We will hear from Ms. Jamieson now.

Submissions by J. Jamieson

J. JAMIESON: Thank you, Commissioner Chiasson.

I want to confirm for the record that no new evidence is being presented in either of the PowerPoint presentations that are not on the record. We've -- we've made a request to file it on the record, and that has not occurred.

In terms of new information, again, I would reiterate that what Canadian Natural was attempting to do with that direct evidence was present an extensive record in an efficient and a visually digestible way, and that's what -- so I think Ms. Riley used the term "they haven't seen this work before" or "this work has not been seen". That simply is not the case. All of this data, evaluation, assessment, you know, is all sitting on the record, either in Canadian Natural's hearing submission or in its responses to the AER, including the geomechanical modelling as well as Canadian Natural's reply submission, which is where things like deformation, Canadian -- the deformation. Those were issues that ISH had raised and Canadian Natural was addressing in its reply submission. But I don't believe there's anything new. I'm going to confer with our geomechanical experts, if I can, just to confirm, because she did point out one or two slides, and I'll just make sure there was nothing new

there, that it all came from either the modelling or the IR responses. If you will give me a moment.

Ms. Chiasson, I'm learning as we go myself, but in respect to Slide 116 that Ms. Riley referenced, this is all information that is sitting in the GeoSim modelling report, you know, the figures and the numbers, all pull from that, and then what I understand is on one bullet, they articulated the maximum confinement strata uplift, which is actually part of the GeoSim model. So it's baked into the model, if you will.

But, again, this is all filed on the record, and I would -- you know, my -- the Canadian Natural witnesses can speak to that point if it's an issue.

COMMISSIONER CHIASSON: Thank you, Ms. Jamieson.

So we'll take a short break. One thing, though, before we take the break that I want to make abundantly clear to both parties is that, as you've indicated, we've not allowed these -- either of these materials, these presentations, and I want the parties to understand the Panel has not seen either of the presentations. So when you're making references to the particular slides of that, we have no idea what's on there. We have not seen any of that material. Okay. We're going to take another short break.

(ADJOURNMENT)

Decision

COMMISSIONER CHIASSON: Okay. Thank you, all.

So we've considered what we've heard from both parties, and on this we have decided that we will not grant the adjournment motion brought by ISH. We heard that there is no new evidence being provided in this, so we are dealing with what has been on the record for -- some of it for some time, several months; some of it for a few weeks, but what has been on the record.

We know -- we heard reference to making the case. The last proceeding, 397, was a regulatory appeal, which is different than this proceeding, which is an application. In a hearing on an application, the parties can present what evidence they choose to convince us with respect to meeting application requirements and any necessary conditions that might need to be attached should we choose to approve the application. That -- parties have had ample opportunity in this to test the evidence, file motions, raise concerns, et cetera, and we would note that we have adjusted the proceeding schedule previously to adjust timelines at the request of each party. So we have accommodated in the past where it's done so, and we feel that that's sufficient.

We would also remind the parties that we are well aware of Rule 24(5), that argument in a hearing must be based on the evidence before the proceeding and that we

feel that that would safeguard against any potential prejudice together with our other procedural rules.

So, as such, we deny the motion, and we would look to proceed.

Discussion

COMMISSIONER CHIASSON: Ms. Jamieson, can you advise us whether or not CNRL would like some time to adjust before you seat your witness panel.

J. JAMIESON: Yes, Commissioner Chiasson. We would appreciate 30 minutes, if we could. That'll take us to 11:00. We could be ready to go by then.

I want to point out that in terms of efficiency, we might have a -- it might be clunkier, the presentation, because they're going to rely on their scripts now. They're going to try to reduce the number of exhibits that they need to be -- that need to be pulled up on the screen, but we will still ask for some visuals up on the screen so that they can speak to those maps or figures or whatever they need to, but we will absolutely endeavour to present the direct evidence within the -- within the rules and the confines of your rulings.

COMMISSIONER CHIASSON: Thank you.

And, Ms. Jamieson, just for clarity's sake, when you refer to "scripts", your clients -- I'm assuming -- will be referring to -- referring to that material that

we've disallowed just in terms of -- as, like, speaking notes, aide-mémoire --

J. JAMIESON: Speaking notes, exactly.

COMMISSIONER CHIASSON: Yes. Okay.

J. JAMIESON: So they had speaking notes prepared with the slides, which -- and, again, the slides were just a compilation of all the evidence sitting on the record. So, yes, what they have, none of this is intended to be filed, but they will have their -- their materials -- their application materials in front of them and their speaking points, and now they will have -- because the exhibit numbers for their figures are sitting in their slides, so they may need to refer to those to get it up, you know, Exhibit 15.01, Tab 42, and then it can go up on the screen, but there's no intention to, you know, do anything outside of that.

COMMISSIONER CHIASSON: Okay. Thank you, Ms. Jamieson.

Ms. Riley, any concern in relation to speaking notes?

M. RILEY: None.

COMMISSIONER CHIASSON: Okay.

M. RILEY: Assuming that ISH has the same privilege.

COMMISSIONER CHIASSON: That's -- that's -- that's

totally fine. We fully expected something complex like this that witnesses would be making use of -- making use of notes, and we would recognize as well that it's fully open to counsel to question witnesses in relation to what they're referring to, so ...

All right. We will break now. We will look to reconvene at 11:00, and, during this break, the Panel will take a look at the schedule to look at where we can adjust accordingly to give people a better idea of timing going forward. So thank you, all. We will be back at 11:00.

(ADJOURNMENT)

COMMISSIONER CHIASSON: So, Mr. Lung, Ms. Jamieson, we're good to go? Thank you. Okay. Let's proceed. I will give the reminder again because we've got lots of people with lots of mics that --

(AUDIO DIFFICULTIES)

COMMISSIONER CHIASSON: That's always an eery feeling. Anyhow, just -- just -- just a reminder -- and I don't mean to be nagging; I will remind this all the way along -- we've got lots of people, lots of mics so just to remember, only five mics can be live at any one time, so it makes it a whole lot easier for everyone if you mute your mic when you're done speaking. Thank you.

Please proceed, Ms. Jamieson.

J. JAMIESON: Thank you, Commissioner Chiasson. Again, my name is JoAnn Jamieson, and I am here representing Canadian Natural in this proceeding. With me still at the table is Maude Ramsay, manager of regulatory affairs for thermal and conventional development at Canadian Natural. I'll take my cue, but I'm thinking before I introduce the Panel this would be a good time to have them sworn in or informed.

COMMISSIONER CHIASSON: Yes. We'll get the court reporters to deal with that.

Actually, while they're being sworn or affirmed, I will mention that the plan is to go till noon, which was our regular scheduled lunch break; we'll take the lunch break; and then we anticipate, given the time that we have allotted for CNRL, we would anticipate going to 3:00 to be able to -- and ideally that gets us to the end of your direct at 3, and we take a break then. So it pushes the break back a touch, but --

J. JAMIESON: Sure. Understood. And we did have -- we do have, like, one hour --

COMMISSIONER CHIASSON: Yes.

J. JAMIESON: -- of material --

COMMISSIONER CHIASSON: Yeah.

J. JAMIESON: -- until the break. And so I will know if Mr. Lavigne's within, you know --

COMMISSIONER CHIASSON: Yes.

J. JAMIESON: -- five minutes of finishing.
COMMISSIONER CHIASSON: Yeah.
J. JAMIESON: Maybe we can do that.
COMMISSIONER CHIASSON: Yes. Please let me -- let me know if that's the --
J. JAMIESON: Okay.
COMMISSIONER CHIASSON: -- case. Yeah.
J. JAMIESON: And just on scheduling, just the other point I want to make at this point, we're already pretty confident that we don't need the full hour -- full three hours requested for our cross-examination of ISH. So that is a spot we could cut back.
COMMISSIONER CHIASSON: Okay. Thank you. Yes.
J. JAMIESON: Okay.
COMMISSIONER CHIASSON: We'll -- we'll -- we'll -- our plan is essentially to assess as we go along and see how things --
J. JAMIESON: Okay.
COMMISSIONER CHIASSON: -- see how things flow.
J. JAMIESON: Understood.
COMMISSIONER CHIASSON: Thank you.
J. JAMIESON: Yes. If I could have the court reporter swear our witnesses in, that would be appreciated.
DEVIN OLLENBERGER, THOMAS BOONE, LENNON ROCHE,

MARC SCRIMSHAW, Affirmed
GERARD IANNATTONE, JASON LAVIGNE, SCOTT SVERDAHL, DALE WALTERS, XIANG WANG, PETER THOMSEN, SCOTT BARLAND, Sworn
Direct Evidence of Canadian Natural Resources Limited Witness Panel

J. JAMIESON: Thank you, Court Reporter.

So I'd like to commence by introducing the Canadian Natural witness panel. I'm going to do this in a fairly quick, abbreviated order just in the interest of time. So as I introduce each of you, if you could identify yourselves to the Panel and the other folks in the room, as well as I'm going to ask you to confirm that your curriculum vitae information is as filed on the record. All right?

Q J. JAMIESON: So, Mr. Iannattone, I'm going to start with you. Mr. Iannattone is seated in the middle. He is vice president for the Athabasca oil sands region and the chair of the Canadian Natural's witness panel, is Canadian Natural's senior representative on the witness panel and has authority to make decisions with respect to the KN08 and KN09 application?

Mr. Iannattone has a bachelor of science in mechanical engineering and is a professional engineer by trade. He has over 40 years experience in the oil

and gas industry which includes a broad and diverse experience within the Western Canadian Basin as well as internationally.

Is my pace okay? A little fast. Okay. I'll slow it down. You bet.

Mr. Iannattone, can you please confirm for the record that your curriculum vitae as filed on the record in Exhibit 40.01 accurately sets out your professional qualifications and experience and was prepared under your direction and control?

A G. IANNATTONE: Yes, I do.

J. JAMIESON: Turning now to Mr. Iannattone's right is Mr. Scott Sverdahl. Mr. Sverdahl has a bachelor of science in geophysics and is a professional geophysicist with APEGA here in Alberta, is the exploration manager for the Kirby Athabasca thermal asset.

Q J. JAMIESON: Mr. Sverdahl, can you please confirm that your curriculum vitae as filed on the record as Exhibit 40.01 accurately sets out your professional qualifications and experience and was prepared under your direction and control?

A S. SVERDAHL: Yes.

J. JAMIESON: Seated to Mr. Sverdahl's right is Mr. Jason Lavigne. Mr. Lavigne has a master's of science in geology and is a professional geologist by

trade. Mr. Lavigne was a Canadian Natural employee for 11 years as a district geologist on the thermal exploration team, is now working as a senior consultant in the development of the Kirby north project.

Q J. JAMIESON: Mr. Lavigne, can you confirm that your curriculum vitae as filed on the record in Exhibit 40.01 accurately sets out your professional qualifications and experience and was prepared under your direction and control?

A J. LAVIGNE: Yes, I can.

J. JAMIESON: Mr. Devin Ollenberger is seated to Mr. Iannottone's left. Mr. Ollenberger is a chemical engineer with over 16 years of experience in SAGD reservoir and exploitation engineering.

Q J. JAMIESON: Mr. Ollenberger, can you please confirm for the record that your curriculum vitae as filed on the record as Exhibit 40.01 accurately sets out your professional qualifications and experience and was prepared under your direction and control?

A D. OLLENBERGER: Yes, that is correct.

J. JAMIESON: Mr. Thomsen is to Mr. Ollenberger's left. Mr. Peter Thomsen has a bachelor of science in petroleum engineering and is a professional engineer by trade. He has experience and expertise in thermal recovery processes, exploitation,

and reservoir engineering, geomechanics of the oil sands formation and caprock integrity.

Q J. JAMIESON: Mr. Thomsen, can you please confirm that your curriculum vitae as filed on the record as Exhibit 40.01 accurately sets out your professional qualifications and experience and was prepared under your direction and control?

A P. THOMSEN: Yes, that is correct.

J. JAMIESON: Seated to Mr. Thomsen's left is Dr. Thomas Boone. Dr. Boone has a bachelor of science in civil engineering, a master's of science in structural engineering from the University of Texas, and a PhD in structural engineering from Cornell University. He has over 39 years of experience in the oil and gas industry, including extensive experience in geomechanics, hydraulic fracturing, reservoir engineering, numerical simulation modelling, heavy oil recovery processes, thermal recovery processes, pilot design and operation, reservoir surveillance, and formal risk assessment.

Q J. JAMIESON: Dr. Boone, can you please confirm that your curriculum vitae as filed on the record as Exhibit 40.01 accurately sets out your professional qualifications and experience and was prepared under your direction and control?

A T. BOONE: Yes, I can confirm.

Q Can you please describe what you were retained to do for Canadian Natural in this proceeding?
A I was retained by the independent assessment of Issues 1 to 4 for this hearing.
Q And can you please confirm that your independent -- your initial independent report was filed as part of Canadian Natural's Hearing Submission 15.01 as Appendix 2, and you also filed a supplemental report as Exhibit 50.002 in this proceeding?
A Yes, that's correct.
Q And does your written report identify and include the data or information upon which it was based, including any factual assumptions made, research conducted, and any other data or documents relied upon?
A Yes, it does.
Q Do you have any corrections or revisions to your written evidence?
A No, I don't.
Q And please also confirm that you're providing an independent professional opinion evidence in this proceeding and that you understand your duty here is to provide evidence to the Regulator that is fair, objective, and impartial?
A Yes. I understand that obligation.
J. JAMIESON: Turning to the back row, and I'll start with Mr. Lennon Roche. He's in the far

corner.

Mr. Lennon Roche is a chemical engineer. He has 17 years experience in production engineer and optimization with a focus on thermal production for the past six years.

Q J. JAMIESON: Mr. Roche, can you please confirm that your curriculum vitae as filed on the record as Exhibit 40.01 accurately sets out your professional qualifications and experience and was prepared under your direction and control?

A L. ROCHE: Yes, I confirm.

J. JAMIESON: Seated next to Mr. Roche's right is Mr. Dale Walters. Mr. Walters has a 'B' -- bachelor of science in civil engineering as well as a master's of science in geotechnical engineering. He has over 25 years of engineering experience participating in large reservoir and geomechanical engineering studies throughout the world within a multidisciplinary team environment.

He is currently working with Canadian Natural as a reservoir geomechanic specialist with responsibilities for supporting all the geomechanical projects related to cyclic steam stimulation, SAGD, unconventional and carbon capture sequestration.

Q J. JAMIESON: Mr. Walters, can you kindly confirm that your curriculum vitae as filed on the

record as Exhibit 40.01 accurately sets out your professional qualifications and experience and was prepared under your direction and control?

A D. WALTERS: Yes, I confirm.

J. JAMIESON: Seated beside Mr. Walters is Mr. Marc Scrimshaw. Mr. Scrimshaw has two bachelors of sciences, one in microbiology and one in civil environmental engineering. He has over 20 years experience working in the area of regulatory applications and environmental assessments and is now the lead regulatory team member for thermal projects.

Q J. JAMIESON: Mr. Scrimshaw, can you please confirm that your curriculum vitae as filed on the record as Exhibit -- and I don't know. I'll have to check with Mr. Lung and provide you with a number because I don't know the most recent exhibit numbers, but I will provide you with that information -- sets out your professional qualifications and experience and was prepared under your direction and control?

A M. SCRIMSHAW: Yes, I confirm.

Q Thank you.

J. JAMIESON: Next we have Dr. Xiang Wang, and Dr. Xiang -- sorry -- Dr. Wang has a master's of science in structural geology and geochemistry. He also has a master of science in structural geology and rock mechanics and a PhD in geology from the University

of New South Wales in Sydney, Australia. He has more than 20 years of experience in multiple sedimentary basins with a variety of tectonic styles and has experience in structural geology, rock mechanics, sedimentology, geochemistry, statistics, and geomodelling and also extensive experience in interpreting image logs for Canadian Natural's thermal operations.

Q J. JAMIESON: Mr. Wang -- or Dr. Wang, can you kindly confirm that your curriculum vitae as filed on the record as Exhibit 48.001 accurately sets out your professional qualifications and experience and was prepared under your direction and control?

A X. WANG: Yes, I confirm.

J. JAMIESON: And next we have Mr. Scott Barland. Mr. Barland has a bachelor of science -- two bachelors of science actually, one in geology and another one in agriculture. He has -- he's also a professional geologist with the Association of Professional Engineers and Geosciences of Alberta, APEGA. He has 13 years experience in the SAGD industry as a geologist. He pioneered work at Devon Canada using GCMS analysis to identify barriers and baffles in the McMurray formation pay starting with the first 13 cores analyzed by Devon Canada in 2013. To date he has analyzed or reviewed over 140 cored wells that have

GCMS data across it. This would be across Canadian Natural's thermal assets in Jackfish, Pike, Kirby, and Primrose areas.

Q J. JAMIESON: Mr. Barland, can you please confirm that your curriculum vitae as filed on the record, again as Exhibit X, accurately sets out your professional qualifications and experience and was prepared under your direction and control?

A S. BARLAND: Yes, I can.

Q Thank you.

Mr. Iannattone, a couple of last questions for you. Can you please confirm that Canadian Natural's written evidence, with the exception of Dr. Boone's report, was prepared under your direction and control?

A G. IANNATTONE: Yes, it was.

Q And do you adopt that evidence on behalf of Canadian Natural in this proceeding?

A Yes, I do.

Q Can you confirm that Canadian Natural's evidence is accurate to the best of your knowledge and belief?

A I confirm.

Q Do you have any corrections or revisions to make to the Canadian Natural evidence?

A No, I don't.

Q Thank you.

J. JAMIESON: All right. And with that,

Commissioner Chiasson, I will turn it over to Canadian Natural's witness panel. We do have about 50 minutes of material here, so we'll try to cut it to 12 noon as best we can, and I will signal, you know, if we do need additional time, but there's a chance we'll get through it. Thank you very much.

COMMISSIONER CHIASSON: Okay. Thank you. Please proceed.

I think Mr. Lung perhaps had the exhibit number?

A. LUNG: That's right. For Mr. Scrimshaw and Mr. Barland's curriculum vitae, it's Exhibit 58.001.

J. JAMIESON: Thank you.

COMMISSIONER CHIASSON: Great. Thank you. Please proceed.

A G. IANNATTONE: My name is Gerard Iannattone. I am Canadian Natural's -- sorry. Got that off all of a sudden. I'll start again.

I am Canadian Natural's senior representative and the chair of Canadian Natural's panel. I'm also here to speak to policy issues.

Good morning, Commissioner Chiasson, Baker [sic], and Zaitlin. I would like to thank the Panel for the opportunity to present our direct evidence. Canadian Natural is Canada's largest and most diverse energy company. I would like to take a moment here to read

our mission statement. It is to: (as read)

Develop people to work together to create value for the company shareholders by doing it right with fun and integrity.

Canadian Natural staff live the mission statement in all aspects of their work, including this hearing, by creating value for the public interest via royalty and tax payments to the Alberta and federal governments, doing it right by adhering to all governing laws and regulations as a responsible operator, being honest and humble, demonstrating integrity.

Canadian Natural has over 24 years of thermal development and operating experience. As part of this vast base, we have safely started up and operated over 390 well pairs at our SAGD projects. Highly experienced technical and operational staff have proven Canadian Natural to be a safe SAGD operator with no incidents of lost steam to other formations during circulation startups or continuous SAGD operations.

Fundamental to our SAGD business is Canadian Natural's ability to contain steam chambers.

The KN08, KN09 pads are part of the next development phase for the Kirby north project, and these pads are expected to recover between 30 and 35 million barrels. The project is an example of how Canadian Natural creates value for all Albertans

through positive contributions to the local, regional economies during both construction and operations with direct, indirect, and induced employment. The successful execution of this project will also deliver up to $250 million in royalties.

On the flip side, value can be easily eroded by spending unnecessary dollars as the Kirby north project is in a post-payout royalty position. Every dollar spent reduces a net profit and the royalties payable by 30 to 40 cents. In effect, Albertans are funding 30 to 40 percent of the costs. It is Canadian Natural's responsibility, as the operator, to be as efficient as possible.

Mr. Lung, I would like to bring up an exhibit now. I will give you the number. It is Exhibit 01.01, PDF page 18 of 387. Thank you.

To provide some regional context, the following figure is a map of the Kirby north project development area and associated drainage boxes. The blue outline represents the Kirby north development area in the scheme approval, which is the red outline.

The grey boxes represent the KNO1 to KN07 drainage boxes, which are on continuous SAGD production. The KN08, KN09 proposed boxes are outlined in red.

Canadian Natural respects ISH's concerns and takes them seriously. We have engaged with ISH since

December of 2021 prior to filing of the application and have attempted to address their concerns at every opportunity since. Obviously we were unsuccessful and are here today to demonstrate that there is a low risk to the gas resource.

Canadian Natural has taken and will continue to take all reasonable steps to mitigate and/or avoid any impact to the gas resource. Canadian Natural also understands that ISH is not seeking an order preventing the KN08, KN09 development, but rather is asking the Panel to impose certain conditions.

Draft Directive 23, Section 4.2 describes the requirements for stakeholder involvement program. The directive states that the ERCB expects applicants to respond in a meaningful way with any party that has raised a concern or has questions regarding oil sands projects and to make reasonable efforts to address concerns raised before filing the application.

Canadian Natural did provide ISH confidential data addressing ISH's concerns directly in the application as filed on March the 10th, 2022. ISH filed their statement of concern on April the 8th, 2022, and three rounds of extensive supplementary information requests from the AER were answered.

In 2023, Canadian Natural initiated two face-to-face meetings with ISH. Canadian Natural has

made a bona fide effort to address and resolve ISH's concerns.

Mr. Lung, I'd like to bring up another exhibit. It is Exhibit 15.01, paragraph 29, PDF page 10 of 505. Okay.

A. LUNG: Sorry, Mr. Iannattone. Can you repeat that.

A G. IANNATTONE: Can we try Tab 4 -- Tab 4, PDF 107 of 505. Yeah. There it is. Thank you.

In the stratigraphic sense, there are two commercial bitumen reservoirs located below the Wabiskaw B, or more formerly known as the Kirby upper Mannville II gas pool. The red vertical bars shown on the graph here represent the gas trapped in the Wabiskaw B and also the gas trapped at the top of the Wabiskaw D.

The Wabiskaw D bitumen reservoir and the McMurray Post 2 incision bitumen reservoir are shown by the vertical green bars. The KN08, KN09 proposed development is in the McMurray bitumen reservoir.

From an aerial sense, it is important to note here that the Kirby Upper Mannville II gas pool overlies both the commercial McMurray and the Wabiskaw D bitumen reservoirs.

Mr. Lung, I would like another slide. It is -- let's see if I can get this one right. It's

Exhibit 50.003, Tab 3, PDF page 48 of 250. You just passed it. Yeah. Thank you. This is a complex slide, but I will walk through it as it is important to understand the gas situation in the Kirby north area.

There are a total of five GOBed Mannville gas pools in the Kirby area. The GOBed gas pool names --

COMMISSIONER CHIASSON: Sorry -- sorry to interrupt, but just -- and I should have said this earlier on. If you're going to use acronyms, just for the record, can you explain what the acronym is first so that we're clear for the record and also for anybody who is watching on the videocast. So, for example, "GOB".

A G. IANNATTONE: GOB, gas over bitumen. Okay. Thank you.

For a total of five gas over bitumen GOB Mannville gas pools in the Kirby areas. The GOB gas pool names and areas are shown in red.

The GOBed Kirby Upper Mannville II pool boundary, which is the subject gas pool in this hearing, is highlighted in -- oh -- in purple, yes, it is, yeah, and the Kirby north drainage boxes are outlined in black.

In addition to the GOBed gas pools, there are four Mannville gas pools that are allowed to produce. The producing names and the areas are shown in green, with the currently active gas wells highlighted in black

circles.

In terms of the regulatory framework, the GOB decisions gave priority and time to the bitumen development. The GOB decisions concluded there exist potential impact on bitumen recovery from the pressure-depleting effects of producing overlying gas. The decisions ordered the shut-in of the Kirby Upper Mannville II gas pool to protect the Wabiskaw D and McMurray bitumen reservoirs. Subsequently, Canadian Natural and ISH have received substantial royalty adjustment payments as compensations for direct impacts caused by the shut-in order.

Bitumen resources can be directly inversely affected by pressure depletion of connected gas. If containment of the steam chamber is lost, the amount of steam required will increase while the bitumen production and recovery factor will decrease, making pad economics uncompetitive for capital allocation. Ultimately, this could lead to the stranding of bitumen resource.

Canadian Natural requires certainty that bitumen pressure depletion will not occur before investing hundreds of millions of dollars on pad developments.

Pressure in the Kirby Upper Mannville II pool are already significantly pressure depleted as measured at the 10-01 well. The current declining pressures are

likely due to connectivity to other producing gas pools, and any further decrease in pressure is a threat to the efficient recovery of the Wabiskaw D bitumen.

As a joint owner of the Kirby Upper Mannville II pool, Canadian Natural shares a mutual interest in protecting the overlying gas as well as protecting the bitumen resource.

This protection relies on responsible operatorship of both the bitumen resource developer as well as the gas operator as required under the Oil Sands Conservation Act, the GOB order, and the Oil and Gas Conservation Act.

I wish to clarify here that this hearing is not about the protection of this bitumen resource from pressure depletion, but rather the reverse situation where ISH is concerned about the potential damage to the remaining gas reserves in the Kirby Upper Mannville II pool caused by SAGD operations in the McMurray Post-B2 reservoir. We are here today to present that Canadian Natural's technical evidence demonstrates that the risk to the Wabiskaw B gas resource is low due to an effective containment barrier and no evidence of fractures or faults, and Canadian Natural's evidence will also demonstrate that it's proposed mitigation and monitoring measures are reasonable in the circumstances given the nature of the

potential effects, practisability [sic], effectiveness, and cost benefits.

Mr. Lung, one more for me, please. It is Exhibit 50.003, Tab 4, PDF page 49 of 250. Thank you.

This is Canadian Natural's workflow. Throughout the course of the hearing, the Panel will be required to value or weigh a large amount of technical evidence. The slide highlights that the difference between directly measured data and data which requires interpretation and expertise to evaluate. In addition, the diagram illustrates no dataset is used in isolation but rather involves an integration of multiple diverse datasets and disciplines.

The arching arrows in blue indicate the workflow is iterative bringing various perspectives together to promote alignment. The best results note that's the overlying triangular area labelled "assessment" in the middle of the diagram are always obtained when there is a convergence of data interpretations and models that support the same conclusion.

Commissioner Chiasson, this concludes my opening statement. I would now wish to turn the presentation over to Canadian Natural's technical panel to address the hearing issues starting with Mr. Lavigne.

A J. LAVIGNE: Thank you, Mr. Iannattone. My name is Jason Lavigne, and I'm a geologist -- I'm a

geologist and will be addressing the first hearing issue. The first hearing issue is whether there's an effective barrier or top seal overlying the bitumen-bearing McMurray formation consisting of a deposit or series -- or aggregation of strata that is not permeable to steam over the life of the KN08 and 9 box -- drainage boxes, which includes but is not limited to whether or not there are fractures in the strata between the McMurray formation and the Wabiskaw B member.

In this section, we will discuss the presence and characteristics of the barrier, and we will discuss the presence or absence of fractures separately in a later section.

Canadian Natural uses the definitions of "barriers" and "baffles" as follows: Barriers are not permeable to steam over the life of operations, while baffles interfere with and impedes the movement of steam but doesn't stop it entirely.

While it is well understood that the regional mudstone units may ultimately contain steam, barriers and baffles that occur within the reservoir units also significantly affect steam chamber development. Extensive operational experience since the gas over bitumen rulings show that steam is often effectively contained in heterolithic strata below the regional

mudstone. These aggregations of strata contain numerous barriers and baffles that work together to ensure containment of the steam chamber over the life of the operations.

In order to ensure efficient operations, the steam chamber must be contained within the reservoir interval. Unanticipated barriers or baffles within the reservoir zone -- and leak off into the overlying units diminish the thermal efficiency of the SAGD process and negatively affect oil recovery. The ratio of steam injected to the volume of oil produced is a key metric in evaluating the viability of potential SAGD pads, and potential loss of steam from the reservoir unit is a risk that is thoroughly assessed in advance of development.

To facilitate steam chamber containment, an analysis of the overlying confinement strata is critical. Characteristics of effective confinement strata include typically mudstone facies with greater than 50 percent volume of shale or V shale and the resulting low vertical permeability and units that are stratigraphically correlatable and have significant lateral extents relative to the drainage boxes. These units must also be geomechanically competent over the life of SAGD operations, which will be covered in Hearing Issue 3.

Because of the large capital expenditure of SAGD projects, Canadian Natural applies a multidisciplinary approach to evaluation and de-risking potential developments. This section focuses on the geo -- the geoscience component of that analysis. Canadian Natural uses wireline logs, cores, and image logs to evaluate details of reservoirs and also the confinement strata. 3D seismic helps to define and identify the continuity of both reservoir -- the reservoirs and confinement strata units and constrain key depositional edges. Geochemical analysis of oil samples taken from cores helps identify potential barriers and baffles within the reservoir and the overlying confinement strata units.

After steam injection has begun, temperature logs in 4D seismic are used to monitor the growth of the steam chamber. Canadian Natural employs a philosophy of continuous improvement and relies on its extensive experience in operating oil sands assets and leverages its large set of internal production analogs to help assess the results of new data and adjust its evaluation and execution strategies to ensure effective and efficient operations.

One tool that can be utilized to potentially proactively predict the presence of barriers and baffles within the reservoir and confinement strata

units prior to steaming is gas chromatography mass spectrometry, or "GCMS". This geochemical tool may also be used to help assess the potential sealing capacity of confinement strata units by indicating layers across which hydrocarbon concentration profiles change markedly. If oil concentrations were not able to equilibrate across low permeability beds or heterolithic units over geological time, it is very unlikely that steam will be able to migrate through these lower permeability zones over the life of the KN08 and -- and 9 pads.

When closely tied to the confinement strata stratigraphy, GCMS is an important tool in predicting the vertical rise of steam within both the reservoir and overlying confinement strata units.

Mr. Lung, could I please bring up Exhibit 043.002, Tab 7A, PDF page 180.

THE COURT REPORTER: Mr. Lavigne, can you just slow down with the terms.

A J. LAVIGNE: Okay. Sorry. Thank you.

If I could please see the figure at the bottom of the page, Mr. Lung.

Thank you very much.

Graphically depicted on the left, connected reservoirs show a gradual downward decrease in light hydrocarbons due to preferential biodegradation of

light hydrocarbons at the oil/water contact. In the centre, baffles are identified by bends in the downward decreasing profile. On the right, barriers show two separate downward decreasing hydrocarbon profiles that are laterally offset.

Canadian Natural uses a third-party vendor to conduct the analysis and follows industry standard practices for plotting the data. Wells are strategically sampled at a reasonable density based on known stratigraphic surfaces and mudstone interbeds within the reservoir and confinement strata intervals. GCMS is used as a qualitative test of stratigraphic surface and is but a part of Canadian Natural's overall evaluation program. However, when closely tied to stratigraphy and analyzed in the context of production temperature data, it has been observed that the rise of steam chambers has been halted across horizons that sometimes display relatively minor concentration changes.

Again, molecular diffusion and hydrocarbon biodegradation happen over geological time and geochemical indications of baffles are likely to be barriers to steam over the time scale of a SAGD operation.

Throughout this presentation, GCMS -- GCMS plots like this will be used to support Canadian Natural's

position that barriers and baffles exist in the strata between the McMurray formation reservoir and the Mannville II gas pool at the top of the Wabiskaw B.

Mr. Lung, could I please have up Exhibit 15.01, Tab 4, PDF page 107.

Thank you.

We will now examine the confinement strata over the KN08 and KN09 boxes in detail. Looking at the stratigraphic column in the KN08 and 9 area, bitumen-saturated intervals are shown in green, including the McMurray reservoir and the overlying Wabiskaw D sandstone. On the right-hand side of the column, note the position of the regional B2 and A2 mudstones, which were defined in the regional geological study, and the mid-B1 mudstone in the -- in the dashed line defined by the KN06 decision report. Where present, these three regional mudstones have been deemed to be effective barriers to steam.

Over the KN08 and 9 drainage boxes, the Wabiskaw D incision cuts deeper and removes portions of the upper B1 regional sequence across the centre of the KN08 -- across the centre of the KN09 box and the northern third of the KN08 drainage box. This incision never cuts down to the level of the mid-B1 mudstone, and as Canadian Natural will demonstrate, this widespread regional barrier is present over the drainage boxes.

North of the boxes where it cuts deeper, the Wabiskaw D incision contains thick saturated sandstones. These sandstones are flanked and onlapped by two mudstone-prone facies, the Wabiskaw D non-reservoir, and the basal upper Wab D heterolithic unit, both of which hold back gas caps.

To the south, over the KN08 and 9 boxes, the incision shallows, and while the basal sandstone is much thinner, the two mudstone units are present. Canadian Natural will demonstrate that, where present, these additional units would also be expected to contain steam.

Mr. Lung, could I please bring up -- my apologies; I'll -- one second. Sorry -- Exhibit 050.003, Tab 6, PDF page 51.

Thank you.

Graphically illustrated, an annotated seismic section with wells projected on it demonstrates the distribution of confinement strata over the KN08 and KN09 drainage boxes. Looking at the total confinement strata present, the post-B2 non-reservoir in grey shows variable thickness. The regional B1 sequence in green, including the dashed mid-B1 mudstone, is present over both boxes, where it is cut out by deeper Wabiskaw D incision just north of the KN09 drainage box. The thin A2 mudstone in red is present over the southern

two-thirds of the KN08 drainage box on the left.

The two Wabiskaw D confinement strata units in purple are undifferentiated in this diagram but can be seen to cover the entirety of both boxes where the incision shallows to the south on the left. Similarly, the thin Wabiskaw C in blue also covers the entirety of the boxes.

Could I please bring up Exhibit zero -- 01.01, Figure 2-19, PDF page 53.

That's okay. Sorry. I'll continue with this figure. This isn't exactly the one I was hoping. My mistake.

In the AA -- oops. Did I -- I'm sorry.

Q J. JAMIESON: Mr. Lavigne, if I could assist --

A Yeah.

Q -- because -- is this the one you're looking for?

A Yes.

Q It's on the same one, but the exhibit number is towards the end, I believe. It's Exhibit 15.01. That's the -- or the hearing submission. Tab 9.

A 15.01, Tab 9, PDF page 16 -- 216? Okay. I'm going to just continue.

Q If that's not the right one, the next reference is right there, 219. Page 219.

A That's not it.

Okay. Last try. Could we please try page 16. Okay. My apologies. I don't have the correct reference.

I'm sorry, Mr. Lung. Could I please have page 216 of that document. My apologies for -- that -- that -- that's it. Thank you very much. Sorry about the confusion.

I'll now describe the confinement strata units in -- in detail. The post-B2 non-reservoir unit occurs directly above the McMurray formation SAGD reservoir. This unit consists of a muddying upwards package of inclined heterolithic strata with 'V' shales greater than 50 percent.

Similar deposits have been well studied in outcrops of the McMurray formation north of Fort McMurray where individual mudstone beds may be traced for tens to over a hundred metres and their geometry and depositional character are well documented.

Could I please have Exhibit 050.003, Tab 16, PDF page 61.

Thank you.

As mentioned, point bar facies are well understood in both modern and ancient settings. The image on the right shows a section of the modern Bow River south of Strathmore, Alberta. Note the position and frequency of abandoned reaches of channel left of centre in the

figure. These portions of abandoned channels represent incipient mud plugs and -- as they will ultimately be filled with mudstone deposits. The effects of differential compaction on mudstone such as these will be discussed in more detail later in Canadian Natural's direct evidence. This reach of the Bow River valley bears a striking similarity to the post-B2 reservoir isopach map over the KN08 and KN09 boxes in the lower left, where mudstone abandonment plugs are highlighted in grey.

Note the yellow shaded area corresponds to the post-B2 incision valley. The variability in post-B2 non-reservoir unit thickness is explained by the distribution of these mud plugs in relation to top set mud beds and the position of the KN08/9 drainage boxes on the inside bend of the post-B2 incision valley.

While the mudstone-dominated character of the post-B2 non-reservoir would, where present, be expected to contain steam, many well -- many wells contain beds that suggest that steam could be contained below this mudstone-dominated facies.

Could I please have Exhibit 15.01, Tab 11, PDF page 21.

That is not it. Oh, I'm sorry. This is the correct figure. My apologies.

In the 100/1-3 well, within an otherwise

continuous connected hydrocarbon column, an upwards -- an upwards increasing shift in hydrocarbon concentrations -- sorry. Within an otherwise connected column, an upwards shift in hydrocarbon columns occurs at a high gamma ray mudstone layer at about 580 metres, which suggests the low permeability mudstone has affected the hydrocarbon concentrations in the column. Geochemistry would suggest this is a baffle rather than a barrier. Both below and above this point, the concentration profile has equilibrated and established a uniform gradient.

The fact that it hasn't done so at 580 metres is likely a result of lower permeability in the mudstone unit. While oil concentration profiles equilibrated over geological time, practical experience in operating SAGD reservoirs shows that in this horizon in this well, steam is most likely to be halted at this mudstone. The top -- the top of the -- the expected steam chamber top would be picked at this horizon and production forecasts would be based on its height above the injector.

After steaming operations have begun, temperature logs can help to understand steam chamber development. The numerous producing SAGD pads within its portfolio provide Canadian Natural with well understood analogs with which to better predict and understand complex

reservoirs and operational data.

Could I please have Exhibit 15.01, Tab 12 -- yeah -- PDF 224.

Thank you.

On the left, PNX logs in the 102/6-4 well show that the steam top has been held up by mudstone-rich IHS. Increased gas saturation above the steam temperature top is due to conductive heating but steam remains contained.

On the right, PNX suite of logs in the 11-4 well for two thousand -- 2022 and 2023 demonstrate that a mud class breccia has been holding up steam for approximately one year. In these logs from the Kirby north Pad KN02, the year-over-year increase in gas saturation associated with the development of the steam chamber, which is at 200 degrees Celsius.

This nearby analog was not available at the time of the KN06 hearing. SAGD is very sensitive to vertical permeability changes, and, where present, the post-B2 non-reservoir base is effective at confining the steam chamber. The KN02 pad is in the same post-B2 incision valley as the KN08 and 9 pads. The stratigraphy is virtually identical to that at KN08 and KN09, and therefore these data are useful in understanding the predicted limits to vertical steam chamber growth. The chamber is contained and will not

be able to rise and affect the overlying GOB zone.

Moving up above the post-B2 non-reservoir, the next unit in the confinement strata is the regional B1 sequence and, in particular, the mid-B1 mudstone.

Despite the heterolithic nature of these regional sequences and variations in the relative percentages of sandstone and mudstones, the units are correlatable over the entirety of the KN08 and KN09 drainage boxes. These units contain a high visual mud index.

Examination of well logs and cores demonstrates that the mid-B1 mudstone can also be correlated over the adjacent KN08 and 9 boxes. Like KN06, the unit also displays some variation in facies, and, similarly, GCMS also confirms that the B1 regional sequence also contains baffles and barriers that would be expected to provide steam containment over KN08 and 9.

Could I please have Exhibit 050.003, Tab 5.

As illustrated in Canadian Natural's reply submission, these core photos from across the KN08 and 9 drainage boxes demonstrate that while the lithofacies of the upper and lower B1 units are heterolithic and variable, they contain a high mudstone percentage. They also demonstrate that the mid-B1 mudstone which overlies the marine flooding surface is widespread and was deposited over the KN08 and KN09 drainage boxes.

My apologies. I just need one second.

J. JAMIESON: Commissioner Chiasson, I'm just watching the clock here. We're just past noon. I believe this witness has 15 -- 10 to 15 minutes left to go. So I'm in your hands. If you want to break for lunch, he can come back and finish up then.

COMMISSIONER CHIASSON: If it's about 15 minutes, let's continue and finish -- finish this piece.

J. JAMIESON: Thank you.

A J. LAVIGNE: In this figure from the reply submission, there are differences between the distribution, the mid-B1 mudstone as proposed by ISH, where the mid-B1 mudstone has been interpreted to be removed in the blue area.

And -- if -- if I could please have Exhibit 050.003, Tab 7.

Thank you.

As discussed in its reply submission, Canadian Natural acknowledges that the 100/01-03 well, in the well, the typical mid-B1 lithofacies is not present. At this level, an upper B1 tidal channel appears to have locally erosionally removed the mid-B1 mudstone. Within this channel, a mudstone rich interbedded lithofacies has been deposited at approximately mid-B1 level.

The three-well cross-section in the top centre of offsetting wells demonstrates that typical mid-B1

mudstone facies is present in surrounding wells and that the 100/1-3 well represents an isolated tidal channel which are normal parts of tidal flat sequences. The lateral extent of this channel is small, and there is no significant down cutting through the underlying mudstone prone lower B1 sequence.

Can I please have Exhibit 15.01, Tab 11, PDF page 219.

Could we please scroll down one page. Down one more, please. One more. One more. Could I try 219, please. 218, perhaps. Yeah. That's it. Thank you. My -- my mistake. Sorry.

GCMS analysis in the previously mentioned well shows that this heterolithic unit may have acted as a baffle to hydrocarbon biodegradation and that the upper B1 unit contains numerous breaks in the hydrocarbon concentration profile suggesting a baffle noticed by these back stepping of values.

It's worth noting, as previously mentioned, that the predicted steam top in this well would occur lower at about 580. There's a well equilibrated hydrocarbon column up into the lower B1 sequence where there is a decrease in concentration, suggesting a barrier in the lower B1. Where the -- where the tidal channel has locally cut into the mid-B1 mudstone, the decrease -- upwards decreasing concentration profile suggests

barriers or potentially baffles. But above this at the base of the Wabiskaw D, the sharp increase -- sorry -- the sharp decrease in concentration profiles supports the existence of a barrier at this -- at this spot.

This suggests that while the channel feature has resulted in the very localized removal of the mid-B1 mudstone, other baffles and a strong barrier are present above that would act to contain steam. This reinforces the concept of confinement strata where no single unit is relied to contain steam but all units work together in -- in tandem.

In summary, we -- we spent some time on the B1 sequence and the mid-B1 mudstone. It's worthwhile to summarize the units as confinement strata before moving on to others. In summary, the facies of the regional B1 sequence consist of bioturbated heterolithic sandstones and mudstones. They are separated by the thin but laterally extensive marine mid-B1 mudstone. This mudstone can be correlated regionally over the nearby KN06 box and beyond the Kirby north initial development area several miles to the east. It can be readily identified on logs and in core.

In one well, the KN08 drainage box appears to have been removed by a very localized tidal channel, but GCMS data suggests that in this well baffles exist within the channel itself and there's a barrier at the

top of the upper B1 base of the Wabiskaw D.

Could I please have Exhibit 15.01, Tab 7, PDF page 193.

I'm sorry. Could we please have -- from the same document -- Tab 8, PDF page 198. Page 326 instead, please. Thanks for your patience, Mr. Lung.

The A2 mudstone has a very distinctive log -- signature and easily identifiable in core. Canadian Natural has provided mapping that shows the aerial extent of the regional A2 mudstone over the KN08 and KN09 drainage boxes. It has locally been removed by the Wabiskaw D aged incision. Where present, the A2 mudstone has been shown to provide a barrier separating underlying bitumen reservoirs from the overlying gas resources. But even where it has been removed, other confinement strata exist to assist in providing steam containment.

Moving on to the Wabiskaw D. As mentioned, it has cut down into the upper McMurray sequence over the KN08 and 9 drainage boxes. It has deposited two mudstone prone units that act as confinement strata. The lowest is the Wabiskaw D non-reservoir unit.

Could I please have Exhibit 043.002, Tab 1E, PDF page 29.

Thank you.

In order to better understand the Wabiskaw units

above the KN08/KN09 drainage boxes, one must examine the Wabiskaw D more broadly in the Kirby north area. In the map on the left, thick Wabiskaw D sandstones -- there is no map. Oh, thank you. In the bottom left -- thick Wabiskaw D sandstones in orange exist just north of the KN08 and 9 drainage boxes. It occurs in a southwest/northeast oriented title scour that thins out over the top of the KN08/KN09 drainage boxes.

To understand the distribution of facies in the Wabiskaw D, Canadian Natural has submitted this geomodel slice that shows two Wabiskaw D mudstone-dominated units that onlap and drape the sandstone body. The Wabiskaw D incision does not cut as deeply, and the sandstone component thins dramatically to the south over the KN08 and KN09 boxes. Despite this, the two Wabiskaw D mudstone-prone facies are correlatable over the KN08/KN09 drainage boxes.

Could I please have Exhibit 15.01, Tab 16, PDF page 327.

Thank you.

The Wabiskaw D non-reservoir unit occurs in a southwest/northeast oriented -- orientation along the flank of the Wabiskaw D pay trend previously mentioned. It covers most of the KN08 box and the western two-thirds of the KN09 box. It is identified in core by a high volume of characteristically dark grey

mudstone and sits directly on top of the bitumen saturated Wab D sandstone.

Can I please have Exhibit 01.01, PDF page 142 and 143. So we could start at 142, perhaps. Could I request to go to 143, please.

Thank you.

This is typical facies of the Wab D non-reservoir units. It has a visual mud index of about 60 percent. While the individual mudstone beds within the unit are laterally likely on the decimetre to metre scale, as a package -- the package as a whole is mappable over several kilometres. This unit locally holds back small gas caps in underlying -- in the underlying Wab D sandstone, which supports its potential sealing capacity.

Could we please go up -- sorry -- to 142. Yeah. Okay. That's okay. We can use this as well.

Above the Wab D non-reservoir, the basal upper Wabiskaw heterolithic unit is the highest of the Wabiskaw D confinement strata. The basal upper Wabiskaw D unit is a mudstone-prone interval similar in character to the underlying Wabiskaw D non-reservoir unit. To the north, it marks the base of a coarsening upward cycle near the top of the Wabiskaw D unit. Over the KN08/KN09 drainage boxes where the Wabiskaw D incision is thinner, it is composed predominantly of

dark grey mudstone with centimetre scale saturated sandstone interbeds and a visual mud index of over 50 percent. Over the boxes, it sits directly on top of the Wabiskaw D non-reservoir unit where the contact is typically demarcated by concretionary cement.

Could I please have 15.01, PDF page 2. My apologies. Page 328. Thank you.

This is an isopach map of the basal upper Wabiskaw D unit, and note how it occurs in the same region where the A1 mudstone has been removed. Its high visual mudstone index suggests it would be expected to be a barrier to the vertical rise of steam.

Could I please have Exhibit 01.01, PDF page 370.

So what I'm going to do is I'm going to walk down here the -- the basal upper Wab D unit is the dark mudstones at the bottom of this slide.

Could we please go down to page 371?

Thank you.

This series of core photos is directly beneath the previously shown ones. The base of the basal upper Wabiskaw D heterolithic unit is marked with a red line. Note the light oil saturation in the three box -- in the three tubes of sand immediately below this. This is a good illustration of the basal upper Wab D heterolithic unit's ability to act as a barrier to steam. In this particular well, the lighter saturation

marks the presence of a gas cap at the top of the Wabiskaw D in this well. Note the light saturation at the top of the sand.

The results of the analysis in this well are significant for two reasons: Firstly, at a location where the total confinement strata is relatively thin, multiple high-quality barriers still exist. Secondly, as can be seen with the basal upper Wab D unit in this well, intervals with high V shale greater than 50 percent can still be seen to contain gas caps. Units that are capable of containing gas caps would also be capable of containing steam.

A summary of GCMS data shows a consistent decrease in hydrocarbon compounds across the top of the McMurray to the base of the Wab D. There is strong geochemical evidence that there is a hydrodynamic barrier that has not allowed hydrocarbon concentrations to equilibrate across the base of the Wab D over geological time. It is therefore more likely than not that the barriers that exist to impede this uniform biodegradation over geological time will also prevent the passage of steam over the life of operations of KN08 and KN09 pads.

The Wabiskaw C is the highest interval of confinement strata units that separate bitumen from -- in the McMurray formation from the gas in the Mannville II pool at the top of the Wabiskaw B.

Could I please have Exhibit 01.01, PDF page 370. Thank you.

The Wabiskaw C represents a transgressive sheet of muddy sandstone with a visual mud index of about 70 percent that has been nearly entirely bioturbated to the point that very few primary sedimentary structures have been preserved. In core, the bioturbation and lighter colour make it easily differentiated from the dark mudstones of the Wabiskaw D below and the intact bedding and variably saturated sandstones of the overlying Wabiskaw B. The Wabiskaw C is present over the entirety of the KN08 and 9 drainage boxes in thicknesses greater than 1 metre. The bioturbation has introduced clay into the pore throats and the resultant vertical permeability is low.

In summary, over the KN08 and KN09 drainage boxes, six low vertical permeability units are present in aggregate thickness of 3.9 to 14.3 metres, as discussed, while individual confinement strata units showed variable thickness and character, an aggregate package of predominantly mudstone-rich facies with low vertical permeability exists over the KN08 and KN09 drainage boxes. Stratigraphic context is a very important factor in assessing a unit's ability to provide confinement of steam. GCMS analysis shows that the confinement strata units display changes in

hydrocarbon concentrations that suggest barriers to biodegradation over geological time that would be expected to provide steam chamber confinement over the life of the KN08 and KN09 pads. This is particularly true of the regional B1 sequence, including the mid-B1 mudstone, and the Wabiskaw D, which seems to act as a barrier in virtually all wells analyzed.

Within the post-B2 reservoir, GCMS supports the presence of barriers and baffles near the top of the reservoir. Operational experience suggests steam will be effectively contained below the post-B2 non-reservoir unit.

The regional mid-B1 mudstone was deposited over an area much larger than the KN08 and 9 drainage boxes. It sits in the middle of the regional B1 sequence, which contains a high volume of shale. GCMS suggests numerous barriers and baffles within this interval.

The regional A2 mudstone, where present, acts as a barrier. The Wabiskaw D contains two mudstone-prone units that are deposited over the area where the A2 mudstone has been removed. GCMS defines a strong barrier at the base of the Wabiskaw D in all the wells analyzed, and gas caps are trapped beneath these units. The Wabiskaw C has a high 'V' shale and occurs everywhere over the drainage boxes.

Canadian Natural concludes that there is an

effective barrier or top seal over the bitumen bearing McMurray formation that would not be permeable to steam over the life of the KN08/KN09 drainage boxes.

Thank you for your patience as I struggled with some figures.

COMMISSIONER CHIASSON: Thank you, Mr. Lavigne.

J. JAMIESON: This would be a good time to break. I may have misspoke earlier, so that concludes addressing hearing the first part of Hearing Issue 1, and it will be Mr. Lavigne that continues when we come back from the break.

COMMISSIONER CHIASSON: Okay. Thank you.

All right. We are at 12:30. We will reconvene at 1:30. We would encourage folks to -- the room won't be locked, so if you have belongings that you're concerned about security, please take them with you rather than leaving them in the room.

PROCEEDINGS ADJOURNED UNTIL 1:30 PM

Proceedings taken at Govier Hall, Calgary, Alberta

February 6, 2023 Afternoon Session

Cindy Chiasson	Panel Chair
Brian Zaitlin	Panel Member
Meg Barker	Panel Member
William McClary	AER Legal Counsel
Shannon Peddlesden	AER Legal Counsel
Andrew Lung	AER Staff
Denise Parsons	AER Staff
Anastasia Stanislavski	AER Staff
Fahad Hamdan	AER Staff
Maryam Rahimabadi	AER Staff
Susan Harbidge	AER Staff
Maksim Xhaferllari	AER Staff
Felix Chiang	AER Staff
Scott Botterill	AER Staff
Baohong Yang	AER Staff
Elwyn Galloway	AER Staff
J.P. Jamieson	For Canadian Natural Resources Limited

M. Riley	For ISH Energy Ltd.
A. McLeod	For ISH Energy Ltd.
S. Murphy, CSR(A)	Official Court Reporter
S. Burns, CSR(A), RPR, CRR	Official Court Reporter

(PROCEEDINGS COMMENCED 1:32 PM)

COMMISSIONER CHIASSON: Okay. Thank you, everyone. So we're now back from the break, so, Ms. Jamieson, just as a time check. By my calculations, time-wise we're close to about halfway through the time allotted for CNRL's direct. Does that jive with where you're -- you were expecting to be in your materials?

J. JAMIESON: Yeah, I -- I have to be honest. I think we're about a third of the way through our presentation, but I also know there's some opportunities to condense further in. Mr. Lavigne's and Mr. Sverdahl's is sort of the most dense part of the presentation, so I think if we can just proceed on that basis.

COMMISSIONER CHIASSON: Okay.

J. JAMIESON: We'll endeavour to --

COMMISSIONER CHIASSON: Okay. Let's proceed. We'll see how far we get. At the very latest, we will plan to take a break at 3:30.

J. JAMIESON: Understood. Thank you.

COMMISSIONER CHIASSON: If you don't reach the end of your evidence beforehand.

J. JAMIESON: Yes, that sounds good. Thank you.

COMMISSIONER CHIASSON: So Panel, please proceed.

DEVIN OLLENBERGER, THOMAS BOONE, LENNON ROCHE, MARC SCRIMSHAW, Previously Affirmed
GERARD IANNATTONE, JASON LAVIGNE, SCOTT SVERDAHL, DALE WALTERS, XIANG WANG, PETER THOMSEN, SCOTT BARLAND, Previously Sworn

A J. LAVIGNE: Thank you.

Thank you for this. I'm going to move up through a series of core photos. The first part of the Hearing Issue 1 dealt with the presence of barrier or an aggregation of strata expected to confine steam, and just very briefly, before we move on to the assessment of fractures in these intervals, I just wanted to move quickly up through a core.

This is the AA/1-3 well near the centre of the KN08 pad, and the bitumen-saturated sands at the bottom is the top of the reservoir, and this is where we would interpret -- we would predict the top of the steam chamber will be. And so there is -- there is a unit of post B2 non-reservoir. Then we move up into the more heavily bioturbated heterolithic deposits of the lower B1.

Could we please move up one photo or -- am I in control as well? Sorry. Or -- okay. Okay. Thank you.

In the bottom three tubes is the lower B1 regional sequence, which contains locally some paleosols and coals that occur near the top of that. Then we can see the regional mid-B1 mudstone. Above it in the top tubes is the -- the bioturbated deposits of the upper B1 regional sequence. And if we could go up another one, please. We pass up in through there to the top of the upper B1 sequence. We can note that it's heterolithic -- its heterolithic nature but also its relatively high V shale component. The base of the Wabiskaw D incision can be seen with the dark grey mudstones in this Wabiskaw D sandier interval.

Go up one more, please.

And then we pass into the two high V shale Wabiskaw D confinement strata units. As mentioned, this is the contact between the top Wab D non-reservoir and the basal upper heterolithic unit.

If we could go up another, please.

COMMISSIONER CHIASSON: Actually, Mr. Lavigne, if you don't mind, one brief question. I'm not a geologist, and so this is my non-geologist -- can you just explain to me briefly what you mean by "V shale".

J. LAVIGNE: Sorry. The volume of shale,

so the percentage of fine grain material relative to the entire unit. So 50 percent V shale would be half shale, half sand --

COMMISSIONER CHIASSON: Okay.

J. LAVIGNE: -- or mudstone.

COMMISSIONER CHIASSON: Super. Thank you very much.

A J. LAVIGNE: So the two Wabiskaw D units with a high volume of shale, high mud percentage. Then the base of the Wabiskaw C, which is the heavily bioturbated heterolithic package, and then we see the base of the Wabiskaw B.

And if we could please go up another slide. We could see abundant calcite concretions within the unit and the lighter saturation that's starting.

And if we could go up one more, please. And this is getting up into the Mannville II gas pool that occurs at the top of the Wabiskaw B in these lower saturation units.

So in summary, there's a sequence of multiple units with high mudstone content and low vertical permeability between the top of the McMurray formation reservoir and the base -- and the Wabiskaw B, which contains the Mannville II gas pool.

Now -- now, we'll turn -- excuse me -- to the second hearing issue -- or part of the first hearing issue, which is the determination of whether or not

there are fractures in the strata between the McMurray formation and the Wabiskaw B member.

Canadian Natural believes it's very important to the success of a SAGD project to determine if faults and fractures are present as they represent a risk to steam containment. Any loss of steam from the SAGD chamber would be very detrimental to the efficiency of the operation and would severely negatively affect project economics.

Also, as previously discussed, Canadian Natural is a majority working-interest partner in the Wabiskaw B gas pool and has a common goal to protect the future production of gas resource once the SAGD bitumen operations are complete.

Canadian Natural has an extensive multidisciplinary workflow to identify the magnitude and locations of potential faults and fractures, not just within the confinement strata units but also within the SAGD reservoir zone, the caprock, and deeper Paleozoic sediments. This includes geological and geophysical structure mapping, 3D seismic amplitude mapping, as well as core and image log interpretation. This data is then integrated with a review of operational data such as pressure monitoring of the McMurray bottom water versus pressures observed in the gas cap and a review of lost circulation events in

nearby wells.

Post-steam, Canadian Natural also regularly reviews data for any indications of loss of steam, including loss of steam via potential faults or fractures through RST or PNX logs, 4D seismic, and continued pressure and steam balance monitoring.

We will now discuss the core and image log data and see how they can be used to identify faults or fractures.

Canadian Natural has conducted a review of its core and image log data at KN08 and 9. Well logs, core data, and image logs were reviewed from 43 stratigraphic test wells in the KN08 and 9 areas. No faults or natural fractures were observed within the confinement strata intervals on 24 cored wells. Additionally no fractures were observed on 36 image logs within the confinement strata units.

Could I please bring up Exhibit 01.01, PDF page 272. Thank you.

Prior to examining Canadian Natural's core evidence, it is important to take a moment to describe the difference as observed in core between in situ natural fractures that are present at depth and induced fractures that were created by the coring process itself. Fractures are often induced by the coring process due to in situ compressional stresses in the

vicinity of the bottom hole. They can be distinguished from natural -- naturally occurring fractures observed in core by their distinctive shapes and characteristics. Specifically, coring-induced fractures can be characterized as petal centre line or petal line -- petal centre line fractures as per the schematic on the left. Centre line fractures wander from side to side, down the middle of the core. Petal fractures are curved and often propagate downwards towards the centre of the core where they may join centre line fractures. Vertical cracking is also commonly observed in oil sands due to degassing of the core on retrieval from depth. In contrast, natural fractures, as illustrated in the figure on the right, are plainer and usually intersect the entire core.

Could I please pull up Exhibit 050.003, Tab 8, page 53. Thank you.

In its January 2024 geology report, ISH referenced the online blog of Ogilvie 2021 and showed Figure 5B in the upper left to illustrate coring-induced petal fractures. Figure 5A, also from Ogilvie, was not shown in the submission which illustrates open coring-induced centre line fractures. It should be noted that Figure 5A bears a striking resemblance to the images of fractures ISH observed in cores over the KN08 and KN09 boxes shown on the left -- on the right.

Canadian Natural believes all of the fractures ISH submitted are coring induced. Furthermore both of these examples -- I'm sorry -- the two centre examples, ISH Figure 6 and ISH Figure 9, are from calcite-cemented intervals. These drilling-induced fractures in these concretions commonly happen due to an increase of weight on the bit during the drilling process in order to continue to core through these hard, dense intervals. These are not indicative of in situ natural fractures.

The oil seen on the fracture plains wicks into the fracture plain during the coring process and is not indicative of a natural in situ fracture network through which oil can migrate.

Other examples from ISH's hearing submission are shown in pairs of photos throughout the slide. In the photo pairs, the photos submitted by Canadian Natural are on the left, and the -- ISH has interpreted fractures and annotated them on the paired right-side image.

Note the hackily nature of the fracture plains and the similarity in appearance to the induced fractures referred to in Ogilvie Figure 5A.

The frequency of these fractures is very small and even if present at depth would not be indicative of a connected natural fracture network that could be a

pathway to steam. However, Canadian Natural reiterates that there is no evidence of natural fractures within the confinement strata interval over the KN08 and KN09 drainage boxes, and the examples highlighted by ISH are coring induced.

Could I please have Exhibit 01.01, PDF page 273.

Thank you. Similarly, it would be useful to quickly describe how fractures are interpreted on image logs. Referring to the figure on the top, an image log can be thought of as an unrolled section of the wellbore surface as shown. Dipping bedding plains will appear as low amplitude sinusoids; horizontal bedding will be -- will appear horizontal and fractures will appear as high amplitude sinusoids cutting across the bedding plains of the image log.

An example of a fracture as seen in image logs is shown on the bottom right where a high amplitude sinusoid cuts across the low amplitude sinusoids of bedding and can be easily identified.

Could I please have Exhibit 15.01, Tab 25, page 339. Thank you.

Canadian Natural has conducted an extensive review of its image log data at KN08 and KN09 and has found no evidence of natural fractures within the confinement strata. As part of its response to AER, SIR1, Question 2, Canadian Natural supplied image logs and

core photos of coring-induced fractures within the various confinement strata intervals. The fractures observed in core in the AA/16-33 wells shown are coring induced. They are centre line fractures in a calcite-cemented interval in the Wabiskaw B. They're a common occurrence in oil sands cores in calcite concretions as mentioned previously.

The image log over this interval shows no fracture in the image in the bottom right, merely continuous bedding shown by the continuous low angle sinusoids. The fractures that can be seen in the core at the top are not seen at depth in the walls of the wellbore; therefore, they are not present at depth.

Could I please have Exhibit 01.01, PDF page 275. Thank you.

The figure on this slide is an example from this response showing a portion of the post B2 non-reservoir strata in the AA/15-34 well. As can be seen in the core photo, there are some fractures observed which are interpreted to be coring-induced petal and centre line fractures. The image log from the corresponding interval in the upper right shows continuous dipping beds expected from this muddy ISH confinement strata, but no high angle -- high amplitude sinusoid features indicative of natural fractures are present.

Note also the effective mud smearing on one of the

pads which somewhat obscures the detail in that track. Additionally sand-filled skolithos-like burrows can be seen in the core photo but not on the image log. That is because the burrows are of low density and do not occur in the walls of the wellbore. They are small with narrow apertures and are not a viable pathway for steam.

Could I please have Exhibit 050.003, page 55. Thank you.

Canadian Natural has re-examined all of the features on image logs purchased by ISH that were interpreted to be fractures as depicted in Table 1 of ISH's hearing submission. Canadian Natural interprets the majority of the fractures observed by ISH to be artifacts caused by tool marks from the imaging tool marking the wellbore walls rather than natural fractures.

An example of this is shown in the 1AA/11-2 well at around 436 metres within the Wabiskaw A formation, which is part of the caprock. Canadian Natural observed several linear features on the image log around 436 metres, which are characteristic of tool marks, not fractures.

In the higher-quality static image right of centre, note how the dark feature at about 436.5 metres is not continuous over all of the tracks, and

continuous horizontal bedding exists higher to the left of this dipping feature. The three pads starting second from the left on the dynamic image log show no evidence of this feature. It does not describe a sinusoid; therefore, it is not a plain and therefore it cannot be a fracture.

ISH purchased numerous image logs from a third-party vendor in the Kirby north area and provided a map of where the interpreted fractures were present or absent. From this review, the only well from the purchased image logs that ISH observed a fracture over the KN08/KN09 pads was in the AA/11-2 well that was just described as representing tool marks. Additionally, this fracture as interpreted by ISH was not within any of the confinement strata units but rather above the Wabiskaw B gas zone in the caprock interval.

Canadian Natural also reviewed the remaining fractures identified by ISH on these wells, and as per Table 1 in the Canadian Natural hearing submission as -- interpreted that none of the fractures identified within the confinement strata represent natural in situ fractures as per Table 12B in Canadian Natural's reply submission. Canadian Natural concludes that the fracture density within the confinement strata values at KN08 and KN09 based on the image log data

purchased by ISH is very low to nonexistent.

ISH had half -- a petrophysical consulting company review in detail only 2 out of the 11 image logs supplied by Canadian Natural. The -- these wells were located in the southern part of the KN08 drainage box. HEF identified only four fractures -- sorry. HEF identified only four fractures within any of the confinement strata intervals within these two wells. Canadian Natural states that this would constitute a very low fracture density within the confinement strata units if the four fractures observed were, in fact, natural. However, Canadian Natural has reviewed these four features identified by ISH in these wells and concludes they're also tool marks and not in situ fractures as per the table in Tab 9 of the reply submission.

Additionally, HEF had made some general statements in their hearing submission report about the fracture nature and density they had observed in these wells that are worth restating. For the AB11-34 well: (as read)

> There are no obvious faulting indicated by the bedding data.
>
> Fractures are sparse and there aren't enough of them to comment on orientation trends.
>
> [For the AA/9-3 well] There is no obvious

faulting indicated by the bedding data.

The image interval has a low-to-moderate intensity of open fracturing with a similar intensity and orientation of heel fractures.

There are no observed shears or interpretable large fractures in the image.

Sorry. I would like to correct it in the second well. It's the AA/9-33 well. My apologies.

Finally, as will be discussed further in Canadian Natural's direct evidence, it is noted that the two wells selected by ISH for analysis are near the seismic feature observed as a zone of expected heterogeneity on the spectral decomposition slice provided in Canadian Natural's application. ISH did not request HEF to review the image log provided by Canadian Natural at the AD/13-34 strat well that directly penetrates this seismic feature, but it will be shown shortly in Canadian Natural's direct evidence that there are no features within the confinement strata as seen on image logs from this well.

In summary, Canadian Natural states from its evaluation of core and image log data at KN08 and 9 the following: No natural fractures have been observed within the confinement strata units on the 24 cores reviewed by Canadian Natural. Canadian Natural interprets all fractures observed by ISH on submitted

core photos as coring induced, not naturally occurring at depth. No natural fractures have been observed within the confinement strata units on 36 image logs reviewed by Canadian Natural. The majority of the fractures identified by ISH on the purchased image logs that they or HEF reviewed are interpreted by Canadian Natural to be tool marks.

Canadian Natural concludes from its review of core and image log data that the fracture density within the confinement strata is low to nonexistent and will not pose a risk to steaming operations at KN08 and KN09.

I will now introduce my colleague Mr. Scott Sverdahl, professional geophysicist, to continue with Canadian Natural's direct evidence on Hearing Issue Number 1. He will speak to Hearing Issue 1B.

A S. SVERDAHL: Thank you, Mr. Lavigne. I will now go through Canadian Natural's seismic evidence, along with a discussion on differential compaction and Canadian Natural's interpretation as to where the Wabiskaw B gas at KN08 and KN09 originated. We will then conclude with Canadian Natural's operational evidence showing there are no faults or open natural fractures within the confinement strata units that would be a risk to steam breakthrough.

Reviewing Canadian Natural's seismic data evidence, we have conducted a thorough review of its 3D

seismic data at KN08 and KN09, and we summarize the following: No large-scale faulting resulting from underlying salt dissolution or Paleozoic karsting is observed or expected at the project area. 3D seismic structure and attribute mapping also show no evidence of faulting within the confinement strata units.

Structural sags from a minor amount of differential compaction over mud-filled abandonment channels is present at KN08 and KN09. This causes some minor folding in the overlying sediments; however, faults from this amount of differential compaction is not expected nor is it observed on Canadian Natural's 3D seismic. Canadian Natural disagrees with ISH's fault interpretation on a representative seismic line supplied in the application and will proceed to show why.

Could I have up Exhibit 01.01, PDF page 68, please. Just one moment, please. Sorry. I meant 63. Page 63. Thank you.

As supplied in the application, this map shows that KN08 and KN09 areas are approximately 30 kilometres west from the Prairie Evaporite salt dissolution edge. The project is in a regionally tectonic stable area and faulting or other deep-seated structural events are not expected here.

Could we go to page 64, please. Thank you.

This deep seismic line through the application area extends from the Clearwater to the basement, which is just below the interpreted red beds reflector on this line. It confirms that no deep faulting is present at KN08 and KN09 from salt dissolution.

Canadian Natural has supplied a collage of various seismic cross-sections and attribute maps as well as depth-converted structure maps at the Wabiskaw B level and the Paleozoic level in its various submissions. These seismic interpretation products show no evidence of faulting or fracturing at KN08 and KN09, but do show some stratigraphic heterogeneities within the post B2 incision SAGD reservoir trends -- start. These seismic interpretation products show no evidence of faulting or fracturing at KN08 and KN09 but do show some stratigraphic heterogeneities within the post B2 incision SAGD reservoir trends, including some effects of differential compaction, which will be discussed in more detail here further.

Could I have Exhibit 50.003, page 58, please. Thank you.

Canadian Natural would now like to address some differences in interpretation of faults and/or fractures with ISH on supplied representative seismic line at KN08. To start, I'll take a few moments to orient the Panel as to what is being shown on this

figure. The original line as supplied by Canadian Natural is on the left, and the line interpreted by ISH, with some additional annotations added by Canadian Natural, is on the right. The near vertical black lines on the right image are ISH's interpretive faults and may have also annotated some near horizontal dashed lines at or near seismic reflector events.

Canadian Natural placed several letters on the right figure near ISH's faults to serve as a key, namely, an 'A', 'B', or 'C'. Canadian Natural has also highlighted an interval at the top of the figure on the right in pink, which is the stratigraphic interval of the wet porous Clearwater sands that lie above the impermeable Clearwater caprock.

I'll now describe why Canadian Natural disagrees with ISH's fault -- fault interpretation on this seismic line.

We will start with the faults marked with the letter 'A' in the right-hand image. You can observe there are -- there is a significant amplitude anomaly at the Wabiskaw B VF level in between the two 'A's. This amplitude anomaly is likely due to a relatively thicker gas in the Wabiskaw B in this area relative to the remainder of the seismic line. ISH has annotated faults at both edges of this amplitude anomaly. However, gas amplitude anomalies can cause phase

chainage in the seismic response that can be misinterpreted as faulting.

Secondly, there are several faults annotated with the letter 'B'. ISH has accentuated potential offset at the locations marked with a 'B' with near horizontal dashed lines on either side of their interpretive fault traces as shown in black. When compared to the original line without the horizontal or vertical annotations, it is clear that there is only a very minor amount of structural role at the corresponding locations with no distinct breaks observed on the nearest seismic event. Canadian Natural interprets this to be subtle folding at best, not faulting.

ISH has also taken liberties to extend these postulated fall traces deeper down into the stratigraphy, including into the confinement strata units and further down into the McMurray. It is observed on these deeper seismic events. That structural role is not even present, let alone a distinct break on seismic reflection events. This is not evidence of faulting as speculated by ISH.

Thirdly, ISH has marked faults at the edges and within some observed structural sags in the McMurray SAGD interval and have extended them vertically up through the confinement strata units and beyond. These are marked with the letter 'C'.

Canadian Natural observes that minor structural sag at and above these locations is present to differential compaction of mud-filled abandonment plugs. Reviewing the original figure on the right at the location of these interpreted sags shows no distinct breaks at the seismic events at or above the marked letter, letter 'C', which would be indicative of faulting. It is also noted that the amount of sag diminishes with shallowing depth above the features.

Finally, ISH's fault interpretation has a significant number of faults extending all the way up into the zone of the Clearwater sands as marked in pink. If these faults were real and exist as open conduits for steam as ISH contends, the Wabiskaw B gas would have leaked up into the Clearwater sands a long time ago, and there would be no gas trapped within the Kirby Upper Mannville II pool.

In summary, Canadian Natural maintains that there is no seismic evidence of faulting at KN08 and KN09 between the McMurray and Wabiskaw B gas and that ISH's seismic fault interpretation is incorrect and speculative.

Canadian Natural will now discuss differential compaction present at KN08 and KN09 and go through its evidence that faults or fractures have not formed within the confinement strata units as a result of this

compaction observed at the proposed drainage boxes.

Could I please have Exhibit 50-003, page 60, please. Thank you.

Canadian Natural observes that differential compaction at KN08 and KN09 is mostly related to areas of the post B2 incision edges and where mud-filled abandonment channel plugs within the incision exist.

Abandonment plugs are areas where the active channel within a river system have been cut off and subsequently filled with mud and clay sediments. This is very common in fluvial river systems. An example of this can be seen in the modern Bow River -- actually -- sorry. We can see this in the modern Bow River example just outside of Calgary.

It is important to understand the relative positioning of abandonment plugs to the adjacent point bar sand deposits as they compact to a greater degree than the sands when buried with an -- with overlying sediment. As sediment continues to be deposited, the layers overlying the -- overlying also sag into the pression [sic] at the location of the underlying mud plug. This process is the primary mechanism of differential compaction observed at KN08 and KN09 as -- as shown in the schematic in the lower left of this figure.

It is also important to understand the relative

scale of the abandonment channel plugs at KN08 and KN09. Post-B2 incision valleys at Kirby north are tributary systems on a much smaller scale than deposits at other McMurray developments, such as at Aspen, which was referenced to in Dr. Boone's October 10th, 2023, independent report.

Abandonment channel plugs at Kirby north, including KN08 and KN09, are visually observed to be approximately 200 to 400 metres in width and 6 to 12 metres deep post-compaction. Visual inspection of the figure provided in Dr. Boone's report for Aspen where -- where some minor faulting due to differential compaction is observed shows it is a much larger McMurray channel system with abandonment plugs in the order of 700 to 1,000 metres wide and depths of 25-plus metres post-compaction.

Resulting amount of compaction observed over these small abandonment plugs at KN08 and KN09 is in the order of 3 to 5 metres at the Wabiskaw B level. This is considered a minor amount of structure due to compaction, and, in Canadian Natural's experience, faults or fractures are not expected from this small amount of sag, which has been confirmed by Canadian Natural's review of its seismic core data and image logs.

Could I get up Exhibit 50-003, PDF 62, please.

As you can see on this figure, Canadian Natural provided a seismic spectral decomposition slice in the 2022 application, which is presented in the upper middle of this slide. There was a northeast/southwest feature noted on the map that was labelled "Area of Expected Heterogeneity", which my colleague is now pointing to. This feature is present -- this feature is present on many of Canadian Natural's other geophysical and geological mapping products, such as the seismic lines shown in the bottom right portion of this slide. On this seismic line, a structural sag on various reflectors observed -- is observed as -- and is circled in red. This sag is directly through the area of expected heterogeneity. Canadian Natural interpreted this feature to be a result of differential compaction from a mud-filled abandonment channel somewhere within the post-B2 incision reservoir.

This channel trend, along with other trends observed from other data sources, was incorporated into a map similar to the one shown on the upper right portion of this figure, which is -- this map is a total post-B2 non-reservoir isopach.

Canadian Natural decided to test the -- this interpretation to determine the exact stratigraphic level of the anomaly, as well to determine an amount of reservoir-quality sand potentially remaining underneath

the feature with a stratigraphic test well. You could see the location here with a red star on the spectral decomposition slice and on the map on the top right.

This well could also test if this area of anticipated differential compaction actually had faults or fractures within the confinement strata units by running an image log.

Could I please have Exhibit 050.003, PDF 62, please. Oh, this is it. Sorry. The same one, yeah.

Yeah. Canadian Natural drilled the 1 AD/13-34 strat well, and the well logs here are on the very left. This well was drilled in February of 2022 directly -- as mentioned, directly through the subject zone of expected heterogeneity at the northeast extent of the trend. As you can see on the well logs on the left, the well encountered a mud-filled abandonment plug at the top of the Bos [sic] B -- post-B2 incision reservoir as expected. A sag observed on the seismic line at the well location was confirmed to be differential compaction with 3 to 5 metres of lower structure observed through the post-B2 incision tops and up through the Wabiskaw B versus the same geological tops in the nearest offsetting wells.

Now I'd like PDF 63, please. Thank you.

This image log analysis of the 180/13-34 well confirmed that despite going through an area of

relatively more differential compaction compared to the other portions of the pad, there are no faults or fractures within the confinement strata units. As shown -- as shown as this -- this is -- figure in the centre of the slide. Note this was -- well was also a directional well with an inclination of around 43 degrees through the confinement strata, so any vertical fractures or near vertical fractures, if present, should have been detected by the wellbore, but none were found. The only fracture event observed on the image log was significantly higher up from the top of the confinement -- confinement strata units near the Viking level.

In summary, this assessment confirms Canadian Natural's interpretation of differential compaction in the KN08 and KN09 areas and shows there are no fracture events present at this geophysical anomaly. The actual results prove Canadian Natural's model that differential compaction is caused by mud-filled abandonment plugs and that the magnitude of compaction is low. This conclusion is in direct contrast to ISH's postulated differential compaction model where it speculates that open faults and fractures must be present within the confinement strata due to compaction over thick channel sands. Canadian Natural's evidence does not support this theory.

We will now discuss Canadian Natural's evidence showing there has likely been no vertical gas migration from the McMurray to the Wabiskaw B gas thrones -- gas zones through faults and fractures.

Could I have Slide 65, please, of this exhibit.

Thank you.

Canadian Natural disagrees with ISH's statements that Wabiskaw B gas is only present in the KN08 and KN09 areas when overlying thick McMurray channel sands. Canadian Natural shows, as per the map in the upper right of the slide, that Wabiskaw B gas does indeed exist to the northeast of the Kirby Upper Mannville II pool. This gas exists within a smaller structural high that is away from the underlying thick McMurray post-B2 incision channel trends as shown in this cross-section.

Can you just point ... So my colleague's pointing to the thick channel sands here and then the absence of them in the gas identified to the northeast.

ISH's assertation that Wabiskaw B gas only exists over thick underlying McMurray reservoir sands is incorrect.

Could I have page 66 from this exhibit, please.

Thank you.

ISH has also stated that the McMurray Wabiskaw B gas within the Kirby Upper Mannville II pool could have only come from degraded McMurray oil by migrating

vertically through preexisting open fractures and faults. Canadian Natural disagrees and postulates an alternative and more likely reason for the occurrence of Wabiskaw B gas in the KN08 and KN09 in greater Kirby north areas is that the Wabiskaw B gas is self-sourced.

Specifically, the Wabiskaw B gas came from the degradation of Wabiskaw B oil that was originally in place in significant volumes at Kirby north. As shown in this figure, the amount of Wabiskaw B bitumen in place within a 1-mile radius around the Kirby Upper Mannville II and Devenish Wabiskaw A pools is comparable in volume to the amount of developable McMurray bitumen volume in the existing and applied-for pads at Kirby north.

This is a more likely explanation for the occurrence of Wabiskaw B gas also explains why there is also gas to the northeast of the Upper Mannville II pool where there is not any significant thick McMurray post-B2 incision sands present.

As a side note, gas -- gas exsolved from this bitumen as a result of Wabiskaw B pressure decline also contributed to the cumulative gas production from the Kirby Mannville II and Devenish Wabiskaw A pools.

Some final comments on the presence of Wabiskaw B gas in and around KN08 and KN09. ISH has repeatedly asked, Where did the McMurray gas go? Canadian Natural

asserts that the gas generated from degraded McMurray oil likely over geological time migrated laterally away from the area updip along the post-B2 incision valley trend that carries further east into the north for several tens of kilometres, where it finally joins up with the main McMurray trunk valley system.

Additionally, there is no evidence of any top water and/or lean zones of low bitumen saturation at the top of the post-B2 incision sands at KN08 and KN09 that might have indicated early trapping of McMurray gas that was then breached by faults or open fractures. It is more likely that faults and open fractures between the McMurray SAGD reservoir sands and the Wabiskaw B gas have just never existed as per all the other evidence shown here by Canadian Natural.

To conclude, we will now -- I will now describe some of Canadian Natural's operational evidence that there are no faults or open fractures that would be a risk to contaminating steam operations between the McMurray and Wabiskaw B gas.

Lost circulation of drilling fluids during drilling operations can be a direct indicator of faults or open fractures. Canadian Natural has observed no lost circulation events during the drilling of the 43 stratigraphic test wells in the KN08 and KN09 areas and also had no loss circulation events in the recently

drilled 16 producer injector wellbores at offsetting KN06.

Could I have Exhibit 50.09, page 340, please.

Thank you.

This slide shows the pressure data at the 10-1 well within the Wabiskaw B gas of the Kirby Upper Mannville II pool as well as the pressures observed within the McMurray bottom water leg at the 7-29 and 12-34 wells. It would be expected that there would be no pressure differential between these zones if there were faults or an open connected fracture system between the McMurray and Wabiskaw gas zone at KN08 and KN09.

However, as you can see, a significant pressure differential does exist, confirming these zones are not in communication with each other. This is compelling evidence that faults and/or open connected fractures between the McMurray and Wabiskaw B gas zone at KN08 and KN09 do not exist, or, in the unlikely case they do exist and remain undetected, they are closed to fluid flow.

In summary, Canadian Natural has shown substantial -- substantial evidence showing no faults or fractures within the confinement strata units at KN08 and KN09. We reviewed that there are -- there is no evidence of faults or fractures with the confinement

strata intervals on core, image log, and seismic data. We also show that differential compaction at KN08 and KN09 has not caused faults and fracture and that the Wabiskaw B gas did not likely come from the McMurray via vertical faults and fractures within the proposed drainage box areas.

Finally, Canadian Natural's operational and drilling data support there is most likely no faults or fractures with the confinement strata units or if they do exist, they are closed to fluid flow.

To close, Canadian Natural concludes that there is a low to nonexistent fracture density within the strata between the McMurray formation and the Wabiskaw B member that would pose a risk to the containment of steaming operations at KN08 and KN09.

This concludes Canadian Natural's direct evidence on Hearing Issue 1. I will now turn it over to Mr. Peter Thomsen to discuss Canadian Natural's direct evidence for Hearing Issue Number 3.

A P. THOMSEN: Good afternoon, Commissioners.

Thank you, Mr. Sverdahl, for explaining the geoscience evidence and showing that there are no currently open pathways through the confinement strata. Next I will present the geomechanics evaluation, which addresses the third hearing issue. It will be shown that the proposed MOPs are appropriate for confinement

strata containment of steam over the life of the KN08 and KN09 drainage boxes.

Kirby north has significant field experience with starting steam circulation without fracturing. Through continuous improvement, enhanced start-up practices have been developed and used for the KN06 start-up. These enhancements will be carried forward to the KN08 and KN09 start-ups.

There are four components to the risk -- to -- mitigating components to the risk of start-up-induced hydraulic fracturing. Number 1, leakoff within the McMurray reservoir and confinement strata; Number 2, a stress contrast between the McMurray reservoir and the confinement strata; Number 3, elastic stress increases within the McMurray reservoir; and Number 4, limited rate and limited volumes injected with elevated pressures.

I will now address operating pressures and maximum operating pressures, "MOPs". SAGD starts with steam circulation, which lasts for approximately three to four months. Once a sufficient amount of heat has been transferred into the reservoir during circulation, the SAGD well pair is converted into gravity drainage operation. The typical SAGD operating time is approximately 10 to 15 years. During start-up, Canadian Natural will endeavour to initiate circulation

with bottom-hole pressures less than 5,500 kPa. Once circulation starts, the bottom-hole pressure will reduce to near the bottom water pressure. The 5,500 kPa threshold pressure is to try starting circulation with bottom-hole pressures below the post-B2 reservoir sand minimum stress.

In the event of challenging operational circumstances, such as high emulsion pipeline pressures, it may be necessary to initiate circulation with bottom-hole pressures above 5,500 kPa and below the requested temporary MOP of 6,600 kPa. Use of elevated pressures would be for short time periods of less than 24 hours and with small volumes of injected steam, less than 180 cubic metres.

In the event of an operational interruption such as a power outage or a wildfire, circulation stops. Once operations can resume, circulation would need to be reinitiated, which could potentially require elevated bottom-hole pressures. Other than circulation start-ups, all other SAGD operations would be constrained by the long-term MOP.

The original application -- the original application requested MOP was 6,000 kPa. Underneath all of the KN08 and KN09 drainage boxes is McMurray bottom water, which has high water permeability and a hydraulically connected area much larger than the KN08

and KN09 drainage boxes.

The bottom water pressure underneath KN08 and KN09 is approximately 2,600 kPa. SAGD operations will need to operate near a balanced pressure with the bottom water over the long term. Neither production from or injection into the bottom water is acceptable for extended periods of time for the bitumen resource recovery.

The purpose of the long-term MOP being above the bottom water pressure is operational flexibility following downtime and for wellbore issues such as scale plugging.

From a confinement strata integrity perspective, there are two risks to consider. The first is the short-term risk of the start-up potentially fracturing from the SAGD wells to the Wabiskaw B gas. Hydraulic fracturing is a mechanism which can create a transmissive flow path. The second risk is a long-term risk of the SAGD-induced stress changes in the confinement strata and whether this could lead to either hydraulic fracturing or shear failure in the confinement strata. The proposed SAGD operations are low risk for both of these.

One fracture containment mechanism is leakoff. Leakoff describes fluid flow through porous media and, specifically for the SAGD start-ups, applies to water

flowing within the post-B2 reservoir. Number 1, water flowing via water permeability, which occurs in the cold and undepleted McMurray oil sand. Number 2, water flowing into the McMurray bottom water, which has a leakoff capacity. In the unlikely event of hydraulic fracturing within the sand, Number 3, water flowing away from a fracture. Leakoff accommodates some injection volume and constrains potential hydraulic fracture heights. If temporary MOPs are used with small volumes, this de-risks fracturing to or through the confinement strata.

In the setting of the KN08 and KN09 confinement strata, stresses are a primary driver for hydraulic fracturing. A fracture pressure needs to be greater than the minimum stress for a hydraulic fracture to initiate and propagate. This extra pressure above the minimum stress is called the "net fracture pressure". A hydraulic fracture orientation depends on -- upon the orientation of the minimum stress, which can be considered as taking the path of least resistance. For the KN08 and KN09 confinement strata, the minimum stress is oriented horizontally, and this leads to hydraulic fracture orientations to be vertical and to open against the minimum horizontal stress.

For the confinement strata, rock strength is not a primary control of hydraulic fracture behaviour, and,

in fact, the low rock strength benefits the sealing of natural fractures and faults.

Mr. Lung, please pull up Exhibit 15.01, PDF page 96. If we could zoom into the upper Figure 6, please.

Within the subsurface, stresses cannot be measured directly. Instead we use diagnostic fracture injection tests, DFITs, to determine an in situ stress. In this figure is a conceptual DFIT graph of pressure versus time. During a DFIT, following the breakdown, the pressure stabilizes at a fracture propagation pressure. A fracture is open when the injection is stopped, and as the pressure declines, a point will come when the -- where the fracture will close. The pressure at this point is called the "fracture closure pressure", the FCP. This is equivalent to the minimum stress.

DFIT-measured pressures consistently show the fracture propagation pressures to be greater than the fracture closure pressures due to the hydraulic fractures requiring additional pressure above the minimum stress, the net fracture pressure.

Mr. Lung, if you could please pull up Exhibit 15.01, PDF page 39, Table 1. Stresses have been characterized from DFITs, and the minimum stress gradients are 14.6 kPa per metre for the regional B1 sequence and 13.1 kPa per metre for the post B2

reservoir sand. Please note the minimum stress gradient difference of 1.5 kPa per metre, which provides fracture containment in the unlikely event of hydraulic fracturing within the post B2 reservoir sand. This is the second fracture containment mechanism. This is consistent with the KN06 stress characterization.

Next, SAGD circulation will create stress increases within the post B2 reservoir sand. In the unlikely event of a hydraulic fracture within the sand, the increased pressure and temperature will create stress increases. The result of the stress increases are that in order to continue propagating a hydraulic fracture, the fracture pressure will increase through time. In a situation with a pressure limit, this will force a reduction in injection rate and can ultimately lead to a fracture closing. Elastic stress increases within the sand are the third fracture containment mechanism.

In Kirby north, 146 SAGD wells have been started up. These wells were assessed for indications of hydraulic fracturing. 145 out of the 146 wells conclusively initiated circulation without hydraulic fracturing of the sand. A 46 -well subset were started up with bottom-hole pressures greater than 6,000 kPa. It should be noted that the use of the elevated

pressure for initiating steam circulation is not a theoretical prediction, but, rather, there is a significant Kirby north experience with this type of operation.

The risk of fracturing the post B2 reservoir sand is low, and without initiating a hydraulic fracture within the sand, the risk of fracturing through the confinement strata is even lower. When bottom-hole pressure is -- greater than 6,000 kPa were used, it was for short time frames, typically between one to four hours, and small volumes of steam were injected, typically 1 to 10 cubic metres per well. The requested MOPs are a low likelihood for initiating hydraulic fractures within the post B2 reservoir, and this is supported by the Kirby north start-up field data.

The stress characterization used for this evaluation is representative for the KN08 and KN09 drainage areas. This is supported by four points. Stresses tend to be regionally consistent for a given stratigraphic unit. Regionally present mud-prone heterolithic strata have consistent elastic properties which are directly related to horizontal stress gradients.

The commercial scale Kirby north data set of -- starting up 146 wells on steam circulation does not show stress variability with either variable or low

fracture pressures. And, finally, significant geological structural features such as karsts are not present in the KN08 and KN09 drainage area.

The requested temporary MOP is low risk in part due to the short durations of less than 24 hours and minimal injection volumes of less than 180 cubic metres. Additional DFITs are not required over the KN08 and KN09 drainage areas, and Canadian Natural is not willing to conduct additional DFITs since the requested temporary MOP is low risk. Further DFITs will increase costs and may result in a further project delay. Additionally DFITs are also unlikely to change the requested MOPs.

The long-term operating pressure gradient will be approximately 5.5 kPa per metre, which is far below the post B2 reservoir sand minimum stress gradient of 13.1 kPa per metre. The bottom water driver on SAGD operating pressure de-risks the long-term risk of hydraulic fracturing of the sand or the confinement strata. Further, the operating pressure gradient of around 5.5 kPa per metre is below the water hydrostatic head pressure gradient of 9.8 kPa per metre. Shear failure is generally considered low risk at operating pressures below the hydrostatic head of water. This is exemplified by Long Lake Pads 14 to 15 which have an MOP of the hydrostatic head of water near seismic scale

faults in the caprock.

Next we will review the geomechanical modelling. The objectives for the geomechanical modelling were to evaluate the short-term and long-term risks. For the short term, what is the potential to initiate and propagate hydraulic fracturing within the post B2 reservoir sand and what is the minimum magnitude of a stress contrast to contain hydraulic fractures?

Specific to the long-term risk is representing SAGD-induced stress changes within the confinement strata and assessing factors of safety. The simulator used for this modelling is GeoSim, which is an AER-recognized simulator for thermal caprock integrity and is an industry standard. GeoSim features include fracture mechanics, multi-phased flow, and coupled reservoir and geomechanical modelling.

The methodology for evaluating the potential for start-up-induced fracturing includes consideration of the initial and the dynamic stress state, flow through effective permeability to water, and appropriate rock properties. Two locations were evaluated for potential start-up-induced fracturing: One is the location of the shallowest well, which is near the toe of KN08 12I, which is more prone to fracture initiation due to the depth.

The second location is where there is the shortest

distance between the base of the regional B1 sequence and the top of the post B2 reservoir. This is near the heel of KN08 6I. For evaluating the long-term SAGD impacts, a 2D model was extracted from the heels of the KN08 development where there is a short distance again between the regional B1 sequence and the top of the post B2 reservoir. Long-term pressure and temperature effects were predicted, which involves uplift of the overburden, including the confinement strata. The modelled stress changes within the regional B1 sequence were assessed for impacts to the tensile and shear factors of safety.

Finally, a 30-day period of elevated injection pressure -- of elevated injection pressures was implemented after a time period of one and five years of SAGD operation.

Conservative inputs have been used for many of the inputs in the modelling. Some of these conservative inputs are representing low effective permeability to water and not representing leakoff to the bottom water. For the start-up modelling, the injected fluid was cold water, which is conservative and does not include any thermal elastic effects from temperature increase. Further, only one hydraulic fracture is represented along the length of the horizontal well.

Low compressibility inputs have also been used.

As has been described earlier, four fracture containment mechanisms are represented in the modelling: Number 1, leakoff of water into the post-B2 reservoir; Number 2, a stress contrast between the post-B2 reservoir and the confinement strata, specifically the regional B1 sequence; Number 3, poral elastic stress increases around a hydraulic fracture; and the fourth fracture containment mechanism is implicit with the inputs of a maximum continuous time of 24 hours with using an elevated pressure and a maximum steam rate of 180 cubic metres per day.

This is conservative, considering the typical use of elevated pressures above the long-term MOP is a duration of one to four hours with a volume of 1 to 10 cubic metres.

Mr. Lung, please pull up Exhibit 46.002, page 64.

Please zoom in to Figure 20.

A. LUNG: Mr. Thomsen, could I just ask you to slow down a little bit for our court reporters. Thank you.

A P. THOMSEN: And zooming in on the upper figure, please.

The most realistic representation of the short-term risk includes the fracture containment mechanisms. This is Case Number 2, which is located at the shallowest well in the KN08 and KN09 drainage

boxes. Case Number 2 is modelled without a constraint on the bottom-hole pressure. In the graph of pressure versus time, the Case Number 2 green line shows a near immediate increase above 6,600 kPa. An unconstrained bottom-hole was required with the modelling in order to initiate a small fracture.

If you could scroll down to the next page and zoom in to Figure 22, please.

This image shows the geometry of the most realistic Case Number 2, which has minimal growth within the post-B2 reservoir sand of less than 2 metres in height.

The key finding is that with realistic modelling of the post-B2 reservoir and with a constraint of a bottom-hole pressure of 6,600 kPa, there is a low risk of fracturing the post-B2 reservoir. It is likely that a temporary MOP of 6,600 kPa will not result in fracturing of the sand.

In the highly unlikely event of propagating a fracture to the base of the regional B1 sequence, the stress contrast would contain a fracture below the regional B1 sequence and far below the Wabiskaw B gas.

Sensitivity cases have been modelled in order to evaluate fracture containment mechanisms.

Same exhibit, if we could go to page 71, please, and Figure 31. If you could zoom in on that, please.

Cases 7 to 8 were modelled in order to consider reduced minimum stress contrasts and fracture containment. Case Number 8 uses a conservatively low effective permeability to water, no bottom-hole pressure constraint, and has no elastic stress increases within the post-B2 reservoir sand. The Case Number 8 inputs use a minimum stress gradient difference of only 0.3 kPa per metre. These changes from a realistic scenario were used in order to model -- represent a fracture propagating to the base of the regional B1 sequence. On this image is the fracture size after 24 hours of injection, which shows containment within the regional B1 sequence. This shows that a minimum stress gradient difference of only 0.3 kPa per metre is sufficient to contain hydraulic fractures. The regional B1 sequence has a minimum stress gradient difference of 1.5 kPa per metre.

Please change to PDF page 53 and zoom in to Figure 10A, the upper one.

For the long-term risk, a 2D cross-section was extracted from the heels of the KN08 drainage area. 12 SAGD well pairs were modelled for 15 years of operation. The steam chamber pressure was set to 4,000 kPa with -- removing any leakoff to the bottom water. This is conservative, considering that the bottom water pressure is 2,600 kPa.

Shown is a model cross-section where the shear stress level -- shown is a model cross-section showing the shear stress level, and one can also identify variable unit thicknesses which have been represented.

Same exhibit, please, go to page 72, Table 4.

Through the life of the SAGD operation, the minimum factors of safety were identified within the middle of the regional -- within the middle of the B1 sequence. The minimum shear factor of safety is 1.9, and the minimum tensile factor of safety is 2.1. These are both far from the onset of failure and are above the Directive 86 shallow SAGD minimum factor of safety of 1.25. Kirby north is not within the shallow SAGD area, but this comparison is made to illustrate that the proposed operating conditions are reasonable.

Sensitivity cases for the long-term SAGD operations were modelled for a 30-day period of steam injection at a bottom-hole pressure of 6,000 kPa after one and five years. Due to the high compressibility of the steam chamber, there are negligible effects, impacts on confinement strata stress changes.

The hearing issues are focused around whether steam could communicate with the Wabiskaw B gas. This is confined to an economic risk, and there are not health, safety, or environmental consequences. For the short-term risk, a sufficient factor of safety is

present with the proposed operating conditions due to the limited durations and volumes for the potential use of elevated pressures, the other three fracture containment mechanisms, operational enhancements for SAGD start-ups, and Kirby north field experience of initiating steam circulation with bottom-hole pressures above 6,000 kPa without communication to the Wabiskaw B gas.

For the long-term risks, the factors of safety are well above the D86 minimum factor of safety of 1.25, which, again, is not applicable to Kirby north, but this comparison is made to illustrate the proposed operating conditions are not pushing the envelope.

In conclusion, the requested temporary MOP of 6,600 kPa is low risk of fracturing through the confinement strata due to multiple fracture containment mechanisms: Number 1, leakoff within the McMurray reservoir and confinement strata; Number 2, a stress contrast between the McMurray reservoir and the confinement strata; Number 3, elastic stress increases within the McMurray reservoir; Number 4, limited rate and volume injected with elevated pressures.

The proposed operating conditions, including a long-term MOP of 6,000 kPa, are a low risk to the confinement strata integrity for long-term SAGD operations.

Regarding modifications to the requested operating limits, the originally requested MOP and temporary MOP are technically justified, as shown in the application and the written materials submitted in this hearing.

While not required, Canadian Natural has modified its requests. Regarding the temporary MOP, Number 1, limit the maximum continuous time to 24 hours when using bottom-hole pressures above 5,500 kPa and below the requested temporary MOP of 6,600 kPa. Number 2, limit the maximum gross steam rate to be 180 cubic metres per day when using bottom-hole pressures above 5,500 kPa. Regarding the -- the MOP, reduce the MOP from 6,000 kPa to 5,500 kPa while maintaining the requested temporary MOP of 6,600 kPa for the purpose of initiating circulation.

While unnecessary, these modifications provide further risk mitigation and demonstrate Canadian Natural's reasonableness. Thank you for your attention, and I will now pass the presenting over to Mr. Devin Ollenberger, who will be addressing Hearing Issues Number 2, 4, and 5.

D. OLLENBERGER: Thank you, Mr. Thomsen.

Good afternoon, Commissioners. As mentioned earlier, my name is Devin Ollenberger, and I am the exploitation engineering manager for the Kirby north asset. Today I will be talking about Hearing Issues

Number 2, 4, and 5, which generally cover appropriate monitoring and observation wells; whether to approve the use of co-injection, more specifically, hydrocarbon-assisted start-up; and the thermal compatibility and/or abandonment of identified wells within or adjacent to the KN08 and KN09 pad developments.

I will begin my commentary with Issue Number 2. Canadian Natural plans to execute a robust monitoring strategy consisting of data collected from both gas monitoring wells and SAGD well pairs in combination with appropriate process controls and operating procedures. This strategy is demarcated into two time periods: the circulation start-up phase and the long-term SAGD operation phase. This is to ensure that the relevant differences of these two operational phases are adequately addressed. When we're available, Canadian Natural also plans on using 4D seismic data to monitor the KN08/09 development. The last such seismic shoot at Kirby north was completed in Q1 2022. Finally, Canadian Natural plans to report all relevant monitoring data as part of the AER Directive 54 requirements or directly to the AER on an as-needed basis, subject to approval conditions.

Canadian Natural originally applied for start-up enhancements for pads KN08 and KN09 that are similar to

those that have been successfully executed at KN06. This includes holding a workshop at least 30 days prior to start-up, which will cover hydraulic fracturing, in situ stresses, and previous Kirby north circulation examples where temporary MOP pressures were required to establish circulation.

Building on the content of the workshop, the surveillance graphs that will be used to review realtime data will be modified to include clear indiction of in situ stresses on bottom-hole pressure trends. During start-up, a geomechanics expert will also review the rate and pressure data for several of the initial wells on each pad to test for evidence of abnormal or unexpected fracturing behaviour.

One advancement that Canadian Natural proposes for KN08 and KN09 development which builds upon the start-up enhancements executed for pad KN06 is the pressure criteria utilized for pad start-up mitigations, which may need to occur during initial unloading of the SAGD well pairs.

Here, as Mr. Thomsen just discussed, Canadian Natural adopts Dr. Boone's suggestion that the pressure limit used prior to utilizing the temporary MOP be set at 5,500 kPa versus 6,000 kPa and less than the proposed temporary MOP of 6,600 kPa. 5,500 kPa will only be exceeded if after four hours circulation is not

established.

Again, Canadian Natural would like to reiterate that the technical evidence my colleagues have discussed this morning supports a long-term MOP of 6,000 kPa. However, in light of ISH's concerns, Canadian Natural is prepared to reduce the long-term MOP to 5,500 kPa and all, accordingly, all SAGD monitoring conditions will utilize this pressure in place of the 6,000 kPa which was previously applied for. Normal operations will continue to target pressures in balance with the bottom water.

Canadian Natural believes that the two monitoring wells mentioned in its submission, the 10-1 well and the 100/1-3, will provide sufficient monitoring of the Kirby Upper Mannville II pool, the pool which overlies all of the KN06, KN08, and KN09 pad developments.

First, the 10-1 well on pad KN06 remains a suitable monitoring well for the pool, which I'll speak to more shortly.

In addition, the inclusion of the 100/1-3 well will provide further robustness to monitoring the Kirby Upper Mannville II pool. The well is ideally located in the heart of the SAGD pay for the KN08 pad --

THE COURT REPORTER: Can I get you to slow down, please.

D. OLLENBERGER: You bet.

-- just south of KN09 and is near three wells identified in the AER SIR Round 2 Question Number 1. The SIR was in regard to cement return volumes for the three OSE wells that were in question.

The 10-1 well remains a sufficient and relevant monitoring well for the Kirby Upper Mannville II pool, just as it was in August 2021 when the AER stated that it was satisfied with Canadian Natural's investigation of the well and that no remediation was required.

The well has been on stable pressure decline since March 30th, 2021, and has not been impacted by the initiation of SAGD operations on the KN06 pad that began in May 2023. Canadian Natural does believe that the decline in the well pressures is indicative of the depletion of the gas over bitumen gas resource in the Kirby Upper Mannville II pool.

In ISH's response to Canadian Natural Information Request Number 20, which is Exhibit 044.O02, page 66 of 95, ISH indicated that they agreed that the 10-1 well data is reliable over the last three years.

I will now transition to speaking on Issue Number 4, whether to approve the use of co-injection for the proposed KN08 and KN09 development.

First, as was stated in our submission, Canadian Natural would like to clarify that hydrocarbon agent assisted start-up is not a co-injection process, as

steam injection is halted prior to hydrocarbon injection.

In this case, typical SAGD steam circulation is conducted for 30 to 90 days before circulation is stopped and hydrocarbon is injected at a controlled rate and volume. This allows pressure to remain below MOP as hydrocarbon injection is initiated after the near wellbore region has been heated, providing additional mobility.

For this reason, no additional geomechanical risk is generated by hydrocarbon injection. A maximum -- a maximum hydrocarbon volume of 350 metres cubed per well pair has been requested to provide flexibility for the potential maximum length of the KN08 and KN09 well pairs and the pad scale nature of the test. The injected solvent will only occupy less than 2 percent of the pore space in the near wellbore region and is expected to stay within a 3-metre radius of the wellbore.

Further, given the small injected volume relative to the near wellbore fluids and xylene's full solubility in bitumen and lack of solubility in water, the solvent is expected to combine with the bitumen and be produced back in the early days of SAGD production.

As mentioned, injected hydrocarbon volume and

rates are controlled in such a way the injection pressure will stay below the approved MOP, 5,500 kPa as proposed. The temporary MOP of 6,600 kPa will not be applied to hydrocarbon-assisted start-up.

Of additional interest, xylene is a component in many common chemicals used in the gas production process, such as wax disbursements and demulsifiers. ISH has indicated that they use such chemicals in their gas operations in their IR response to CNRL ISH Number 34, which is Exhibit 044.05, pages 3 and 34 of 62.

Though Canadian Natural does not support a comprehensive monitoring program for hydrocarbon-assisted start-up, such operations will be monitored closely using traditional monitoring methods such as that that was utilized previously on our pad KN01 test.

Finally, four other SAGD operators have also utilized hydrocarbon start-up without issue, which is why it is extremely unlikely that the hydrocarbon-assisted start-up process would impact the overlying gas resource.

I will now transition to discussing Issue Number 5. As per Directive 23, Section 7.8 and the requirement for well integrity in the Kirby commercial scheme approval Condition Number 13, Canadian Natural

has reviewed all well bores that penetrate the McMurray formation within a 300-metre buffer of the proposed KN08 and KN09 drainage boxes. Four wells were identified as thermally non-compatible following Canadian Natural's review. I will cover these wells and associated mitigation shortly.

Canadian Natural does require timely approval in order to gain access and execute these workovers by the end of Q1 2025 in order to progress the KN08 and KN09 development pending regulatory approval. Canadian Natural maintains an implied commitment to restore production capability of the gas resource once the GOB order is lifted.

Canadian Natural is willing to accept ISH's recommendation and convert the 10-34 well to Wabiskaw B gas monitoring well. This will also provide a redundant gas monitoring well location within the KN08 pad in addition to the 100/1-3 well. For the 10-2 well, the McMurray zone will be -- sorry -- the McMurray will be zonely [sic] abandoned and the perforations into the Kirby Upper Mannville II pool will be patched, and the wellbore will be cemented to allow the uphole Grand Rapids to be returned to production.

The implementation of a patch is to minimize workover losses and maintain existing Kirby Upper

Mannville II potential, protecting our combined gas resource. The additional expense of the casing patch is $30,000 and is above and beyond Canadian Natural's normal recommendation.

12-34 well was previously equipped with continuous monitoring, but pressure data ceased on November 19th, 2020. The data taker and radio had failed and were repaired on August 14th, 2022. This well is now thermally compatible due to the restoration of continuous monitoring. And, finally, the 10-3 well will be abandoned.

Canadian Natural believes that we are in alignment -- sorry -- that alignment has been achieved with ISH's hearing submission on all four well workover proposals.

In ISH's hearing submission at paragraphs 141 and 142, Exhibit 32.02, PDF pages 44 and 45 of 47, they stated several requested monitoring conditions and conditions of approval. Throughout our direct evidence this morning, Canadian Natural has largely discussed the major components with regard to what Canadian Natural is willing to commit to with respect to ISH's request with three exceptions that I will now touch on.

First, in addition to the 10-1, 100/1-3, and 10-34 wells, Canadian Natural is also willing to commit to a future monitoring well location on or in the vicinity

of the KN09 pad development and to have that well in place prior to KN09's steaming operations in order to satisfy ISH's request of one monitoring location per pad.

The second item is the inclusion of surface gauges on monitoring wells. Canadian Natural actively responds to and mitigates all downhole gauge issues and therefore does not believe that surface gauges are required.

The final item not previously touched on is with respect to ISH's request for gas sampling. Here Canadian Natural is willing to take baseline samples from a well over the KN08/KN09 development and another sample prior to production of the GOB gas for comparison purposes.

Canadian Natural does not, however, support ongoing sampling over the life of the KN08/KN09 development.

Mr. Lung, can you please bring up Exhibit 050.002, page 43, Table 4.

Thank you.

In ISH's response to Canadian Natural's Information Request Number 19, they provided estimated values of the gas resource both individually and -- and combined for the Kirby Upper Mannville II and Devenish Wabiskaw A pools. These values are provided in the

leftmost common of the table on your screen. Of note is that ISH used an effective date of January 1st, 2024, for their economic evaluation. This date does not capture the appropriate discounting of the Kirby Upper Mannville II pool which is currently shut in under a GOB order.

Utilizing the values provided by ISH, Canadian Natural has provided discounted values of the gas resource assuming both 10 and 20 years delays. These are in the next two columns on your table.

Assuming that the Kirby Upper Mannville II pool will not be able to produce until the bitumen resource at Pads KN08 and KN09 are completed, a 20-year delay is appropriate. SAGD pads known in industry have exceeded this productive lifespan.

After applying appropriate discounting, the value range of the gas resource is 548,000 for the Kirby Upper Mannville II pool, and using $5-per-million BTU gas pricing and 3 percent escalation as provided by ISH can reach up to 1.175 million using a 100 percent working interest and assuming communication of both pools. ISH's share of the Kirby Upper Mannville II pool would be 46.25 percent, and these values would also assume 100 percent of the gas resource is impacted, which is highly unlikely.

Mr. Lung, can you please bring up Exhibit 050.002,

PDF page 44, Table 5. You've just got to scroll down.

The table provided in Canadian Natural's reply submission as shown on the screen summarizes the estimated cost for ISH's requested monitoring and approval conditions on the left side of the table; in contrast, to the estimated costs of Canadian Natural's commitments on the right.

It is evident that the costs of Canadian Natural's committed monitoring, which are near-term expenses at $1.10 million is essentially equivalent to the high-end 100 percent working interest discounted value of the combined Kirby Upper Mannville II and Devenish Wabiskaw A pools of $1.175 million and twice the value of the remaining gas in the GOB Kirby Upper Mannville II gas pool at five thousand -- $500,048.

Additional monitoring measures will increase the disproportionate nature of the risk mitigation costs in comparison to the value of the gas resource. Canadian Natural's proposed mitigations and monitoring measures are reasonable under these circumstances.

Thank you. I would now like to hand it back to Dr. Tom Boone who has previously been --

COMMISSIONER CHIASSON: Actually, before you move on, Mr. Ollenberger, in relation to this Table 5 --

D. OLLENBERGER: Yes.

COMMISSIONER CHIASSON: -- just some clarification

here, which, I think was causing us a bit of concern ahead of the hearing. We've got 'M'. We've got 'K' showing up in the -- this -- in this table. We've got estimated --

D. OLLENBERGER: Sorry.

COMMISSIONER CHIASSON: -- cost dollars 'M'. We've got under ISH request, the second box down on the very left-hand side --

D. OLLENBERGER: I see that now, yes.

COMMISSIONER CHIASSON: -- three wells times 20K. Can you please clarify --

D. OLLENBERGER: I will clarify that both --

COMMISSIONER CHIASSON: -- for the Panel the abbreviations so that we're making sure that we're all understanding the same thing.

D. OLLENBERGER: Yes. We thought we had cleaned off all the Ks. Both 'M' and 'K' in this instance are $1,000.

COMMISSIONER CHIASSON: Thank you.

D. OLLENBERGER: You're welcome. Thank you for that clarification.

Sorry. If there are no further questions, I will now hand over to Dr. Tom Boone as previously being introduced as Canadian Natural's independent expert witness.

T. BOONE: Thank you, Mr. Ollenberger.

Now, I'm going to be about 20 minutes and Gerard is maybe five, four?

COMMISSIONER CHIASSON: Well, as we indicated, we will be having a hard stop at 3:30 for a break in any event, so --

J. JAMIESON: I think we're going to make it. There's a path forward here.

COMMISSIONER CHIASSON: All right. Thank you.

A T. BOONE: Thank you. Good afternoon, Hearing Commissioners. My name is Tom Boone, and I've been engaged by CNRL to provide an independent assessment of Issues 1 to 4 with specific focus on the confining strata at KN08 and KN09.

Now, this presentation will summarize key points that I made in my initial and supplemental reports that I have prepared independently. Now I'm only going to refer to figures in my supplemental report, which is Exhibit 050.003, and if it's okay, I will just refer to the PDF page numbers going forward.

So can I have PDF page 9, please. Now, with respect to the first hearing issue, the approach I've taken is to conduct a comprehensive technical review of factors that may affect the containment of steam. Now in the chart shown, I've listed a suite of parameters along with criteria for assessing each parameter. My assessment of the parameter is in the third column,

which is coloured based on whether it's supportive of containment, is neutral -- supportive of containment being green, neutral being yellow, and lack of containment being red, although there are none there.

I'll briefly comment on most of these parameters using this slide and then highlight the production pressures and core assessment.

So, first, geology stratigraphy. As discussed by Mr. Lavigne, stratigraphic mapping shows there are multiple low permeability zones in the confinement strata at all the stratigraphic wells.

Core assessment. There is 24 core wells within the drainage area. All these wells have significant zones of low strength, low stiffness mudstones, where any fractures are very likely to be closed.

I'll comment subsequently on how the mud content will act to contain steam.

Microimaging logs. There is 36 microimage logs from the drainage areas with very few, if any, observed fractures in the confinement strata. Nowhere is the observed fracture frequency near the threshold that would be required for a connected pathway through the containment strata.

3. Seismic. There is full 3D seismic coverage of the drainage areas. No large-scale faults have been identified. Also there's no underlying salt

dissolution, karsting, or other such features that might contribute to faulting or local variations in the stress state. Only minor differential compaction features associated with relatively shallow mud channels have been observed.

GCMS. There's six wells within the KN08/KN09 drainage boxes that have GCMS sampling. And all show one or more likely barriers to fluid migration within the confinement strata.

Analog data. The annual in situ performance presentations are available for all major SAGD projects in Alberta. They include a variety of temperature and saturation logs which can be used to ascertain if steam is migrated into the overlying confining strata. I've reviewed most of the available documents and have not found any where steam has migrated more than a few metres into the muddy confining strata.

Now, I'll just discuss pre-production pressures. Now, in conventional reservoir engineering, pressure monitoring is the primary tool used to assess connectivity between reservoirs. A pre-production difference -- pressure difference is definitive evidence of a barrier or a lack of communication.

So I requested that CNRL review its historical data for all original pressure measurements in the Kirby north area. Critically, there are two consistent

pre-production pressure measurements from the 1970s in the McMurray formation that also agree with more recent pre-SAGD pressure measurements. Now, plots are included in my original report. I'll just summarize briefly what the results are.

So the results are that the original pressure measurements in the Wabiskaw B gas zone are approximately 100 kPa above the McMurray pressure gradient. I concluded based on these measurements that over a production time scale, there's likely no hydraulic connection between the McMurray sands and the Wabiskaw B gas.

Now, considering post-production pressure measurements. The pressures in the Wabiskaw B gas zone were approximately 1,100 kPa shortly after gas production was shut in in 2004 due to the GOB decision. In the subsequent two decades, pressures have continued to decline to approximately 800 kPa, most likely due to nearby ongoing production.

However, if there was any significant hydraulic connection between the McMurray at approximately 2,000 kPa and the Wabiskaw B gas zone, the gas zone pressure would have been expected to rebound after the GOB shut in due to water migration from the McMurray up to the Wabiskaw.

Can I have PDF page 18 now, please.

Now, Mr. Lavigne, previously showed you core images like the one on the screen and discussed it from a geologic perspective. However, since this issue was framed in terms of the steam migration over the lifetime of the drainage boxes were approximately 15 to 20 years, it's very much a reservoir engineering and a geologic issue. I've reviewed all the core photos for all the wells available from the perspective of a reservoir engineer to assess the presence of both barriers and baffles to steam. Based on my experience, it's extremely difficult for me to imagine steam migrating through the confinement strata for any of the cores.

Now, SAGD is a very sensitive process, and even one single thin mudstone can act as a barrier over the life of the project. However, in order to provide a quantitative measure of the time required for steam to migrate through the confinement strata, I developed a methodology that's presented in my supplemental report. The method is tied to the standard facies definition used by most SAGD operators. It estimates steam rise rates for the different facies based on a theoretical model matched to field data, along with measured, model, and estimated permeabilities.

Now, the colour coding adjacent to the core in the image on the bottom of the screen there corresponds to

the facies definition in the table on the upper right. The facies are assigned based on visual determination of the mud content. Facies 5 shown in orange is, for practical purposes, a barrier to steam. This facies also corresponds to the confinement strata as described previously by Mr. Lavigne.

Based on the total thickness of the five facies in this core, the method estimates that steam would require 393 years to rise through the F5 facies. Now, this is much longer than any production time; however, it's clearly supported by the observation that there's a gas cap in the Wabiskaw D that is contained by the Wabiskaw D heterolithic and Wabiskaw C at the five facies over a geologic time scale.

Now, I'm also showing this well because it's located in the north of KN09 pad where the Wabiskaw D has cut into the McMurray B1, and as can be seen, the McMurray B1 mudstone, which is identified by orange in the middle at the bottom of the screen there, is relatively thin. Now, the facies -- sorry -- and then what generally is not included in CNRL's geologic assessment of the confinement strata is the F4 facies which corresponds here to 30 to 70 percent mud content.

An example in this well is the muddy B1 facies just below the mid-B1 mudstone that I just referenced. These facies can be described as a strong baffle to

steam rise.

Now, as shown in the table, the method estimates it would take 34 years for steam to rise through the F4 facies. So, in effect, the F4 facies alone would act as a barrier to steam over the life of the drainage boxes.

Can I return to PDF page 9, please.

Now, returning to Hearing Issue 1, in summary, collectively all of the assessed parameters are supportive of the confinement strata being an effective barrier to steam. The conclusion that I've drawn from conducting my assessment is that it's very unlikely that steam will migrate through the confinement strata from the McMurray sands to the Wabiskaw B gas zones during the life of the drainage boxes. The key reasons supporting the assessment are the historical pressure measurements, the high interbedded mud content in the confinement strata, the absence of fractures in the confinement strata, the high likelihood that any fractures will be sealed, and the absence of any known occurrence of steam migration through similar confinement strata at any SAGD operations in Alberta.

Page 28, please. Now, before moving to Issue 2, I'll address two pertinent geomechanical concepts: the first being brittleness of the mudstones or why natural or induced fractures in the confinement strata at KN08

and KN09 are very likely to be closed and sealed. Now, rocks commonly behave in a brittle manner at shallow depths and in a ductile manner at greater depths. The figures shown on this page provides a clear, succinct illustration of brittle versus ductile behaviour.

In the top left of the figure is a typical stress/strain diagram for a triaxial test of rock. Notably, after the peak stress is reached, there's a decline in the stress with additional strain. This behaviour is termed "strained softening". It's commonly seen in most rocks at lower confining stresses. Now, it's important because it is the reason that shear fractures or faults form in most rocks as shown in the figure -- in the lower left of the figure. However, at higher confining stresses, the stress does not decline with additional strain, and induced fractures are less likely to occur.

Now, what is most critical from the perspective of whether the fracture is open or sealed is whether it behaves in a brittle or ductile manner, as shown on the right of the figure. Brittleness is associated with volumetric dilatancy in a laboratory test; means the test specimen expands because of the added volume of the fracture. Ductile behaviour is associated with volumetric contraction or non-dilatancy. When rock behaves in a ductile manner, the failed rock at the

fracture face smears along the fracture face, sealing the fracture.

Page 26, please. And, yes, if we can just make that figure fully visible. Thanks.

Dr. Chalaturnyk has provided some very useful and pertinent test data in ISH's response to CNRL's information requests. Specifically, I'm referring to the compression test data of Wabiskaw D mudstones from Suncor's MacKay River project. Test -- CTS4 is a good example of brittle or ductile behaviour, whereas CTS5 is ductile or non-dilate.

Now, in the top figure, I've plotted the degree of dilation or contraction for the samples taken at 4 percent axial strain versus the confining stress. This figure illustrates that there is a transition from brittle to ductile behaviour at approximately 1,400 kPa.

Now, the confining stress is also the minimum effective stress in these tests. And since CNRL has measured the minimum effective stress gradient at Kirby north, the gradient can be used to estimate the depth at which behaviour will transition from brittle to ductile.

The figure on the bottom shows that this transition would occur at a depth of approximately 140 metres. However, the confinement strata at KN08

and KN09 pads is at a depth of 470 metres, where the minimum effective stress is greater than 4,000 kPa. Clearly the confinement strata is in the ductile regime and, as a result, any fractures are highly likely to be closed and sealed. This also explains why there are very few fractures observed in the confinement strata at KN08 and KN09.

Page 31, please.

Now, I'll get to this table in a minute, but Dr. Chalaturnyk has speculated that there's potential for SAGD operations to induce open fractures or pathways in the confinement strata and offers centrifuge test results as evidence. However, the beam centrifuge tests were approximately scaled to a much shallower SAGD site and not scaled in any way to KN08 or KN09.

The -- the overburdened stress in the model scales to about 500 -- scales to about 500 kPa or 50 metres of depth. This compares to the confining strata depth of approximately 450 metres at KN08 and KN09.

Now, not only does the model scale to very shallow depth, the overburden on top of the caprock in the model has no stiffness. Also, the material in the model simulates Clearwater caprock and not the McMurray Wabiskaw confining strata. Furthermore, the loading is mechanical and not representative of thermal SAGD

loading.

The resulting mostly tensile fractures are shallow, low stress, low confinement phenomenon. It's my opinion that these tests should not be considered when making engineering or regulatory decisions related to KN08 and KN09.

Now, referring to this chart here, induced shear deformations in the confining strata that are caused by SAGD operations can be very effectively identified, imaged, and quantified using multi-censored caliper surveys from SAGD wells.

In cyclic steam operations, it's very common to observe induced shearing this way; however, SAGD is a much gentler process, and the operations induce much less shear movement. In my supplemental report, I've included tables of casing deformations from multi-caliper logs for the Jackfish and the Kirby sites. The table for the Kirby site is shown here. While shear deformations are observed in shallower strata, none have been observed in the confinement strata. Furthermore, even if they were to occur, it's highly likely the fractures would be sealed, as discussed previously.

Page 24, please.

Now, moving on to Issues 2, 3, and 4, in my experience, the risk assessment process is an effective

tool for assessing the acceptability of a wide variety of operations involving steam, solvent injection, and then determining monitoring needs. In my supplemental report, I've included risk assessments that address Issues 2, 3, and 4. I've elected to use the same format as the ISH Aardwolf report to facilitate comparison. However, I've been much more specific in describing the risk, which is critical to enabling more objective evaluation of the likelihoods.

In the figure on the screen, the original unmitigated risks are shown in red. The final risks after consideration of mitigating factors such as monitoring and other factors specific to Kirby north are shown in green. It can be seen that all the resulting risks are in the white or low-risk category.

Page 23, please.

Now, I don't expect you to read this table, but I'll refer to it. It's in my report. Okay? The -- and I'm going to address Hearing Issue 2: Is one additional monitoring well sufficient?

The specifics of Risk 1 in this table for steam mitigation -- for steam migration from the McMurray into the Wabiskaw B gas zone are summarized in the chart on the right. The risk scenario assumes a 300-metre long subseismic open fracture results in 20,000 cubic metres of steam and reaction products

migrating into the Wabiskaw B gas zone over the life of the drainage box.

Now, while ISH assumed in its risk assessment that all value of the gas zone was lost, in this more specific scenario, calculations show that only a small region of the gas zone is impacted, so only a fraction of the gas value is impaired.

The likelihood is difficult to estimate because there are no known occurrences of steam migration through similar confinement strata at other SAGD operations. The initial likelihood is assessed as "could happen once in the lifetime of the project". However, recognizing the confinement strata at KN08 and KN09 has very few identified fractures and the fractures are expected to be sealed, the final likelihood I've assessed to be "not during the lifetime of the project".

Now CNRL's surveillance program includes one existing and one additional monitoring well for the Wabiskaw B gas zone. This will be supplemented with produced water to steam ratio monitoring to assess for any significant steam loss into the gas zone. However, no likelihood credits are taken for this monitoring as its direct impact on the consequence is likely very limited. Nonetheless, the resulting risk here is assessed to be low.

Additional considerations are the cost of -- additional monitoring is comparable to the financial risk itself, and there are no known specific locations of high concern such as a fault that might warrant additional monitoring.

So it's my assessment that no additional monitoring wells should be required for the purpose of mitigating steam migration through the confining strata.

Now, Hearing Issue 3, determination of the temporary MOP, is addressed by Risk 2 in this table. And, again, while ISH assumed that -- for this risk, that all the value of the gas zone was lost, a realistic scenario is one where only tens of cubic metres of condensed steam with no reaction products enters the gas cap through an induced fracture. The only possible consequence is that a producing gas well might require a workover at some time in the future to remove the water.

For this risk, there's a reliable set of data from the wells that have been -- previously been started up at Kirby, which can be used to assess the likelihood of the event. In my risk assessment, three likelihood credits are applied for leakoff barriers, stress barriers, and the proximity to a gas well. So any -- any fracture would have to be near a gas well to impact

it.

The resulting risk is low, and my assessment is that the temporary MOP of 6,600 kPa should be allowed during the start-up period for KN08 and KN09 pads with the planned additional start-up mitigations. And, again, it's noteworthy that similar mitigations were applied to wells at KN06 and were effective.

And, now, moving on to Issue 4: Should solvent injection during start-up be approved? This is addressed by Risk 3. ISH considered the value of potentially lost solvent in the risk assessment. However, lost solvent is a consequence to CNRL and not to ISH.

Here I have taken the scenario to be a small volume of solvent, tens of cubic metres, not containing any reaction products enters the Wabiskaw B gas zone through a preexisting open conductive fracture. Since any solvent that might enter the gas zone will fully mix with the bitumen in the gas zone, it will be practically immobile and have no financial consequence.

The likelihood of the event is so low because of the very low frequency of fractures in the confining strata and the high likelihood that any fractures are closed. Hence, the resulting risk is low.

So it's my assessment that solvent injection should be allowed with the maximum pressure during this

operation being the MOP.

This concludes my presentation. Thank you for your attention, and I'll now hand it over to Mr. Iannattone.

A G. IANNATTONE: Thank you, Dr. Boone.

In closing, Canadian Natural's evidence demonstrates that the development of the McMurray bitumen resource at the KN08/KN09 drainage box will not impact ISH's mineral rights. You heard from Mr. Lavigne that the mud-filled facies create an effective barrier to steam with up to six intervals of confinement strata. This is not just argued but is strongly supported by Dr. Boone and in the academic literature.

Mr. Sverdahl confirmed no evidence of faulting or fractures are observed. The risk of breach to the confinement strata from natural fractures or faults is extremely low.

Mr. Thomsen's geomechanical data and analysis that was further supported by GeoSim modelling demonstrates that a 6,600 kPa temporary start-up pressure will not hydraulically fracture through the confinement strata. Having said this, Canadian Natural is prepared to modify the temporary start-up time and steam volume conditions as shown -- sorry -- and lower the requested long-term MOP to 5,500 kPa.

Mr. Ollenberger's evidence shows that the monitoring of the gas pool pressure at a total of four locations is more than adequate with the existing 10-1 well, the 10-34, and the 1-3 well on the KN08 drainage box. Also, Canadian Natural is committed to providing a future gas monitoring well on or in the vicinity of KN09 prior to the commencement of steaming.

Mr. Thomsen and Dr. Boone have shown that an additional DFIT is not warranted or justifiable given the cost and project timing delay.

Mr. Ollenberger, supported by Dr. Boone's risk assessment, concluded that hydrocarbon-assisted start-up poses no threat to the GOB gas. Also, Mr. Ollenberger has shown that Canadian Natural will make wellbores thermally compliant in a safe and efficient manner following AER directives.

Canadian Natural has made reasonable gas monitoring commitments. The ISH requested monitoring, which could add up to a total of $6 million of project costs, are not justified in comparison to the discounted value of the gas pool. More importantly is that Canadian Natural is being asked to spend significant dollars today to monitor for potential damages to a low value resource that will not likely be allowed to produce for decades.

Canadian Natural is a majority leaseholder of the

GOB gas pool. Any potential impacts to the pool would not only affect ISH's gas rights but would also impact Canadian Natural's gas rights. This fact should be taken into account in the Panel's deliberations.

Canadian Natural recognizes its responsibility to develop the bitumen in a manner that also protects the gas resources. It is Canadian Natural's view that the technical evidence and commitments to the continued enhanced monitoring and controls demonstrates that the development and operation of the KN08/KN09 project will not impact ISH's gas rights. Additional conditions as requested by ISH will add unnecessary incremental costs and schedule delays to the project, which ultimately are significantly funded by Albertans.

Finally, I would like to remind the Panel that if damages occur, Canadian Natural is prepared to pay for the cleaning of the gas or connection of the gas to be burnt as fuel or pay reasonable compensation for the damage at the time when the gas production from the Kirby Upper Mannville II pool is allowed to resume.

Respectfully, Commissioners Chiasson, Barker, and Zaitlin, the merits of Canadian Natural's technical evidence and additional commitments warrant the approval of the KN08/KN09 development without imposing additional conditions. Thank you for your attention to Canadian Natural's direct evidence.

COMMISSIONER CHIASSON: Thank you.

We'll now break for 15 minutes 'til 3:45, at which point, unless there's anything we need to be aware of, we would look to have ISH start their cross-examination. All right? Thank you.

(ADJOURNMENT)

COMMISSIONER CHIASSON: So thank you, everyone. A couple of points just on timing for today. What we are thinking of now is to look at starting up and going 'til about 5 and assessing just before 5 where we're -- where we're at in -- in relation to that if that suits in terms of a spot for you to break, Ms. Riley. If not, we -- I would suggest that we may be able to go later, but we would anticipate not going any later than 5:30 today at the -- at the maximum.

And that -- then the other piece, just to get started, is we are aware that ISH has provided in the timeline that was set out in relation to aids to cross, and we're just checking to make sure no concerns -- no -- all right.

So Mr. Lung will mark that in. Yes?

A. LUNG: Yeah. We can mark in as an AQ, AQ Number 1.

COMMISSIONER CHIASSON: Okay. Thank you.

And otherwise, then, Ms. Riley, please proceed.

M. RILEY: Thank you very much, Panel

Members. I will note that we have -- with the planned timing of today, have identified one or two, maybe three topics that we can cover, and then we would like to break, and we will still finish within the time allotted, if we start tomorrow as planned.

COMMISSIONER CHIASSON: Thank you. So, yes, if you just let us know, then, where it -- where it suits for you to -- for you to break, then that's -- that's fine. We're glad to work with that.

M. RILEY: Thank you.

COMMISSIONER CHIASSON: Thank you.

M. RILEY: Very well. Mr. Lung, if you could then bring up EQ1, the first of the ISH aids to cross-examination.

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

Q M. RILEY: And I will address the questions to Mr. -- and I apologize if I get this wrong. I always thought it was Iannattone. Apparently it's Iannattone.

A G. IANNATTONE: You're correct. It is Iannattone, but that's the Italian. So if you want to go with that, I'm fine with it too.

Q Very well.

So, Mr. Iannattone, you testified about the values of CNRL and specifically your mission statement the

first thing this morning; is that correct?
A That's correct.
Q If we look at the screen at PDF page 3, we see there a printout from Canadian Natural's website, and it essentially confirms what you said this morning, that Canadian Natural's main purpose is to develop people to work together to create value for the company's shareholders; is that correct?
A That's correct.
Q So if we go to the next page, we -- again, a printout from the company's website, and here we have CNRL's strategy. And the main message here in blue at the top of the page is "we are creating value for our shareholders"?
A That's what it says.
Q And it is fair to say that if you look at your mission statement, you look at your strategy, these things are what informs your decision-making?
A Sorry?
Q If we look at your mission statement, we look at your strategy, these are the things that inform CNRL's decision-making, at a high level?
A Yes, at a high level.
Q If we then go on and -- and we just looked at CNRL's peers. If we look at Cenovus's strategy --
M. RILEY: If you could just move on to

the next page, please, Mr. Lung.

Q M. RILEY: The very first thing that is part of Cenovus's strategy is top-tier safety performance and environmental, social, and governance leadership. If we scroll down and we look at Cenovus's purposes and value, they energize the world to make people's lives better. If we look at the values on the next page, they start with, "We protect what matters". So it's a bit different from CNRL's?

A G. IANNATTONE: I wouldn't really say so. I think it's quite similar. I see that "doing it together" is on the list. You know, "making it better", "doing it right" is on the list. What you don't see on Canadian Natural's website is we have another layer of values and principles that we use internally, and, you know, we have nine core values -- I'm not going to read them here, but I'll just, you know, highlight a few of them, adhere to the mission statement is important to Canadian Natural. Safety is paramount. We do it right. Way down the list, Number 5, we return real value to shareholders; humility prevails; working together really matters; and outstanding corporate citizen -- citizenship is a core value. So although that is not directly accessible to the public, it is directly accessible to every Canadian Natural employee. In fact, we take the mission

statement very seriously. We have mission statement meetings with every employee no matter what their position is at least once a year. So -- and at those mission statements, they are run and presentations are given by the executive team.

Q So that is very interesting to me because if we were to compare CNRL's general approach to monitoring with some of your industry peers, it does not look to be the same. Is that -- is that surprising to you or ...

A No. It's not surprising to us. We don't mold ourselves to mimic our competitors necessarily. We do what's right for us. That's the "doing it right" in the mission statement.

Q Doing it right for CNRL. Good.

We provided some industry examples in -- in -- in the evidence, and I can find you the reference if it's important to you, but the way we interpreted what CNRL's response was -- the examples that ISH provided was not really applicable to the situation; is that correct?

A I'm not sure what your reference to -- referencing, the examples. Which examples?

Q Very well. I will -- tomorrow when we get into this a bit more, I will come back to this topic.

One of our questions was that if CNRL owned 100 percent of the gas, would it waste it in favour of

the bitumen production?
A Would it -- sorry -- be wasted? Is that what you said?
Q In favour of the bitumen production.
A No, it would not be.
Q If ISH was not yet to request additional monitoring, would you have undertaken the additional monitoring that you have now offered?
A Sorry. I'm just pulling up some notes on gas wastage.
Yeah. CNRL has no intention of gas wastage under any circumstances. Canadian Natural is a majority working interest owner of the GOB gas, and AER recognizes Alberta case law that, you know, bitumen rights -- mineral rights owner can extract bitumen even if it interferes with another minerals. So we would not -- we would not waste the gas. That's for sure.
Q That was the only question.
The second question was -- that you haven't answered yet -- if ISH was not here to request additional monitoring, would you have undertaken the monitoring that you have now offered in your reply?
A No, we wouldn't. We've gone beyond what we think is reasonable, to tell you the truth. We think one gas-monitoring well is sufficient, but we also understand that we have to accommodate ISH's request to some extent.
Q I see.

M. RILEY: Mr. Lung, if we could go to Exhibit 50.002, paragraph 13, and I did not write down the page number.

COMMISSIONER CHIASSON: Ms. Riley, is it possible if you either pull the mic a little closer or speak up a little more. We found that the speakers tend to be pointed towards the main room rather than us, so it -- it makes it a little challenging sometimes for us to hear. Thank you.

M. RILEY: I believe it is on page 6. Paragraph 13. Yes.

Q M. RILEY: So if I can direct your attention to paragraph 13. And specifically there in the middle of the -- of the paragraph, it's a reference to the staff submission group, and there's a reference to three referenced -- the Kirby Upper Mannville II pool in potential vertical association with the Wabiskaw D valley fill and McMurray channel.

So the issue in -- in the GOB decisions, the underlying rationale was that there could be communication between the gas pools and the underlying bitumen zone; correct? And that could eventually -- if we produce the gas, the bitumen production would become uneconomical. That's -- that's the underlying rationale?

A Yes. I think I have that in my opening statement.

Q So how does that work with CNRL's assertion that the Wabiskaw B gas is isolated from the SAGD operations?
A This, I believe, was a 2003 document. You know, at the time, there was a limited amount of information. Since that time, there's been a tremendous advancement in SAGD knowledge and technology, not to mention a tremendously greater amount of information where you heard in our evidence from our geoscientist that -- that we have confinement -- confinement strata that isolates -- that isolates the Wabiskaw B from the McMurray channel reservoir.
Q In the beginning of your evidence, you adopted all of the CNRL evidence. Did that include the application? Was the application prepared under your direction and control?
A Yes, it was.
Q What did Mr. Scrimshaw prepare?
A Sorry?
Q What did Mr. Scrimshaw prepare?
A Mr. Scrimshaw?
Q Yes. The lead application officer.
A What -- sorry.
Q Or your --
A I can't -- I'm sorry. Could you maybe speak a little slower and --
Q Certainly. So even the application was prepared under

your direction and control?
A That's correct.
Q Did any other panel member other than Dr. Boone have any direct involvement with any of the application material?
A With the application, yes. I would say Dr. Boone had no involvement, but most of the other panel members would have had some involvement for sure.
Q We've heard all of your evidence, and we've heard very little from most of your panel. I'm just curious what their expected role is.
A The back bench here is for support primarily, and we have -- if we start there with Mr. Roche, he is a -- a production expert. Dale Walters is a geomechanical expert. Specifically, Dale Walters was responsible for the geomodelling. Marc Scrimshaw is regulatory. Mr. Wang is log interpretation, image logging. The panel was introduced quite extensively. They all have a role, and they all have a reason. And, finally, Scott -- Scott Barland here is primarily focused on the GCMS -- GCMS evidence.
Q I was just curious because you also mentioned that Albertans pay essentially 40 percent of -- of your expenses, and it's a very extensive panel, most of whom have not given direct evidence.
A Yes. That -- that is a fact, but -- you know, and to

quite honestly say, you know, we don't want to be here; and we don't want to incur the hearing expenses. We believe it is -- it's very expensive for us. It's expensive for ISH. It's expensive for the regulatory. And I would also add given our perceived value of the gas resource, it's unjustified.

Q We will get into the gas values tomorrow.

We will now turn to the topic of GCMS data and analysis. The evidence was that CNRL uses a third body to do their analysis. Who -- who is that?

A Sorry. If I could have a minute. We just need to get the right person to answer this question.

Mr. Barland will answer this question.

A S. BARLAND: So Schlumberger labs does all of our GCMS analysis. They're an industry leader. They actually bought Gusher Energy or Gusher Laboratories that started -- or pioneered the GCMS analysis and have continued that same procedure.

Q Why do we not see a report from Schlumberger?

A We have several reports from Schlumberger. They have not been filed, but what we do is we take the data from them and interpret it, plot it versus depth, and interpret these concentration gradients.

Q So the interpretation is actually CNRL's work, it's not Schlumberger's work?

A Yes.

Q I will then -- just give me one moment. I just need my note because I don't want to misquote anyone.

The evidence this morning was that if oil concentrations were not able to equilibrate over geological time, it is very unlikely that steam will be able to migrate through these lower permeability zones; correct?

A Yes.

Q So my question is: Is the suggestion that geological time is equivalent to -- and I'm not clear on whether the SAGD operation is now 15 years or 25 years, but is geological time equivalent to SAGD operational time?

A I would say geological time is probably -- probably more -- geological time, we're talking from the time of deposition, which would have been -- in the lower McMurray would have been 120 million years ago. The SAGD lifetime of a pad would be probably 15 to 20 years. So the geological time equivalents is very tough to determine.

Q So it's not really accurate, then, to say that because the oil concentrations were not able to equilibrate over the geological time that the steam will not be able to migrate?

A No. I -- I believe we would still say that that's true just because if you give something 80 or 90 million years to equilibrate and then you introduce the steam

over 10 or 15 years, that would be an approximation.
Q So what we take away from this is that the introduction of steam will change things?
A I don't think it would change the nature of a barrier just because they're very low permeability, and over 80 million years approximately, it would still -- it's been a barrier for that long, and it still will be a barrier to steam.
Q Very well.
Let's go to Exhibit 50.01, Tab 4, PDF page 218. Here we see some of this interpreted GCMS results, and as I understand it now, this interpretation is CNRL's own work; it's not a third party's work?
A No, this is our own work. The concentrations you're seeing in the blue dots up there are exactly from Schlumberger's work. We're just plotting them versus depth.
Q I see. On the topic of those blue dots, which compound are you mapping?
A I believe in this well, this is phenanthrene class of compounds, so all of the phenanthrene molecules would be grouped, some individually, at each depth location, and then plotted versus that depth.
Q How did you decide to use those?
A So over the years, I've been working with GCMS data for approximately ten years, and the phenanthrenes were

chosen as a marker compound or a compound class of organic -- hydrocarbon molecules that do vary versus depth. If you have something that is uniform versus depth, that suggests there's no change, so no biodegradation in those. That doesn't help you determine where barriers and baffles could be.

Q I see. So you look for the compounds that support your outcome, and then you use those, or is there another rationale for picking a compound?

A You want a compound that changes versus depth so you can actually determine if those changes are meaningful.

Q Do you -- and in your experience, do you think that weigh zones are tighter -- zones or intervals are tighter, that it has any effect on the biodegradation of bitumen?

A Clarify "tighter".

Q Smaller, not as large. In other words, if -- if your compartment is smaller, does it have an effect on the level of biodegradation?

A If it was wet -- if all of these zones were wet to begin with, so they had connate water or water that was associated with them during deposition, if there was no room to remove that water, there could be more biodegradation. The bacteria live in the water.

Q So it does have an effect?

A Pardon me?

Q So it does have an effect?
A Yes. The longer that bacteria spend with water that was associated with them originally, the more biodegradation you would have.
Q Is this something that you considered in your interpretation?
A Yes. That's the whole basis of our interpretation. If you see marked changes in biodegradation in different compound classes or any compound class, that signifies that there was a layer or a barrier between those two zones.
Q And is an increase and a decrease a sufficient change for you to interpret a barrier?
A CNRL believes so.
Q Could you -- could you explain the rationale for that?
A So a decrease in concentration versus depth, viewed from the bottom up, CNRL generally looks at things from where the injector and producer would be up towards the top of the reservoir because that's the way steam would -- steam growth would occur. If we have a decrease in those concentrations, that suggests a perched or a paleo water contact that that compartment below did not talk to the compartment above.

The forward stepping or an increase in concentration would also suggest a lower permeability layer, preventing those two zones from equilibrating

over geologic time.

Q So explain to the Panel, please, how -- how biodegradation works. Let me ask -- give you the premise of my question.

As ISH understands it, biodegradation works at -- you start at a high level -- relative high level, and then the value goes down up to the oil/water contact, and then it should usually increase again because there might be a barrier.

A Yes.

Q So -- so if the level going down suggests that there is a barrier, why would the level going up equate to a second barrier? Is it not -- does it not make sense that if the level keeps on going down and -- and then goes up again and then goes down further that it is still the same compartment?

A That's been -- I -- I would say that any lateral change in biodegradation suggests that that compartment, either above or below a lateral change, did not equilibrate across that change. So the diffusion of the oil molecules or the bacteria cannot come from that same compartment.

Q If we can then go to Exhibit 43.02, page 6.

We see here some comparisons that CNRL has made to the Weser Estuary in Germany, and I'm looking at that second paragraph there, and CNRL says there, more or

less the last sentence of that paragraph: (as read)

> In the KN08 and KN09 area, the Wabiskaw D non-reservoir facies shows a concentration of fluid muds that GCMS supports is locally a barrier to communication with the overlying units.

Do you see that?

A It's hard for me to read at the very bottom, but I -- I'm -- I'm sure if you read it to me, it would be fine.

Q Well, in full disclosure, I -- I did use the acronym "GCMS".

A Oh, okay.

Q So do you agree that what CNRL says there is that there is a local barrier?

A The nature of GCMS is it's a 1D technique. So you look at the core in that well, and it's a vertical local barrier. Lateral extents cannot be determined by GCMS.

Q Can you give me one moment to confer, and then I will tell you if I have more questions for you.

We may have one or two more questions on GCMS, but that is most of what we wanted to cover with you. Thank you very much. My friend Mr. McLeod is now going to take over for me for a bit, and then we will see what time it is. Maybe we can squeeze in one more topic.

COMMISSIONER CHIASSON: Okay. Thank you. As I said,

we're open to working with your timing.

M. RILEY: Thank you.

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

Q A. MCLEOD: Good afternoon. My name is Andrew McLeod, M-C-L-E-O-D, for the record.

I'm going to ask a few questions of Dr. Boone. And to start with, I'm curious, Dr. Boone, have you been retained by anyone other than CNRL in the last year?

A T. BOONE: No, not in the last year.

Q Very good.

Could we bring up Exhibit 50.01 at page 60.

Now, in the second paragraph there, Dr. Boone, you write that: (as read)

> I have also consulted with CNRL technical experts to clarify specific questions and make a personal assessment of the reliability of the data.

Who were the technical experts that you consulted?

A The technical experts would include numerous people here: Mr. Thomsen, Mr. Walters, Mr. Wang, Mr. Sverdahl, Mr. Lavigne.

Q And are there any technical experts who you consulted in relation to your statement on page 60 here who are not present today?

A What's -- so Mr. Gonzales is here. He's right there. And I specifically consulted with him on this one.
Q Okay. And Mr. Gonzales is -- is in the audience, and he's not a sworn witness today; is that correct?
A As far as I know.
Q Okay.
A G. IANNATTONE: That's correct.
Q Now, did any of the technical experts that you consulted with write any portion of either of your reports?
A T. BOONE: No, they did not.
Q Now, you also say on paragraph -- or on page 60 here that you made an assessment of the reliability of the data, but I notice that you don't come to any conclusion about your opinion on the reliability of the data. Is that because the data was unreliable?
A No. That's because I -- I assessed the data to be reliable. I mean, it's -- it's a small pressure difference, at least in -- in heavy oil terms. So, I mean, it -- it -- if it had been 3 or 400 kPa, I would've said this definitively is -- or this is definitive evidence of lack of pressure communication or a barrier between the zones. But because it's small and because, you know, data like this does have some, you know, some variability, I said it was only likely.
Q Okay. And -- and when you say that this data has some

variability, does that mean that your conclusions have some degree of uncertainty?

A I think that's always the case, yes.

Q Okay. Now I'll turn you to page 62 of Exhibit 50.01. And I see here that you say you have reviewed all the core photos provided in CNRL's SIR response, and you say: (as read)

> I reviewed the core photos as a reservoir engineer looking to identify the potential for steam to migrate through the sands and specifically I reviewed them looking for natural fractures.

Now, sir, are you a reservoir engineer?

A Yes, I am.

Q Okay. And -- and you're aware that part of ISH's concern has to do with the potential for induced fractures, not just natural fractures; right?

A Yes. Yeah.

Q And so your review of what natural fractures existed there would not necessarily allay ISH's concerns in terms of what happens after SAGD operations start?

A Correct. That's core before -- that was acquired before operations.

Q Okay. Now, later on page 62 there, you say -- I think it's on the second paragraph under "Microimaging Logs". You say: (as read)

I have met with CNRL's technical expert, who has analyzed all of the FMI logs for fractures and reviewed the process employed to identify the fractures and selected logs through the confining strata.

Now, Dr. Boone, who did you meet with?

A That would be Mr. Wang or Dr. Wang.

Q And did anybody else contribute to the analysis of the FMI logs?

A Not to my knowledge. You'd have to ask Dr. Wang.

Q All right.

Dr. Wang, did anyone else contribute to the analysis of the FMI logs?

A X. WANG: I'm the only --

Q Can you turn on your mic, sir.

A Okay.

Q And just repeat the answer to your -- to that question.

A Yeah, I'm the interpreter for -- for the FMI.

Q Very good. Thank you.

Now, you say that -- sorry. Dr. Boone, you say that you evaluated the FMI analysis process that CNRL uses. Now, can you tell us what qualifications you have to evaluate the FMI analysis process?

A T. BOONE: I'd say I'm qualified in that -- and -- and if you look at my résumé, for my last five years with ExxonMobil -- or four years, five

years, I was Exxon's senior reservoir engineer for enhanced oil recovery. And so I went around the world on projects everywhere providing technical reviews and evaluating them in a very similar way to what I did here -- to what I did here.

Now, I recognize I'm not, you know, a geophysicist, but I have some experience in the area, and I at least like to think I know of some of the right questions to ask.

Q All right. I'll turn you to page 63 of Exhibit 15.01. Now, right under the fifth heading there, "Seismic", you say: (as read)

> I have reviewed the seismic cross-sections provided and noted that CNRL's geophysicists have not identified any faults.

Are the geophysicists who -- who evaluated those seismic cross-sections here today?

A Yes. Mr. Sverdahl is right there.

Q And --

A Sorry. Go ahead.

A S. SVERDAHL: Just to clarify, our -- our staff geophysicist is not here today but also was part of that review.

COMMISSIONER CHIASSON: Mr. Sverdahl, could you speak up. The Panel can't hear you.

A S. SVERDAHL: My apologies. Our -- CNRL's

geophysicist, Waiman [phonetic] Wang, is not here today.

Q A. MCLEOD: Okay.

A She was part of that review.

Q So aside from you and -- did you say it was Dr. Wang?

A Ms. Wang.

Q Ms. Wang.

So aside from you and Ms. Wang, no other CNRL geophysicists were involved in the analysis of the seismic cross-sections?

A No. Ms. Wang and myself were the primary geophysicists involved.

Q And what was the source of those seismic cross-sections, Mr. Sverdahl?

A They were seismic sections taken out of our seismic interpretation package called "Petrel" based on the SEG-Y data from -- from the seismic data CNRL has acquired at Kirby north.

Q And, Dr. -- or -- sorry -- Mr. Sverdahl, you agree that the faults or other features that may exist, they cannot be resolved through seismic imaging?

A Smaller scale faults cannot be resolved through seismic imaging. That is correct.

Q And, Dr. Boone, I believe that you made that statement in your report. You still stand behind that?

A T. BOONE: That's definitely true.

Q Thank you.

Now, I'll turn you to page 64 of Exhibit 15.01. Under Heading 8 there, Dr. Boone, you say: (as read)

CNRL's geoscientist responsible for analysis of the Wabiskaw B gas cap has compared the pre- and post-production evaluation logs from the Wabiskaw B gas cap and seen no evidence of water invasion.

Sir, can you tell me -- is CNRL's geoscientist present today?

A No. Not the one that -- that provided that support.

Q Okay. And who was that who provided that support?

A Is it Ms. Holman? Ms. Holman.

Q Ms. Holman. Okay.

And so I guess we can't test Ms. -- Ms. Holman's evidence because she's not here. But do you agree with their conclusion that there's no evidence of water invasion?

A I mean, I didn't review the data specifically myself. I -- I asked the question just because it seemed to be a good question to ask: Do you have any evidence from the wells you've drilled that there is water invasion? Because that might be indicative of fluid flow through fractures. And -- and the answer was not. Although I'm going to say that's -- it would be -- it might be difficult to -- to definitively determine that from

just core alone.
Q And so I guess --
A And logs. I should have said "logs". I said "core", but it's -- it's log analysis.
Q Okay. And -- and what qualification do you have to reach that conclusion that you just did?
A Well, there's a reservoir engineering aspect to it, which is that -- so, you know, initially the -- the saturations before any development in the area and before -- I think this even predates gas production -- is -- and I'm going to -- I think it was roughly 20 percent. Okay? And don't quote me on that. But it's a relatively low number. But then the question of how much it would change is a reservoir engineering question. And so if water is invading, you have -- you have to look up and see what can that saturation be driven down to? And it's called "trapped gas saturation". And it's going to be roughly half that 20 percent or so. So you could drive it down to 10 percent. So you're looking for that difference between the saturations.
Q All right. I'll turn you to page -- oh, I guess we're already on 64. At the top of paragraph 9 there, you say: (as read)

> I've reviewed the steam injection volumes and water production volumes for both the Kirby

north and Kirby south fields over the life of their operations.

How did you obtain that information?

A I went to the annual reports.

Q CNRL's annual reports?

A Yeah. Their annual in situ reports.

Q Okay. And has that information been provided to ISH?

A That's in the public domain.

Q Okay. Okay. I'll turn to page 66 of Exhibit 15.01. Now, you say there that based on -- sorry. It might be ...

The information contained in the D54 document, it appears to be essentially like a PowerPoint presentation. How are you able to do calculations based on that?

A I'm -- I -- I mean, there's data provided in those reports that you could use for calculations, but I'm -- I'm not sure exactly what you're referring to. Is there a -- is there a line you could refer me to here, please.

Q Yeah. Just hang on one sec.

Let's turn back to page 64. Okay. So, yeah, the -- the question is: Under -- under paragraph 9 there, you say that if any significant volumes of fluids were migrating out of the McMurray formation, either through the combining strata or down into the

bottom water zone, this would be manifested as a net loss of fluids where the rate of water production was less than the rate of steam injection. And so the question is: How did you calculate those -- those rates?

A So I -- I didn't calculate the rates. They are presented in plots in the D54 annual presentations that are provided. And so -- and -- and this is something that typically is always compared, is how much steam do you inject and how much water do you produce? Because, you know, you want to know where your steam is going. If you're losing it, you're losing money. And they're within 1 or 2 percent as best I could see from the -- from the charts.

Q Okay. All right. So now I'll turn to page 66 of Exhibit 15.01. And there -- I'm having -- oh, yes. It's about -- it's in the second paragraph under the "Required Fracture Intensity". You say: (as read)

> Based on laboratory tests that measured the fluid conductivity of fractured shale, it is conservative to assume that an open conductive natural fracture in the overlying strata in Kirby north would have a conductivity of no more than 300 MDM.

And -- and so I'm curious what lab you're referring to that conducted that test.

A So that's described in more detail in Appendix 1; right? And the references are provided --
Q Okay.
A -- in footnotes in Appendix 1. And those were papers. And it's not the shales that we're specifically dealing with. The work that's been done on this relates to shale gas and production of shale gas because that's where people worry about it most. And -- and I -- it's conservative because they'll give you a -- you can get a flow -- they've measured flow rates in these shales, but they're much stronger and stiffer than the shales we're talking about here.
Q Okay.
A And so they -- they stay open and flow.
Q And -- and so then there wasn't any specific laboratory testing performed in order for you to reach this -- this conclusion?
A No.
Q Okay. And how is it that you reached the conclusion that the -- about the maximum conductivity?
A The conductivity of the fractures?
Q Yes.
A So I -- I took -- I looked at the data, and I picked a number that was in the middle of the data and was at the confining stress that's applicable to the confinement strata at KN08s and KN09.

Q And the data you're referring to?
A Is in these papers that are referenced in the appendix.
Q Okay. And those papers refer to production of shale gas?
A Well, they -- they refer -- they refer to tests that were done on samples that were actually quarried at surface from outcrops and then taken into the lab and then fractured, and then they measured the permeability of those fractures.
Q Right. But it's not directly relevant to -- or directly derived from the -- the geology that we're talking about here?
A That's correct.
Q As a result of that, there is some uncertainty in -- in your conclusion that the maximum conductivity would be 300?
A Yes, there is, but I've -- I really do believe it's conservative. I think if you -- these shales here are so much weaker than the shales that were tested. Like I said earlier in my presentation, almost certainly these fractures will be closed and not conductive.
Q All right. I'll turn you now to page 74 of Exhibit 15.01. Now, about halfway down the page there you say: (as read)

> Experience with SAGD has established bounds on the rates of steam rise in the Athabasca

oil sands.
Now, you're not talking about your own experience there, are you?
A No. I'm -- well, I mean, I have some experience, but I'm speaking more broadly of experience in the industry and what's reported in papers.
Q Okay. And so it's not specifically CNRL's experience, it's just the experience that you've gleaned from reading papers?
A To a large extent, yes.
Q Okay. Now, I'll turn to --
A. MCLEOD: Well, perhaps I'll -- I'll mention to the chair, I've got -- or, rather, Commissioner Chiasson that I've got maybe three more questions to ask on Exhibit 50. So I think I would probably be done in about 10 or 15 minutes, but I'm open to stopping now if you'd prefer.
COMMISSIONER CHIASSON: No. Actually, we can continue with your questions, and just for clarification, then you're proposing to essentially finish for -- for the day after those questions, or were you anticipating more questions from Ms. Riley?
A. MCLEOD: Let me just confer with my co-counsel, and I'll tell you.
COMMISSIONER CHIASSON: Thank you.
A. MCLEOD: Yeah. We'll conclude after

these last few questions for the day.

COMMISSIONER CHIASSON: Sorry.

Dr. Boone, did you have a question?

T. BOONE: Sorry. Should I be facing the Panel when I answer questions?

COMMISSIONER CHIASSON: Frankly, if you're using the microphone, we will be able to hear you. So if it -- whatever you're most -- whatever you're most comfortable with, but I would suggest because you've got interplay going with either Mr. McLeod or Ms. Riley, that that may be more suitable. We'll let you know if we're having problems hearing.

T. BOONE: Okay.

COMMISSIONER CHIASSON: Thank you.

Q A. MCLEOD: I'll turn you now, sir, to Exhibit 50.003 at page 5.

A. MCLEOD: Can you scroll down a little bit there.

Q A. MCLEOD: I thought that on this page you said something, but hang on one second while I find my reference. Oh, yeah. There it is. Okay.

So on the second paragraph here, after the first sentence you say: (as read)

With the support of CNRL's geoscientists, I have classified the facies in the confinement strata for four cored wells -- two from each

of the KN08 and KN09 drainage boxes -- and made a calculation of the time required steam to migrate through the confinement strata.

Can you confirm whether those geoscientists who support what you relied on are here today?

A T. BOONE: Yes. Two of them are at the end of the table down there.

Q Okay. And are there any of those geoscientists who you consulted with in -- in relation to this statement not here today?

A Oh, sorry. Colleen is -- Colleen is over here.

Q Okay. So we have one other geoscientist who is not a sworn witness; is that right?

A Yeah.

Q Okay. Great. Now, I'll turn to page 10 of Exhibit 15.03. There you say, sir: (as read)

I've reviewed the available information for this well and have concluded that it is indeed providing reliable data.

And I'm curious what qualifications you have to opine on the -- the reliability of that data?

A Well, I'm -- I'm a reservoir engineer. I've been involved in pilot design, pilot monitoring. I ran the pilot programs at -- for Imperial at Cold Lake for many years, and a big part of that is assessing reliability of data that you're getting from wells.

And another part of it was in the KN06 hearing, but I think this is in the -- in the record for this hearing was the well test report, which as a reservoir engineer, we're trained to review well test reports and in reviewing that well test report, it gave me a lot of confidence that this well was providing reliable data.

Q And -- and is it that -- that you're saying that it is presently providing reliable data or that it's always provided reliable data?

A It's presently providing reliable data, and there may be some periods in the past where it didn't provide reliable data. I can't guarantee that.

Q Okay.

A But a lot of the data in the past is -- can definitely be interpreted and was interpreted by the well test engineer that was hired by ISH for the KN06 hearing.

Q So I -- I -- I'm a bit confused about how -- how you could determine that the data was previously unreliable and then became reliable. What objective measure are you using to make that finding?

A I didn't make that conclusion, by the way, that it was previously unreliable. I mean, there's some data there that -- that where you're seeing the pressures going up and down and you're wondering what might be causing that, and it would require some more in-depth review of the data, but the recent data, when you look at it,

when you look at the temperatures and the pressures, they're all very consistent with a well that was shut in and is -- now the pressure is recovering in the area.

Q You'd agree, though, that gauge was -- for the 10-01 well was broken at one point?

A I -- I don't know the details on that. I believe that something to that effect is in the record, yes.

Q And -- and a broken gauge, you'd agree, wouldn't provide reliable data?

A Yes, I can agree with that.

Q Okay. I'll turn you to Exhibit 50.003 at page 30. There you say at the second-from-last paragraph: (as read)

> CNRL has run caliper logs on 12 wells at the Jackfish operation and 4 wells at the Kirby operation.

The logs have identified a total of approximately 60 caisson deformations that may be associated with shear movement above the reservoir.

Can you confirm, sir, who collected those logs?

A CNRL provided me that data. They have a database of all the logs they run and the deformations that are observed.

Q And do you know if a third party collected those logs on behalf of CNRL?

A I'm sure they did, but I -- I can't speak to the specifics of the contract.
Q Okay. And so did CNRL interpret those logs before giving them to you?
A I -- you know, I didn't review the logs. I just asked for the data, and the data is in the tables that you see there.
Q Okay. But you then go on to draw the conclusion that: (as read)

> Based on the considerations above, it is my assessment that it is unlikely that any significant shear features will be generated in the confining strata.

So you reached that conclusion without reviewing the logs?
A Well, I'm not a log analyst. I mean, the logs were analyzed and the results were tabulated, and they provided, you know, the type of deformation that was observed and the frequency of the observations. I -- I have a lot of experience reviewing logs like that for CSS operations, and in CSS operations you see a lot of deformation in the -- the caprock and the -- you know, the confinement strata above the CSS formation itself, and when you really look at these, these are very mild by comparison.
Q Very good. Sir, those are all of my questions for

today. We'll have some more for you tomorrow, I imagine, but subject to Commissioner Chiasson's comments, those are my questions for today.

COMMISSIONER CHIASSON: I think Commissioner Barker has one.

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Q COMMISSIONER BARKER: Thank you.

Dr. Boone, just wondering, what's "CSS"? Could you just clarify what that acronym is, please?

A Cyclical steam simulation.

Q Okay.

A Are you familiar with "cyclical steam simulation".

Q Well, I just wanted to know what the acronym meant, so ...

A I can expand on that, or you can just have the answer.

Q That's all I need to know. Thank you very much.

COMMISSIONER CHIASSON: No, I think -- I believe that we are done for the day, then, and I would note that we are hoping to catch up some time tomorrow. I think there is some flex in some of our timing that may -- may catch us up. So I would just remind everyone to remove any belongings you have from here in the hearing room, and parties, unless you've made arrangements that we're not aware of with the building operator, to also remove all your belongings from the breakout rooms

because there's no guarantee of security of any of the space.

And we will also remind all of the witnesses, both tables, that you're still under oath or affirmation, so do not discuss any of the evidence between yourselves, with your colleagues who are not sworn, with your counsel because you're still -- you're still in the process, and we haven't released you, so that reminder between now and when we return tomorrow morning.

And unless there's any other timing concerns that we're not aware of, parties, we would intend to resume back here tomorrow morning at 9:00. Any questions or concerns? No? Thank you all very much for your participation today, and we will be back tomorrow morning.

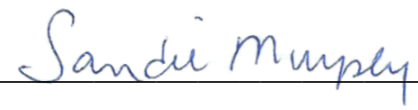
(WITNESSES STAND DOWN)

PROCEEDINGS ADJOURNED UNTIL 9:00 AM, FEBRUARY 7, 2024

CERTIFICATE OF TRANSCRIPT:

We, Sandie Murphy and Sandra Burns, certify that the foregoing pages are a complete and accurate transcript of the proceedings, taken down by us in shorthand and transcribed from our shorthand notes to the best of our skill and ability.

Dated at the City of Calgary, Province of Alberta, this 6th day of February 2024.



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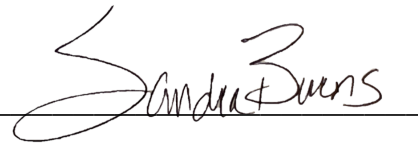

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