UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

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Investigation of: *
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ENBRIDGE OIL SPILL, *
MARSHALL, MICHIGAN * Docket No.: DCA-10-MP-007
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Interview of: EDWARD "TED" FARQUHAR

Enbridge Headquarters
Edmonton, Canada

Thursday,
December 16, 2010

The above-captioned matter convened, pursuant to notice.

BEFORE: MATTHEW NICHOLSON
Investigator-in-Charge

APPEARANCES:

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Enbridge Energy Company, Inc.
[redacted]

I N D E X

I N D E X (Cont.)

I N T E R V I E W

MR. NICHOLSON: Okay, Karen, we're going to start.

MS. BUTLER: Okay.

MR. NICHOLSON: Okay. I'll start with my part.

Good morning. Today is Thursday, December 16th, 2010. My name is Matthew Nicholson and I'm an investigator with the National Transportation Safety Board in Washington, D.C. We are currently in Edmonton, Canada at the Enbridge headquarters, and meeting in regard to the pipeline spill in Marshall, Michigan that occurred on the 25th of July 2010. This is Case Number DCA-10-MP-007.

Before we begin, Ted, I'd like you to please state your full name and whether or not we have permission to record this interview?

MR. FARQUHAR: My name is Edward Alexander Farquhar. I go by the name Ted Farquhar. You have my permission to record the interview.

MR. NICHOLSON: Okay. Also, Ted, if you'd like, you are permitted to have one other person present during these interviews. This is a person of your choice: supervisor, friend, family, or nobody at all. Please confirm for us on the record whom you have chosen to be present during these interviews.

MR. FARQUHAR: I chose nobody.

MR. NICHOLSON: Okay. All right. At this point we'll go around the room and have each person introduce themselves.

State your name, your title, organization that you represent, and include a business e-mail or phone number. I'll start and we'll go to my left.

Matthew Nicholson, M-a-t-t-h-e-w, N-i-c-h-o-l-s-o-n, IIC, NTSB. I can be reached at [redacted]

MR. PIERZINA: I'm Brian Pierzina, B-r-i-a-n, P-i-e-r-z-i-n-a, and I'm an engineer with the PHMSA [redacted] out of [redacted]. And my business [redacted]

MR. JOHNSON: Jay Johnson, Senior Compliance Specialist in the Pipeline Safety Compliance Group of Enbridge [redacted], [redacted]. I can be reached at [redacted] and that's J-a-y; Johnson is J-o-h-n-s-o-n.

MR. FARQUHAR: My name is Ted Farquhar. I'm a senior engineer in the Pipeline Modeling Group with Enbridge Pipelines. My name is spelled T-e-d, F-a-r-q-u-h-a-r. I can be e-mailed at [redacted]

MR. CHHATRE: My name is Ravi Chhatre. That's R-a-v-i-n-d-r-a. Last name C-h-h-a-t-r-e. I'm accident investigator with National Transportation Safety Board. My e-mail address [redacted] And I'm here to assist IIC Matt Nicholson.

MS. BUTLER: I'm Karen Butler with PHMSA [redacted], the supervisor over accident investigations. My e-mail address is [redacted]

MR. NICHOLSON: Okay. I guess with that -- I don't know

at what point you want to get into show and tell, Ted, but we can probably just start with questioning and maybe that will lead us into some of this.

MR. FARQUHAR: Sure. I can do that whenever you like.

MR. NICHOLSON: Okay.

INTERVIEW OF EDWARD FARQUHAR

BY MR. NICHOLSON:

Q. Okay. I guess I can start on this. And the way I wanted to start really is just to have you give us -- there's been a lot of questions about the MBS system over the past couple days that we've been interviewing and I guess what I'm looking for is maybe just kind of a theory of operation, if you could tell me, you know, just high level, what the system's doing, what it's using to calculate from and how it interfaces with the operator, what they're seeing?

A. Okay. To answer that in detail would require spending a lot of time. We have responded to some IRs and given some details on how it works. For the purpose of this, I'll do high level. If you have further questions, ask me.

MS. BUTLER: I'm sorry, you guys, you're going to have to speak up.

MR. FARQUHAR: Okay. I'm sorry.

MR. PIERZINA: Actually, maybe if you can just kind of turn sideways, Ted, that'll -- I think we can hear you probably as well as Karen.

MR. NICHOLSON: Yeah, we can do that. Yeah.

MR. FARQUHAR: All right. I was saying that I'll answer for the purpose of this interview at a high level. If you have specific questions, we can drill down and I can respond to that.

BY MR. NICHOLSON:

Q. That's fine.

A. Okay. So what the MBS is it's a CPM, computational pipeline monitoring. We call it --

MS. BUTLER: It's a what?

MR. FARQUHAR: It's a CPM, computational pipeline monitoring. It -- we call it an MBS and it's a real time transient model. We use proprietary software called Stoner Pipeline Simulator as the base for the MBS.

MR. CHHATRE: MBS is Mass --

MR. FARQUHAR: Material Balance System.

MR. CHHATRE: Material Balance System. Okay.

MR. FARQUHAR: So the way the system works is that the MBS algorithm receives real time SCADA data. This is various types --

BY MR. NICHOLSON:

Q. Pressure?

A. -- types of processes, instrumentation. Things like pressure and flow, temperature, density, sometimes viscosity. In addition, it receives valve statuses and pumps statuses.

MS. BUTLER: I'm only getting about every third word. I

heard pressure, flow -- was it viscosity, velocity? What was that?

MR. FARQUHAR: I'll sit over here closer to the phone for you, Karen.

MS. BUTLER: Thank you.

BY MR. NICHOLSON:

Q. Okay. You receive like --

A. Pressure, flow, density, temperature. In some cases we receive viscosity. We also receive valve statuses and pump statuses.

MS. BUTLER: Valve and what status?

MR. FARQUHAR: Valve statuses and pump statuses.

MS. BUTLER: Okay, got you.

MR. FARQUHAR: And this data is fed into the SPS algorithm to perform a volume balance calculation.

BY MR. NICHOLSON:

Q. Can you just explain SPS? What is the SPS?

A. SPS is an acronym for Stoner Pipeline Simulator, which is the trademark -- it's the brand name of the software.

MR. CHHATRE: Is that (indiscernible) specifically for Enbridge or is it off-the-shelf item?

MR. FARQUHAR: Yeah, it's used across industry by lots of different pipeline companies.

MS. BUTLER: What version?

MR. FARQUHAR: We're using version 9.31.

All right. In addition to receiving the real time SCADA data, a virtual pipeline is essentially built using the code, the SPS code. So we would describe the various pipeline segments. This would include the length of pipe, wall thickness, diameter, roughness, and the elevation profile. In addition, we describe locations for valves, locations for pump stations, and then you indicate where things such as pressure transmitters and flow meters are, and these are all used by the algorithm to round the volume balance calculation. Does that make sense so far?

MR. CHHATRE: Now, if you have two pressure transfusers and flow meters coming into the pump station and leaving the pump station, which input do you give?

MR. FARQUHAR: We use all of them. Well, I'm sorry, if we had two going in and two going out, we would select one to use. You could bring both in. Some of the data will be used to directly drive the volume balance calculations. Some of it just brought in and it's available for observation, but it doesn't directly drive the calculations.

BY MR. NICHOLSON:

Q. You manually have to tell it which point to --

A. That's right.

Q. -- use for calcs?

A. That's written into the code. We specify which one to use.

MR. CHHATRE: But can you see both of them? I guess

what I'm saying is one of them --

MR. FARQUHAR: I sure can. Yes.

MR. CHHATRE: Okay. Then (indiscernible) somehow goes bad, then you will know which one?

MR. FARQUHAR: Yeah, it would cause an anomaly or an alarm. During the troubleshooting process, we would probably find out that one of those is bad.

MS. BUTLER: So could you repeat one part of that? Is it that you manually choose which or the code has software designed to select which one?

MR. FARQUHAR: No, you manually select which one and you program that in.

MS. BUTLER: Okay, so --

BY MR. NICHOLSON:

Q. But it's not user selectable, it has to be written --

A. That's right.

Q. -- into the code? There's no user interface --

A. Not interactively.

Q. Yeah. Writing it into code, is that as simple as having a dialogue box brought up and you type in that point name or --

A. I wonder if I should show you? Would you like me to?

Q. Yeah, we might be getting into some of that aspect.

A. Because I'd have to -- I could bring up -- I think I can bring up a window here.

Q. Yeah, why don't we do that?

MS. BUTLER: Is there any way I can see that or not?
MR. NICHOLSON: No.
MR. CHHATRE: Fly over here, Karen.
MS. BUTLER: Yeah, okay, that's fine. That's fine.
MR. PIERZINA: No, it's -- basically, Karen, it's not your standard computer screens that we're going to be able to -- would be able to do net meeting or anything like that on. And actually, we're going to be on about three screens.
MS. BUTLER: Okay.
MR. PIERZINA: So we apologize. You'll have to trust us.
MS. BUTLER: That's fine, but can you do print screens or not?
MR. PIERZINA: We'll try to describe it as much as possible.
MR. FARQUHAR: I don't --
MR. NICHOLSON: Are we allowed to get screen shots or --
MR. FARQUHAR: I can't answer that. I don't think I can do it from -- this is basically interface to a UNIX server.
MR. NICHOLSON: Yeah, okay.
MR. FARQUHAR: I don't know how to get screen shots from that, and it's a Windows machine. I know we have responded -- we have sent some in some of our IRs.
MR. NICHOLSON: Yeah, you're right. We do have some of that. I might not have digested everything you've sent.

MR. FARQUHAR: All right. Well, if you want to look at the files specifically, I'll start with this window on the right. And it's basically a UNIX window. It's a command prompt. And from here I can look and I can see all the files and see the directories.

BY MR. NICHOLSON:

Q. What are those files? Those are hydraulic models or --

A. Well, this is -- I'll go back to the master directory. So this is the Line 6 model. These are all the directories that are used in the Line 6 MBS.

Q. Okay.

A. If you wanted to, say, understand what SCADA values are brought in, you go into this directory called Inprep (ph.). And inside here, these are all the -- essentially, these are the model building files. This is where I describe the pipeline. This is where I put in some of the logic on controlling the MBS and it's also where I describe all the SCADA points that are used --

Q. Okay.

A. -- to drive the MBS. So, we have a file called the SCADA.include file. And when I look at that, it's a very long text file and it describes from the top of the line all the way to the end of the line, and it describes each and every SCADA point that's brought in. For instance, this one --

Q. How is this written? Is this C++ or is this written in Stoner --

A. In Stoner code.

Q. -- code? Okay.

A. Yeah. This, for instance, will show at Superior -- this is for Line 6A, not 6B. But it shows I've got this data point is a SCADA point. It's the sonic flow meter.

Q. Okay.

A. This is the actual temperature at Superior.

MR. CHHATRE: Can you tell me where it is, the -- I mean, where is the data point coming from on the line?

MR. FARQUHAR: Where is -- it's somewhat descriptive with this identifier. It's a -- it would describe -- you see it's on the injection stream.

MR. CHHATRE: Okay.

MR. FARQUHAR: And beyond that you have to look at our Visio schematics with the P&IDs, and you can look it up and see which data point it is. In some cases there are notes added to say exactly where it's at. So this would be -- just for Superior, I've got probably a couple dozen SCADA points.

BY MR. NICHOLSON:

Q. Okay. So the include file is nothing but SCADA tag names for use in the model?

A. Yeah.

Q. Okay.

MR. CHHATRE: Does it have some kind of a beeping alarm that if some data point is erroneous or faulty or sometimes user

is not working that it'll alert the person looking at it? How would a person who is looking at the screen would know --

MR. FARQUHAR: Well, they wouldn't know from looking at the UNIX prompt command line. You would -- you might know from looking at the MBS interface, which is this window here.

MR. CHHATRE: Okay.

MR. FARQUHAR: Normally, if a data point went bad and it's controlling the calculations, it would cause an anomaly or an alarm. And then it's through the troubleshooting process that you identify that -- the data point's gone bad (indiscernible).

MR. CHHATRE: But it could bring to your attention of -- the person's attention that something is not right here?

MR. FARQUHAR: Yeah.

BY MR. NICHOLSON:

Q. So, I mean, if you did typo a wrong tag name there, you wouldn't know that until your model failed?

A. Oh, it was programmed incorrectly?

Q. Yeah, if you --

A. Yeah.

Q. -- forgot an underscore or something, right?

A. Oh, yeah.

Q. Okay. Because it would be looking for it, but it wouldn't say I can't find it. You'd just have a zero or a question mark or --

A. Yeah. Or what you might find is we have prebuilt menus

to say -- here are all my data points at Superior. If something is coming back bad, then it may just be that it's broken or it could be that it wasn't linked correctly in that file.

Q. Okay. All right.

A. So that's how -- when you build a model, you would go and check that. But if you make a change --

Q. Yeah, you'd flex it first before you -- okay.

A. -- you would say -- you'd look at it and say is it going to come back.

MR. CHHATRE: But once you do all this stuff, you don't really go back on a daily basis to look at this stuff, or you do?

MR. FARQUHAR: Oh, on a daily basis, no.

MR. CHHATRE: How often you going check to see if the system is working?

MR. FARQUHAR: You mostly rely on alarms that come in. That's the first thing. Like after you build it and you test it out, then you put it in production if it's working. And then when changes occur in the field, you'll want to add --

MS. BUTLER: You're fading.

MR. FARQUHAR: When changes occur in the field, you'll want to add these things to the MBS. So test it, make sure it's working, and then you leave it. If something happens that we're unaware of, if it causes an alarm or an anomaly or something, some kind of common error, then you would investigate why and then that's when you start looking at things with your drawings and

identify if there's an issue.

MR. CHHATRE: What I was asking, is there something like a maintenance schedule, if you would? Use the word very loosely. Even though there are no alarms, that routinely you will go weekly or monthly or somehow just to double check, make -- (indiscernible).

MR. FARQUHAR: Yeah, there is some reporting that's done that's checked out by one of analysts (indiscernible).

MR. CHHATRE: Okay.

MS. BUTLER: Reporting's done what?

MR. FARQUHAR: You can do a report on which data points are coming back bad, which would be (indiscernible) a problem. And those are checked from time to time by Jim Knudsen.

MR. CHHATRE: Okay.

MR. FARQUHAR: And I think there is -- I cannot (indiscernible).

MR. CHHATRE: A month or whatever --

MR. FARQUHAR: Something that's documented to say that you have to do this and here's a check list of things that you have to do.

MR. CHHATRE: Okay.

BY MR. NICHOLSON:

Q. What does that mean, data point that's bad? What exactly are you talking about?

A. Well, this one's coming back bad. I don't know why this

is bad.

Q. Oh, it actually says bad on there?

A. Yeah. So that would say that it's either not updating or that the data from the SCADA is corrupt and it's flagged as bad. It's like a --

Q. And that's an actual device we're looking at there?

A. Yeah.

MR. PIERZINA: It looks like Superior density on discharge; is that what that is?

MR. FARQUHAR: Yes.

MS. BUTLER: What did you ask, Brian?

MR. PIERZINA: Oh, there's just a tag on the file that Ted has up. It's the Superior density discharge --

MS. BUTLER: Okay.

MR. PIERZINA: -- point and it's showing it's bad as far as the status of that point.

MS. BUTLER: Okay.

BY MR. NICHOLSON:

Q. So you wouldn't call that out to the field to have someone go look at the device? You'd just --

A. If I had saw that and it was a surprise to me, then I would investigate it.

Q. Okay. So you don't have to wait for Jim --

A. I know what this -- from before.

Q. Okay.

A. No. No, I'm not going to just wait for Jim.
Q. To look at a report.
A. Yeah, but there's not like a defined timeline to go in and check regularly.
MR. CHHATRE: No random check --
MR. FARQUHAR: Everything's coming back correctly and that everything is completely up-to-date.
MR. NICHOLSON: Okay.
MS. BUTLER: I'm a little bit confused on a process question here, Matt, so --
MR. NICHOLSON: Jump in, Karen.
MS. BUTLER: I want to make sure, are we allowed to interactively ask questions as we go through or do you want us to just let him talk for a period of time and save our questions to the end?
MR. NICHOLSON: I don't know. I think kind of the way that it's set up here, it might be better to do it as he's showing us. I guess I'm afraid we might lose a screen or forget a question.
MS. BUTLER: Okay.
MR. NICHOLSON: What we're looking at are two screens with basically text files on them right now.
MS. BUTLER: Right. Okay. So --
MR. NICHOLSON: So there's a lot of data.
BY MS. BUTLER:

Q. So the first question I have is, I've built some models before. I didn't use Stoner. I used a different, entirely different software package. So based on that, I'm going to be asking questions around what I used to do for a little bit of this. All right?

So, when you have a specific element that you've tagged in your database as being the transmitter information you're going to pick up, and you have to override that because that transmitter's bad and you know it; you've received a signal and you've got to go in and make that change, do you have to make that change actually in the text file you're (indiscernible) or can you force an override while the model's running?

A. No, typically, you're going to have to go into that file, change it, and then restart the model.

Q. Okay. So when you do that and you're actually going to have to go do that, do you take the model offline for a period of time?

A. No, you leave the model running while you make the change and you test it, and then once the test is done and you're satisfied it's going to work properly, then you take the production model offline and you switch it with the new one.

Q. Okay. So you're actually saving a separate file, is what you're doing?

A. No, I create a new version of the same file.

Q. Okay. Okay. So you create a new version. So the

previous version continues to run based on the bad data until you get the new data input, tested and put in production?

A. Right.

BY MR. NICHOLSON:

Q. Well, how do you test that data without --

A. You can run it on a test server.

Q. You've got another --

A. Yeah. Or I can run --

Q. -- MBS system running?

A. Yeah, I can run lots of test models at the same time.

Q. Oh, okay.

A. That's very easy. So you'll just run one in the background.

Q. Okay. And then change the file name once you're satisfied and it integrates into the --

A. Yeah, well, I just copy over the old one.

Q. Yeah, just replace it.

A. Yeah. The reason why you do that is that it might get --

MS. BUTLER: Okay. And --

MR. NICHOLSON: Just a second, Karen.

MR. FARQUHAR: I was saying the reason why you do it that way is that it might take a couple hours or it might take a couple days to do a test depending on what's happening. You wouldn't want to just take the production MBS down for the entire

time, especially if it's only -- has a minor impact. So you get your test done and then you only bring the MBS down for the shortest amount of time possible while you switch out the old one and the new one.

MR. CHHATRE: And do you have a capacity to go back -- let's just say you are off. The new model is, let's just say, working with a erroneous data point or data points -- well, let's take a worst case scenario, like for two days while you are doing the revisions and all that stuff. And you are satisfied, you put a new model in. Is there any way you go back for those two days previous and check and make sure that there was not nothing wrong happen between those two days or do you have no ability to do that?

MR. FARQUHAR: I'm not sure how to answer that one.

MR. CHHATRE: Do you see what I'm saying?

MR. FARQUHAR: Yeah, I think I know what you're saying. You're saying like to run it and make sure that there wasn't like extra alarms that were coming in that should have.

MR. CHHATRE: Or there was more basically that happened during that period or something that you can -- I'm just bringing a comfort level up, say, okay, I was working on this one for two days; nothing bad happened.

MR. FARQUHAR: Well, there's a couple different things that you can have -- you can do. It really depends on what type of change you're making. In some cases the MBS would be degraded

because there's something -- like a significant impact occurring.

MS. BUTLER: Something like what?

MR. FARQUHAR: There might be a significant impact to the MBS's capabilities occurring.

MS. BUTLER: I got you.

MR. FARQUHAR: So what you -- something you could do is discuss it with the control center, tell them that there is an impact on the sensitivity as a precaution while you do your changes as fast as you can. And so they might initiate some other form of pressure, like, leak detection, like pressure monitoring or extra volume balancing.

BY MR. NICHOLSON:

Q. Extra volume balancing through --

A. Manual volume balancing.

Q. -- CMT?

A. Yeah.

Q. Well, that's all they have, right, would be CMT or flow meters --

A. They can do -- they can create a -- they've done things like create a spreadsheet and do like half hour manual checks.

Q. Okay. I got you.

A. That would be if there's something serious. If it's not too serious, like it probably -- if it's just a single pressure transmitter, it probably doesn't have much of an impact on the capabilities. However, when I run the test model, I would usually

start it from when -- from the time period when the data went bad. And I would run through all that data on my own and I'd be monitoring it to see if there's anything off. I'm really doing sort of like a test to make sure that it works the way it's supposed to.

Q. Okay.

A. If I saw something like -- I think you're worried about a leak happening that wouldn't get detected. Say if I saw something like a leak pattern because we have the good data in, then I would say something. But that's just not common.

MS. BUTLER: You're going to have to speak up.

MR. FARQUHAR: I'm sorry. What I was saying is that when I do a test for a change, such as like a pressure transmitter, I would begin the test at the point where the pressure transmitter went bad. And then I'd run through all that data. If it took me a couple hours or if it took me a day or two to get this change in, like I would have monitored the MBS response over that time period as part of my testing.

BY MR. CHHATRE:

Q. Now, for your regular historical information, do you save all these old and corrupt files for checking and see if you have the same problem operating at certain locations? I mean, I guess -- you said you can overwrite a old program. But then if you had to go back and look at historical information, if you, you know, if you --

A. If I overwrite it?

Q. Do you have some regular -- (indiscernible) to go back and look at --

A. If I want to go back and re-run some old data?

Q. Yeah, or if you want to find out what's happening -- why I'm getting the same data or same problem at certain locations for diagnostic reason or for historical data, is there any way you can go back to a corrupt file or --

A. There is now.

Q. Okay.

A. We're implementing a version control software that stores all the old versions. It's in place now. It wasn't at the time of the Marshall incident. It was in development.

MR. NICHOLSON: All the old versions with their include files?

MR. FARQUHAR: Everything.

MR. NICHOLSON: Okay.

MR. FARQUHAR: Everything.

MS. BUTLER: So what did you say about -- in regards to the Marshall incident? I'm sorry, I couldn't hear you.

MR. FARQUHAR: Oh, I said that we now have a version control software in place which logs and archives all changes permanently to all of our MBS files. And it's very easy to pull an MBS from date and you can see what was in production.

MS. BUTLER: And that was after Marshall?

MR. FARQUHAR: Yeah. It was in development at the time of Marshall.

MR. NICHOLSON: So it wasn't because of Marshall; it was already in the works?

MR. FARQUHAR: It had been a project for a while in development.

MS. BUTLER: Marshall just pushed the need forward? Is that correct?

MR. FARQUHAR: Yeah, we got it in right after that for Line 6.

MS. BUTLER: Yeah. Obviously, with the bypass situation. Okay.

BY MR. NICHOLSON:

Q. Is that true? Was it because of the bypass situation?

A. That we put this in, version control in?

Q. Right.

A. No.

Q. No. Okay.

A. We would have done it anyway.

Q. Okay.

MS. BUTLER: Did you push it forward because -- the versioning issue?

MR. NICHOLSON: You mean the bypass issue?

BY MS. BUTLER:

Q. Well, because -- we'll go through how a bypass happens

in a minute. But because of the bypass at Niles and the revisions that had to be made, and when we asked had that ever been there before and they said previously that, well, obviously, they've bypassed Niles before, but it wasn't necessarily reflected in the model. Did you push the versioning control forward so that you would know when you viewed a specific model version for a bypass mode?

A. I would reply to that by saying we do it for like any change.

Q. Right.

A. We think it's really important, including a bypass.

Q. It helps you know what's in that version, correct?

A. Can you repeat that? I didn't hear it.

Q. It helps you know what's in that version, correct?

A. Exactly. Yes.

Q. Okay. So if you keep one version of the model that has certain stations bypassed and another version of the model without them bypassed, you would know that from this data directory; is that correct?

A. Yeah. You would see what changes occurred.

Q. Yeah.

A. And I think there may be a misunderstanding about why, like, we're having two different models: one for bypass and one for no bypass. Like we would configure it so that -- I think you're referring to the Niles and the pressure transmitters.

UNIDENTIFIED SPEAKER: Yes, right.

MR. FARQUHAR: We configured it now so that we're driving the model with the pressure transmitters on the main line. We're not going to change back to using the ones on the stations at any time.

BY MS. BUTLER:

Q. Right. So you -- that was a change --

A. Permanent change.

Q. -- that you've made in how you're controlling your model that's running, correct?

A. Correct.

Q. Yeah. Okay.

BY MR. NICHOLSON:

Q. But at the time of Marshall, you were using the pressure transmitters in the station, is that --

A. That's right.

Q. Okay. And he had to build the whole macro thing to simulate a bypass; is that what the --

A. Build a macro?

Q. I thought he had put in some kind of --

A. Jim?

Q. Yes, Jim.

A. Jim needed to disable some of the pressure transmitters.

Q. Okay.

A. And override a couple parameters for our logic on

controlling Niles station in order to have it balance correctly.

BY MS. BUTLER:

Q. And so that would have meant a new version or a different version?

A. I'd say the changes that Jim made are -- those are things that you'd make operationally. They'd be operational changes, temporary. But --

Q. So back to the original question. Is switching between two transmitters, you can do it live or you can do it through the file?

A. No.

Q. Okay.

A. Jim did not switch the transmitters --

Q. All right.

A. -- on the 26th.

Q. So what did he do?

A. He disabled them so that the model --

Q. Oh, he just took any reference to pressure out of that section of the model?

MR. NICHOLSON: Oh, and then just went to the nearest upstream, nearest downstream --

MR. FARQUHAR: Yeah. The MBS software is capable of estimating pressures.

BY MS. BUTLER:

Q. Got you.

A. When you disable it, what you're saying is -- you still have all these other pressure transmitters at all the other stations. You know what your flow is, your temperature, your density, and it's up to the software to determine what pressures make sense at Niles.

Q. Right.

A. And so --

Q. So the length of the segment upon which the material balance is working is just longer? The length of the segment -- because you don't have -- now you don't have an active pressure there that you can compare it to, so you just take that out of your model. It continues to calculate estimated pressures and estimated volumes, correct?

A. Yes.

Q. For that location?

A. Yeah.

Q. But it's just got a longer section of pipe between where it sees two actual readings to compare?

A. That's right.

Q. And so what that does is decrease the accuracy within that area.

A. I'd say to some degree it might reduce the sensitivity in that area.

Q. Okay.

A. Yeah.

Q. Okay. Thank you.
A. But the model is designed to, to some degree, compensate for that.
MR. NICHOLSON: How would it compensate?
MR. FARQUHAR: Like the algorithm, it's an intelligent -- like state estimation software.
MS. BUTLER: It's an intelligent what?
MR. FARQUHAR: Well, the software is designed to do state estimation and it's able to compensate and can calculate the pressures to drive the volume balance calculations.
MR. NICHOLSON: Do they tell you in the software that you have to have pressure transmitters at specific intervals for it to be accurate?
MR. FARQUHAR: I don't think it specifies intervals. I don't -- I've never seen that.
BY MS. BUTLER:
Q. So isn't that really something that you actually discover as you're building your model and testing it?
A. What's that?
Q. For example, when you -- you've got certain pressures at certain locations. You build your model around that. You go out and test it, comparing the current hydraulics the model predicts to actual hydraulics on the pipeline. When it gets within a certain allowable accuracy, then you believe that you've got a good model for that configuration. Is that true?

A. Yeah, that's a good way of explaining it.
Q. Okay. How would you explain it?
A. No, I'm saying that what you've described is a good way of describing it.
Q. Okay. So then when you have a different setup because you've bypassed, you change a transmitter configuration, you add a lateral to the line, you change a metering facility and you input that, then that change also goes out and gets tested and then is compared to the actual hydraulics that are being measured by SCADA versus what the model output would be; is that correct?
A. Sure. Yeah.
Q. Okay. So, previously when a bypass happened, we ran it off of a separate model version; is that correct?
A. You mean like each time they bypassed they did something?
Q. Well, if they bypass Niles or they bypass -- as they would go up the pipeline, was there just something you activated within the model that said this station now, this station now, or did you trigger that off of bypass valve position?
A. Well, I think -- how would I answer that?
Q. Can you --
A. We didn't know that there was main line -- that the model was using station transmitters versus main line transmitters --
Q. Okay.

A. -- on the 25th.
Q. All right.
A. If we knew, then we would have changed it.
Q. I got you.
A. And drove it by --
Q. So it really wasn't a recognition of the problem associated with the bypass?
A. No, there wasn't any attempt to use those station transmitters and do a work around every time they bypass.
Q. Got you. I got you. I got you. Okay.
MR. NICHOLSON: So I'm looking at Jim's interview here. What he called it was a header force device?
MR. FARQUHAR: Yeah.
MR. NICHOLSON: Okay. Is that similar to what you just explained?
MR. FARQUHAR: Well, it's an HF device. It's (indiscernible) in the Stoner logic that gets driven by your pressures --
MR. NICHOLSON: Okay.
MR. FARQUHAR: -- and an estimate of flow to model the pressure and flow across that -- across the station.
BY MS. BUTLER:
Q. So that header force device, that automatically comes up or that's something that you like hit a hot key and you're telling it that because of the circumstances you're going to force the

device out of the equation or out of the loop?

A. No.

Q. Okay.

A. I like to call it an HF device.

Q. Okay.

A. That's what I call it. The HF device is built into the in prep files.

Q. Okay.

A. And it's a way of simplifying a pump station rather than designing each of the elbows and each of the pumps, you just say -- it's like a --

BY MR. NICHOLSON:

Q. It's a block.

A. -- block. I know what the pressure is on going in and going out, and then it can do calculations to tell you what the flow is across it.

Q. So he basically just blew away Niles and put that HF device in there?

A. HF device is always there.

Q. Oh, okay.

A. It's driven by the pressure transmitters.

Q. On the line or at the station?

A. On the 25th, they were driven by the ones in the station.

Q. Okay.

A. But now, when those two pressure transmitters were isolated, they were no longer providing good values to drive the flow across the HF device.

Q. Okay.

A. That's why Jim had to disable the pressure transmitters and allow the model to use different values of pressure to drive flow across the HF.

BY MS. BUTLER:

Q. So repeat that one more time.

A. I said the HF device is always there and it's --

Q. Right.

A. -- always driven by the pressure transmitters, which on the 25th were the ones inside the station.

Q. Okay.

A. When those transmitters got isolated by the bypass --

Q. Right.

A. -- they were no longer a valid representation of pressure on the main line.

Q. Okay.

A. So they were driving like incorrect flows at the HF device. It was incompatible. So Jim had to disable them to allow the model to come up with its own values.

Q. Okay. So the header force device actually did what?

UNIDENTIFIED SPEAKER: Well, it was already in place, I think is what you're trying to say.

MR. FARQUHAR: Yes.

BY MS. BUTLER:

Q. Yeah, I guess that it's a function of being in place. But the outcome of that is what?

A. Of the HF device?

Q. Yes.

A. It estimates flow across the station, basically.

Q. Okay. So, it was -- the header force device was still doing its thing, but it was just receiving bad input data?

A. Yes.

Q. Okay. So, then what?

A. By disabling it?

Q. Yes.

A. Sorry. By disabling the pressure transmitters, better pressure estimates were allowed to drive the HF device.

Q. Okay.

UNIDENTIFIED SPEAKER: So, basically, because -- well, at Niles, so you had LaPorte and you had Mendon and you knew the pressures at both of those and your system would tell you what you had at Niles?

MR. FARQUHAR: Yeah.

UNIDENTIFIED SPEAKER: Yeah, that's all now --

MR. NICHOLSON: So then the software could estimate it.

UNIDENTIFIED SPEAKER: Right.

MS. BUTLER: Right.

MR. NICHOLSON: So it was forced to use bad pressures at first?

MR. FARQUHAR: Right.

MR. NICHOLSON: And when you disable it, it can use better estimates of pressure.

BY MS. BUTLER:

Q. Okay. So basically, all Jim did is disabled the header force device?

A. Technically, that's not quite right. He disabled the pressure transmitters.

Q. And how did he disable the pressure transmitters?

A. By poking them off.

Q. Okay.

A. I can show you guys.

Q. Okay. Got it. Got it. Got it.

MR. FARQUHAR: Do you want to see?

BY MR. NICHOLSON:

Q. Well, I think you're -- describe it to us at this point. I mean, you didn't have to go into the include file. It looks like it's something --

A. No, no.

Q. -- you can do right here? Actually, I wanted to ask you to explain this screen anyhow.

A. Sorry. I don't know what happened to it.

Q. (indiscernible) these here?

A. It disappeared.

MS. BUTLER: So he poked those off and then poked them back on after the bypass was over?

MR. FARQUHAR: Yes.

MR. NICHOLSON: Well, that's just a screen shot of another computer or is it --

MR. PIERZINA: Well, remember that it never got poked back on because the failure occurred and the line was down for a couple months, right?

MS. BUTLER: Well, at that particular point, (indiscernible) he thought they were false alarms. So they most likely poked that back on when they were trying to do a restart, I would guess. Unless you're saying, Brian, because Niles never changed state?

MR. PIERZINA: Right. Well, he did the HF on the --

MR. NICHOLSON: He did that on start up.

MR. PIERZINA: Before the second start up, between the first and second start up, right?

MS. BUTLER: Right. Correct.

MR. PIERZINA: So I don't think it ever got changed after that until --

MS. BUTLER: Got you.

MR. PIERZINA: Yeah.

MR. NICHOLSON: Until?

MR. PIERZINA: Until the -- prior to the restart or --

well, actually, no, it wouldn't have gotten changed until after --

MS. BUTLER: Until Niles was no longer bypassed, I'm guessing.

MR. PIERZINA: Yeah.

MR. NICHOLSON: Where are you going -- that's not an issue though. In fact, I think --

MR. PIERZINA: Correct.

MR. NICHOLSON: -- in Jim's statement --

MS. BUTLER: Oh, no, no, no. We were just talking out loud.

MR. NICHOLSON: Okay. Okay. And Jim said there really was no change to the model once he disabled those pressure transducers. He didn't see any big difference, I think is what he had said.

MR. FARQUHAR: It wouldn't have a whole lot of impact. It's not the type of thing you want to leave for a long term, indefinite type of thing, that when you identify something like that, you'd make the change in the files and restart the model.

BY MR. NICHOLSON:

Q. So just so I understand it, essentially what it's doing, it's looking at the pressure at LaPorte, the pressure at Mendon, and that's solving for a flow rate that gives us that differential, right? Okay. And then at that point it can tell you what the pressure is at Niles?

A. Yeah.

Q. That's essentially --
A. It can do calculations. It looks at your density profile, your elevation and your temperature as well. All that --
Q. Is that Darcy-Weisbach. But what equation is? What formula is it?
A. Darcy-Weisbach, yeah, for frictional pressure --
Q. Okay.
MS. BUTLER: You said Darcy-Weis?
MR. NICHOLSON: Darcy-Weisbach. It's not Colebrook.
MS. BUTLER: Okay. Yeah, got you. And are you capable in that model, then -- with this header force device, do you still have to input friction coefficients or does it just assume them for you?
MR. FARQUHAR: No, in the in prep files you'll stipulate your friction, like all your parameters such as that.
MS. BUTLER: Okay. Are you only allowed to use that equation or can you switch equations?
MR. FARQUHAR: You know, I'm not quite ready to answer that one right now. I don't recall right now.
MS. BUTLER: Okay. That's fine.
BY MR. NICHOLSON:
Q. Is this -- are we back up here? Is this --
A. Yeah, I got this one running.
Q. Oh, okay.
A. So --

Q. I'm sorry, what do you call this screen again? Is this the --

A. It's called the PQ display.

Q. Oh, this is the PQ display.

A. So pressure flow. This over here under mode, they're all on. What Jim would have done, he would have gone here to Niles, NL, and he said, okay, they're not working properly and he can poke it off. So if I click on it and type off, it disables it.

Q. Oh, you have to click it and type off?

A. Yeah.

Q. Okay.

A. And then it would show up here after the next time step, it would say off. So everybody would know that it's been disabled.

Q. While we have this screen up -- because I think some of these are screen shots we have on IRs. Can you just kind of walk through some of these values?

A. All right. This is, in my opinion, it's the most important display.

Q. This is an old -- I'm sorry?

A. No, the most important display.

Q. Oh, the most important, PQ.

A. I think. This is like one of the first things I look at. So this is for 6B. It shows -- it's broken up into two

sections: Griffith to Marshall, which is what this one is; and then over here, this is Marshall to Sarnia.

Q. Okay.

A. So going down the left-hand column, it shows station call letters, Griffith, LaPorte, Niles --

Q. Yup.

A. -- Mendon, Marshall. The mileposts, those are hard-coded in. In this column it's your diagnostic flow. So it's the measure of the imbalance that is detected at each of these stations. Right now it's zero. The line is shut down. In the event of the leak, you would have seen like (indiscernible) diagnostic flows down here around Marshall, not so much up here.

Q. And I just want to be -- the differential is what? The model minus actual or actual minus --

A. No, this is diagnostic flow.

Q. Yeah.

A. So it's the measure of the imbalance that detected measured in meters cubed per hour.

Q. Okay. But when we say imbalance, the hydraulic model's doing it. It's back solving for pressures or flow, right?

A. It's doing a lot of stuff.

Q. Okay.

A. Yeah.

Q. But what is it comparing -- where is the imbalance compared to?

A. Okay. So it's compared -- there's a SCADA state, which is basically your processed data that's come back and says I got pressures -- these are all my pressures along the line.

Q. Right.

A. These are my flows. This is my temperature, my density. And then the model is in real time it's looking back a couple time steps and looking forward a time step.

Q. Okay.

A. It brings in some extra data and then it estimates where the pressures and flows should be --

Q. Yes.

A. -- based on conservation --

Q. These are all calculated, right?

A. -- of mass.

Q. Okay. Right.

A. And if it says -- if it shows there's an imbalance in what it thinks should be occurring and what's actually occurring --

Q. Right.

A. -- then it says --

Q. And the actual is off the flow meters?

A. Yeah.

Q. Essentially, right?

A. Right off the SCADA data.

Q. Yeah, right. And those are volumetric flow or are they

mass meter --

A. No, they're -- yeah, volumetric. So they'd be (indiscernible) --

Q. Okay. So they're adjusted for pressure?

A. Yeah, they'd be adjusted for pressure and temperature.

Q. And temperature. Okay.

A. So it brings in the flows. It brings in --

Q. Okay.

A. -- the pressures. It brings in everything. It does a lot of calculations, a lot of iterations, and then it compares what it thinks should be occurring versus what is actually occurring.

Q. Okay.

A. If there's a difference, it shows in the form of diagnostic flows.

Q. Yes. And I think I had seen that.

A. Which is shown here.

Q. Okay.

A. So when there's an alarm occurring or an imbalance, let's say, I would look to see where the diagnostic flows are occurring. And that's an indication of where you have to start looking to troubleshoot an alarm.

Q. Right.

A. Okay. Each -- inside these brackets, these are links to trends.

Q. Oh, okay.

A. So if I click on that, that will show me my diagnostic flows at Griffith going back 2 hours. I had nothing there.

Q. Well, that's -- so what's the orange over on the left? It looks like it actually rises.

A. Yeah, 620. So it measured something, a positive imbalance.

Q. Yeah, that's what I was getting at before when I was asking about which subtracts from which. You can positive and a negative, actually?

A. Yes. I negative would quantitate that there's --

Q. That's all you worry about is the negative?

A. Well, I worry about -- if I see a large positive imbalance, and let's say something's not working right.

Q. Okay.

A. Then I'd investigate why because I don't want to have a large positive imbalance permanently.

Q. Okay.

A. Also, in this display -- so this shows your pressures. So this is the raw values. This is right from SCADA. The use is what the model is actually using. You're allowed -- basically you apply repeatability to the pressure. If I'm coming at 200, we say your repeatability is 12. So it can use plus or minus 12 on that pressure in this case.

Q. Plus or minus 12 psi?

A. Yes, right.

Q. Okay. It's not a percent?

A. No.

Q. Okay.

A. As I say in this case, it's using 196 instead of 200 for it's rolling balance calculation.

Q. Okay.

MS. CHHATRE: And why is that again?

MR. FARQUHAR: It's -- well, every instrument is going to have some uncertainty. So you apply some uncertainty to it. Or in the case it's -- sometimes you have a complex model, you need to add a little bit more uncertainty to get you to 12 psi. The pressure transmitters are probably more accurate than that.

MR. PIERZINA: Yeah, like 1 percent of (indiscernible).

MR. FARQUHAR: Yes. But when you count your, you know, your density error and your elevation error, you probably -- you need to add in a little bit more repeatability.

BY MR. CHHATRE:

Q. So you do your mass balance, you do your band based on these two values, but you're just using only one value?

A. Yeah. That's right. But I say I give it a band that it can use. It has to choose pressure somewhere in that band for the calculation.

Q. So the program does it ran automatically on its own which value you pick between that band?

A. That's right.

Q. You have no control on that?

A. Well, no, I control the band though.

Q. You control the band, but you don't control the actual number it's picking.

A. No, no. That's why I let the software do it.

Q. Okay.

A. That's its thing.

So beyond that, these are some qualitative things. Like this shows your repeatability, your effective repeatability. RC is the amount of repeatability that's being used.

UNIDENTIFIED SPEAKER: What was the A, B, C next to that?

MR. FARQUHAR: A, B, C -- oh. Instead of -- you can interactively change the repeatability.

UNIDENTIFIED SPEAKER: Oh, okay.

MR. FARQUHAR: So if I click on that, I can change it to 10. And then it would accept that, just the same as poking it to off.

UNIDENTIFIED SPEAKER: Okay.

MR. FARQUHAR: Alternatively, I could type Capital A and then it would wait for me to input the pressure.

BY MR. CHHATRE:

Q. So you can manually --

A. So I input a repeatability to use.

Q. Yeah, okay.

A. But I'm not going to do that. I don't want to mess around with the production model. So there's just two different ways of changing it.

Q. Okay.

A. Let's see, RC, this shows how much of the repeatability is being used. So say it's allowed 12; it's using 3.6.

Accuracy, this is would be if the MBS detects a constant bias in a pressure or flow, then over time it could create an inaccuracy, and this would say -- if this was, say, 1 and it was saying I'm always going to add 1 pound --

BY MR. NICHOLSON:

Q. Okay, to offset --

A. And then I'm going to apply my band of 12 psi on top of that.

Q. Okay.

A. They're all zero.

Q. You can put something in there or it will --

A. Yeah. You don't normally throw in a value, but we display it here so that when you're troubleshooting you can see if there's something. If I see like an inaccuracy of like 20 pounds and everything else is 0, that will be a sign of -- I'll say, well, what's going on there?

Q. Be a sign someone's forcing something.

A. Good. This is the same thing I showed you on the

display for Superior.

Q. Oh, right.

A. So it's coming from SCADA and it says -- it's a tag to say that the quality of the data is good. It also says that if my update time is -- the time -- sorry, if the time in between updated values, is greater than a set value, then I say it's bad. It's gone frozen or it's not reporting back.

Q. So --

A. Everything's greater --

Q. -- greater than .42 seconds?

A. Yeah, this is the current update time.

Q. Okay.

A. So that means I've gotten a value within the last half second.

Q. Oh, okay.

A. So --

BY MS. BUTLER:

Q. So on yours, are they pulling by exception then?

A. I think I'd have you ask Les about that.

Q. Okay.

A. There is -- Les Reschny.

MR. NICHOLSON: They're pulling at the same rate that SCADA is, though, right?

MR. FARQUHAR: SCADA feeds us everything.

BY MS. BUTLER:

Q. No, but he's impacted by that, so --
A. Yeah. It says -- whatever SCADA gets --
MR. NICHOLSON: Yeah, exactly.
MR. FARQUHAR: -- they pass it on directly.
MR. NICHOLSON: Right. So you're not going to be any different than SCADA?
MR. FARQUHAR: No.
MR. NICHOLSON: All right. Okay.
MR. FARQUHAR: And there is, yes, some pull by exception, but Les can explain that better than I.
MR. NICHOLSON: Yeah, SCADA is by exception. Okay.
MR. FARQUHAR: All right.
BY MS. BUTLER:
Q. So on the pulling that you just mentioned, though, basically what it's going to do is if it hasn't received an update, so the value is stale, for a period of time it's going to let you know that?
A. Yeah, the status would go bad.
Q. Okay.
A. So this would be like a filter that we apply, not that SCADA applies.
Q. Okay. And so you would have that filter set up on each pressure?
A. Yeah.
MR. NICHOLSON: What is that time; do you know?

MR. FARQUHAR: Off the top of my head --
MR. NICHOLSON: I'm curious how generous --
MR. FARQUHAR: All right. Let's take a look and see if I can find it.
MR. NICHOLSON: Well, we don't need to spend time on it if you can't -- sorry.
MR. FARQUHAR: No, I can't tell you off the top of my head.
MR. NICHOLSON: Okay.
MR. FARQUHAR: It's a global set value. It's not like 10 minutes or anything like that.
BY MS. BUTLER:
Q. So on that status when it goes bad, that's just tapping, I mean, interactively; is that correct? It doesn't like get logged anywhere with a time and date stamp?
A. Well, first of all, there's two ways I can go back. One is right from SCADA. That's logged in the R2 data file. We can look back and find that.
If it goes bad in the MBS -- yeah, well, here's a couple that have gone bad.
Q. I'm sorry?
MR. NICHOLSON: Oh, we're looking at a few tags that are bad or data points.
MS. BUTLER: Okay.
MR. FARQUHAR: Yeah, I'd have to get back to you to say

if we have a permanent log for when something goes bad according to the MBS.

BY MS. BUTLER:

Q. Yeah, I'm just wondering if -- because let's say that the transmitter is functioning fine, right, and that the R2 unit is not going to show any issue because everything's cool there.

A. Um-hum.

Q. But then all of a sudden in the model I, for whatever reason my communication circuit didn't go as planned or I've got this filter option and I didn't meet the timing of that filter option, then that would flag this as a bad data point, right? And so I'm just wondering it that's captured. So that would be helpful to know.

A. I'll get back to you on that one.

Q. Okay.

A. I know there's ways to see that, but I don't think we have a way of -- we permanently archive that so you can look back.

Q. Okay.

A. Interactively, if I see something that's bad, I can see how long it's been bad.

Q. Yeah, got you.

A. I can look at how long it's been since it's updated. Okay. What else do I have here? These are more trends. If I click on this, it'll show me my Griffith discharge, my LaPorte suction pressure.

MR. NICHOLSON: I'm sorry, what was mode? Did we cover mode?

MR. FARQUHAR: Oh, that's on if it's on or off.

MR. NICHOLSON: Oh, that's the one you were talking about.

MR. FARQUHAR: That's for (indiscernible) disabled. Pressures.

So continue on. These are trends. And then here is PDF. This is -- it's really hard to explain, but it's like an internal algorithm for compensating for pressure changes in pipe segments.

BY MS. BUTLER:

Q. What is that called?

A. A PDF.

Q. PEF?

A. PDF.

UNIDENTIFIED SPEAKER: PDF.

MR. FARQUHAR: Pressure drop force is the acronym.

BY MR. NICHOLSON:

Q. When do you use it or (indiscernible) --

A. It's on all models.

Q. It is on all --

A. Yeah.

Q. Okay. Your diagnostic flow, those values are in meters cubed per hour, is that what you said?

A. That's right.

Q. Okay. So it get some (indiscernible) in the MBS system?

A. Right here.

Q. Okay.

A. I can see my sum for Griffith to Marshall. And then for over here, it'd be for all of Line 6B.

So GTMR, Griffith to Marshall, and here is global.

It's also summed up on the CCO display. So this would show over time what the value of the diagnostic flows there. They've been constantly 0 over the last hour.

Q. And that's the same display that the operators see? Is that part of their hydraulic profile?

A. That's something that they used to --

Q. Or on their MBS display.

A. -- they used to be able to look at. They've changed what is available to the operators to look at from an MBS perspective. They're not allowed to see all the displays.

MS. BUTLER: And what's that called, the display called?

MR. FARQUHAR: I call it a CCO display.

BY MR. NICHOLSON:

Q. That's what this is? This is a diagnostic flow display here?

A. Yeah, the common term would be CCO. That would mean the most --

Q. That's what this is? Okay.

A. -- the most to everybody at Enbridge.

MR. CHHATRE: What is CCO?

MR. FARQUHAR: Control center operator.

BY MR. NICHOLSON:

Q. That's what you're calling this screen here, the CCO display?

A. Yeah.

Q. Okay.

A. This is shows now diagnostic flows over time.

Q. For each segment, right?

A. Yup. It says for Griffith to Marshall. Here are my thresholds. So if it stays below this blue line, which is the 2-hour threshold, for a long enough period of time, then it would trigger a 2-hour alarm.

Q. Right. Okay.

A. Same thing here for the 20 minute.

Q. That's your 20-minute.

A. It has to accumulate.

Q. How were those values arrived at, those thresholds?

A. Through testing. When you first build an MBS, you'll do -- you'll run through weeks or months of data. You set your thresholds as low as you can so that every --

MS. BUTLER: So what's the threshold's set at for the 5-minute alarm at Marshall, that came in initially and then cleared, do you know?

MR. FARQUHAR: I do. It is -- we have reduced them by half since the incident.

MS. BUTLER: Okay.

MR. FARQUHAR: That was part of the startup plan was to reduce them by half on Line 6B.

MR. CHHATRE: What does that mean?

MR. FARQUHAR: They're a lot lower. So right now it's set at an average flow of 300 cubes an hour. It's an average detected leak of 300 cubes an hour over a 5-minute period would trigger an alarm.

BY MS. BUTLER:

Q. But is that only volume based and not pressure based?

A. I don't think I quite understand the question. Like --

Q. Okay. On the thresholds that you're setting, you're only setting a threshold for the predictive flow at various pressures; is that correct, then?

A. No, not quite.

Q. Okay. Well, explain it to me and how it should be.

A. Okay. I was talking earlier about how the MBS detects, creates a model state of the pipeline and it compares it to the status state. So what's it predicting should be happening versus what is actually happening.

Q. Right.

A. If there's a difference between the two, it displays that in the form of diagnostic flows.

Q. Right.

A. Only diagnostic flows. And those are measured in meters cubed per hour.

Q. Got you.

A. It takes into consideration all your pressures and flows --

Q. Right.

A. -- temperatures, essentially everything goes into that and it is spit out as diagnostic flows.

Q. Right.

A. And that's what we track over time.

Q. Okay.

BY MR. CHHATRE:

Q. And if that difference now is 300 cubic meters per -- you said per --

A. Per hour.

Q. Per hour. Then you start your 5-minute alarm?

A. Yeah, if it detects an average imbalance at that rate for a 5 minute period, then it will alarm. It has to be cumulative over time.

Q. Is it a continuous average?

A. Yes.

Q. Okay.

A. Yeah, it's like a circular -- yeah, moving -- it's a moving calculation.

Q. Okay.

BY MR. NICHOLSON:

Q. So why not 2 minutes? Where's the 5? How did you guys arrive at 5, 20, 2?

A. These values were set a long time ago. The people who run the department decided on 5 and 20 and 2 hour as the most meaningful thresholds.

Q. Probably doing a similar analysis you were talking about with the thresholds where you kind of like what's occurred before and find things --

A. You do that -- well, you have to -- you set 5 and 20 -- you set the values of those thresholds based on your tuning.

Q. Yeah. Okay.

A. But 5 and 20, 2 hour is -- that's what we have for all of our lines. They're all treated the same. And it's based primarily on the EPI 1149 uncertainty calculation.

Q. Okay. So there's a standard.

BY UNIDENTIFIED SPEAKER:

Q. So you said currently it's 300 meters cubed per hour?

A. Yeah.

Q. Okay. So at the time of the accident was 600 meter cubed per hour in a 5-minute -- so does that mean, so if you had a much larger imbalance over a -- so in a minute, if you've got a large enough to trigger that 600 over 5 minutes, was --

A. Yeah, if it was 600 and 5 --

Q. Would it trigger the alarm faster or --

A. Yeah, if you had, whatever, 3500 in 1 minute, that would trigger the alarm.

Q. Yeah, within 1 minute. So if you have a release, and probably like we did in this case, you don't have to have 5 minutes worth of that imbalance to get the alarm, it'll -- as soon as it hits that threshold --

A. Yeah.

Q. So --

A. It's just like it accumulates the imbalance over a running 5-minute period.

Q. So once it had 1200 meter cubed of imbalance, you'd get an alarm in 2-1/2 minutes.

BY UNIDENTIFIED SPEAKER:

Q. Now, this is Griffith to Marshall right here, right?

A. That's right.

Q. So that's a summation of all the imbalances on each of the segments.

A. All the way from Griffith to Marshall, yes.

Q. Yeah, so -- but I thought you could also -- don't you have the same thresholds for each segment?

A. Yeah.

Q. Okay.

A. So Marshall to Sarnia would be its own calculation.

Q. With the same thresholds, 300 --

A. That's right.
Q. Okay.
A. Yeah. Another way of displaying it is --
BY MS. BUTLER:
Q. So talk to me again. You've reduced the cubes per hour by half.
A. That's right.
Q. So theoretically, because you're doing averaging, it can see that quicker; is that correct?
A. Yeah, well, it would alarm on a lower detected leak rate.
Q. Right. So -- yeah.
A. And it would -- and for the exact same leak rate --
Q. Now, the time span doesn't change. I apologize for saying it that way. Yes.
A. If you have the exact same leak rate, it would trigger faster --
Q. Faster.
A. -- with these thresholds.
Q. Yeah, got you.
MR. NICHOLSON: I'm sorry. I'm sorry, just a quick question. Is that -- those thresholds are -- is that just for 6B?
MR. FARQUHAR: That's right.
MR. NICHOLSON: Those changes? Everything else is still at --

MR. FARQUHAR: You mean like at 6A?
MR. NICHOLSON: Yeah.
MR. FARQUHAR: Yeah, 6A has not been changed.
MR. NICHOLSON: Okay.
BY MS. BUTLER:
Q. Yeah, so only 6B?
A. That's right.
MR. NICHOLSON: But those thresholds are pipeline specific, right?
MR. FARQUHAR: Yes, correct.
MR. NICHOLSON: Okay.
MR. FARQUHAR: I want to show you this display. Yes?
BY MR. CHHATRE:
Q. If it's a moving average, then why would a large spill, a leak, would instantly trigger it? I mean, if you are taking a moving average for 5 minutes (indiscernible) but are not in balance for 4-1/2 -- or 4 minutes and 58 seconds.
A. Yeah.
Q. And then I've got a 1,000 barrel release, would it -- why should it trigger if my balance is still below your threshold of 300? Do you see what I'm saying? I have 0000 for 4 minutes and 58 seconds.
A. Okay.
Q. So my average on this one is 0 for 5 minutes. And suddenly I get 1,000 cubic meter --

A. In a 1-minute period?

Q. Yeah. And then why would my average for, I guess, (indiscernible) 300 meters (indiscernible) change?

A. I don't completely understand the question. I mean, I'll try to explain this display. This might help. Okay?

Q. Okay.

A. We've talked about your thresholds in meters cubed per hour. The best way to show your detected leak rate, I think, is the imbalance display. And this is measured in just meters cubed over a 5-minute period, not meters cubed per hour. So it's like -- it's your detected imbalance over the 5-minute period and it updates once a minute. And I guess that's what this shows. This shows what your total accumulated imbalance is in that 5-minute period. And so, it shows our threshold at 25 meters cubed in a 5-minute period, which is 0600 -- 300 cubes an hour. Let's say if my total imbalance is 300 -- sorry, 25 cubes in a 5-minute period, then that would trigger the alarm. And even if I had 25 cubes in 1 minute, that would still be enough. It doesn't hold me for 5 minutes.

Q. Oh, okay. That makes sense.

UNIDENTIFIED SPEAKER: And that's called a what?

MR. FARQUHAR: The imbalance display.

UNIDENTIFIED SPEAKER: So it's measured in just volume.

MR. FARQUHAR: Right. Absolute.

UNIDENTIFIED SPEAKER: Not in volumetric rate. And

that's the best way I like to communicate what thresholds are --

BY MR. CHHATRE:

Q. Really not a rate; it's just an absolute quantity (indiscernible).

A. Yeah. You can go back and forth between the two of them, but when you're talking about diagnostic flows in a CCO display, you have to talk about your average detected in that time period. This one just says your total in that time period. And that's why I like to communicate this as -- when you're talking about thresholds. That's the best way to understand it. But you can go back and forth.

UNIDENTIFIED SPEAKER: And is this something that we've requested? Matt, do you --

BY MR. NICHOLSON:

Q. I don't remember seeing this screen, that's why I was asking. Because I think what we've seen are the diagnostic flow screens.

A. This value is basically just a function of the diagnostic flow CCO display. It's just --

Q. No, I know.

A. It's just accumulative over 5 minutes, that's all. It's just another way of displaying it.

Q. And it's updating all the time. It's a continuous --

A. Correct.

Q. -- rolling average, I guess.

A. Correct.

MS. BUTLER: Is the imbalance display something that the controllers previously could see?

MR. FARQUHAR: Yes.

MS. BUTLER: Can they see it now?

MR. FARQUHAR: No.

MR. NICHOLSON: Oh, so the control center operators could see this before?

MR. FARQUHAR: Yes.

MR. NICHOLSON: Okay.

MS. BUTLER: Can see it now?

MR. FARQUHAR: No, they can't.

MS. BUTLER: Okay.

MR. NICHOLSON: Why is that?

MR. FARQUHAR: You'd have to talk to Kurt Minion (ph.), but they have decided they want to have only one display available for the operators as opposed to having all of them.

MR. CHHATRE: So they are seeing the average?

MR. FARQUHAR: No.

MR. CHHATRE: Average of -- what are they seeing?

MR. FARQUHAR: This is the only display they can see now. It's the flow the display or the head display. I think they'll have to answer to tell you why, but I think it's an effort to just put any kind of analysis of the MBS completely in the hands of the analysts and not have it available for the operator.

MS. BUTLER: So on the flow display or the head display, explain that. What's on that, to me just verbally.

MR. FARQUHAR: The flow display is basically a distance plot of the entire pipeline. It shows the elevation profile. It shows the location of each of the stations that's here. It shows the call letters. It shows a batch line up at the bottom. And then it also will show your hydraulic head and your flow for the entire distance of the pipeline.

MR. NICHOLSON: That's your actual flow, not your --

MR. FARQUHAR: That's right.

MR. NICHOLSON: -- model flow, right?

MR. FARQUHAR: No, it's actually model flow.

MR. NICHOLSON: That is model flow?

MR. FARQUHAR: Yes. So right now Line 6B is shut down. Line 6A is running at about 3200 meters cubed per hour. And this is the head display.

MS. BUTLER: I'm sorry.

MR. FARQUHAR: Yes?

MS. BUTLER: So the modelled flow that is displayed on the flow display/head display for the controller, that does take into account the actual flow meters that they have on that line or not?

MR. FARQUHAR: It does.

MS. BUTLER: Okay.

MR. FARQUHAR: Head display. You know --

BY MR. NICHOLSON:

Q. Now I'm confused.

A. You're confused?

Q. When you said that was modelled flow, I took that to mean it was a calculated flow out of your MBS system.

A. Let me show you an example. Here on 6A, here's your modelled -- here's your SCADA flow. At Rio Station it's reading 3172. The model is using 3262.

Q. Okay.

A. It's similar to the pressures, how there's a repeatability applied --

Q. Sure.

A. -- and it's allowed to use anything within the band.

Q. Right. Yeah, they're not going to be perfect.

A. The same thing is happening with the flow.

Q. Okay.

A. And that's what is driving the calculations, is the use value or the modelled flow.

Q. Okay. And that's what the SciAn line that we were just looking at --

A. Exactly.

Q. -- it would use -- okay.

A. Yeah. And they're -- they'll be pretty close. They'll be very close.

UNIDENTIFIED SPEAKER: Yeah, if everything's working,

they should be.

MR. FARQUHAR: Correct.

BY MR. NICHOLSON:

Q. But if there's an imbalance, then that will show up on that SciAn line then, right?

A. Yeah, if there's something strange --

Q. It'll be off.

A. -- happening, you would see -- you could see a strange flow profile. Like if one of your pressure -- if one of your flow meters started reading half of what it was supposed to, let's say it was broken or something, then you'd see like this weird step pattern here. And then you'd also get alarms that were coming in. You'd also -- you'd probably get alarms.

Q. Now, why if your flow meter weren't on, because that's a calculated value and it's calculated off pressures, I thought.

A. It uses pressures and flows.

Q. And flows?

A. Yeah. The flow line is primarily based on your flow meters, your SCADA -- your --

Q. Well, go back to your MBS. I want to be sure I understand that -- that display we were just looking at, the text file.

So this, the raw, I thought was from your flow meters?

A. Yes.

Q. Okay. I mean, it's just what the flow meter sees. Use

I thought was calculated by the model based on station-to-station pressures and pressure drop?

A. Yes.

Q. It's not accurate?

A. It's a little bit more complex than that.

Q. Okay.

A. It's based on your pressures, the flows that's coming in, your temperature and your density. It takes everything into consideration to calculate your flow, to calculate a model flow.

Q. So it's actually -- well, I'm trying to figure out how flow fits in -- if it's using two pressures, well, how's it --

MS. BUTLER: It's flow being used similarly to the pressures in that the model is going to predict pressures based on certain knowns and --

MR. NICHOLSON: So it's working both ways?

MR. FARQUHAR: That's right.

MS. BUTLER: Yet you have known pressures. The model's going to predict flow, and you have known flows. So those are keys to being able to prove that your model has some accuracy. Because you have those elements known to compare it to.

MR. FARQUHAR: That's right. And we apply a band with repeatability on what is -- what flows, pressures it's allowed to use.

MR. CHHATRE: The band, how wide or how narrow the band is?

MR. FARQUHAR: It's dependent --

MR. CHHATRE: (indiscernible) of the band.

MR. FARQUHAR: It's based on the accuracy of the flow meters.

MR. CHHATRE: Then that comes from the manufacturers?

MR. FARQUHAR: Or based on observed performance. Observed performance isn't necessarily going to be the same as what the manufacturer states.

UNIDENTIFIED SPEAKER: What exactly do you mean by observed? Are you training them as you measure --

MR. FARQUHAR: Yeah, normally you do some work to see what the actual uncertainty of a flow meter is over time.

MR. CHHATRE: That is (indiscernible) by the operator or the supervisor that are using --

MR. FARQUHAR: No, we can do that.

MR. CHHATRE: Okay.

MR. FARQUHAR: Yeah.

UNIDENTIFIED SPEAKER: So you proof all your meters, you don't obviously just default to the manufacturer's --

MR. FARQUHAR: No. No. When you build an MBS, you would review it and then you'd set your repeatabilities based on that.

MR. NICHOLSON: What are these flow meters? Are they DP based or are they Coriolis? What do you guys use?

MR. FARQUHAR: A lot of these are sonic meters.

MR. NICHOLSON: Oh, they're ultrasonic?

MR. FARQUHAR: Yeah.

MR. NICHOLSON: Okay.

MR. FARQUHAR: Some of the lines we've got differential pressure. On some of them we've got segemental wedge. We've got all sorts.

BY MS. BUTLER:

Q. So if the analyst during a shift notices that some values are locked up, meaning pressures aren't updating, either the model's not updating and he's, oh, gosh, this data isn't updating, either, does that get put down as a shift notation somewhere?

A. Oh, if -- you say if a model isn't updating? Sorry.

Q. Yeah, or if, say, a SCADA point isn't updating that affects the model, does that get notated in a, like a shift summary or soemthing?

A. Let's see. Yeah, best practice would be you'd either create an MBS report or if it's something that's very temporary, it could be handled from shift to shift through communication between the analysts.

Q. Yeah. So that communication would just mean that you're verbally telling someone; it doesn't have to be written down in like a report or anything?

A. I know the analysts, they have their own documentation. They had a white board to write things down. Now we have like a

shift changeover report, which would be more -- more explicitly describe what's happening and something that would be archived.

Q. Okay. Was that after Marshall?

A. That's right.

BY MR. NICHOLSON:

Q. I want to just clarify something, though. Your position is -- you're a modeler, right? What is your position? What's your title?

A. I'm a senior engineer, pipeline modeling. Yeah, I build and maintain.

Q. But what you're showing us now is really what the analyst might be looking at, these screens here?

A. I look at them, too.

Q. Okay.

A. All the time.

Q. But you build them, right?

A. I build them, yeah. I make changes to them.

MS. BUTLER: But aren't you called occasionally, Ted, to help troubleshoot?

MR. FARQUHAR: I sure am.

MR. CHHATRE: You are 24/7 troubleshooting, are you not?

MR. FARQUHAR: Yeah. I take the pager.

MS. BUTLER: I can't hear you. I'm sorry.

MR. FARQUHAR: I carry a pager.

MR. CHHATRE: He is 24/7 troubleshooting.

MS. BUTLER: So you would be like their technical support?

MR. FARQUHAR: That's right. Or I'm their backup support. If they have a difficult alarm that they're unable to troubleshoot, then they call backup.

MR. NICHOLSON: In fact, that's what you did, right? On the 26th you were called and eventually --

MR. FARQUHAR: That's right.

BY MS. BUTLER:

Q. So on the 26th, did the control room actually find the pressure drop before you did, or do you know?

A. I don't know. It's the first thing I notice, I think. I saw column separation. I saw the pressure drop.

Q. Did you call the control room when you did that, when you found that?

A. Yeah.

Q. Or did you call the analyst or --

A. Both.

Q. Okay. And so we would know about what time that happened, then?

A. You mean with recorded -- yeah, I think you would. It is -- yeah, it was pretty early in the morning on Monday.

MR. NICHOLSON: I'm sorry. You called the mass balance analyst, which was Shane?

MR. FARQUHAR: Yeah. He called me.

MR. NICHOLSON: But you called him back with the pressure drop?

MR. FARQUHAR: Yeah. I told him then.

BY MS. BUTLER:

Q. And you said you also called, what, the shift lead?

A. That's right.

Q. And do you remember which one of them you talked to?

A. One of them was Blaine and I can't remember the other one.

Q. Okay.

A. I made a couple calls in that first couple hours.

Q. Okay.

A. I can't remember who I talked to at which time and who exactly I told which information to.

Q. Would you say it was before 9:00 in the morning?

A. I'd say it was before 10, maybe before 9.

BY MR. NICHOLSON:

Q. So I kind of wondered if you could -- I wanted to actually see what screens you looked at or what prompted you to get back to pressure drop, while we have this in front of you. Because it's interesting -- you seem to zero in right away to the issues and the analysts didn't.

A. Yeah, well, it -- part of the reason was that there was a suspected leak --

Q. Yeah, I know.

A. -- when I called, right?
Q. Okay.
A. So what I would have done is -- probably the first thing I would have done is look at the diagnostic flows over time. I'd go to this display. I'd look back.
Q. How far back can we go on that display? Twenty-four?
A. I can go back a couple days, however long you --
Q. Is that what you did?
A. Yeah, I went back -- well, we -- they said it was going back to last night, so I'm back about a day, 24 hours.
Q. Okay. Let's back up just a little bit then. So you got a phone call --
A. Yeah.
Q. -- from, was it Shane?
A. Brendan (ph.).
Q. Oh, Brendan. Okay, yeah. That's right.
A. So Shane called Brendan, who was on call for backup support that morning. And Brendan called me right away because I'm the line custodian for this line. And he said that --
Q. Right. Okay.
A. -- there was some stuff happening. They were uncertain. He wanted me to take a look.
Q. Well, that's what I was wondering. So he mentioned a possible leak, so you had that to go on?
A. I don't think he actually said leak. They said

something about they're putting flow in and not as much was coming out the other end of the pipeline as they thought.

Q. Okay.

A. And they were investigating. And they wanted an opinion on the MBS.

Q. And they told you that this had started 24 hours prior?

A. Yeah, going back the night before.

Q. Okay. So you kind of had a span of time to look at. And when they said they were putting flow in and they weren't getting as much out, you sort of had a hunch --

A. You have a pretty good idea that there could be something very serious happening. So I looked back --

MR. CHHATRE: How far back can you go?

MR. FARQUHAR: You can -- it depends on how long it's been since the model's been restarted. But you can go back a month if the model's been running straight for a month.

BY MS. BUTLER:

Q. So, Ted, when you first found this was the pipeline still running?

A. No. It had been down for a couple hours.

Q. And when you found this, had they isolated?

A. I don't know the answer.

Q. Do you know if when you found this they had closed sectionalizing valves?

A. No, I don't know the answer to that.

Q. Okay. And when you called them in the control room, did they say they had already indicated a leak?

A. No one said leak. They said --

Q. Okay. Did they say they had already taken the pipeline out of service?

A. I can't recall if they said that exactly.

Q. All right. Do you know if the reason that the controller on the third shift started looking at his trends was because of what you found?

A. Oh, if because -- they started looking at things because I said it?

Q. Yeah.

A. I don't think so. I think they found it around the same time. I'm not sure if it was Blaine or the other shift lead, but when I first talked to them, I said, did you notice the pressure drop, or something like that, at 1500 the night before? And they said, I know. I think that's what they said.

Q. They said what?

A. I think they said, "I know", as if they had seen it as well.

Q. Okay.

A. I think we both figured that that was suspicious.

Q. Thank you.

UNIDENTIFIED SPEAKER: Just quickly, Ted, do you happen to recall what the total imbalance was on that shutdown on that

first initial 5-minute MBS alarm?

MR. FARQUHAR: We have that -- we have like a snapshot of it.

MS. BUTLER: You said you have that?

MR. FARQUHAR: I think we have a snapshot to show what the response was. I know we have snapshots of the diagnostic flows.

MS. BUTLER: Okay.

MR. FARQUHAR: I think I also have one of the imbalance.

UNIDENTIFIED SPEAKER: Oh, I think that's important to have. At first, you know, not being familiar with it, I have a hard time looking at the diagnostic flows, but --

MR. CHHATRE: Is that something you could show us now to make it easy --

UNIDENTIFIED SPEAKER: Yeah, can you pull that up?

MR. FARQUHAR: Of what happened that day?

UNIDENTIFIED SPEAKER: Sure.

MR. FARQUHAR: No. It's -- it would be -- it's archived on like a different directory. It's not hard to get and e-mail it to you. But I can't do it on this --

UNIDENTIFIED SPEAKER: To do an IR request, what would I ask for?

MR. FARQUHAR: You know what, I think I already sent this in.

MR. NICHOLSON: Do we have --

MR. FARQUHAR: I think I did.

MR. NICHOLSON: I've got some screen shots. Are they of the data? That's what I couldn't -- I thought I (indiscernible)

UNIDENTIFIED SPEAKER: I know I've seen diagnostic flows from the accident, but I don't think I saw the imbalance shot. And me not have asked for it --

MR. FARQUHAR: I might not have sent that one.

UNIDENTIFIED SPEAKER: You guys are pretty good about not giving us stuff if we don't ask for it, so --

UNIDENTIFIED SPEAKER: I'm shocked.

UNIDENTIFIED SPEAKER: No, I'm kidding. Actually, you guys are good.

MR. CHHATRE: You say display can show the pressure drop. When the pressure drop, there's a key chain that you can see the instant pressure drop and you know a volume -- a volume change in some way, like 1,000 cubic meters -- if I -- okay, on my volume display here on the screen.

MR. FARQUHAR: Yeah.

MR. CHHATRE: If I have a sudden leak, rupture, let's just say, and I lose 1,000 barrels in a few minutes, depending on the pipe size, you will see the volume drop even though it's continuous calculation, you will see instantly in there (indiscernible) something like, the (indiscernible).

MR. FARQUHAR: You're saying if you had a rupture, basically, what would I see on the imbalance display, is that --

MR. CHHATRE: Yeah, with a rupture what kind of display I will see on the screen? Because it's a moving average. Let's just say I have a rupture. I was picking a number like -- and your threshold was what? 300 --

(Simultaneous speaking.)

UNIDENTIFIED SPEAKER: Matt was just pulling some of the pages out of his folder here and --

MS. BUTLER: Okay.

UNIDENTIFIED SPEAKER: Because these are --

MS. BUTLER: Can we make sure if we do submit that IR request that we're getting the volume imbalance snapshot for all the leak alarms that occurred on the 25th and 26th?

UNIDENTIFIED SPEAKER: Yeah, right. Right. Through the restarts and everything, right?

MR. NICHOLSON: Submit diagnostic flows for July 23rd -- that's IR 117. So I haven't really gone through this. So this is what you're saying was submitted? 2-hour, 20-minute -- but we don't have --

MR. FARQUHAR: These are the imbalance displays.

MR. NICHOLSON: Right.

UNIDENTIFIED SPEAKER: Oh, the quantity?

MR. NICHOLSON: Yeah. But it's the -- oh, okay, this is volume balance here, yeah.

MS. BUTLER: Is it the same display, guys?

MR. NICHOLSON: It is.

MS. BUTLER: Okay. All right. So we don't need to request then --

MR. NICHOLSON: I'll try to make something out of that.

UNIDENTIFIED SPEAKER: Well, some of these are for a couple days before. You need to see for the actual event?

MR. NICHOLSON: These are 23rd through 26th. That's for --

UNIDENTIFIED SPEAKER: Let's see the next page. There you go.

UNIDENTIFIED SPEAKER: Okay. So this is diagnostic flow, correct?

MR. NICHOLSON: Karen, this is IR 117 if you've got it.

MS. BUTLER: Okay.

MR. FARQUHAR: This is the imbalance display. So this is the accumulated flow, accumulated volume.

MS. BUTLER: And that was considered a volume imbalance screen or a diagnostic flow screen?

MR. NICHOLSON: Imbalance screen is what we're looking at.

MS. BUTLER: All right.

MR. FARQUHAR: Oh, this shows my 5-minute alarm window, my imbalance. I had one here. That's the shutdown, the 25th. This is the starter 1, startup at 4.

UNIDENTIFIED SPEAKER: So what is this (indiscernible) --

(Cell phone ringing.)

MR. FARQUHAR: It's about 65 meters cubed.

MR. NICHOLSON: About 65 cubic meters, okay.

MR. CHHATRE: What hours?

MR. FARQUHAR: Sixty-five meters cubed over 5 minutes.

MR. CHHATRE: Oh, 5 minutes. Okay.

MR. FARQUHAR: Yeah. Volume, not flow rate.

UNIDENTIFIED SPEAKER: Over 5 minutes? Yeah, that's totally fine. Okay.

And then from there, I guess you go back to that PQ screen to figure out which section it was in, is that how -- how do you pinpoint it to an actual section?

MR. FARQUHAR: The location?

UNIDENTIFIED SPEAKER: Yeah.

MR. FARQUHAR: I look at -- normally, I look at the diagnostic flows and I say where did -- I'd say which section had the diagnostic flows and at what time did it start? And I'd say that's my starting point. I'd say I had something, like on 6B starting at 1500. And then I would go and look and see what happened. I'd look at my pressures and flows during that time period.

MR. NICHOLSON: Right. Okay. But you're saying you look at diagnostic. But here we're still at Griffith to Marshall, right?

MR. FARQUHAR: Yeah.

MR. NICHOLSON: Okay.

UNIDENTIFIED SPEAKER: And it's not running, so --

MR. FARQUHAR: There's nothing --

MR. NICHOLSON: No, I understand that. But at what point do you figure out it's from Mendon to Marshall or Marshall to --

MR. FARQUHAR: Oh, specifics?

MR. NICHOLSON: Yeah, when --

MR. FARQUHAR: Specifically?

MR. NICHOLSON: Yeah.

MR. FARQUHAR: In this case I looked at the pressures.

MR. NICHOLSON: On the entire line, at every station? Okay.

UNIDENTIFIED SPEAKER: Oh, before you change that, can we go back to the shutdown of 6B from Griffith to Marshall, assuming it's been within the last X number of times that -- I'd like to see that.

MR. FARQUHAR: Okay. Let me see when it shut down. All right. So we shut down at about 5:00 this morning. So here, during the shutdown we had some measure of imbalance, not enough to trigger an alarm. And then it cleared. I'm sorry, and then it balanced out to 0.

MR. NICHOLSON: Which you would expect, because you have no flow, right?

MR. FARQUHAR: Well, yeah, and it's -- hydraulic it's

compatible. The MBS is very happy with my pressures, my static pressures.

MR. NICHOLSON: But you say it wasn't enough to trigger an alarm, but yet it drops below your threshold?

MR. FARQUHAR: It has to do -- it has to be below the threshold for a certain amount of time.

MR. NICHOLSON: Oh, okay. So just -- okay, (indiscernible).

MR. FARQUHAR: The imbalance will show how far it went. GTMR -- see, it had this little blip. That's what it corresponds to.

MR. NICHOLSON: Okay. Yeah, I like this screen better.

MR. FARQUHAR: If this dropped below the orange line, then it would trigger an alarm.

MR. NICHOLSON: Right.

UNIDENTIFIED SPEAKER: So in that -- to read that, is that about 10 cubic meters, is that what we're seeing there?

MR. FARQUHAR: Yes.

UNIDENTIFIED SPEAKER: Okay.

MR. NICHOLSON: So if an analyst were looking -- I guess they really wouldn't be called to look at that, but what would that be? Noise?

UNIDENTIFIED SPEAKER: Transient, right?

MR. NICHOLSON: Is it a transient?

MR. FARQUHAR: I don't know. I'd say it's a pretty good

bet. It's very common that during startups and shutdowns, rate changes, you get some diagnostic flows.

MR. NICHOLSON: Okay. Because that was actually a question I had. So is the model accurate on startups or shutdown? It sounds like it's not. There's some --

MR. FARQUHAR: I'd say it's inherent in all -- there's a lot of uncertainty in the instrumentation when things are changing quickly.

MR. NICHOLSON: Yeah, but the trend is, right?

MR. FARQUHAR: Yeah.

MR. NICHOLSON: Okay.

MR. FARQUHAR: That'd be common for, I think, an CPM.

MR. NICHOLSON: Okay. So it has no way of deadening some of that transient or -- like a dead band or --

MR. FARQUHAR: No, it -- not really.

MR. NICHOLSON: Okay.

Did you want to see anything else on that shutdown?

UNIDENTIFIED SPEAKER: I'm good. I'm good. Nope, I just --

MR. NICHOLSON: Oh, okay.

UNIDENTIFIED SPEAKER: I just wanted to, you know, just assuming it's a normal shutdown --

MR. NICHOLSON: Just a (indiscernible).

UNIDENTIFIED SPEAKER: Yeah, just kind of wanted to get a sense for what an uneventful shutdown would look like.

MR. CHHATRE: You're saying a lot of these displays are available to the operators?

MR. FARQUHAR: Not anymore. They used to be available.

MR. CHHATRE: At the time of the accident?

MR. FARQUHAR: Yes.

UNIDENTIFIED SPEAKER: And the decision was made by the control center of what screens they have?

MR. CHHATRE: No, I understand. I'm just going back to the accident time. I mean, (indiscernible) static condition, why it did not ring -- or trigger any concern within the operators. I thought this was not available to the operators.

MR. NICHOLSON: I did, too. I didn't realize this was available.

MR. CHHATRE: If this was available to them, so it clearly showed a significant drop in pressure and volume and it was available to the operators at the time of the accident. Maybe we need to go back and find out if they were looking at this and if they are not, why they are not looking at it.

MR. NICHOLSON: They didn't go back and even look at their pressures.

MR. CHHATRE: Yeah, I mean, they (indiscernible) --

MR. NICHOLSON: Well, I don't know that they would have looked at --

UNIDENTIFIED SPEAKER: Well, this was available to them, but I think the statement's been made that they don't consider

themselves MBS analysts and I don't think they'd feel comfortable interpreting the screens.

MR. CHHATRE: You're right. But what I understand from the transcripts, this information was not conveyed to anybody. That tells me that (indiscernible) did not know.

UNIDENTIFIED SPEAKER: So are we not going to interview the MBS person next or following to ask about that?

MR. NICHOLSON: Yeah.

UNIDENTIFIED SPEAKER: Okay. I think that's better then to question --

MR. CHHATRE: I'm sorry, (indiscernible) I was thinking and that's why I was focusing on those two screens.

UNIDENTIFIED SPEAKER: Okay.

MR. CHHATRE: Okay.

BY MR. NICHOLSON:

Q. I was having you walk me kind of through your thought process on the day. Can you get back to what you were looking at? How you pinpointed it.

A. Okay. What I do is I look to see when did the imbalance occur and where did it occur.

Q. On that diagnostic flow?

A. Yes.

Q. Okay.

A. And so I narrow down to something happening around Marshall. Then I start looking at my pressures and flows. I say

-- it's very -- actually, what I would do, I say -- I know that diagnostic flows occurred at 1500. So the first thing I do is I look at my state of flow display and I say, what happened at 1500? That's my starting point. I say what's my line running steady state, and I got something happening or was it doing a re-change; was it doing a startup or shutdown or do I see something like a flow froze?

Q. Okay.

A. That's the first thing I do. I look at flows first. And then after that, I would have said there's a shutdown occurring.

Q. Okay.

A. And then I look at my pressures.

Q. Pressures all along the line at every -- on that main screen?

A. Yeah.

Q. Okay.

A. So here, and I go to Mendon-Marshall.

Q. Oh, you pull a trend at that point?

A. Yup. And I pull this back to 1500. I'll show you what happens 6 hours later when we shutdown. I say -- I was running -- this shows my Mendon discharge pressure. This is here is my Marshall suction, so it's on that segment of pipe. I know I was going steady state and then at 1500 my shutdown happens, and that's where I saw Marshall pressure just dropped to 0. You can

see in that display.

Q. You saw instead of converging, they both drop to 0?

A. Yeah. And I said -- it happened very fast, too. And that was -- like to me, that's like -- I knew there was a suspected leak. I see column separation and I see the pressure --

UNIDENTIFIED SPEAKER: A little louder for Karen maybe.

MR. FARQUHAR: I see what -- in my mind I say I got a shutdown; I got a large pressure drop; I know I have column separation, I said -- that's most of my analysis there. I said this is really suspicious.

MR. NICHOLSON: Okay. So you just went station to station until you saw something?

MS. BUTLER: And so it was the pressure drop that you just said was really suspicious?

MR. FARQUHAR: Correct.

MS. BUTLER: Okay. Thanks.

MR. NICHOLSON: Yeah, we're looking at a pressure trend right now, screen.

UNIDENTIFIED SPEAKER: From a shutdown earlier this morning.

MR. NICHOLSON: Yeah, actually, from a shutdown. Right.

MS. BUTLER: So a shutdown on 6B?

UNIDENTIFIED SPEAKER: Yes. Yeah, 6B --

MS. BUTLER: That looked suspicious this morning?

UNIDENTIFIED SPEAKER: No, no, no.

MR. NICHOLSON: No, no.

UNIDENTIFIED SPEAKER: We just happened to have a recent shutdown on 6B that he could pull up. But he was describing --

MS. BUTLER: Got you.

UNIDENTIFIED SPEAKER: -- what he saw on the 25th shutdown.

MS. BUTLER: I got you. He's just translating and explaining. That's what I thought was going on, but when you said that, I'm thinking, wow. Okay.

See, I was listening. I just couldn't visually connect everything.

MR. NICHOLSON: So and on this screen you can actually zoom in if you wanted to see those transients?

MR. FARQUHAR: If I want, I can choose any time period.

MR. NICHOLSON: Is that a -- have to do with (indiscernible)?

MR. FARQUHAR: This is set up for two -- well, it changes it at 6 hours. I could say go from 4:30 to 5:30 exactly or from 4:30 to 4:35.

UNIDENTIFIED SPEAKER: So the multiple lines -- so yellow was suction pressure?

MR. FARQUHAR: Yeah. Remember how I was showing you on the PQ display there's the SCADA value and the model value --

UNIDENTIFIED SPEAKER: Oh, okay. Sorry.

MR. FARQUHAR: -- for each pressure? This shows the

SCADA and model Mendon discharge and it shows the SCADA model Marshall suction.

MR. CHHATRE: Are you always going to see those very tight?

UNIDENTIFIED SPEAKER: Yeah. When you have --

MR. CHHATRE: The model and the actual.

UNIDENTIFIED SPEAKER: When you have flow measure. It seems like they spread apart a little bit without flow --

MR. FARQUHAR: Well, here --

MR. CHHATRE: Even (indiscernible) you're going to see them pretty tight, don't you? Very little flow.

MR. FARQUHAR: I mean, they'd be within the repeatability band, yeah.

MS. BUTLER: Could you repeat the question, Ravi?

MR. CHHATRE: Well, on the screen the model and the actual line are very close, almost one over the other, and I was asking a question whether that's the way they want it, so that the model matches with reality. And the answer was yes.

MR. FARQUHAR: Yes, you do want it to be close.

MR. CHHATRE: And my next question was you will see the same thing during the line shutdown and I guess the answer was, yes, but I don't (indiscernible) band --

MR. FARQUHAR: Things are happening very quickly, so -- I mean, that's why you get diagnostic flow. So maybe your SCADA pressure, you get time stamps off a little bit from what the model

is reading.

MR. CHHATRE: So you don't expect the same (indiscernible) but a very close tight band in those?

MS. BUTLER: So, Ted, is the model disabled at all when the pipeline is shut down?

MR. FARQUHAR: Normally, no.

MS. BUTLER: Okay. So they would be able to see model data or still get leak alarms that are valid regardless of whether the pipeline is down or running, correct?

MR. FARQUHAR: Yes.

MS. BUTLER: And because this is a transient model, you're able to continue to provide somewhat of leak indications even through transient conditions, correct?

MR. FARQUHAR: Correct.

MS. BUTLER: Okay. Thank you.

BY MR. NICHOLSON:

Q. So maybe to carry that question further. So if you have the line shut down but you're seeing pressure change at a certain point, would that indicate an imbalance?

A. It could if the pressure change is not compatible with your line pack. Like if it's saying that my pressure's dropping a lot faster than it expects it to because of thermal, that would cause an imbalance which could cause an alarm.

Q. So even though the model's static or the flows are static, it doesn't disable the model? Okay.

A. No.

Q. So let's say on 6B, if you're shut down but maybe the, you know, holding pressure isn't pinching off at Sarnia, so you're draining into Sarnia, you're seeing -- you'll see pressure drop, you know, at an upstream point and you'll see some flow going into, say, Sarnia?

A. Um-hum.

Q. And is the model all -- is it looking at that then to see if --

A. Yeah, it's supposed to see that kind of thing, and if the imbalance is too big, then it could cause an alarm.

Q. Okay.

A. Yeah.

MS. BUTLER: So if the imbalance is too big it would? I'm sorry.

MR. FARQUHAR: I guess if there's a drain -- I'd actually say -- let's just say it's draining and it's not being measured, or something like that. Then what you have you is sort of an unmetered delivery occurring on shutdown pipeline. So your pressures are dropping. You'd expect the MBS is going to be able to identify that. And if it's dropping fast enough, then it would trigger an alarm.

UNIDENTIFIED SPEAKER: Yeah. Right. It still ash to meet the thresholds?

MR. FARQUHAR: Yeah.

UNIDENTIFIED SPEAKER: But if you're shut down, you wouldn't be going in to Sarnia or anywhere because your valves are closed, so you wouldn't see that.

MR. FARQUHAR: That's right. So what you described, it's not common, right?

UNIDENTIFIED SPEAKER: But they did talk about it on startup, right? You open your end of line valves.

MR. FARQUHAR: I'm sorry. On startup, yes.

BY MS. BUTLER:

Q. So I haven't heard all the details, but what I sense is that whether they drained up more than anticipated, the model would just reflect that, correct?

A. Yeah.

Q. Yeah. So you would know that because you also have a meter at Stockbridge, right, that you'd be balancing that against?

A. Yes.

UNIDENTIFIED SPEAKER: Well, but we were -- we're even at Stockbridge at this. We are going past Stockbridge. So there is no meter then. I mean --

BY MS. BUTLER:

Q. But you would have had it at the last time you flowed. And then the meter's going to continue to sense whatever is free-flowing, right, after you stopped. And you've adjusted a holding pressure to keep that balance there or attempt to keep that balance and the holding pressure is something that would be

reflected by other pressures that the model would see, correct?

A. Yeah, I'm not completely following you, Karen.

Q. Oh, I'm just trying to figure out why they think it would or would not have been seen by the model.

A. What is it?

Q. I thought that Brian's question was the excessive drain-up.

A. Okay. You're talking like a hypothetical situation? Okay. Excessive drain --

Q. I thought that he was just --

A. Like, okay, yeah, I've seen this before on other pipelines where they shut down and then for some reason they're unable to control, there's a little bit extra drain-up before they can close off a valve. And the model is designed to handle line pack calculations and accurately estimate the state of the pipeline, even in a situation like that.

Q. Yeah. It's -- so what impacts, in your opinion, the model's effectiveness the most?

A. You mean in terms of sensitivity?

Q. That or in another category if there's something that has a greater value than sensitivity to you. I didn't want to restrict how you might think about that when I asked it.

A. Yeah. Well, to me, usually sensitivity is the primary thing.

Q. Okay.

A. And I think that the primary thing that impacts sensitivity would be a loss of a flow meter.

Q. Okay.

A. Loss of a delivery flow meter. I think in the situation of 6B, column separations degrade the MBS and impacts the reliability of it.

Q. But the MBS can actually help detect when column seps have happened, though, correct?

A. Yeah. Well, it models when it --

Q. Yeah. So it --

A. -- detects column separation.

Q. The recognition of that condition is something that the model helps you with, but once it's occurred, your calculations are suspect?

A. Yes.

Q. Is that a yeah? I'm sorry?

A. That is a yes. That's true.

Q. Okay.

BY MR. NICHOLSON:

Q. So I thought when we were talking about the drain-up situation we were sort of referring to column sep, right?

A. We didn't say that. So if the column is still full when you're doing a drain-up, then the model is able to do state estimation (indiscernible). It's conversation of mass. Once you get to the point where you have like a verified column separation,

the MBS's capabilities are degraded.

Q. When do you -- at what liquid fraction do you call it column sep?

A. Anything when it's not completely -- wait. I guess, when the pressure is below the vapor pressure of the fluid.

Q. Okay.

MR. CHHATRE: How does the model see the column separation?

MR. FARQUHAR: I can show you the display.

MR. CHHATRE: That'd be great.

MS. BUTLER: This here -- are you pulling up the liquid fraction display?

MR. FARQUHAR: Yeah.

MS. BUTLER: Okay. So as you explain that, Brian, can I ask you to take some good notes here?

MR. PIERZINA: Okay. And mostly just trying to absorb, but --

MS. BUTLER: Yeah, because on this particular one I'm very interested in this display.

BY MR. NICHOLSON:

Q. I want to just real quickly, because I have some questions on vapor pressure. Because you run various batches through the line, right? Are the vapor pressures added to the system -- does it use the real time properties of the batch that's in the line or you just kind of --

A. A mix. We have a book value for all the fluid properties of every fluid in the line.

Q. Okay.

A. We overwrite those with real time values, such as density, when you have it.

Q. Oh, okay.

A. If you have a viscosity, you would overwrite that as well. We don't have viscosity on Line 6.

Q. Okay. So there's something hard programed --

A. Absolutely.

Q. -- but when you get the real time information it's overwritten?

A. You overwrite the density, yeah.

Q. Okay. So vapor pressure then is (indiscernible) coded in there already. Is there a big range on those or -- I don't know anything about crudes. Are these lines, are they --

A. In my opinion, I don't think it's much. It's usually below atmospheric.

Q. Okay.

A. The only thing that's really noticeable is when you have a NGL, not on Line 6, that has a really high vapor pressure.

Q. And it tracks -- the MBS system is tracking batches?

A. That's shown here.

Q. Oh, is that -- yeah, down at the bottom. And that's different than CMT?

A. Right.

Q. Okay.

UNIDENTIFIED SPEAKER: From a timing standpoint, if we're looking at to be done at 10, that puts in about the 40-minute range here until we're done with Ted. So I just thought I would bring that up.

MR. CHHATRE: Thank you very much.

UNIDENTIFIED SPEAKER: Well, I think Ted is overlapping a lot of what we're going to be asking Jim, too.

UNIDENTIFIED SPEAKER: Okay. Well, I just wanted to, you know, try and set a little bit of a schedule today.

MR. CHHATRE: I guess this is a good time to ask Ted if he needs a break.

MR. FARQUHAR: I would like to get -- take a couple minute break.

MR. CHHATRE: Yeah, I mean --

MR. NICHOLSON: Okay. So we're going to take 5.

(Off the record.)

(On the record.)

MS. BUTLER: I'm ready when you all are.

MR. NICHOLSON: Okay, we're back on record with Ted looking at the mass balance system. Okay, and I think where we left off is we were going to look at the liquid fraction display.

MR. FARQUHAR: Yeah.

MR. NICHOLSON: Okay.

MS. BUTLER: Right.

MR. NICHOLSON: Go ahead.

MR. FARQUHAR: Okay, so the liquid fraction display is not unlike the flow display in that it's a distance plot, and it shows the location of all the stations, it shows mile posts, it shows batch lineup at the bottom of the screen, but instead of showing elevation and flow and head, we show pressure, density, and liquid fraction. So this shows the entire line seg's, both 6A and 6B shows the pressure down at the bottom. We're shut down on Line 6B, which is from here, Griffith to Sarnia. It shows a density plot, and then the liquid fraction. Liquid fraction is at one for the entire pipeline. We're showing two column separations, it looks upstream of Leonard I think that is. Here --

MR. CHHATRE: Which are column separation? The one, the bottom dip?

MR. FARQUHAR: Right here.

MR. NICHOLSON: Where the yellow spikes.

MR. FARQUHAR: If the yellow line is not equal to exactly one, that's an indication that the MBS is detecting a column separation, and it shows the exact location. I'm able to zoom in very close from what we see. We've got one here; one here and here, so.

MS. BUTLER: So Matt, do you happen to have the screen shots that they sent us as the result of the data request?

MR. NICHOLSON: IR 119 that you're looking at?
MS. BUTLER: Yes.
MR. NICHOLSON: Yes, we have it here.
MS. BUTLER: Can you show him that for just a second?
MR. NICHOLSON: Yes.
MR. FARQUHAR: I'm looking at it.
BY MS. BUTLER:

Q. Okay, if I'm looking at the very first of the three screens, at the beginning it, this was the I think it says July 26th beginning around 1:00 a.m., when you look at the screen in general and you look at the title at the top, is that something that changes with the location of the fractionation, or when, it says liquid fraction between PE and RW, am I not catching what that means?

A. Okay, so the title says PERW underscore DNS, that's the title of the display, that's what you type in to access it.

Q. Okay.

A. And then its says, line six, density, pressure, and liquid fraction between PE and RW, PE is Superior, RW is Sarnia, so they're both 6A and 6B. For the purpose of responding to this IR, I didn't change the title --

Q. Okay, got you.

A. -- but I reduced it so that I only show 6B.

Q. Okay, so that eliminates that confusion. And then at the time in the upper right, that would be just the time of this

snapshot?

A. Yeah, I reran the data in the test model.

Q. Okay.

A. And so I stopped it at 2:20 in the morning on the 26th.

Q. I got you. And then what would normally be in the step?

A. Oh, step is the time step that the MBS is using to do holding (ph.) balance calculations.

Q. Okay.

A. It varies.

Q. Okay.

A. We set minimum and maximums, and in this case it was set at, it was 30 seconds at that instant.

Q. Okay, so that's in a second. Okay.

A. Yeah.

Q. So when I'm looking at the screen in general, the bottom is going to be milepost markers, is that correct?

A. Yes.

Q. And then the last is pressure and PSI?

A. Yes.

Q. And then my density, then what?

A. Kilograms per meter cubed.

Q. Okay, and my liquid fraction measurement is then what? Just one or nothing?

A. They could be percent. One would be 100 percent liquid.

Q. Okay, got you. And so on the right, that's just like

looking at the percent, the right scale?

A. That's right.

Q. All right. And so if I were to then drop down, I've got to scroll down in order to look at it, at the bottom I've got my batches, and where I've got say an M, that's a batch type as well, correct?

A. That's right.

Q. And when I hit like a short segment of LLK and then a longer segment of batch of LLK, that's broken into two separate batch elements simply because of how it was scheduled, put into the scheduling system, or are we trying to show an interface and I'm not picking that up?

A. Yeah, it would have been either from when the batch line up was loaded and the model started.

Q. Okay.

A. There might have been, it might have said two LLK's.

Q. Got you.

A. Or it's possible there could be a real small batch of something in between them.

Q. Okay.

MR. NICHOLSON: How are the batch, does it detect a batch from density, or is it manually entered when a batch is started?

MR. FARQUHAR: There's two ways. If I start a model up for the first time, it's like I get a batch line up from CMT. I

import that into the model, and then I start the model, and so it uses that. As you're running, it's injecting batches, right, and it gets that from, through CMT and SCADA we get like a hexadecimal number, and that's converted into an acronym like WCS or LLK, and then the model knows that that's what type of fluid that is and it starts injecting it and it knows what the fluid properties are supposed to be.

MR. NICHOLSON: Okay.

MR. FARQUHAR: And in addition to that, it also overwrites the density with whatever the injection densitometer is reading.

MR. NICHOLSON: Okay.

BY MS. BUTLER:

Q. So theoretically, when I look up at the display, is that first significant drop in density, is that matching up with the M batch?

A. Yeah.

Q. Okay, all right, so when I'm looking over at the liquid, the first set of liquid fractionations, it looks to me like there's almost like a darker yellow line behind a lighter yellow line. Is there more than one event right there?

A. A dark yellow line. No, what that means, you're talking about like the first drop in liquid fraction?

Q. Yeah, the first one like the top almost half of that line is a darker yellow than the bottom in my particular screen

print.

A. Yeah, no, that's accurate. What that would imply is, first of all it's just liquid fraction over the entire distance.

Q. Right.

A. Lance boulder, that just means that it's for length of the pipe, liquid fraction was, sorry, for the upstream length of pipe it was reading about .7 liquid fraction, and then as the column separation went downstream, and I'm not describing it all that well, the liquid fraction changed with distance, and because we got 300 miles here, it looks like that. If I zoomed into like a one mile increment there, what you would see would be sort of like a --

MR. NICHOLSON: A step.

MR. FARQUHAR: Yeah, like I guess a step like Matt is saying where --

BY MS. BUTLER:

Q. So like the liquid fraction value is different when I zoom out or zoom in I guess?

A. Yeah, you can see it more accurately.

Q. Okay, got you. But that doesn't necessarily mean that there's two separate occurrences --

A. That's right.

Q. -- within that small segment?

A. No, I don't think so.

Q. Okay.

A. I think that'd be just one.
Q. Okay, so to a controller and to you maybe, when you say liquid fraction, is that synonymous with column sep?
A. Yes.
Q. Okay, so there's really no difference when people talk about it?
A. No, there's no difference.
Q. I'm sorry, I didn't hear you.
A. I said there is no difference.
Q. Okay, so basically when a controller would have said to us previously that they had column separation, if an MBS analyst had sent that to them and they could pull this up and they said, "Oh, yeah, I clearly do," then that would just be enough confirmation for them and they would be off and running?
A. I'm sorry, who would be off and running?
Q. They'd be off and running down the path that it truly was the column separation?
A. Yeah, it's be a verification.
Q. Yeah. Right?
A. Yes.
Q. I mean they probably wouldn't look at much else, would they?
A. I'm sorry, you're saying the analyst wouldn't look at much else?
Q. No, I meant --

A. Oh, to determine if there is a column separation?
Q. Yeah.
A. Okay, so you're saying if the question is do I have a column separation --
Q. Right.
A. -- no, I'd say looking at this is, that's all I need to look at.
Q. Right.
A. You don't need to look at other stuff.
MR. NICHOLSON: Is that where the MBS analyst's job stops, right here, just to say it's col sep?
MR. FARQUHAR: If the question is do I have column separation, I'd say yes, you look at this and you say I'm detecting a column separation. That's all you have to look at.
MR. NICHOLSON: The question from the operator is really, "I've got an MBS alarm, what is it?" Okay.
MR. FARQUHAR: Right. What do you --
MR. NICHOLSON: And he would go here.
MR. FARQUHAR: Because that's what happened. They looked at the column sep. They said they have a column separation.
MR. NICHOLSON: Okay.
BY MR. CHHATRE:
Q. How does this thing get in the program? How does the program know what a column separation is?

A. How does it know?

Q. What (indiscernible) are entered in the program?

A. Vapor pressure. Each of these fluids at the bottom of the batch has a vapor pressure associated with it.

Q. Okay.

A. And the model would essentially compare the pressure that it's estimating versus the vapor pressure of that fluid. If the pressure is lower than the vapor pressure --

Q. So there are times for instance that the transducer may change the vapor pressure some place?

A. No.

Q. (indiscernible).

A. Well, it's a book value. We program it in. If I have the fluid M in the line, then the associated vapor pressure for that batch is always, I don't know, six pounds atmospheric or something like that.

Q. At the beginning. It doesn't matter. Okay. But how you are maintaining the vapor pressure? Where is that number coming in for you to tell that I have vapor pressure in the line?

A. How does it tell?

Q. Yeah, I mean I have a line full of liquid coming in --

BY MS. BUTLER:

Q. So in other words, your elevations are modeled into your model, right?

A. Correct.

Q. And because your elevations are into your model and you're reading actual pressures and flows to create your model dynamic, then you know based on the elevation difference and the pressures and flows at various locations where you should have a vapor pressure issue, correct?

A. Yeah. The model will interpolate between the stations to estimate then pressure at every piece of pipe.

Q. Right. And you're metering, so you know volume in and out. So on your batching, does it pull in this batch schedule from the CMT system?

A. Yeah. Basically, I said you get like a hexadecimal number that's going to be converted into letters or the acronym for the fluid.

Q. Yeah, but it isn't just the type of batches, the timing and where it should be also, right?

A. Oh yeah. Oh, no. Well, basically when you start up a model you would load a line fill from CMT.

Q. Right.

A. And then after that the model is able to track those batches as it moves, as batches are delivered or injected.

Q. Okay, so from your sensors in the field you're pulling, you know when you've hit the end of a batch, so it's pulling that in actual real time or close to it because it pulling?

A. Exactly.

Q. And so just initially on the load is when it pulls in

the timing of what should be in the pipeline based on your CMT system?

A. Yeah, I think I understand you. I think we're saying the same thing.

Q. Yeah. Okay.

A. It's updating based on the, somehow from CMT and through SCADA we get the updated fluid data.

MR. CHHATRE: So you --

MR. FARQUHAR: And it updates in real time.

MR. NICHOLSON: I'm with you where you load the initial CMT part. After that I thought MBS took over and did its own batching, and I thought maybe it was doing that off density, is that not correct then?

MR. FARQUHAR: No, it uses, unless CMT is not available it uses just density. Let's see. Here. Here's an example. At Griffith, that's at the injection point of 6B. I get this number. It's a fluid ID underscore, injection underscore CMT. So that's a value from CMT. It's 36,685. The model logic converts that into a fluid like WCS or LLK.

MR. NICHOLSON: Oh, okay. That's the identifier.

MR. FARQUHAR: And then that drives the model that says I've got LLK being injected. I also have a SCADA flow saying I'm putting in say 1,000 cubes an hour. So it says I'm putting in 1,000 cubes an hour of LLK.

MR. NICHOLSON: Okay.

MR. FARQUHAR: And it just populates that. It paints over, it creates the injection fluid. And then as the batch is run down the line, the model is able to track that fluid.

MR. CHHATRE: So the input will be I'm going to follow X 1,000 cubit meter put out at the starting point?

MR. FARQUHAR: Yep.

MR. CHHATRE: And then the vapor pressure is not really a measured number, but it's a calculated number based on the elevation of all the other parameters you put in?

MR. FARQUHAR: Yeah.

MR. CHHATRE: Is that correct?

MR. FARQUHAR: Yeah, well you program in the parameters for the pressure.

MR. CHHATRE: Right, so you put pressure at the white line there, it's a calculated number telling you that you have column separation because you are measuring vapor pressure or you are calculating vapor pressure at the location, is that correct or?

MR. FARQUHAR: Yeah.

MR. CHHATRE: It's a calculated number. It's not really --

MR. FARQUHAR: Well, yeah, vapor pressure is --

MR. NICHOLSON: A characteristic, right?

MR. FARQUHAR: Yeah, it's a --

MR. NICHOLSON: Is it a constant or is it being

adjusted?

MR. FARQUHAR: Vapor pressure will change a little bit according to pressure and temperature.

MR. NICHOLSON: But is your program actually doing that?

MR. FARQUHAR: Yeah.

MR. NICHOLSON: Okay.

MR. CHHATRE: Let's do calculated number.

MR. FARQUHAR: So what I would do is we would program in, it's not showing significant digits here, but we would say, oh here it is, vapor pressure at five degrees is 1.9 PSI. My vapor pressure at 38 degrees is 7.6 PSI, and it creates slope and it can interpolate and extrapolate from that.

MR. CHHATRE: So it's a calculated number to begin with where you're measuring it. Now, an analyst in looking at this graph, if he sees column separation, now he or she assumes the column separation because the program sends the leak --

MR. JOHNSON: You're asking him to assume what an analyst would ask him; we have an analyst coming up --

MR. CHHATRE: Okay, I'm just trying to understand the program. I mean if it's a calculated number, do the analysts know it's a calculated number?

MR. FARQUHAR: Liquid fraction? They know it's calculated. The model calculates whether or not there's a column separation. It uses the vapor pressure of the fluid and the elevation and all the other data to determine whether or not

there's column separation.

MR. PIERZINA: Just a quick question. So the liquid fraction value that's displayed, is that just a function of the differential between the measured pressure and the vapor pressure? So if you measure a pressure at point X and it's below --

MR. FARQUHAR: Yeah, there's something, I don't know what Stoner uses to actually calculate the percent, but I know that it would use your vapor pressure and your pressure to determine that there is a column separation and to what extent. Yeah, there's some function there. It's just not something I would --

MR. PIERZINA: I don't know what else might affect it.

MR. FARQUHAR: Your temperature and pressure and elevation and display and vapor pressure; that all goes into it.

MR. PIERZINA: Right. Okay. And so if the one variable is the pressure, then that would determine the extent of the liquid fraction, right?

MR. FARQUHAR: Right.

MR. CHHATRE: So what else can give you a false number in this program for the vapor pressure? Besides, I mean if the elevation is wrong, you can get a wrong vapor pressure number.

MR. FARQUHAR: Yeah, anything. If you have a bad elevation, that could possibly cause an incorrect detection of column separation. If the batch line up is completely wrong, let's just say we put in a batch of NGL instead of LSB here, well,

the vapor pressure of NGL is going to be a lot higher.

MR. CHHATRE: Right.

MR. FARQUHAR: So it's more prone to cause a column separation. It'd basically be data error could cause it.

MR. NICHOLSON: If someone's entering that manually, that CMT data is being entered by a person? Or how is that --

MR. FARQUHAR: I don't know if -- yeah, I might ask SCADA about that one.

MR. CHHATRE: That's fine. I'm trying to understand what built in factors are in the program that could give you erroneous, inappropriate number. You are saying one is the density and the other is the elevation. Anything else that can give the built in parameters --

MR. FARQUHAR: Possibly incorrect fluid characteristics. If somebody made a mistake and put the wrong vapor pressure values in, then it could cause it. Yeah. That's really it.

MR. CHHATRE: Okay. The program is tested for the product of (indiscernible) chance of it happening?

MR. FARQUHAR: I'd say it's remote. Yeah.

MR. CHHATRE: Okay, understand (indiscernible); what else can cause the column separation to be erroneous?

MR. FARQUHAR: You mean for the MBS to say there's a column separation when there isn't one?

MR. CHHATRE: Exactly.

MR. FARQUHAR: Maybe a broken pressure transmitter.

MS. BUTLER: So when there's a pig in the line, does that cause any differences in your model calculations and signatures?

MR. FARQUHAR: You know Karen, I've seen lots of pipelines with pigs and I can't say I've ever seen an impact like that that could be attributed to a pig.

MS. BUTLER: Okay. Okay, so the main impact would be if we add pipe or change -- how long is your longest segment, do you know?

MR. FARQUHAR: Between pressure transmitters?

MS. BUTLER: Yeah.

MR. FARQUHAR: On 6B? I could estimate that right now.

MR. PIERZINA: Hey, Karen? Your cell phone may be close to your phone again.

MS. BUTLER: Oh, I'm sorry. It's underneath the cord. Yeah, sorry. Thank you.

MR. PIERZINA: Yep.

MS. BUTLER: If it comes back, let me know because it rang and I moved it.

MR. PIERZINA: Okay.

MR. FARQUHAR: All right, to answer your question, the longest distance on 6B looks to be about 43 miles.

MS. BUTLER: Okay. And so the types of things that could impact this, I'm just thinking through, okay, so we have a CMT error, we have a data update problem. What about a point

being taken off the scan? That would really have the same impact as an update problem, wouldn't it?

MR. FARQUHAR: You mean like a variable not reporting?

MS. BUTLER: Yeah.

MR. FARQUHAR: Yeah, that would be similar, yeah.

MS. BUTLER: Okay, now on sep. points, okay, so when, if their range of maximum pressures change, do you have any maxes in your model? Like I used to model all of my max discharges. Do you do that?

MR. FARQUHAR: To model them? No. What we would do is we would set the maximum allowable pressure on a SCADA device to match basically what the range is on the actual PT. That's what we attempt to do. So if a PT is calibrated to go to 2,000 PSI or 1,000 PSI, then that's what you would do.

MS. BUTLER: I'm sorry, you dropped out.

MR. FARQUHAR: I was saying then you would set it up, you configure the transmitter in the models to match that.

MR. NICHOLSON: That full range of the transducer?

MR. FARQUHAR: Yeah, that's what you're trying to do --

MS. BUTLER: Yeah, but so you're not putting in any, like if you've got a regulation cut or an element that would actually reduce that pressure allowable somewhere in the line, you're not actually modeling that?

MR. FARQUHAR: Okay, this is pretty much like the operating restrictions that are currently on 6B?

MS. BUTLER: Yeah.

MR. FARQUHAR: No, we wouldn't put that in the MBS.

MS. BUTLER: I'm sorry?

MR. FARQUHAR: I said we would not put that in the MBS.

MS. BUTLER: Okay. All right. So the pressures will not affect it. Okay, so all of these pipe change outs and things, if they're actually cutting out pipe then you've got conceivably different outside diameters than inside wall thickness, right?

MR. FARQUHAR: Yeah.

MS. BUTLER: How do you get those updates?

MR. FARQUHAR: Let's see. That's very rare for something like that to happen except for maybe really small segments.

MS. BUTLER: Okay, so how do you get, when there's an inside diameter change?

MR. FARQUHAR: We get elevation profile data from like one of the engineering services groups. They're able to supply spreadsheets that would show the chainage, and it would show the outside diameter and the wall thickness.

MR. NICHOLSON: I'm sorry. Who gives you that?

MR. FARQUHAR: I forget what the departments name is right now. It changes from time to time, but it's one of the engineering service groups.

MR. JOHNSON: It's in the U.S. which is what we're dealing with, it's Technical Records, and that information comes

in through the PLM activity report, and from there if it is new pipe install, which as Ted said is very rare in our system, that information with the associated pressure test records goes to facilities management for setting up the pipeline model. And then that from Facilities Integrity then would get down into this group.

MR. NICHOLSON: Pipeline model? What's the pipeline model?

MR. JOHNSON: Basically that is, it's the line -- that's got everything. I mean that's where the MOP is set. They have all the information on every piece of pipe in Facilities Management.

MR. NICHOLSON: You said model. I was thinking like a simulator or --

MR. JOHNSON: There is a model which basically allows them to go in and tell you at any point in time what the MOP of that pipe is.

MR. NICHOLSON: Oh, okay.

MR. JOHNSON: So that's, you know, we talked about MOP and then when we adjust what would be our allowable working pressures. So that would be the group, that database where any of that information goes in. So in the case of 6B, you know, we've got a couple of new pieces of pipe that we've put in; that's how that information gets up.

MR. NICHOLSON: Okay.

MS. BUTLER: Okay, so --

MR. PIERZINA: Maybe, how about on Line 5, Iron River Station was recently redone. So that'd be a fairly significant change to the model I would imagine, right?

MR. FARQUHAR: I'm not aware of what happened in Iron City or on Line 5.

MR. PIERZINA: Okay.

MR. FARQUHAR: Or Iron River. I don't, that's not one of the lines that I would maintain.

MR. PIERZINA: Oh, okay. So it'd be a different modeling engineer with --

MR. FARQUHAR: Yeah, they'd be the ones if there was a significant change they'd be the ones that are responsible for putting something in.

BY MS. BUTLER:

Q. So, if they move a transmitter, how do you get notified of that?

A. There's a couple ways, Karen. If it's project based, we would expect to be on, like the review team, we would review drawings and P-90s during the 30 percent and 60 percent and 90 percent phases.

Q. So if it's a project you said based, you would expect to be on what? I'm sorry.

A. On the project team where we'd be on the circulation list to review drawings. Like design drawings.

Q. So I take it that that would happen in advance of construction ideally?

A. Yeah.

Q. Okay. And then what about when it's maintenance driven?

A. Yeah, if it's maintenance driven and maybe it's not like a project, we wouldn't be on a review team. We would rely on being informed of the work ahead of time by either the SCADA group who might be making changes to the SCADA displays in RTAP, or by field staff.

Q. Okay so is there a formal process for that? I mean I know that there's a change management process, but I just want to make sure you're I that process.

A. I'm not aware of like a process document that says how this is supposed to be done and who's supposed to be communicated to about these things.

MR. JOHNSON: So from a timing standpoint for less --

BY MS. BUTLER:

Q. I just want to make sure that I've kind of got this because it's a little different technique than I was used to. So when you have like a telescoping MOP, for you in the model everything's transparent. So if they were to exceed, pressure doesn't matter because the model is just going to go right up to where the transmitter reads and continue to calculate, is that correct?

A. Yeah, that's right.

Q. Okay.

A. It wouldn't stop working because you exceeded your maximum operating pressure.

Q. Right.

A. As long as that's valid.

Q. And it wouldn't alarm or give you any specific indication?

A. No.

MR. NICHOLSON: But it would cease to work if you went out of the range of the transducer that was --

MR. FARQUHAR: Yeah. Like let's --

BY MS. BUTLER:

Q. Well, it would most likely just lock up at the highest value, wouldn’t it?

A. I think they have different ways of failing. Let's just say they started reading 2,000 PSI and the maximum is supposed to be 1,440 and then it would go bad, the status would go bad.

Q. Okay. So you'd get an alarm on that?

A. That could generate an MBS alarm for sure. I've seen that happen.

Q. Okay, so talk to me a minute about the Marshall situation. The first five minute cleared, right?

A. Correct.

Q. Was that due to just a transient wave because of leak?

A. Was the alarm due to a transient wave?

Q. Yeah -- no, that it cleared. Meaning, the pressure came back up because we had some type of transient wave that was caused by the leak and then went back down and that's why we saw the clearing, and then the secondary, or why did you think the first one cleared and then the second one stayed, I guess?

A. Okay, what's the second one?

Q. Well, actually there was, you know, several afterwards that we diagnosed as false, meaning the MBS diagnosis, as false later.

A. Okay, like the 1:00 and the 4:00 startups?

Q. Yeah.

A. Okay. We could talk about that afterwards. The 1,500 one, it alarmed during the shut down, and then it cleared. The simplest way of saying why it cleared is because the MBS did not detect an imbalance after five minutes.

Q. Okay

A. It cleared.

Q. So this was tied to the being down for a period of time and no movement?

A. Well, I'd say the pressures went static after a couple of minutes. They flat lined.

Q. Yeah.

MR. NICHOLSON: At zero.

MR. FARQUHAR: At zero. We also had column separations on either side of Marshall.

BY MS. BUTLER:

Q. Right.

A. So whatever was happening at the leak site was separated from the closest pressure transmitters by the column separation.

Q. Okay.

A. I don't think it would cause pressure changes at those sites because they're no longer connected by a full column; degrades the MBS.

MR. NICHOLSON: So upstream and downstream at Marshall you've got column seps?

MR. FARQUHAR: Yeah.

MR. NICHOLSON: Okay, so it's no longer able to calculate pressures downstream of that last col sep?

MR. FARQUHAR: Well, yeah, where the leak was happening it was, basically it was on, once you have the column separation, something happening in that area would be basically unprotected because it's --

BY MS. BUTLER:

Q. Okay, so --

A. -- there's no --

Q. -- on that particular time, that initial alarm, is that something that when the analysts pulled it up they can zoom in far enough to see that they had a column separation upstream and downstream, right?

A. Yes.

Q. Is that a yes?
A. Yes, it is.
Q. Okay. So based on that particular point in time, they would have known conceivably that something isn't quite right?
A. Yeah, and they'd see there's a column separation occurring.
Q. On either side. So effectively the MBS, it can't do its thing?
A I'd say it's significant degraded.
Q. Okay.
MR. NICHOLSON: Where is it significantly degraded though? I don't understand that part. At the place you have column separation?
MR. FARQUHAR: Yeah, it's a, the pipe segments that have column separations.
MR. NICHOLSON: The entire segment?
MR. FARQUHAR: Yes. Let's say our column separation was on upstream and downstream of Marshall. So I say from the upstream station to Marshall, Mendon to Marshall, you're degraded. The MBS is degraded because you have column separations in there.
BY MS. BUTLER:
Q. Okay, so between those two column seps you're completely out of the water, right?
A. I'd go further than that. I'd say between Mendon and Stockbridge basically because you've got a column separation, one,

between Mendon and Marshall, and one between Marshall and Stockbridge.

Q. Got you.

MR. NICHOLSON: Right. So both of those segments you can't trust.

MR. FARQUHAR: No, you're degraded.

MR. PIERZINA: Degraded.

MR. CHHATRE: What come of the --

MR. FARQUHAR: The MBS ability to do state estimation and leak detection is degraded because they don’t have --

MR. NICHOLSON: The entire length.

MR. FARQUHAR: Yeah, you don't have a full column. It's really hard to model and do prediction.

BY MS. BUTLER:

Q. Okay, so where it could do that effectively would be upstream of the first column sep?

A. I'd say upstream of Mendon.

Q. Okay.

A. I'd go to like the closest pump stations on either side of the column separation.

Q. Got you.

A. And I'd say go upstream of Mendon, go downstream of Stockbridge and say yeah, I've got some capabilities.

Q. Okay, so when the analyst reports things back to the control room, are they telling them things like that? Like, you

know, we've got column sep. here and here, and the leak detection model is running but it's really only going to be its typical value between here and here?

A. Yeah, it's a, you have what is your typical procedure, what you should do and what we normally do, and I don't know specifically what was said on the July 25th incident.

Q. Okay.

A. I don't know what words Shane used with the operator.

Q. Okay.

A. You guys would know that better than I.

MR. CHHATRE: But --

MR. FARQUHAR: I think my recollection of our MBS analyst procedures would say that, you might say you've got a column separation in these locations; the MBS is therefore degraded in those locations. It doesn't rule out that there could be a leak occurring and that the operator should understand the cause of the column separation.

MR. CHHATRE: What does degraded means? I mean is it 50 percent accurate, 100 percent accurate?

MR. FARQUHAR: I couldn’t put a number on it. I really couldn't.

MR. NICHOLSON: Would you trust it at all?

MR. FARQUHAR: I might not, no.

MR. CHHATRE: Now --

MR. FARQUHAR: I might not at --

BY MS. BUTLER:

Q. Okay, so now that procedures have changed and you guys are the ones just getting the call from the operator, right?

A. Yeah.

Q. Or the shift lead, however the current procedure is working, will you be required to give more detail back?

A. Not yet, no. No. The control center is taking responsibility completely in determining if the cause of the column separation is something that is expected or something that is unexpected.

Q. Okay, so but regarding the effectiveness of the model in certain areas, are you going to pass that information back or not?

A. During column separations? Yeah, that's something that you would pass along if you got an alarm --

Q. Okay, well, here's something that we heard about the new change, okay, and so I just want to understand it better from you guys' perspective, and one of the operators I believe or it may have been a shift lead said, well, the only thing they're going to tell us is if the model is running or not. Well, in a case like this it would be running for a portion of the line but not all?

A. That's accurate.

Q. So I just want to make sure that we understand that you would be passing along the information as to where it's running and where it isn't.

A. Yeah, I don't think our response to the level of detail

that you're saying is written up in our procedures yet, but you're right, that's what we should say is where it's running and where it's not.

Q. Okay.

BY MR. CHHATRE:

Q. Now does the column separation gives you a new distance as to how big a column you have to deliver pressure or --

A. This kind of shows it. This display. This shows, and I zoomed in quite a bit, and you can see, so it'd be for like this chunk for this distance --

Q. Right.

A. -- is showing column separation. And again here, it's showing that.

Q. The distance.

A. Yeah. And you can get an actual mile post down to the hundredth of a mile.

Q. Okay, it would tell between mile post 5.3 and mile post 5.5, you've got column separation in that portion.

A. Yeah.

Q. It's full of vapor.

A. Yeah, that's what this could tell you. I normally wouldn’t, I might say you've got a column separation at, in this case 7/10, and I say because of that your modeling capabilities between Leonard and the upstream pressure which is, I say that's degraded, and likewise downstream.

Q. Now what, how does a -- an alarm goes away. What in your program makes this column separation disappear?

A. When the column separation actually disappears.

Q. But it's a calculated number, right? The number is calculated.

A. Yeah, so when you lift the pressure high enough so that the pressure is above the vapor pressure, then it will say I'm no longer detecting column separation.

Q. Okay. And for you to do that, does the pump pressure has to go up?

A. Yeah.

Q. Or the pipe has to pass through a hill or?

A. Your pressure has to go up. As long as your pressure's at this level, it's going to say you have column separation forever.

Q. And does the model tell them how much pressure increase they need to go?

A. No. No, when you get to the high enough pressure then it will show it's no longer in column separation. But --

Q. But doesn't the model require pressure to calculate the --

A. Yeah.

MR. NICHOLSON: He didn't understand you exactly.

BY MR. CHHATRE:

Q. Okay, if you're, let's just say I, as an operator you

tell me where your column separation, and so I manually increase the pressure in my line. Now that nobody's getting fed to you for modeling.

A. Uh-huh.

Q. Now so the model doesn't go back and tell me because of this column separation at this location you need that pressure to increase to get rid of that column -- it's a calculated number. The model should be able to tell me that, look, we are running at 350 PSI, you need 500 to get that other column based on calculation.

A. Model wouldn't know that, but that's not something it would ever report.

Q. Okay.

A. It would never say --

Q. I understand now.

A. Yeah. It just wouldn't do that.

BY MR. NICHOLSON:

Q. It could do it, it just doesn't.

A. Yeah.

Q. The numbers are there.

A. I could probably, if you gave me enough time I could probably create something to do an estimate.

Q. So go back with this screen here and explain to me again, I'm not sure I understand why that alarm on the 25th cleared itself. You were saying because of the column separation

errors, the break downstream --

A. Yeah, I think there's a couple things. The column separation, basically it took the piece of pipe that was leaking and it separated it from your closest pressure transmitters.

Q. Yeah, the downstream side of Marshall. Right. The discharge of Marshall was the nearest.

A. And then Stockbridge. That's no longer connected to the leaking site, so it's just basically you have a piece of pipe that's not being, that's not --

Q. So Stockbridge still has pressure on it though, right?

A. Yeah.

Q. I don't know what elevation is, but --

A. But it has a pressure.

Q. And you're zero upstream.

A. I'm zero upstream. Yeah, basically at this point your model is broken because you have --

Q. It flows in reverse according to the model, right? Pressure's higher downstream now than --

A. So is there a way that you could program the model as such that when that situation occurs that it indicates to the controller through an alarm that the model is invalid in that section?

Q. I think we could, yes.

A. I think that's something we need to move on. So I'll, gosh, I'm not really sure.

MR. NICHOLSON: Karen, I'm sorry, I didn't get a good explanation. I'm still trying to get an explanation from Ted. I want to be sure I understand.

MR. JOHNSON: Well, I mean it can be programmed, but is that not why we have an MBS analyst and then, you know, a person like Ted on-call? So I mean, there is some glitches with programming everything in for an operator. I mean this system is an independent from the operator. I mean, we're giving the operator less of the screens and relying on the experts, no ifs, ands, or buts, so I don't, you know, I don't know that that's the direction the company would want to take. You know, I don't speak for the company here --

MS. BUTLER: I can see why you're saying that, but in all sincerity what's happened is you've just pinned the responsibility to determine when a column seps valid and when a column sep isn't back on the operator. And what the operator may not necessarily know is what portion of the leaks is leak detection system is working and what isn't. So if they know the section that is invalid, then they can better concentrate on the appropriate error location. It's going to give them another mechanism to fine-tune that. It's not going to hurt them. It's certainly not going to hurt them.

MR. CHHATRE: My question Karen is are we near the stage of making any recommendations at this point of the investigation?

MS. BUTLER: I’m just saying that since that could be

done and it's obvious that it's between two column seps that that's something they should be thinking about now based on their changes.

MR. NICHOLSON: So how would that have prevented the accident on the 25th? The operator would have seen that the MBS was invalid from Marshall to Stockbridge?

MS. BUTLER: He wouldn't' have assumed that the model alarm that cleared, cleared for the reason that the pressure came back. In other words, he wouldn't have looked at that and said, well, it cleared; it does that all the time on shut down. If it went into a shut down mode and the alarm comes in and then this tells it when it's got two column seps it can't see between there, and it says, hey, we've got a problem with the model in this area, then they're going to dive in closer. The part that we got in trouble with is they dismissed it because it cleared, and it cleared not because pressure came back. I thought it was because of the pressure surge, which, you know, was the result of the leak, but if this is what we think actually occurred because it was between two column seps, then this is a pretty simple change that could provide a lot of information. And then --

MR. NICHOLSON: But the analyst should have known that the model was invalid between those two points, right?

MR. CHHATRE: I honestly feel, I guess, that should be an internal discussion really and not --

MS. BUTLER: That's fine. I'm just saying.

MR. CHHATRE: No, that is fine.

MS. BUTLER: They should be thinking about it. We'll drop it there.

MR. PIERZINA: So I'm just trying to understand, Ted, and I'm sorry I'm probably struggling at this point like everybody else, but it seems like it was a big deal that that cleared on its own, and we had heard statements that actually it was, I thought I'd heard in some of these interviews it was typical for it to clear on a shut down, and I think, did Jim in his interview even kind of talk about how it clears on a shut down?

MR. FARQUHAR: How an alarm clears?

MR. PIERZINA: Yeah.

MR. FARQUHAR: The MBS would alarm only as long as it's detecting a negative imbalance greater than the threshold.

MR. NICHOLSON: So show me here, Marshall we lost, you know, where rupture was here, we had pressures here and discharge here on suction, right? And you had a col sep upstream, and this would have been your col sep downstream, right?

MR. FARQUHAR: Right.

MR. NICHOLSON: So where did it, and you had a pressure here?

MR. FARQUHAR: Yeah.

MR. NICHOLSON: And this was still a valid pressure?

MR. CHHATRE: It would not get, according to him.

MR. NICHOLSON: This would have been valid. This would

have been a good pressure, right?

MR. FARQUHAR: Yeah.

MR. NICHOLSON: Okay, so where did it clear itself? If you're stilling losing liquid here, you've got a pressure there, right? And this is zero? Because of the col sep you're saying they can't calculate?

MR. FARQUHAR: It degrades it, or what I'd say is that -- I'm having trouble explaining it, I have to admit.

MR. PIERZINA: Isn't it best explained with zero flow? You have zero balance?

MR. NICHOLSON: That's kind of where I'm going. Is it simply because you no longer have any flow?

MR. FARQUHAR: As part of it? Let's say it's just that you no longer have a continuous pipe full of liquid.

MR. NICHOLSON: Okay.

MR. FARQUHAR: So you have a piece of pipe that's leaking, MR, downstream of Marshall, and because there's column separation between it and the, well, it is the column separation.

MR. NICHOLSON: That is your column, right.

MR. FARQUHAR: It might keep leaking but it's not been, it can't drive the Marshall discharge pressure down any further. It's at zero. There's nothing to drive it. Or there's no pressure transmitters that would still be picking up on a change in pressure associated with the draining of the pipe.

MR. NICHOLSON: Okay.

MS. BUTLER: So --

MR. FARQUHAR: You know, flat lined.

MS. BUTLER: But basically on a normal shutdown and you don't have a leak, you would still conceivably get the leak detection alarm because you've got some transients going on, and when it's down it would stabilize, and when it stabilizes it would clear, and everything would be wonderful. But in this case, it cleared for a different reason. It cleared because it didn't have good information to process, and there's no separate indication of that. Now the leak detection analyst could have told that, and I do believe that there was a comment at one point of upstream and downstream in some of our logs, but the real story is that that didn't translate into anything more than a column sep., which they frequently see. So is that fair, Jim? Have I said -- Ted. I'm sorry.

MR. FARQUHAR: I mean you said a lot of things there.

MS. BUTLER: Could you restate any of that differently and explain it in your own words?

MR. FARQUHAR: We're really bogging down on this detail, and it's important, can you -- I'm sorry, can you -- or do you have a specific question?

MR. JOHNSON: Can you put it in the form of a question?

MS. BUTLER: Yeah, in a normal shut down, would the MBS alarm that may be triggered clear because of stable pressures occurring?

MR. FARQUHAR: Yeah. There's a difference though. If you had an alarm during a shutdown and there was no column separation, and it clears, that's a good sign. If you have a shutdown and you have column separation, that's different. Having a column separation doesn't mean it's not a leak. The root cause of the column separation needs to be investigated and determined if it's something that was expected or not.

MS. BUTLER: Okay.

MR. FARQUHAR: And there's a couple ways that you could look at that. You might look at the pressure profile during the shut down versus something that say happened over a couple hours due to thermal. There's a difference between those too. Alternatively you could look at the elevation profile and say I've got zero pounds at Marshall; does that make sense compared to my upstream and downstream? Somebody should look at that. In my opinion this is, I have some hindsight bias now. I would say Marshall is at a low point in elevation. It's not a place that I would expect to get a column separation on a shutdown.

MS. BUTLER: Right. So there's where I was headed which is the fact that the model and your history files and your elevations all know where you would have a typical column separation on a normal shut down. Is that a fair statement?

MR. FARQUHAR: Yeah, and I would add to that by saying we document MBS alarms, and if it's attributed to column separation we write it's a column separation and try to say what

location it's at.

MR. NICHOLSON: Is that in the worksheet that the analyst fills out?

MR. FARQUHAR: We have a database and we create reports for each of the alarms. And if you look at past reports, say on line six you would say it's common to get column separations downstream of Stockbridge on shut downs, it's common to get column separations at Leonard, which is where we had one today, that's a particularly high point.

MS. BUTLER: Can you speak up?

MR. FARQUHAR: I thought I was speaking loud. I'd say going through all of the 6B alarm reports, Karen, I've noticed that we have a fair number of column separation alarms downstream of Stockbridge.

MS. BUTLER: Uh-huh.

MR. FARQUHAR: And we also have a lot around Leonard, which is a really high point.

MR. PIERZINA: Ted, in your initial interview transcript, you talked about an MBS cause analysis. Is that the database that your, or an MBS alarm cause analysis?

MR. FARQUHAR: Our database?

MR. PIERZINA: Yeah, it sounded like something that's done, and I think you just talked about it. So you have a database of MBS alarms?

MR. FARQUHAR: Yeah.

MR. PIERZINA: And you do a cause analysis?
MR. FARQUHAR: Yeah, or include it in the alarm would be the cause of the alarm. Included in the report you would say what caused the alarm.
MR. PIERZINA: That's one takeaway that --
MR. NICHOLSON: You're talking about the material balance event form?
MR. PIERZINA: Yeah.
BY MR. NICHOLSON:
Q. Those looked pretty superficial, the ones I saw from say the 25th. It just kind of says where it is. It says, "I looked at pressures, flows, and determined it was column separation." So it doesn't go, like you say, analysts should really go one step farther. Column sep. is not the root cause. You should go farther to explain the source of the col sep.
A. I think you're on to something there, and I think that's something that will probably have to be discussed.
Q. But it's not required no, no.
A. You'd say who, you know, who is responsible for doing that extra step, right? Somebody has to investigate whether that column separation makes sense in that location.
Q. And that's not covered under this flow chart here that the MBS analyst refers to? There's a lot of steps here, and I see when you, you know, you get your five minute analysis and determine it's col sep. Are you familiar with this?

A. Yeah.
Q. Okay.
A. And then you go down here.
Q. Go down here. This part kind of threw me off. Liquid fraction at problematic region. In our case which path did we go, yes or no?
A. Yes.
Q. It was problematic in our region.
A. We had a, what that means is did I have a liquid fraction less than one in the area that was having diagnostic flows.
Q. Okay.
A. Yes. The answer is yes.
Q. It did. Okay. And it does say here to indicate that the model is not reliable when there's two pace fluids, right? So it's kind of a, you can just read them right off the flow chart. You don't have to understand the model.
A. Wasn't our case on the five minute though, Matt, that what actually happened is they saw it clear so it was considered a temporary alarm? And went --
Q. But this, does this talk about that? I don't think there's any mention of whether it's temporary or not in this analysis.
A. Is that the flow chart from 6B restart only?
Q. No, this is IR 108. This is what the mass balance

analyst would use when reviewing a 520 or two hour alarm.

A. Okay.

Q. So I guess when I'm looking at this, it does say to go look at the P data analysis. That's pressure data? Do you know what these --

A. Yeah, I've got --

UNIDENTIFIED SPEAKER: You should ask Jim.

MR. FARQUHAR: Okay, so P data analysis, that would be right here. Pressure data.

BY MR. NICHOLSON:

Q. But what -- it is pressure data. Because you mentioned one of these screens was called a PQ.

A. PQ. Different.

Q. Okay.

A. I think what that's referring to is saying you're looking at pressure trends.

Q. Okay. Just as you did?

A. Just like I did.

Q. So I guess if you said yes and you went down this path, you would stop here? You actually wouldn't have to go any farther on this flow chart, right?

A. That's right.

Q. And if it was no, then I guess that's when you would, okay, so there's really nothing in the flow chart that tells you you have to pull up any other trends right now?

A. No.

Q. So the only reason you did is because you're much farther into this startup and you were asked to go look for something?

A. Yeah, and typically if I get a column separation alarm, I look at pressure trends because they're scary. They should be. I want to see what caused it, how fast was that happening.

Q. So has this flow chart been updated or has there been any discussion of updating the flow chart to take some of that into account?

A. I think that's definitely going to happen.

Q. Okay.

A. It'd have to be done in conjunction with the control center because, you know, they've said they're going to do this analysis now, we just say that you have a column separation --

Q. Actually going back to this, determine start time, location, and pattern of diagnostic flows, and that will actually throw you down here, right? Proceed to all flow trends, proceed to all pressure trends. So wouldn't it have been looked at in this step before you ever get to your column separation analysis? Or does this mean something other than what I'm taking it to mean?

A. Procedure to all pressure trends.

Q. Is that a specific screen?

A. I think that would be the pressure trends I showed you.

Q. Oh, like you did, yeah. Where you went from station to

station. Okay. So really then it probably should have been cut there, because your default window, when you go to that station is what, six hours?

A. Two hours.

Q. Oh, does it default to two?

A. Maybe three hours.

Q. Then you still should have seen something.

A. He said he looked at it, didn't he?

Q. Well, this is the MBS analyst. Oh, so in his write-up where he says I looked at pressures, he's referring to this. I thought maybe he was referring to that other screen of yours where it just shows all line pressures, the liquid fraction screen.

A. I think that would imply time trends.

Q. Okay.

A. Not the distance applied.

Q. Yeah, his write-up does actually say that. It says he looks at pressures. Okay. So then the take away from that would be he looked at it and just didn't recognize something --

A. I don't think he, yeah, I'm not going to speak for Shane. I mean he said, I think what he focused on was column separation. Not the first thing I saw. It's very, that jumps out at you when you see this.

Q. Okay.

A. I mean, I look at it and look at the pressures as well.

Q. Yeah, actually his quote is, "After checking pressures,

flows, and liquid fraction I determined it was column separation." Okay. He didn't really have to look at any of that to determine column separation.

A. Liquid fraction.

Q. Yeah, well liquid fraction alone will tell you.

MS. BUTLER: So, Ted, when you were looking through historical information, do you know what is a lowest pressure at Marshall we've seen in recent history?

MR. FARQUHAR: No, I wouldn't be able to tell you.

MS. BUTLER: All right.

MR. FARQUHAR: That's something I could look up.

BY MR. NICHOLSON:

Q. So when he says, "While looking at the alarm the DFs began clearing on their own, that's this right here, right? That DF display?

A. Yeah. The CCO trend as well. It's the green line.

Q. Right, okay, right. We've covered a lot of what I was going to ask already.

When did they implement the Stoner software, the MBS system at Enbridge, do you know?

A. Early to mid-'90s was when the first one was put in.

Q. It's been Stoner since day one.

A. That's right.

Q. Are there other technologies out there?

A. There's other vendors who supply real time transient

models. There's other vendors who would supply like Cystico Systems (ph.), wave based, and there's just more and more, like volume balance, or compensated with volume balance systems as well. Lots of different ones.

Q. All pretty much operating on the same parameters and premise?

A. Most of them, yep. Statistical is different.

Q. What is statistical trying to achieve?

A. It'd be like the ATMOS System would be one brand, and it does --

Q. Could you repeat that? Sorry, I couldn't hear you.

A. I said ATMOS System would be one type of statistical system. I don't really have very much familiarity with it, but it basically looks, I'd say it's for like unexpected changes in your process, instrumentation, and it compares it against what it would have seen in the past.

Q. Oh, okay.

A. And uses statistical approach to determine if it's statistically significant and indicative of possible leak.

MR. JOHNSON: That's the system we use in our North Dakota --

MR. NICHOLSON: Oh, we've got that elsewhere.

MR. JOHNSON: Yes, we do.

MR. NICHOLSON: I think we've got it --

MR. FARQUHAR: Okay.

BY MR. NICHOLSON:

Q. In your first interview, Ted, I think you said that the modeling group used to be part of the SCADA group?

A. Yeah.

Q. When was that? How long ago?

A. I joined the company in 2002. It was there at that point.

Q. Okay.

A. I think it had been moved into SCADA within a year, maybe within in two years of me joining.

Q. And then it was eventually broken out for what reason?

A. There's been a lot of work changes. The group was split up into different segments of SCADA and then they were brought together and then they had a change of names and their move from one department to the other.

Q. Enbridge has a technology group, right, that you guys kind of farm this stuff out to other companies or build these models for?

A. We have ETI, Enbridge Technologies, Inc.

Q. Okay.

A. And we've built MBS's for other companies, Cosensa (ph.).

Q. Okay. That's pretty much this.

MR. JOHNSON: We've got, you know, depending on what you're looking at, I mean we've certainly got a technology group,

but in many cases they're going to bring in third party experts to do work like this. I mean they can support the system. It doesn't necessarily mean they would develop it.

MR. NICHOLSON: Do you train the people to use it and interpret the results like your own?

MR. JOHNSON: I cannot answer that.

BY MR. NICHOLSON:

Q. When you get down to valves in your system, I don't know how complex this thing is, do you put CD values in there? Do you have all of the valve characteristics?

A. Or we put our best estimate in for valve charac.

Q. Do you know what kind of characteristic those valves have? Are they proportional as to opening, linear? I'm speaking actually primarily of your PCB's.

A. We don't model the PCB's.

Q. Oh, okay.

A. We model lock valves, sectionalizing valves.

MS. BUTLER: Can anything the operator do change the thresholds in the model?

MR. FARQUHAR: No.

BY MR. NICHOLSON:

Q. A col sep doesn't alarm, only a mass balance? A mass imbalance, right? I think there's a statement somewhere that Shane might have looked at this and he had seen two column separations, yet there's just one alarm, right? Okay. SO you

could have col. seps without mass balance alarms?

A. Yes.

Q. It's only when they exceed that five minute threshold.

A. Yeah, you can have column separation that doesn't alarm at all. You can have some that do cause alarms.

Q. I was looking for a quote. I can't remember if it's you or Jim. Someone was trying to explain the reason that the alarm cleared. I think his explanation was something like the MBS system, because it was confused, I guess it tries to account for the volumes in the line by throwing it into line pack or basically, they can't calculate a number or if they can't explain the volume that's gone through and somehow attributes it to line pack or is any of that ringing a bell with you?

A. I know I didn't say that.

Q. Okay. You were zooming in here, which is really just changing your range I guess --

MS. BUTLER: What was your answer to the previous question? I'm sorry.

BY MR. NICHOLSON:

Q. He says it was not him that had said that.

A. Yeah, I didn't say that.

MS. BUTLER: Okay, thank you.

BY MR. NICHOLSON:

Q. I'll have to find that quote. I think it must be Jim. You could zoom in as well on that elevation profile. Can we go to

that screen, your hydraulic profile? What do you call it, the MBS screen?

A. This is the flow display. Yeah, it's got the elevations. I can zoom in. I'll change the Y axis.

Q. So we are zoomed in right there, right?

A. Yeah. It shows all of your peaks and valleys. This is Marshall.

Q. So you could even zoom in closer, right? Right on Marshall?

A. Yeah, I can get it right to the tenth or hundredth of a mile, whatever you could want.

Q. Can you go to like a mile or something like that on either side?

A. Okay.

Q. Yeah, okay. So it is flat. So zooming in like that would show you right away that there is no drop.

A. Yeah. What I'd do is I'd look at Marshall, the elevation. It says, say Stockbridge is here, and I say here's my high points here, here, and here. If I have zero balance at Marshall, I'd have to have a lot less up here.

Q. Right.

A. I would expect, if I was going to get a column separation between Marshall and Stockbridge, it would show up around here at these points, and therefore my pressure at Marshall would be greater than zero. Because due to the elevation change

it's going to be higher. If I've got zero here, then it's going to be greater than zero at Marshall.

MR. CHHATRE: A person asked yesterday for the interview, my, I still have a tough time understanding this column separation. You said rupture can cause column separation?

MR. FARQUHAR: Yeah. I think every leak --

MR. JOHNSON: That's exactly what it is.

MR. CHHATRE: That's what I'm trying to understand in my mind not being a --

MR. FARQUHAR: Every leak is going to cause a column separation eventually.

MR. CHHATRE: (indiscernible) person in program.

MR. FARQUHAR: I think.

MR. CHHATRE: Okay. Look at the pressure drop.

MR. JOHNSON: Yeah, you don't have a line pack.

MR. FARQUHAR: You keep leading pressure --

MR. CHHATRE: (indiscernible) column separation is a calculated number. It is not something that resets by any kind of sensor.

MR. FARQUHAR: That's right.

MR. CHHATRE: So what I'm trying to understand, if I have a rupture, what number will the key factor in your calculation that will do your column separation, and only handles things like pressure, but is there any other number to the rupture? Because it's a calculated number, even the sensor, I can

clearly see the rupture --

MR. JOHNSON: So for instance, downstream of Leonard, how much drain up do you have to get, I think, is that where you're going?

MR. CHHATRE: Yeah, I'm trying to understand. I mean (indiscernible) tells me that rupture can give me column separation. I assume until that point until this morning that there was some kind of a sensor you have in lines that raises the vapor pressure which is not the case.

MR. FARQUHAR: No.

MR. CHHATRE: So what part of rupture, the (indiscernible) that you guys are measuring to calculate the vapor pressure? Which of this (indiscernible) that will give you quote/unquote, a false column separation if you would, that will, the leak will give you that column separation.

MR. FARQUHAR: You mean like is there a parameter that could tell me that a column separation is for natural reasons or --

MR. CHHATRE: No, what I'm saying is how a leak but not really vapor pressure being built up in the (indiscernible), right? Column separation really means that vapor pressure is being built up in the pipe.

MR. FARQUHAR: No.

MR. CHHATRE: And it's a calculated number.

MR. FARQUHAR: No, it means that my pressure is below my

vapor pressure in the pipe. That's what it means.

MR. NICHOLSON: He's operating the pressures lower than they --

MR. CHHATRE: So really it's the vapor pressure that's --

MR. NICHOLSON: Yes.

MR. FARQUHAR: Yes.

MR. CHHATRE: The serial pressure (ph).

MR. NICHOLSON: Line pressure that's telling them --

MR. CHHATRE: Line pressure.

MR. FARQUHAR: Yeah.

MR. NICHOLSON: Is it assuming isothermal conditions, or what's the assumption on temperature? Because you only read it at the station, right?

MR. FARQUHAR: It's isothermal. So we usually do changes from line to line. I just do like a linear, if you have two temperatures, I'll draw a linear flow.

MR. CHHATRE: Going back to, which pressure it will be using to calculate?

MR. FARQUHAR: Use the suction and discharge.

MR. CHHATRE: Both?

MR. FARQUHAR: Yeah. Like we tell it which pressures to use, so it's usually my suction and discharge at Marshall. These are my Stockbridge pressures, it's using my Mendon pressures to drive calculations.

MR. CHHATRE: So all (indiscernible) are being used?

MR. FARQUHAR: Uh-huh.

MR. CHHATRE: Do you use a calculated number? Did you know the column separation (indiscernible) --

MR. PIERZINA: Yeah, just correlated to elevation and the measured pressure to the other elevations of the pipeline, right?

MR. FARQUHAR: I'm sorry.

MR. PIERZINA: The column separation. It's correlated from an elevation and a measured pressure to the other elevations along the pipeline, right? And compared to the vapor pressure --

MR. CHHATRE: But it's a calculated number, not a measured number.

MR. FARQUHAR: So it interpolates if the pressure at ever chunk, every piece of pipe. Every foot of pipe --

MR. PIERZINA: Yeah, it's total pressure on the line compared to vapor pressure.

MR. FARQUHAR: Yeah.

MR. NICHOLSON: But what we don't really know is how the liquid fraction is calculated. Does the Stoner Manual show you the formula for that or?

MR. FARQUHAR: I could look and see what it says.

MR. PIERZINA: With a zero pressure measured, your liquid fraction is going to go very close to zero, right?

MR. CHHATRE: What time is it?

MR. NICHOLSON: We past, yeah,

MR. NICHOLSON: I'm sorry. I'm trying to review my questions and make sure I've asked them.

Karen, you got anything else? Usually you're pretty good.

BY MS. BUTLER:

Q. No, I think I've pretty well got an understanding of what happened and how things have changed. Is there anything maybe that's also changed regarding the MBS system that you haven't mentioned? You talked about tracking, you've talked about bypass is now part of the original model and handled differently. You've talked about how the volume is different for the threshold. You've talked about the operational differences and in the control room and the screen changes that they can see. Anything else change that we haven't identified yet through this conversation?

A. I've added various SCADA data, like valve statuses and redundant pressure transmitters. That was mentioned in the startup plan.

Q. Okay, anything else?

A. I've changed some of the tuning parameters.

Q. Okay.

A. We are running simulated leak tests on 6B and 6A now.

Q. I'm sorry, I couldn't catch that.

A. I said we're running simulated leak tests on 6A and 6B.

BY MR. NICHOLSON:

Q. Hold on, wait. What's a simulated leak test?

A. The best way to test a model is to do an actual fluid withdrawal in the pipeline.

Q. Okay.

A. In cases where you're looking at large volumes, sometimes it's better or safer to do a simulated test. Basically you build the simulation of the pipeline and you generate SCADA data with noise impressed on it to reflect the accuracy of those devices or the uncertainty in them.

Q. Okay.

A. And then you can run that data through an MBS with a leak in it. So you simulate a leak, create a dataset, run it through the MBS, and then you see what the capabilities are that's underway.

Q. Capabilities. You just --

A. Sensitivity.

Q. Okay, make sure it shows up at the right location.

A. You see what size leak you can detect.

Q. Oh, okay. You actually find the threshold of the leak? Okay.

MR. CHHATRE: That will be based on the total volume for so many cubic meters per hour this is?

MR. FARQUHAR: We set like leak rates at meters cubed per hour so you have this constant leak rate, and then you just run it and we see if you get the alarm when you're supposed to.

BY MR. NICHOLSON:

Q. Who runs the simulators? I think you might have talked about it in your previous interview. You said there are simulators used for doing kind of what if analysis?

A. Yeah, there's a couple different groups you can do different levels of simulation.

Q. But it’s not your --

A. No, our group also runs simulations.

Q. Okay.

A. Not very often yet. We also run trainers. So there's a person in our group who is using our Line 6 trainer to create a simulated leak.

Q. Oh, okay.

A. And generate the data sets for me and I run them.

Q. Where I was going with that is it seemed like one of the shifts kind of got hung up on figuring out what kind of pressures I'd need to get out of La Porte into Mendon and to Marshall, and they went through a lot of analysis. It seems like, I was just wondering if anyone used a simulator before a known station bypass just to, you know, make sure that the line was capable of moving the volumes with a station out and prior to the shutdown.

MR. JOHNSON: Like specifically for the Niles situation?

MR. NICHOLSON: Like in this situation, engineering goes Niles is going to be out, let's just see if we can, you know, what impact --

MR. PIERZINA: That's probably a Richard Foquima (ph.) question.

MR. NICHOLSON: And that's fine.

MR. FARQUHAR: Yeah, that's, personally I haven't done that and I don’t think anybody in our group has done something like that in quite a long time.

MR. NICHOLSON: But if that were to be done, it'd be done on the simulators, not the MBS?

MR. FARQUHAR: Probably a trainer. Maybe Richard can explain that.

MS. BUTLER: I've got a couple more when you guys are done with yours.

MR. NICHOLSON: Go ahead, Karen.

BY MS. BUTLER:

Q. With this version of Stoner that you're currently running, are there any known issues with the software?

A. Known issues with the software?

Q. Yeah, that you've experienced or?

A. No, I don't think there's anything particularly wrong with it. It's a couple versions behind and we're updating to a new version and going to be transferring to Windows. We've got a project to do that.

Q. Do you know when that upgrade will happen?

A. The project was opened this year. It's still getting going. I think we'll have the first one ready to go at some point

next year, and if that one is successful, then we'd rule out the other ones as quickly as we could.

Q. Would you just do that on one particular console or how will you do it?

A. We do it line by line.

Q. Okay. So Windows based, that means the units stuff goes away and it's?

A. Yep. Use Windows servers.

Q. So what line will you pick first?

A. I don't think we selected one yet.

Q. What factors will be in that process?

A. You'd want to select something that's complex.

Q. Okay.

A. Like a difficult line to model, something that would throw a lot of difficult modeling scenarios at the MBS.

Q. So I take it that you don't get to see all the pipelines, is that correct?

A. Over the course of the year I will. I've got responsibility for a subset of the lines.

Q. Okay, so which models or which pipeline are the most complex by what you've seen so far?

A. I'd say line four is very complex.

Q. Is that mainly due to elevation differences or deliveries and elevations or?

A. It's a busy pipeline. I think there's several

injections and delivery points. It's our largest diameter and largest flow rate. It's long --

MR. PIERZINA: And it's actually a dual diameter, right? It's across 36, 48?

MR. FARQUHAR: Is it, yeah, it's 36 at the beginning. It used to alternate. It used to have loops in sections.

MS. BUTLER: Okay.

MR. FARQUHAR: Line 2 can be tough as well because there's a lot of DRA on that line and that's difficult to model at times.

MS. BUTLER: You said no DRA?

MR. FARQUHAR: No, there's a lot of DRA.

MS. BUTLER: A lot of DRA. Okay. That makes sense.

MR. CHHATRE: What is DRA?

MR. PIERZINA: Drag reducing agent.

MR. CHHATRE: Okay.

MR. NICHOLSON: Which line uses that?

MS. BUTLER: On line two.

MR. FARQUHAR: We have several lines that use DRA.

MS. BUTLER: Keep going. You said Line 4, Line 2.

MR. JOHNSON: It's a polymer that gets in there and takes the turbulence --

MR. FARQUHAR: I'd say Line 6 is complicated too. There's a lot of delivery locations on it. Line 5. I mean, it's a long pipeline. It has MGL on it.

BY MS. BUTLER:

Q. Okay.

A. Probably Line 13, that one has just recently been reversed and it's a very long pipeline. I could go on. I mean, every line has its own challenges.

Q. Yeah, it's uniqueness.

A. Yeah.

Q. But, now Line 4 was quick to surface and so was 2. So I guess also I would ask you, besides the factors that we just named, like injection and delivery, diameter, elevation, are there any crossovers in any of these lines where you're actually connecting to another one of them?

A. Like a lateral?

Q. Yeah.

MR. JOHNSON: Actually what we used to have, as Brian will remember, a lot of crossovers until we looped out our lines. So I don't believe we're in that mode anymore, Karen. I mean, the lateral for instance, I mean, we deliver to Line 17 off of 6B.

MS. BUTLER: Right.

MR. JOHNSON: But I wouldn't consider that a crossover.

BY MS. BUTLER:

Q. Okay. Okay. How do routine calibrations of transmitters impact you?

A. Hopefully we'll get the call ahead of time from the field technician to see if they're going to calibrate a pressure

transmitter.

Q. Okay, and then when you get the call, what do you do? Just use your toggle?

A. Yeah. You have to disable it because the pressure transmitter is going to provide an invalid reading for a while.

Q. Okay, so when you guys do calibrations does the field ever force in a fake value?

MR. JOHNSON: We do now. Our new procedure is to force a value into the transmitters and then we read those locally on the PLC screen to ensure that the logic, so we don't just test the device remotely like the old style ones. So we force that, we send a milliamp signal to it. It shows up as reading yes, no, into the PLC.

MS. BUTLER: Okay.

MR. JOHNSON: So basically that came out of an inspection by the New York state that we hadn't been doing that.

MS. BUTLER: Okay.

MR. JOHNSON: So that's what we do now to prove the logic, if you will. So we force that value.

MR. NICHOLSON: Sorry, force what value? The pressure?

MR. JOHNSON: We force a value into the transmitter and see if the PLC would have read that, and then if it read, for instance it may begin a cascade shutdown. So it just forces a value, and I think that, does that answer your question, Karen?

BY MS. BUTLER:

Q. Yeah, because, well, a lot of people also will calibrate just routinely by forcing a value at the PLC level, go ahead and calibrate the transducer there at the device, and then unforce the value at the PLC just to make sure that it doesn't influence a lot of other programs inappropriately, and they just force it at last known value. The problem with that is it can stay forced without people realizing it. So your model, it sounds like you would pick up the stale or the data not being updated anyway, so that's good. And yes, then there's other routine calibrations and I think some notations in 1130 of certain requirements to be tested. So this looks good.

What about recommendations that come out of the things you see? So for example, are there routine locations where you have to say override transmitters on 6B more than others?

A. I'd say there's not a lot of instances where we have to override transmitters.

Q. Okay, is there any other type of juggling or manipulations, maneuvers that you would have to do at certain places on 6B to get the model going and that happens a lot?

A. I think I understand. You're saying like something that's like a common procedure that may cause an error in the MBS's capabilities?

Q. Yeah, and you're just like all the time thinking, you know, I have to do this all the time?

A. I'd say no.

Q. Okay.

A. There's nothing common that would happen.

Q. So what about for example making recommendations back to management? For example, we know you've already noted two locations where you have routine column sep., right?

A. Sure.

Q. One of which clearly has holding pressure capability already because we're at a delivery, but do you ever make like recommendations that at Leonard you put a back pressure control valve there to help eliminate that?

A. To get rid of the column separation?

Q. Yeah.

A. I'd say it's not very common. I think I have in the past but not on 6 recommended like a delivery PCB in one of our laterals because it wasn't able to hold pressure during shut downs and you get column separations.

Q So there have been things that you've noted and brought to their attention?

A Yeah, I've done stuff like that. Yep, definitely.

Q How does that process work? Do you just inform the shift leads or tell SCADA or?

A. t depends what's causing the problem.

Q Okay.

A. f it's an operational thing, like say doing something with the valve open whereas closing that valve would have no

impact on how they operate it but it impacts the MBS, then I would go to them and say I recommend that you have this valve in this position.

Q. Okay, so you would say that, who would you recommend that to?

A. I'd go to I think the CCO leadership team.

Q. Okay.

A. And then they'd assign or delegate somebody to address it.

Q. Okay. if it wasn't something like that, wasn't operational?

A. If it's equipment related and it costs money, and things like that are usually addressed in the annual Corp Capital process.

Q. Okay, so you would submit a bunch of line items?

A. Yeah.

Q. Or a request?

A. That's right.

Q. What would you call it?

A. I'd call it a capital budget submission.

Q. Okay, all right, meaning once you are submitting something for the capital budget process, what form do you fill out I guess?

A. It'd be the project proposal form.

Q. Okay. All right, and then is the leak detection

capability actually in the simulator? Like do you actually have leak detection interface with the simulator when they're running various cases?

A. Oh, like in test scenarios when the control center is running?

Q. Well, like when, let's say they put an operator through a typical startup and that's a simulation that they've created, is the leak detection system and how it would perform in that same scenario?

A. Yeah, Jim Johnston is the best person to respond to that.

Q. Okay.

A. Do you want me to keep going?

Q. As a result of the things that have happened at Marshall, has there been any thought to providing the operators some more training or to better understand that column sep. can have a certain impact on the model?

A. I don't know what they've done with the operators at the control center. In our group we've talked about that and we've said we'd like to have, we did a lessons learned session and we said we'd like to have more group sessions to take one focus area like column separations and do a presentation and discuss it.

Q. So has that been implemented yet?

A. No.

Q. Okay, but are you planning it specifically?

A. Yeah, our group is going to do it.

Q. Okay. Now when you say your group is going to do that, is that just like a tiny subset of everybody that does what you do, or is that everybody?

A. It'd be the pipeline modeling group which consists of people like myself, who are the line custodians.

Q. Got you.

A. And the analysts.

Q. All right, and I don't think we actually offered you this opportunity, but we would certainly do that, and that is if you have any thoughts on specific things that should be implemented to prevent this from happening again, we'd really like to hear them, and we ask this of just about everyone, so this is nothing that's unique to you. So if you have any thoughts, what would they be?

A. Yeah, I look at this and I say there was a rupture in the pipeline. I think there was enough things that went off to say that there was something happening and that somehow it got rationalized and we were allowed to leave the pipeline down without doing any kind of emergency response, and we need to address that so that emergency response is going to be initiated when something like this happens. It looks to me like we didn't do enough investigation into the cause of the column separation, which, to me I say the cause of the column separation is critical here in determining if there's something serious happening or not.

Q. I lost you.
A. I was saying that determining the cause of the column separation is critical in determining whether or not something serious is happening or not.
Q. Do you believe an MBS analyst should possess that ability?
A. To look at the root cause of the column separation?
Q. Yes.
A. Whether they should?
Q. Would you expect it?
A. I'd say that the capabilities would vary amongst the analysts a little bit.
Q. Okay.
A. This isn't always the easiest thing, and I don't think it's something that was in our training like to look at root cause of column separations. I say that, it typically would say identify that there is a column separation, and then the rest of the procedure is, you know, that the MBS has degraded. It doesn't mean it's not --
MR. NICHOLSON: By procedure you're referring to that flowchart we were looking at earlier?
MR. FARQUHAR: Yeah.
BY MS. BUTLER:
Q. And so you said it wasn't in your specific training. Is that easy to have incorporated?

A. Yeah, I think we'd look at that for sure. I believe that this responsibility for determining the root cause would fall either with our group or with control center staff.

Q. Okay. Anything else on that?

A. Let's see, I understand, I've seen the PHMSA release about upcoming changes to leak detection, possibly.

Q. Uh-huh.

A. I'd say to maybe take a look at CSA's Zed 662, annex E.

Q. You're going to have to repeat that because I couldn't type that that fast.

MR. NICHOLSON: Slow down a little bit.

MR. FARQUHAR: CSA, Zed or Z 662 annex E.

BY MS. BUTLER:

Q. Got you.

A. It's a --

Q. That's a Canadian standard?

A. Yeah. It's a non-mandatory annex that talks about CPM and MBS's.

Q. Okay.

A. It's similar to API 1130, but it also specifies flow meter accuracy, which is not PHMSA. Of course I am not in API 1130. That's not a bad thing to include.

Q. All right. What else?

A. That's all I have right now.

Q. Okay. I think I'll -- do you believe that that, okay,

so we have these two common column separation areas on 6B. Do you believe that with some modifications to a line they could be eliminated or not based on other types of models you've seen and pipelines?

A. Are you saying like can we run the pipeline without column separations occurring?

Q. No, what I mean is could we change the profiles in that section such that we don't as frequently get into column separations?

A. Yeah, I think the answer to that would be that you'd have to be able to shut down and hold enough pressure so that it doesn't drop and cause column separations. That's the only way to do that.

Q. All right, so I'm guessing that the lower pressures required due to integrity management problems on this line have impacted that ability, is that correct?

A. I’m not an --

Q. In your opinion?

A. That's not my area. You're probably right, but that probably you'll go to Richard Foquima (ph.).

Q. But the key point I think you just said is you have to be able to hold while you're down.

A. That's right.

Q. At a sufficient pressure.

A. Yes.

Q. Is that a good translation to what you just said?
A. That's a good translation.
Q. Okay. All right. Okay. And theoretically do you think we could model what that pressure would be?
A. You mean like a minimum pressure to prevent?
Q. Yeah.
A. Yeah, that's easy to calculate.
Q. Just needed (indiscernible). Thank you. Okay. All right, I think covered everything that I had. And I thank you for your patience with some of my questions.
A. I'm here to help out, so if I'm asked I can answer --
BY MR. NICHOLSON:
Q. I've just got three quick ones here. You mentioned that you get valve status into MBS?
A. That's right.
Q. Okay, what do you do with valve status?
A. In most of the cases you don't do anything except you trend it and then you can observe it to see where your flow path is (indiscernible). And in several cases it's used in the logic to determine whether or not flow, whether or not like a station is being bypassed or if their delivery is occurring, and then you will be able to control some of the volume balance calculations or the state estimation where it will control the amount of repeatability that you apply to an instrument. It's possible to do that. For instance, if I'm bypassing a pump station that has a

flow meter in it, normally my flow meter would be reading zero and my repeatability is set to a certain value. When I have the valves set so that it's bypassed, that will tell my repeatability logic to let the repeatability go from its regular value to full range.

Q. Okay, that makes sense. And that valve status was available on the 25th as well? That's not --

A. Well, I brought in a lot of valve statuses that weren't in the model after the 25th.

Q. Okay.

A. But they weren't in controlling the logic.

Q. They were not?

A. They were not. No, they were just used for observation.

Q. Okay. So that's what's changed now, the logic.

A. Actually, I don't think any of them read in the logic. I just trend them so people can see what's going on at a station.

Q. Would it make sense to approach a column separation as a leak until you've ruled out any additional triggers into the procedures, to just go ahead and assume it's a leak until you've, I mean is that a safe approach or not?

A. When I see a column separation I find that they're scary, and I'm careful. I don't know. I wouldn't just say a column separation period. I look at the pressure and then that's what I would communicate to the operator --

MS. BUTLER: You look at the pressure and then what?

I'm sorry.

MR. FARQUHAR: I look at the pressure, I say when the column separation, look and see when the column separation occurred, what the pressure was like, and then I'd communicate that to the operator. I'm responsible for support calls for all of our pipelines. Thirty pipelines, right? I'm not really an expert on every single pipeline. And I say the operator is usually set to run one or a couple of pipelines. In the past I would have said I'd rely on the operators' experience to tell me if it makes sense to have a column separation there, or if that pressure trend is something that they would have expected during a shut down. I'm not an expert on that. I'm sorry.

MS. BUTLER: You're fine. I hate to keep doing that to you, but I can tell you must have turned your head towards the screen or something and I lose you.

MR. FARQUHAR: I don't know. Maybe it's the phone. But what I was saying is that I communicate these things to an operator if I have a column separation alarm, and I say I rely on their experience to tell me if that, if it makes sense that what's occurring should be occurring.

BY MR. NICHOLSON:

Q. It just didn't seem like it was a lot of work for you to identify where the col seps were and then to look at pressures and look at elevations.

A. No.

Q. So it's a pretty minor inconvenience from what I can tell to just assume it's a leak and look for those other triggers until such time you can say, oh, well now the pressures are okay but the elevation is relevant to the issue here.

A. Yeah, and you know, I've got to admit that before the 25th I wouldn't have spent a lot of time looking at the elevations unless I was concerned about something. Like I said, I would communicate pressure and column separation time to the operator. I don't know if that makes sense.

Q. So then I was just curious, and I think we already touched on this, but did procedures or people fail on the 25th?

A. That's a big question. There was a big failure, I think --

Q. The procedures we went through were sound?

A. I think they're okay to provide the minimal amount of information in that case to see it's a column separation was, that's a minimum amount.

Q. Okay.

A. But I've done more investigation on this, as I said, and when I look at it now, I say that column separation was there, it's significant, but that was not the direct cause of the alarm. I think the pressure drop is the direct cause of the alarm and column separation is due to the pressure drop. It's a little bit different. They both communicate important information about what's happening with the MBS.

Q. Right.

A. But, as I say, the focus is really, should be on that pressure drop.

Q. And by procedure that should have looked at from that one block we saw, can see the procedure is probably okay. Maybe we're talking about persons not trained or doesn't understand the relationship maybe between the pressure drop and the col sep?

A. I don't want to say what Shane understood exactly.

Q. And I don't want to focus in on one person. I'm thinking more of the position of the MBS analyst because you were asked earlier is the MBS analyst capable of understanding this or looking into it in debrief, you indicated that maybe they weren't, there were different levels of understanding of the system.

A. Yeah, and it wouldn't be just analysts but even line custodians. Everybody has a little bit different depth of understanding. I think everybody has slightly different ways of investigating MBS alarms and they can come to the same conclusion or they can come to slightly different conclusions.

MS. BUTLER: So if we've had a couple of people tell us that they actually reviewed the (indiscernible) trends and we have no reason to doubt that they didn't, do you think then it's just a lack of understanding what's typically on that system?

MR. FARQUHAR: Are you saying specifically for the 25th?

MS. BUTLER: Yeah.

MR. FARQUHAR: If they looked at the pressures and flows

and they didn't, it didn't trigger any kind of concern, are you asking me if I think that might be a lack of understanding?

MS. BUTLER: Yes. For what's typical for that pipeline in certain areas?

MR. FARQUHAR: I'm not really sure.

MS. BUTLER: Okay.

MR. FARQUHAR: I'm sorry.

MR. NICHOLSON: But if you see that pressure drop and you've got other information like elevations in front of you, you have to know what's typical. You've got all the information there that would tell you, you know, the elevation is rising outside of Marshall, you should still have pressure on that line. If the elevation is still rising flat outside of Marshall. I mean, you're seeing two pieces of information that don't coincide or don't line up.

MR. FARQUHAR: Are you saying --

MR. JOHNSON: That may be asking an analyst to know the hydraulics of it also, which may not be in their role.

MR. NICHOLSON: Okay. Is that fair?

MR. FARQUHAR: That's fair.

MR. NICHOLSON: Okay.

MR. FARQUHAR: They don't typically, they're not typically expected to look at --

MS. BUTLER: They're not what? I'm sorry.

MR. FARQUHAR: I don't think it's expected for them to

look at that level and do an analysis of elevation profile and what your pressure should be doing.

MR. NICHOLSON: Okay, then I just don't understand their role I guess. Okay, so they are strictly software people?

MR. JOHNSON: Not saying they can't have more, Matthew, but you know, as we sit here and we know that, we can't assume that they know the basic hydraulics.

MS. BUTLER: But would they, if they've worked on, they're typically only assigned only certain models, is that true?

MR. FARQUHAR: No. They --

MS. BUTLER: Okay, so they move around?

MR. FARQUHAR: Well, no, no. Actually we have one analyst on 24 hours a day and they respond to alarms from all of our lines, just like I do.

MS. BUTLER: Okay, so one analyst in the control room is handling all of the 22 consoles?

MR. FARQUHAR: Yeah. With 30 pipelines I think that we have. So they're not going to have an expertise on every single line by any means. Over time you might get some, you'll pick up trends. I think probably everybody now knows that Leonard gets column separations unlike 6B. There's probably a few other locations too where people will know that you're always going to get a column separation there on a shut down, but if you get a location like Marshall, they might not, I wouldn’t expect them to know that that you're never going to get a column separation

there.

MR. NICHOLSON: When you guys get a leak at Leonard now, how is anyone going to know since column separation is typical there? Is that the next problem?

MR. FARQUHAR: It depends. If you have a leak on a running pipeline like let's say a small leak, yeah, you can still detect before it gets to column separation. The model will be degraded if they see you do pressure monitoring.

MR. NICHOLSON: Right. At shut down or start up?

MR. FARQUHAR: If you're shut down, you had a big column separation, then you have a small leak, it's possible that it'd be masked because of the degradation.

MR. NICHOLSON: And because that's typical to see that column separation.

MR. FARQUHAR: To see have a column separation, yeah. And they have procedures now, they can tell you about it, but they have, they do a calculation to fill the void, and time and they follow that very strictly so that if the void isn't filled --

MS. BUTLER: Can you raise your voice a little?

MR. FARQUHAR: I said there's new procedure in place so that when you have a known column separation the operator is only allowed to pump into for a certain amount of time, then they do like a column separation specific calculation for each one, and if you exceed that time then you shut down, isolate, and you, I don't know what you do, fly over it or something.

MR. NICHOLSON: We saw that form last night.
MR. FARQUHAR: Yeah, that's different. To answer your question, that is the plan that's in place to protect us.
MS. BUTLER: So on your analyst that's there for all the consoles in the control room, how would one go about determining if there were other pipelines and similar problems at the same time that a request came in for Line 6B?
MR. FARQUHAR: How would they know?
MS. BUTLER: No, how would somebody like me know if they're working on multiple problems at that time?
MR. FARQUHAR: How would you know?
MS. BUTLER: Uh-huh?
MR. JOHNSON: I think what Karen's driving at is how would we verify the workload that that person was under at the time. Is that fair, Karen?
MS. BUTLER: Right. Yep, that's it.
MR. NICHOLSON: There would be a material balance at that for each col sep you worked on, right?
MR. FARQUHAR: Yeah.
MS. BUTLER: But there wouldn't be a document like the sample that we got for each one of those?
MR. FARQUHAR: For each alarm? Yeah, there's supposed to be a report prepared. There'd be control center phone logs would say who called the analysts would be another one.
MS. BUTLER: Because I can see where easily when at

least two people indicated that they had reviewed pressure information, I can see where easily the need to review it would be dismissed by others, when in fact even though they reviewed it they might not have understood what they saw. So if they were really busy I can also see where they might have said that they reviewed pressure data and actually had been working on another line. And so that's just something we should probably request total reports potentially I guess.

MR. NICHOLSON: Request what? Sorry?

MS. BUTLER: Because obviously the control center call logs would be very (indiscernible) for the entire room. Okay, cool.

MR. NICHOLSON: I don't understand what you're getting at there exactly, Karen, but.

MS. BUTLER: Well, when you try to do an accident investigation right, you try to make sure you know all of the things that could cause a certain element to occur, and work load is clearly one of them that can impact both what the operator has time to do, what maybe the analyst was doing at the same time, and so all of those can factor in to whether or not anybody had reasonable time to look at it.

MR. NICHOLSON: Okay.

MS. BUTLER: At that particular moment, okay? Also, it can help explain away some miscommunications, meaning if somebody says they did something and you actually know that they were just

working on a different line, then the question can be raised and it's better, it can help prompt memory in such a way that they can say, well, yeah, I was working on that. So that's what it's about. That's all it's about.

MR. NICHOLSON: All right. Okay, anything else Karen?

MS. BUTLER: No, I think I'm done.

MR. NICHOLSON: Okay. I think, anything from you, Brian?

MR. PIERZINA: No.

MR. NICHOLSON: Ravi?

MR. CHHATRE: No.

MR. NICHOLSON: Jay?

MR. JOHNSON: No.

MR. NICHOLSON: Okay, and at this time I think we'll conclude our interview with Ted, and I appreciate your time, and if you think of anything else that might help us prevent these things in the future, feel free to contact us.

MR. FARQUHAR: Thank you.

(Whereupon, the interview was concluded.)

CERTIFICATE

This is to certify that the attached proceeding before the

NATIONAL TRANSPORTATION SAFETY BOARD

IN THE MATTER OF: ENBRIDGE OIL SPILL
MARSHALL, MICHIGAN
Interview of Ted Farquhar

DOCKET NUMBER: DCA-10-MP-007

PLACE: Edmonton, Canada

DATE: December 16, 2010

was held according to the record, and that this is the original, complete, true and accurate transcript which has been compared to the recording accomplished at the hearing.

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Kay Maurer (pages 1 to 97)
Kristen Shankleton (pages 98 to 178)
Transcribers