UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

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Investigation of: *
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ENBRIDGE - LINE 6B RUPTURE IN * Docket No.: DCA-10-MP-007
MARSHALL, MICHIGAN *
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Interview of: PETRA SENF

Volume 1 (Parts 1-3)

GE Pii Facilities
Calgary, Alberta
Canada

Wednesday,
January 11, 2012

The above-captioned matter convened, pursuant to notice.

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Investigator-in-Charge

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I N D E X

ITEM	PAGE
Interview of Petra Senf:	
By Mr. Nicholson	8
By Mr. Pierzina	18
By Mr. Nicholson	19
By Mr. Chhatre	40
By Mr. Pierzina	57
By Mr. Chhatre	59
By Mr. Pierzina	68
By Mr. Nicholson	70
By Mr. Chhatre	81
By Mr. Pierzina	86
By Mr. Nicholson	89
By Mr. Chhatre	90
By Mr. Nicholson	99
By Mr. Chhatre	103
By Mr. Nicholson	105
By Mr. Chhatre	111
By Mr. Pierzina	141
By Mr. Chhatre	142
By Mr. Pierzina	147
By Mr. Chhatre	148
By Mr. Nicholson	165

I N D E X

ITEM	PAGE
Interview of Petra Senf:	
By Mr. Chhatre	167
By Mr. Nicholson	192
By Mr. Chhatre	195
By Mr. Nicholson	199
By Mr. Chhatre	201
By Mr. Nicholson	214
By Mr. Chhatre	217
By Mr. Pierzina	229
By Mr. Nicholson	237

I N T E R V I E W

MR. NICHOLSON: Okay. We'll go on the record at this point. This is NTSB Pipeline case number DCA-10-MP-007, Enbridge Energy July 2010 crude oil release in Marshall, Michigan. These are the Integrity Management Group interviews being conducted in Calgary, Alberta, Canada, at the GE Pii facilities. Today is January 11th, 2012.

This interview is being recorded for transcription at a later date. Copies of the transcripts will be provided to the parties and the witness for review once completed.

For the record, Petra, please state your full name, with spelling, employer name, and job title.

MS. SENF: Okay. My name is Petra Senf, P-e-t-r-a, S-e-n-f, and I'm the technical aide for global data analysis ultrasonics.

MR. NICHOLSON: And, if you could, your -- did you say -- state your employer's name?

MS. SENF: So it's -- working for Pii Pipeline Solutions.

MR. NICHOLSON: Okay. Thank you. And Petra, for the record, please provide a contact phone number and e-mail address that you can be reached at.

MS. SENF: Okay. The telephone number, it's [redacted]. The e-mail address, [redacted]

MR. NICHOLSON: Okay. Thanks. Petra, you are allowed to have one other person of your choice present during this interview. This person may be an attorney, friend, family member, co-worker, or nobody at all. If you would, please indicate whom you've chosen to be present with you during this interview.

MS. SENF: It's Bill Killoran.

MR. NICHOLSON: Now we will go around the room, have each person introduce themselves for the record. Please include your name with spelling, employer's name and contact phone number and e-mail address.

I'll start and we'll progress clockwise from my left. My name is Matthew Nicholson, M-a-t-t-h-e-w, N-i-c-h-o-l-s-o-n. I'm the National Transportation Safety Board, investigator-in-charge. My phone number is [redacted] My e-mail is [redacted]

MR. CHHATRE: Ravi Chhatre. That's R-a-v-i, last name Chhatre, C-h-h-a-t-r-e. I'm an accident investigator at National Transportation Safety Board, assisting IIC on integrity management in this accident. My e-mail is [redacted] My phone number is [redacted]

MR. PIERZINA: I'm Brian Pierzina with the PHSMA Central Region in Kansas City, and that's B-r-i-a-n, P-i-e-r-z-i-n-a. My e-mail is [redacted] And my phone number is [redacted]

MR. KILLORAN: My name is Bill Killoran, K-i-l-l-o-r-a-n. I am associate general counsel for GE Oil & Gas. My phone number is [redacted] and my e-mail is [redacted]

MR. FOREMAN: I'm Geoff Foreman, G-e-o-f-f, F-o-r-e-m-a-n. I'm the global growth and strategy leader for Pii Pipeline Solutions. My phone number is [redacted] and my e-mail address is [redacted].

MR. GARTH: My name is Clint Garth, C-l-i-n-t, G-a-r-t-h. I am with Pii Pipeline Solutions. My e-mail address is [redacted] and my contact phone number is [redacted]

MR. JOHNSON: And Jay Johnson, J-a-y, J-o-h-n-s-o-n. I'm a supervisor of U.S. compliance for Enbridge Pipeline. My e-mail address is [redacted]

MR. NICHOLSON: Okay. That's everyone in the room.

INTERVIEW OF PETRA SENF

BY MR. NICHOLSON:

Q. So, Petra, I thought maybe to begin with you could give us -- I mean, you started this off the record, but if you would do so on the record, give us a little bit about your background, educational experience, how long you've been with Pii, the type of work you do, and just kind of bring us up to date with that sort of thing.

A. Um-hum. Okay. Then my original profession is a technical designer. And I started in 1997 as a data analyst with Pii Pipeline Solutions, and I became a team leader for USCD in 2002. And since 2008, January 2008, I'm the technical lead for

the global analysis ultrasonics.
Q. Okay. So 2002 you were the USCD team leader?
A. Yes, right.
Q. Can you elaborate a little bit; what does that entail?
A. So, that means leading the -- leading all the CD projects which were processed in Stutensee at that time. So, it means not having any direct reports, because direct reports were another analysis manager, but just -- yeah, managing the projects with the analysts available at that time.
Q. And what sort of projects would they be?
A. So, the projects means when an in-line inspection is done the data will come to the analysis department. And starting with data processing, DQA, the analysis itself, the quality check, and the report generation, this part of the project.
Q. Okay. So a project is an in-line inspection run?
A. It's one in-line inspection, correct.
Q. Okay.
A. Yes.
Q. And to back up a little bit, did you say it was 1987 when you started?
A. '97.
Q. 1997?
A. 1997.
Q. And at that time you were a data analyst?
A. Yes, right.

Q. So you worked under a team leader?
A. Correct, yes.
Q. Okay. And your function then was to do what?
A. Doing pure data analysis at that time. Yeah, analysis, and after a year or two I also did quality check on the data and generated reports mainly.
Q. And was this all done at -- are you -- was this originally part of the Center for Excellence? Have you always been stationed in Germany?
A. Yes, always.
Q. Okay.
A. Um-hum.
Q. And in 1997, is that where all the in-line inspection data analysis was being performed is Germany?
A. Yes, at that time it was only performed in Germany, yes.
MR. FOREMAN: And a clarification here.
MR. NICHOLSON: Geoff, you would like to clarify?
MR. FOREMAN: Yeah, Geoff Foreman here. Just to clarify. We're talking about 1997.
MS. SENF: Um-hum.
MR. FOREMAN: So, that was Pipetronix. That was before the acquisition of Pii with Pipetronix. So I don't want it to come across that all analysis, because that's not Pii; that was Pipetronix analysis was done in Germany.
MR. PIERZINA: And this is Brian Pierzina. I just

wanted to clarify here -- data analysis, was it ultrasonics or --

MS. SENF: It was ultrasonics, USCD, yes.

BY MR. NICHOLSON:

Q. Okay. So I wanted to know a little more about your data analyst days, I guess. You say you're doing pure data analysis. Can you just walk us through those steps? Is this after the features are boxed? We've heard a little bit about that sort of thing.

A. Um-hum, um-hum. Yes. So the data translation of processing means the data are brought into a format that it can be visualized on the analysis software, and when it comes to data analysis the boxes are already generated for analysis. And the analyst starts with getting -- or with creating a list of boxes which need to be reviewed. And though the criteria for this is determined before, based on the amplitudes which were received -- so the maximum amplitude, the relative amplitude, the overlap of a feature, and the minimum lengths of a feature, these are the criterias for the features which need to be analyzed. So lots of boxes are generated during the data processing, but only a part of it is actually analyzed which meets the analysis thresholds.

Q. And that's a procedure? That's a document, a written document that tells you what thresholds you're looking for, for analysis?

A. There is a document that describes the analysis process, but in the analysis software the analyst gets -- he just selects the section which he needs to analyze and says, okay, I'll do Step 1 analysis, coarse (ph.) analysis, which means with the lengths of 80 or 100 millimeters only, and then he gets a list of the features he has to look at.

Q. Oh, okay, so it's by a threshold; is that what you --

A. Yeah. Correct, yeah.

Q. Okay. And would you only analyze corrosion features or -- this is back in '97 -- would you look at both cracks and corrosion?

A. Only crack features.

Q. Only crack features. Okay.

A. Um-hum, yes.

Q. So, that's fairly typical to split up the analysis between corrosion and cracks?

A. Yes. So we have two separate departments for that and also the data itself looked different and, yeah, the software, the analysis software is different as well.

Q. So, you continue doing data analysis from '97 through 2002?

A. Yes, right.

Q. Okay. And at what point -- when do you transition from a data analyst to a team leader? How does that --

A. When?

Q. What got you -- what qualified you to be a team leader, I guess is what I'm asking, from a data analyst? Did you reach a certain level in certification?

A. Yes. At that time we didn't have any levels of certification so it was mainly based on experience. So, at that time I had provided some trainings for new analysts. So I was in Calgary, for instance, for 3 months in 2001 to provide a training, and based on this experience -- so a second team leader was needed in Stutensee and I applied for that role.

Q. Oh, okay.

A. Um-hum.

Q. So you actually applied for that?

A. Um-hum.

Q. But you said you had no direct reports? Did I hear that correctly?

A. Yes. I didn't have a direct report. The analysis manager at that time did have all the -- did have me as a team lead and also the analyst as his direct reports.

Q. Okay.

A. Um-hum.

Q. But as a team leader, you're not necessarily doing the data analysis? You're monitoring other --

A. Yeah. So, at that time I also did some quality check on data, but it was mainly managing the project, yes.

Q. And can you talk a little bit then about the quality checks? We had heard before, in previous interviews, that like a Level 0, I guess, essentially a new analyst, gets 100% of their data checked and then it changes.

A. Um-hum.

Q. Can you talk about that a little bit?

A. So, so --

MR. KILLORAN: Just for clarification, are you asking back then; today, 2012?

MS. SENF: Yeah.

MR. NICHOLSON: Actually, I am asking back then and then we're going to project forward.

MR. KILLORAN: Okay.

MS. SENF: Okay. So, in 2005 or 2006 we just started with our certification program. And at that time a Level 0 or a trainee needed one year of experience before you were certified to a Level 1. And at that time the quality check mainly included the check of all the reportable features, which go to the final report, and also included a check, a percentage of, of the non-reportable features, which are features called irrelevant, which are not relevant to the -- or, yeah, not in any way severe to the pipeline, just seam weld reflections, for instance, or geometries or weak inclusions. So and at that time we checked 5% of the non-reportable features, independent if it was a Level 0 trainee or a Level 1 or Level 2.

MR. CHHATRE: Five percent of non-reportables?

MS. SENF: Of non-reportable features, yes.

BY MR. NICHOLSON:

Q. And that's for, you said, regardless of level, 5%?
A. Correct. At that time it was regardless of level.
Q. But I missed -- you talked about a Level 0 needed one year of experience to be Level 1?
A. Um-hum.
Q. And I'm not sure I heard, what quality check is performed on the Level 0's analysis?
A. So, it was the same as for a Level 1 at that time. It was 5% of the non-reportables and 100% of the reportable features.
Q. Okay. So it's the same for a Level 0 or a Level 1?
A. Yes, correct.
Q. Okay. So would you ever have -- is data analysis always performed by Level 0, Level 1 at that time, or would you have a Level 2 or 3 doing analysis?
A. No. No, at that time also Level 2's. At that time we didn't have any Level 3's, so at that time it was done by Level 0's, by Level 1 and by Level 2 analysts.
Q. Okay. So then the Level 2's work would be -- how much of the reportables would be checked for a Level 2?
A. At that time the process wasn't as strict as it is today. In some cases we even didn't check the work of a Level 2 a second time because the assumption was that a Level 2 knows what he's doing so there is no second check necessary.
Q. And you said earlier a Level 0 needed one year of experience to be a Level 1.

A. Um-hum.
Q. Am I to extrapolate and say that a Level 2 had two years' experience or did it not --
A. From Level 0 to 1 is one year and another year to a Level 2. So that means, yeah, at least two years --
Q. So, your level is essentially years of experience?
A. Yes.
Q. Okay.
(Whispered conversation.)
MS. SENF: It's also passing a test, yes.
So, and it's not only that they achieve a certification after a year, there is a test.
BY MR. NICHOLSON:
Q. Oh, okay.
A. So, it's a theoretical test and also practical test. They have to do analysis on a data set and based on the result of that -- so it's 70% -- if he's right 70%, then he will pass the test, yes.
Q. I'm going to ask you to recap that. So it's a theoretical test. That's something about the theory and then --
A. Um-hum.
Q. -- what was the rest of the test?
A. A practical test.
Q. Okay.
A. So they have to do analysis on a data set --

Q. Oh, okay.
A. -- identified data set and -- yeah.
Q. Okay. So they're actually presented -- they're challenged with a set of data they have to interpret, correct?
A. Um-hum. Yeah, um-hum.
Q. And you said they have to get a 70% --
A. 70%.
Q. -- on the practical?
A. Yes. On both of it.
Q. Okay.
A. So, practical -- so the practical is one part of it and, yeah, overall -- for each task it's 70%.
MR. FOREMAN: Geoff Foreman here. I've got the impression you believe it's another year for a Level 3 from a Level 2?
MR. NICHOLSON: That's what I thought I heard.
MR. FOREMAN: No, but it's not. It's a big step.
MR. NICHOLSON: Oh, okay.
MS. SENF: Not to a Level 3. It's 5 years.
MR. FOREMAN: It's 5 years for a Level 3.
MR. NICHOLSON: Oh, okay.
MS. SENF: Yeah, for a Level 3.
MR. FOREMAN: It's not just gradual every year you go up a step and a test.
MR. NICHOLSON: Right.

MR. FOREMAN: It's only to a Level 2. And then Level 3 you have to have 5 years' experience, because they're inspectors and experts.

BY MR. NICHOLSON:

Q. So up to a level -- so to move from 2 to 3 you have to have 5 additional years at a Level 2 level?

A. In total 5 years of experience.

MR. FOREMAN: A total of 5.

MR. NICHOLSON: A total of 5?

MS. SENF: A total of 5 years of experience.

MR. FOREMAN: A total of 5, so additional 3.

MS. SENF: Yeah.

BY MR. PIERZINA:

Q. This is Brian. Is there an additional test to be certified as a Level 3?

A. Yes. So for each level there is a test to be certified, yeah.

Q. Okay. Can you describe that test also?

A. So for Level 1 it is really basic analysis, so that they know how the analysis software works, how to identify the different feature types.

And for a Level 2 it's the different steps of the data analysis, means data processing, markers, pipe correlation and data analysis and report generation.

And for a Level 3 it's -- in addition to the Level 2 stuff it's also client presentation and DQA to do the assessment if a run is acceptable or not. And, yeah, and kind of leading a project.

Q. So is the Level 3 test still the 70% pass/fail threshold or is it more a demonstration?

A. Yeah, it's -- no, it's still 70%. It's the same for all the different levels.

Q. Okay.

BY MR. NICHOLSON:

Q. So with that understanding, you then -- Petra, yourself then, in 2002 were you a level -- you would have been a Level 3?

A. No, at that time, in -- we started with our certification program in 2005.

Q. Okay.

A. The beginning of 2005, so --

Q. So, you were just a team leader?

A. I was just a team leader, yeah.

Q. No such thing as certifications prior to 2005?

A. No, no.

Q. Okay. So, when 2005 came about, did that mean persons like yourself with many years' experience were grandfathered or just put right in as a Level 3 or did you --

A. No, no.

Q. -- have to start at 0 and --

A. No, no. So, we all passed -- had to pass a Level 2 test.

Q. Okay.

A. So -- was it even -- no, it was just the Level 2 test, not a Level 1 test. And I'm not sure when I achieved my Level 3. I guess it's 6 years ago. Then it was in 2006, I guess, I got my Level 3 -- 2006 or 2007. I guess it was in 2006.

Q. Approximately.

A. Yeah, um-hum.

Q. And I haven't heard anything beyond a 3, so is 3 like that's it; that's where you capped out? That's the maximum?

A. Yeah, that's the maximum.

Q. Okay.

A. Which would include all the team leader tasks, I would say, yeah.

Q. Right. And from team leader where do you go? Manager? Did I hear you say there was a manager of the analysis group or --

A. So, there was -- at that time we had in Stutensee an analysis manager.

Q. Um-hum.

A. But so, I moved from the team leader at that time to the technical lead --

Q. Okay.

A. -- which where I am still.

Q. And then I guess -- the other thing I'd like to know is, what is -- I mean, you're here today for a reason.

A. Um-hum.
Q. And I'm not sure -- I think, as I understand it, you were asked to review the Enbridge data from 2005?
A. Um-hum.
Q Is that -- could you explain a little bit what your involvement's been? Were you -- did you do any quality check in 2005 on this Enbridge Line 6B or -- explain to us why you're here today, what it is you can talk to on the Enbridge Line 6B, so we have some background, please.
A. Yeah, okay. So, in general, if there is a failure in a pipeline related to USCD technology, I'm the expert for it. And so, I'm first point of contact to look at the data and to explain what we see in the data. And, yes, and in 2005 or 2006 I also did some quality check on that project.
Okay. To clarify my involvement in data analysis -- so at that time we provided the analysis result in two steps: in a Step 1 analysis, which means the deeper features with a longer length; and Step 2 means the final analysis threshold. At that time, I guess, it was 60 by 1 millimeter.
And I was involved in the Step 2 analysis, especially from this section here. I also did analysis on it, but it was Step 2, means it was a find evaluation. The feature in question was a part of the Step 1 analysis.
Q. Okay. Can you go back over the steps again?
A. Um-hum. Yes.

Q. I think I got lost.
A. Yes. So Step 1 means it's -- the deeper features, which -- to give the client an idea what kind of features are in the pipeline. So, it means we set the threshold -- these are higher thresholds we use for data analysis.
So this -- the failed feature or this pipe joint was part of this Step 1 analysis.
Q. Those are your worst case features? They're obvious --
A. The worst case, yeah. I don't want to say that there are other -- that there are no worst case features in the Step 2 analysis --
Q. Oh, okay.
A. -- could also be. But it is assumed that the most severe features are found in Step 1 analysis.
Q. And that's based on depth thresholds and --
A. It's based on the amplitudes. Not really on depths --
Q. Okay.
A. -- but on the amplitudes and on the feature lengths and overlap.
Q. Okay.
A. Um-hum.
Q. And the feature that failed was actually a Step 1?
A. Step 1, yes.
Q. Okay. So that wouldn't have been anything you looked at in 2?

A. No. Yeah.
Q. Okay. And then if you could then, the second step again was what? It's just --
A. It's --
Q. -- features you had to look a little harder at?
A. The second step means just -- no, the client requested all features with a certain length and a certain depth. So, in this case, I believe it was 60 millimeter length, minimum length, and 1 millimeter depth.
Q. Okay.
A. So, all the features which are above this threshold will be looked at in the Step 2 analysis. So, all the ones which were not captured in Step 1 are captured in Step 2.
Q. Okay. And you said -- and so your involvement specifically was QC-ing that?
A. Yes, I did QC also on this section, um-hum.
Q. On the section that failed?
A. Yeah. So, the data are separate, in two sections. So, it's -- we have -- I'm not sure how long the section is -- 200 kilometers or so. I'm not sure. So, but we separate our data in 1.5 kilometer sections --
Q. Okay.
A. -- because we had several analysts and one -- when I talk about sections I always mean this 1.5 kilometer section.
Q. Okay.

A. Um-hum.

Q. And so then, I'm not sure we ever got an answer. The person -- the analyst that looked at the section -- this 1.5 kilometer section that included the failed segment, what level was that?

A. The analyst was a trainee --

Q. Okay.

A. -- at that time. And --

Q. And the same trainee -- that's a Level 0, I guess, you're saying?

A. That's a Level 0, yes, right.

Q. That trainee then would have done both the Step 1 and the Step 2 analysis?

A. No. No, only the Step 1 analysis. So, we do the Step 1 analysis. We do the QC on that analysis, generate a preliminary report, and then we continue with Step 2 analysis. So we go through all the sections again, just with different thresholds. Do the Step 2 analysis, do the Step 2 quality check, and then generate the final report.

Q. So Step 2 would go to a different analyst?

A. Yes.

Q. Oh.

A. Yeah. And so, it's not really mandatory that it's a different analyst but we like to have different analysts just to make sure that not one analyst is checking maybe a real big chunk of data, yeah. Or it's not -- let's say like this -- there is also a control when a Step 2 analyst -- he sees the Step 1 analysis, right, and so he can control Step 1 analysis and he also can get some guidelines from the Step 1 analysis, and it's better to have that with two different analysts.

Q. Okay. So, that's by design then that you have different analysts at the different steps. So, who would have -- who did the QC on the Step 1 analysis that this trainee performed?

A. It was a Level 2 analyst at that time.

Q. And would that have also been done out of that Center for Excellence; is that --

A. So we started with analysis center in Poland at that time in 2005. So, the analysis was done in Poland.

Q. Okay.

A. At that time we only had trainees in Poland. And the quality check is always done by Pii. So that was done in Stutensee by -- yeah, by one of the analysts in Center for Excellence.

Q. Okay. So, you had -- so for the failed feature you really had no involvement other than present day?

A. No.

Q. Okay. And then -- let's fast forward then to what you looked -- when were you asked to look at the feature that failed? Can you go back and tell us when you -- when were you first asked to review this?

A. Um-hum. It was right after the failure. So, the failure happened on the -- it was in July, wasn't it?

Q. Um-hum.

A. And I'm not sure if it happened on a weekend. It happened on a weekend, then I would have left on Monday. Is that right, or was it a Sunday? It was a Sunday, because I had to get my laptop from the office and it wasn't easy because the alarm was on.

Q. So you were asked on a Sunday to review it, in July? Okay. That's awfully quick.

MR. JOHNSON: It's immediate. This is Jay. No, that's -- historically that's what we've done with GE and they have reacted that quickly. The minute we have an issue, we get with GE. They mainly pull in anyone and everyone. Maybe you could talk to this better, Geoff.

MR. FOREMAN: Yeah.

MR. JOHNSON: So to us that -- those of us that traveled there, that wasn't quick. That's --

MR. NICHOLSON: So that's not unusual then?

MR. JOHNSON: There you go. That's a good way to put it, yeah.

MR. PIERZINA: And this is Brian. I guess it would be important to understand exactly how that process works. So, you didn't get a call from Enbridge; you got a call from somebody probably in Calgary or something. So if we could maybe understand the who's and --

MR. KILLORAN: Perhaps the best way is simply for Petra to explain who called you and --

MR. PIERZINA: Right. Exactly. Thank you, Bill.

MS. SENF: Yeah, yeah. So, who called me? I guess it was you, Geoff, wasn't it?

MR. FOREMAN: I can't remember, to be honest. I don't think it was me, no.

MS. SENF: Yeah, so --

MR. FOREMAN: It might have been -- I don't know. I'd have to find out who it was.

MR. JOHNSON: That may be -- this is Jay -- maybe an IR, if we could, probably from our side of it too, is what's the, you know, the chain of command, for lack of a better term, on who calls who?

MR. FOREMAN: Yeah. I have been the first to receive calls. Like Tom Zimmerman called me --

MR. JOHNSON: Um-hum.

MR. FOREMAN: -- on a previous occasion on a weekend and we spoke at length. Actually, it might, to be honest on this one --

MR. KILLORAN: Well, if you don't know, don't speculation.

MR. FOREMAN: I don't know. I don't know. But, we have -- it's normally via the desk engineer, the project manager or myself, depending if it's -- if it's a workday, it will be through the desk engineer, project manager. If it's out of hours, it could be me if they can't reach anybody else.

We have kind of a contingency phone list at Enbridge, who are the people that they can contact in an emergency if they can't go through -- you know, we have a checklist. So, if I'm -- if no one was available, it would be me. On this particular occasion it wasn't me, I don't believe.

MR. CHHATRE: This is Ravi, NTSB. If you can just maybe give us a timeline what --

MR. FOREMAN: Yeah, yeah.

MS. SENF: Um-hum.

MR. CHHATRE: -- on that one. I think (indiscernible) what happened after the incident, after you got a call or somebody --

MR. FOREMAN: Yeah.

MR. CHHATRE: -- at GE got a call from Enbridge, what happened from that point on?

MR. JOHNSON: And I have one confusion because that would have been Monday. Did I misunderstand something?

MS. SENF: So, what I am not sure, if it really was at the weekend or not. So, I know there was a failure at the weekend and I was called on a Sunday, but I'm not sure if it was Line 6B. If it was not Line 6B, then I got an e-mail on the next --

MR. JOHNSON: On Monday.

MS. SENF: -- on Monday, yes.

MR. FOREMAN: But just, just to clarify, I think, to go through the process.

MR. NICHOLSON: Yeah, that's -- I want to go back to that.

MS. SENF: Yeah. Yeah, I guess, um-hum.

MR. FOREMAN: Go through the process. So, what tends to happen is, one of us at a senior level will be contacted from either the operations or integrity group or the projects group in Enbridge to say that they have had an incident.

At that time we never really know precisely where the failure feature is. So, what we do is we mobilize the team lead in Clint's group that was responsible for the analysis of that pipeline and we have a rough approximation, maybe a 5-mile section from here to here; could you just look through the data and tell us if there's anything that we should know about? We can't give you any more information than that.

So, what we do is we restore on our servers all of the data from the report. So that takes probably a day or two to get all of the relevant data transferred onto the screen so that we can look at it. And we tend to then push hard on Enbridge for information, because we don't know what's failed or why it's failed. So, we don't know if it's a crack; we don't know if its corrosion; we don't know if its mechanical damage, somebody's hit the pipe. So we're not focused directly straight into CD. We might be -- it might be WM. It might be a caliper run.

So we restore all the data we've got from all of the tool runs that we've had, the most recent ones. And then we wait for Enbridge. And Enbridge will come back and say, we've isolated down to these five joints. Then now we can start doing something.

Five miles is a hell of a lot of data to try and zoom in on. Until we can get an exact location -- and even then on the joint you might have multiple features, so which is the feature we should be looking at? So it becomes an inquitive [sic] process, as and when Enbridge get more and more field information to us.

So we can speculate. We can look at stuff. We can lay it out to the Enbridge Integrity Group and say, this is what we've seen in the last inspections with a caliper, an MFL tool, a WM tool and a CD tool, but until we know exactly which feature failed, it's very difficult to get anything meaningful, other than -- to the Enbridge guys, this is what you can expect when you open up.

But until you actually get the forensics and the field detail and the measurement from the welds upstream, downstream, the orientation, that's when we can really start doing our analysis work on which is the most likely cause of failure, what did it look like X months, years, days when that inspection took place. So, that's the kind of process that goes on.

Then we have a lot of meetings with the Enbridge Integrity Group, passing information saying -- you know, as they get more information we get -- we may have WebExes with them and share screen shots, and we look and we diagnose. So we have a bit of a brainstorming on -- to help as much as we can on what we saw, when we saw it.

MR. NICHOLSON: This is Matt. Does that include -- do they bring up analysis that they performed on, say, crack defects? Do they bring up their CorLAS or their FlawCheck analysis?

MR. FOREMAN: No.

MR. NICHOLSON: No. They don't get into that?

MR. FOREMAN: No.

MR. NICHOLSON: Okay. Dig reports or --

MR. FOREMAN: They're mainly asking us for what we see.

MR. NICHOLSON: Okay. Okay, so then I think at this point, we should go back to Petra and let her -- unless, Brian, did you have a comment?

MR. PIERZINA: Nope. No, that's exactly what I was thinking.

BY MR. NICHOLSON:

Q. Then maybe, Petra, you could talk then to, as Geoff described, what you did --

A. Um-hum.

Q. -- once you started pulling that data?

A. Um-hum, um-hum. Yeah. So, I was looking at the data. So, yeah, I remember that I was told that it might have been at 26.5 feet from the upstream girth weld. At that time I had the number of the girth weld. Looked at the data at 26.5. And we saw that we reported six features in that pipe joint. And the one which we reported was a crack-like indication of 12.5 to 25% deep and about approximately 1.3 meters long.

Q.   Okay. So, that was pretty targeted then. You -- I mean, the process you described really didn't have to take place here. You had it nailed down.

A.   Yeah, well --

Q.   You had girth weld. You had approximate --

A.   Yeah, this was -- I guess, this was after the process.

MR. FOREMAN: At the end of my process.

MS. SENF: At the end of his process that -- yeah.

MR. NICHOLSON: Oh, at the end.

BY MR. NICHOLSON:

Q.   I was curious about on that Sunday or Monday --

A.   No.

Q.   -- what you had to pull up.

MR. JOHNSON: And this is Jay. And certainly, Matt -- you were there -- it took us a long time to even nail down the joint, much less --

MR. NICHOLSON: Well, yeah, that's --

MR. FOREMAN: Because of the water and everything.

MS. SENF: Um-hum, yes.

MR. NICHOLSON: That's how I remembered it too.

MR. JOHNSON: Because of the area we're in.

MR. NICHOLSON: So I was interested to hear.

MS. SENF: But when I got involved the girth weld number was there.

MR. NICHOLSON: Okay.

MS. SENF: And the approximate distance of the feature was there.

MR. NICHOLSON: Okay. So I must have missed it.

MS. SENF: Um-hum.

MR. NICHOLSON: So the preliminary stages it's all you.

MR. FOREMAN: Right. So --

MR. NICHOLSON: You don't bring Petra in until you have that?

MR. FOREMAN: That's right. So it's Geoff Foreman here. So, until we can actually give Petra a real target zone.

MR. NICHOLSON: Oh, okay.

MR. FOREMAN: And then -- it's not worth us involving the Center of Excellence until we can actually give them a -- something to actually look at.

MR. NICHOLSON: Okay.

MR. FOREMAN: So we do all of the preamble here in Calgary with the team here and Enbridge, until we -- and as soon as we can identify an exact location, then we get the Center of Excellence. They already are preparing data and they can look at our servers, but we actually officially involve them when I have a target.

MR. NICHOLSON: Okay.
MS. SENF: Um-hum.
BY MR. NICHOLSON:
Q. So if you can continue then; you saw the six indications?
A. Um-hum, yes.
Q. What was -- what happened from there and can you --
A. So, what I did, I -- normally I would contact Arne Mayer. So, he's responsible for our failure in all -- he's the --
Q. Can you spell that name? I'm sorry.
A. Arne Mayer, A-r-n-e, M-a-e-e-r.
Q. Okay.
A. M-a-i-e-r, yeah.
MR. FOREMAN: M-a --
MS. SENF: M-a-i-e-r.
MR. CHHATRE: Can you repeat that? This is Ravi.
MR. KILLORAN: A-r-n-e, M-a-y-e-r.
MR. CHHATRE: Okay.
MS. SENF: Okay. So he's responsible for our failure investigation team. So he was on vacation at that time, so I have contacted his deputy, and this was Dieter Hallmaier. I'm getting you -- so it's D-i-e-t-e-r, H-a-l-l-m-a-i-e-r. Okay.
So, and I asked him to initiate a FIT. So this is the first thing then we do because now we have to investigate, even if we have reported feature here, to make sure that we check

everything again. So that we check if the -- what -- if the analysis was right, if the settings for the -- the online settings for the inspections were right. So we check all the parameters again to see everything was right and also provide some screen shots of the feature.

BY MR. NICHOLSON:

Q. And you say you do -- you recheck all the analysis on those six features or on other features?

A. Yeah. On the -- first on the feature which failed, so this is the first thing we do. We check the analysis there.

Q. But you didn't know which feature had failed, even at the that stage, right?

A. Well, at that stage I knew that it was at 26.5 feet from the upstream girth weld.

Q. But you had six features. You didn't know which one of those?

A. Well, I have a distance to each feature and so --

Q. Oh.

A. I had the upstream distance or the distance from the upstream girth weld.

Q. Okay. So that must have been after they pulled the pipe out?

A. Um-hum.

MR. KILLORAN: I don't think you're understanding. Did you know which of the six features had failed?

MS. SENF: I was told that I should look at distance 26.5 from the upstream girth weld and there was one feature box, yes.

MR. NICHOLSON: Okay. No, I understood.

MS. SENF: Good.

MR. NICHOLSON: I think we're good.

BY MR. NICHOLSON:

Q. Okay. And then -- I didn't hear -- when you analyzed that feature what were you seeing versus what had been reported? Did you come to the same conclusions as the original analysis?

A. No, I did not. So, I looked through all the different B scans and the first thing I thought, hey, this should have been classified as a crack field not as a crack-like.

Q. Okay. Can you elaborate on that why -- what did you see this time --

A. Okay.

Q. -- that they didn't see the first time maybe?

A. What did I see? So, I saw some typical crack field indications, which means some irregular short cracking indications in a kind of a colony. And I had at least four sensors, clockwise and counterclockwise sensors, which detected that feature. I also saw a kind of a -- or a linear indication, which could be identified or interpreted as a crack-like indication. So, I saw two feature type in that feature box.

MR. PIERZINA: This is Brian. So you said you saw crack-like and crack field indications --

MS. SENF: Correct.

MR. PIERZINA: -- within the box?

MS. SENF: Yes.

MR. PIERZINA: So, in your mind does that make it a crack field feature at that point or two different features?

MS. SENF: Today I would say there should be two different features, two different boxes for these features, because we have two different feature types, yes. So that should be reported separately today. I would say so.

MR. JOHNSON: This is Jay. So you say today.

MS. SENF: Today.

MR. JOHNSON: So that change has been made?

MS. SENF: Yes. So, in the past, when we were at the long seam, we didn't really see that there is a need to have separate boxes. So, we took the most severe indication. And so, we boxed all the indications we saw but took the most severe one as the feature type and based on all the signals we saw, we did the depth sizing.

So, because the feature type crack-like and crack field didn't mean such a big difference for the analysis group, right, so we -- so it's a crack. So if it's a colony or if it's an individual, at that time it wasn't really that clear that these two feature types might be interpreted or used by the -- by Enbridge in different ways. But by the analysis team, okay, it's a cracking indication and, yeah, I see that crack-like. I also see the crack field, but I think I should rather go with crack-like. It sounds more severe, 1.3 millimeters.

MR. JOHNSON: Yeah. This is Jay again. So when -- and certainly you can answer this or Geoff can answer it. When was that change made within GE's process?

MS. SENF: So it was made in 2008, because in 2008 we changed our sizing algorithm. So we figured out that we -- that there is a tendency to undercall crack fields because of the nature or characteristic of these features. And so, the crack fields are treated more severe or are treated, let's say, estimated deeper based -- when they have the same amplitude as a crack-like, they still would be called deeper now meanwhile.

And using different sizing algorithms would mean we have to box each feature as it is. So when there is a crack field we only have to use the crack field indications in that box for sizing. And when there is an additional crack-like, we have to have a separate box and use a crack-like algorithm for that.

MR. JOHNSON: And I -- this is still Jay. I don't want to lead anyone here. Did some of these findings come from things we didn't find or feedback from the pipeline companies like Enbridge?

MS. SENF: Yeah. Actually we -- we started with our new sizing algorithm for a project in the U.S., a non-Enbridge project. So, it was with our new tool called Duo tool. So at that time when we did the first inspections with our Duo tool, which had a slightly -- which does have different sensors.

So we used our CD sizing algorithms right at the beginning, but then we figured out that we have to -- that we undercalled crack fields, especially. And then we first developed a sizing algorithm for crack fields for using Duo. And when we had finished that, we also went back to crack fields from the USCD tool or reported by the USCD tool, went back there and applied a similar algorithm to the USCD tool. So we have crack field sizing algorithm for CD and one for use for the Duo tool.

MR. FOREMAN: This process was -- Geoff Foreman again. This process was documented in a joint paper we wrote with Marvin, with myself. That was presented at IPC, at the last IPC.

MR. NICHOLSON: Did we ask for that paper? This is Matt.

MR. FOREMAN: No. I can get you a copy of that paper. But, again, it was based on the US Duo tool, but the learnings from that was -- we incorporated back into the CD tool.

MS. SENF: Yeah, right.

MR. JOHNSON: Thank you.

MR. KILLORAN: Just off the record for a second.

MR. NICHOLSON: Yeah. Off the record.

(Off the record.)

(On the record.)

MR. NICHOLSON: Okay. Back on the record. Ravi, you've got some follow-up questions?

BY MR. CHHATRE:

Q. Yes. This is Ravi, NTSB. And we're going to go back to the beginning a little bit to clarify some of the issues I have. And, if you would, it looks like there is a crack tool, there was some takeover with Pii, and it would be nice to know as to how the structure worked, when you took over Pii, and --

MR. FOREMAN: I can answer that.

MR. CHHATRE: Yeah, Geoff can answer that. That's fine.

MR. FOREMAN: Geoff Foreman here. So in 1997, '97, '98 -- '97?

MS. SENF: '99?

MR. FOREMAN: '99.

MS. SENF: '99.

MR. FOREMAN: So in 1999, Pii purchased Pipetronix. Pipetronix was a German-based inspection company.

MR. CHHATRE: Can you spell it?

MR. FOREMAN: P-i-p-e-t-r-o-n-i-x, GBH. And GE procured Pii, the total entity, in 2002.

BY MR. CHHATRE:

Q. Okay. And now, what were the tools used by Pipetronix until 1999? Was it ultrasonic crack detection for longitudinal defects or circumferential?

A. We had the USCD tools for longitudinal detection and also one tool for circumferential detection.

Q. Okay.

A. Yes, the 20-inch tool at that time.

Q. And this is the same tool or technology that had been used with the techniques for ILI like the one that you --

MR. FOREMAN: Well, I think, first of all -- Geoff Foreman -- first of all, I think Matt got a little bit -- maybe got the wrong impression as well. So there are -- there's two ultrasonic tool technologies. There's the wall measurement tool and the crack detection tool. Pipetronix had both these technologies.

The wall measurement tool measures the remaining wall thickness, therefore, corrosion. It also sees laminations. And the crack detection tool, the CD tool, looks primarily for cracks, so longitudinal cracks in the direction of the axis of the pipe.

Pipetronix also have -- had a magnetic fleet as well of MFL tools, which is not relevant to this, but -- but as far as Enbridge was concerned, Pipetronix were running wall measurement and CD technology for Enbridge prior to our acquisition of Pipetronix. We, Pii, were running magnetics tools for Enbridge, prior to or during this timeframe. So in the end, we ended up becoming a tool provider of the ultrasonics or magnetics for Enbridge.

BY MR. CHHATRE:

Q. Okay. Now -- and I'm going back at the beginning of your description here. You said you were lead -- can you describe the organization a little bit? Apparently the analyst report to somebody else --

A. Um-hum, um-hum.

Q. -- and your job was a specialist for something else and that's not really clear to me. Can you tell us?

A. Um-hum, yeah. So, at that time in 2005 we had an analysis center in Stutensee and an analysis center in Calgary. So the Stutensee center was led by Ralf Weber at that time. So it's Ralf Weber, R-a-l-f, W-e-b-e-r. So he was the manager of the analysis team in Stutensee and there were two team leaders. It was me as a USCD team leader and Thomas Rider (ph.) as a WM team leader. So all of the analysts and the team leader reported to Ralf Weber at that time.

Q. And his title then would be?

A. He was the analysis manager, the regional analysis manager.

Q. Okay. And so your job then at that time was to do what? The analyst will report directly to the analyst manager?

A. Correct.

Q. What -- how you would get involved? You said you managed the project, so I'm just --

A. Yeah, I just was managing the project but not really managing the team. So the team was working for me or was doing the analysis of my projects, yes.

Q. So, okay, (indiscernible), your job would be then just

to make sure that the deadlines are met, the project will be --
A. That the deadlines are met.
Q. -- okay, is that what --
A. Yeah.
Q. -- would be the responsibility?
A. Yes.
MR. PIERZINA: Excuse me, this is Brian. Did the -- there's an analysis group in Poland as well?
MS. SENF: Correct.
MR. PIERZINA: In 2005?
MS. SENF: Yes, in 2005, yes.
MR. PIERZINA: Okay. Did that report to Ralf Weber?
MS. SENF: No, that's not a GE company or -- yeah, that's not a GE company. That's an independent company and, yeah, they didn't, yeah, report to GE.
MR. FOREMAN: Geoff Foreman. Just for clarification. We changed from a matrix organization. So if a title was manager you actually have people working for you. If you're a team lead it's more like a project management role.
MS. SENF: Um-hum.
MR. FOREMAN: So that's the first one. The second clarification is we went with global analysis process. I think Clint mentioned it in his testimony. That changed from regional to global. So, that was one of the drivers for certification and training, so we needed a level playing field across all locations

with a common certification.

The Polish entity was a private company that had individuals that were trained by us and supervised by us but that -- they only did Step 1 analysis. So, first take -- all the quality checks and the control was done by us in Germany. So the Step 1 analysis had to be done in Poland. The quality check and the Step 2 was done in --

MS. SENF: No, the --

MR. FOREMAN: No?

MS. SENF: -- the analysis, not necessarily Step 1 or Step 2. Analysis is done in --

MR. FOREMAN: Analysis was done in Poland.

MS. SENF: -- Poland. Quality check was done in Stutensee.

MR. FOREMAN: Quality check was done in Stutensee.

MS. SENF: Yes.

MR. PIERZINA: Thank you. Sorry, Ravi.

MR. CHHATRE: Yeah.

BY MR. CHHATRE:

Q. Ravi again. Now, you said the software came and identified the features for you.

A. Um-hum.

Q. Who developed the software?

A. This was developed by Pii or by Pipetronix, at that time.

Q. Okay. Did your software was developed by somebody else, not by analysts?
A. Correct. We have a software department.
Q. Okay.
A. Yes.
Q. And what interaction do they have with the analyst, either communication, they are officially fed input by the analyst to the software and vice versa?
A. There is communication, but I guess it's rather for you about interpreting signals or not. So this is not really between software and analysis. This is rather between the experts or the team leader, for instance, and the analyst, that they communicate to each other.
So software-wise it's just when we see that something is not working in software, that there is a bug, that one function isn't working well, or that we have improvements. Now, this communication is between analysis and software. But interpreting the signals, it's not really communicated with the software team.
Q. So what -- who are the drivers for making the change from crack-like features to crack field and, you know, that kind of input?
A. That was me.
Q. So it's coming from analyst group not the software people?
A. Yeah. No, this comes from analysis. So we -- and this

is one thing we give also to the software group. So we tell them, hey, the -- we need a different sizing algorithm for crack field. We tell them what we need. We have a specification.

Q. Um-hum.

A. And then they implement it into the software.

Q. Now, the Level 0 analyst, if that's the correct term --

A. Um-hum.

Q. -- what kind of background do you expect that person to have to begin with?

A. Yeah, a technical background is what I expect.

Q. There is no particular qualification? You are not looking for a mechanical engineering degree or some type of electronic engineering degree or something like that?

A. No, no, it's not required.

Q. And so what kind of training do they get before they start analyzing it?

A. So meanwhile they get a basic training, which takes approximately 4 weeks. So, and this is about explaining them the software, the analysis software and explaining and showing them or that they learn how to interpret the signals, what kind of different feature types we have, how the different feature type look in the data, look like.

Q. In the software there is the boxes, then the software program -- programmers, they will look at these boxes that you identified --

A. Um-hum.

Q. -- that the analysts look at or the analysts generate the boxes?

A. No, the boxes are generated by the software.

Q. Okay.

A. Um-hum.

Q. So, who gives them the parameters as to what should be used to generate those boxes?

A. So, the generation of the boxes, it's -- so we don't have really special parameters for them. I would say though this is really -- when the data is processed, so the signals of all the individual sensors are projected on the right precision. So online the data of each sensor is treated separately.

Q. Um-hum.

A. But then the data processing puts them into the right place, right? And when there is -- when there are two sensors which have seen something at the same spot -- this is, for instance, a criteria -- that box is created. So that's a -- quite a simple rule. The data is projected. Once sensors have seen something, create a box.

Q. Okay. So, I'm still trying to understand.

A. Um-hum.

Q. So analysts develop those boxes or the program does it?

A. No, the program. The program develops these boxes.

Q. So program is told that if these features are there, then create a box?

A. Right. So, so the signals of two sensors are in one spot, create a box.

Q. Create a box.

A. So, pretty simple.

Q. Okay. Based on amplitude?

A. No, no, not at that time. So it's just create a box.

Q. Right.

A. And then the software reads out of these projections what the parameters of the box are.

Q. All right.

A. So it's just the box is created and then it tells me, okay, in this box we have a maximum amplitude of 50 dB, X sensors have seen it, it's such a length and such a -- yeah. No, its overlap, it's the length and it's the amplitude.

Q. Okay.

A. Um-hum.

Q. So who provides the input to the software people if you have these features, create a box? Because software people obviously -- I guess they will understand the tool then or -- understand -- understand myself as to what the process is?

A. Yes, right. Um-hum, yes. So, when the software was developed -- the translation software was developed right at the beginning when we started with our CD tool. So the rule was made, we need to have at least two sensors who have seen something.

Q. Okay.

A. So and -- yeah, this is how it came up, how they came up with the rule.

Q. Okay.

A. Two sensors should see something and then we create a box.

MR. CHHATRE: And not to take time, I'll mention, Geoff, if you can -- (indiscernible) can send us how this process came about as to when the company started, who acquired who? Because some of these questions are asked in Board meeting -- may be asked at a Board meeting.

MR. FOREMAN: Yeah.

MR. CHHATRE: So, provide them the history as to the company started in this year.

MR. FOREMAN: I can actually give you a diagram --

MR. CHHATRE: That would be beautiful.

MR. FOREMAN: -- timeline that shows --

MR. CHHATRE: Yeah, yeah.

MR. FOREMAN: -- all the different acquisitions.

MR. CHHATRE: That will be great. That way we know what started and where we are, to be clear.

MS. SENF: Um-hum, um-hum.

MR. FOREMAN: Yes.

BY MR. CHHATRE:

Q. That answered that. The Level 1, Level 2 and Level 3, you said 100% of the data is -- data are analyzed by Level 2?

Q. If I am Level 0 --

A. Um-hum.

Q. -- looking at Enbridge's data and 100% of that plus 5% of non-reportable is checked, that is checked by Level 1, Level 2, or who does that?

A. A Level -- quality check is always done by a Level 2 or by a Level 2.

Q. Okay.

A. So that's a minimum requirement for quality checker, yes.

Q. Okay.

A. Um-hum.

Q. And in this particular case, I mean if they check it and if they find discrepancy or they change the finding, either up or low, is there a document generated for that, or are they just done and the previous stuff they did gets wiped out?

A. Um-hum, um-hum.

Q. What is the process?

A. So when we have an analyst in Poland doing the analysis and we have to change something, it depends how we have to change it. So we see it was a non-reportable but must be a reportable, so we give feedback. So we have a feedback form for it. And so we give feedback for each feature back to the analyst.

Q. Okay.

A. When the analyst is in the same location, normally we go through with the analyst and show him what was wrong, so and --
Q. Personally.
A. -- give him directly the feedback, yeah.
Q. Okay, on an informal basis, one-on-one basis?
A. Yeah.
Q. There is no paper trail, per se?
A. Yeah.
Q. But do you also -- when you send an e-mail or whatever document, does it explain why you are doing that change, either up or down, so that the analyst kind of learns at the same time or just --
A. I don't send an e-mail for that, no. No, it's just telling him, hey, this was wrong; you have to look at these kinds of things.
Q. Okay.
A. Yeah. And so we have a process in place, which means when we -- when we see that a non-reportable needs to be upgraded to a reportable. So we show the analyst what he has done wrong and he needs to check the features again. So, the features of that wrong feature type --
Q. Um-hum.
A. -- so he has to go back and check it again, because to make sure that he hasn't done this mistake several times.
Q. So in Enbridge's case, the data was analyzed by Polish

-- if I can use the word contractor, I guess?
A. Correct. Yeah, uh-huh.
Q. That was done in Poland?
A. Yes, correct.
Q. And who did the QC check on that data? Was it done in Germany?
A. It was done in Germany by a Level 2, yes.
Q. Okay.
A. Um-hum.
Q. And are both people still working for the respective units?
A. Yes.
Q. In this 5% non-reportable check, are they random number generated, or how do you pick which ones to check for the non-reportable?
A. Do you mean at that time or --
Q. I mean a quality check at the levels --
A. Yeah.
Q. -- you don't do the analysis?
A. Yeah, that's right.
Q. Let's just say in this case --
A. Um-hum.
Q. -- and Level 2 is looking at a QC on that.
A. Um-hum.
Q. The Level 2 is going to look at 100% of every reportable

incident that the Level 0 analyzed?

A. Um-hum.

Q. Also looking at 5% of non-reportable?

A. Yes, correct. Yeah, yeah.

Q. So those 5%, how are those picked?

A. Yeah. So, at that time they were -- we were told, okay, you have to do 5% or when they're -- it's getting (indiscernible) -- when there are 100 features, every 20 features you need to check, for instance.

Q. Okay. But they're just -- they themselves pick ones?

A. Yes, at that time. Yes.

Q. And what is it -- how is it different now?

A. So today we have quality check mode it's called. So we have analysis mode and a quality check mode. And when he opens that section he just clicks "select list" and then all the criteria -- so, the 5%, for instance, for every X feature is selected then from the list, from the software now.

Q. So the software picks?

A. The software picks all of them.

Q. Okay.

A. So for the non-reportable features, so we say, okay, it's more important to look at the ones with the higher amplitude. So it's -- it generates a list sorting by amplitude and then it takes the most severe of the list. Yeah.

Q. Is that a random number generated program? I mean --

A. No, no. We have a defined number for it. So it's depending on the feature types. So for irrelevant features, we say 5%. For weld IGs there's always a risk to mismatch that or to misclassify it crack-like, so we say 50%, for instance.

Q. And when did the change happen year-wise, if you remember?

A. When did we introduce the --

Q. If you don't, you can get back to us on that one.

A. I guess it was in 2008 or 2009, I would --

UNIDENTIFIED SPEAKER: Yeah.

BY MR. CHHATRE:

Q. I mean --

A. 2008, I believe. 2008, I believe. Yeah, yeah.

Q. (Indiscernible) maybe we can hit that process --

A. Yeah, yeah. Yeah, um-hum.

Q. All right. It was before the rupture --

A. Um-hum.

Q. -- is what I'm really looking at?

A. Um-hum.

Q. Okay.

MR. PIERZINA: And this is Brian. And that change that we're talking about is the change from -- to where the computer generates the list?

MS. SENF: Correct, yes.

MR. PIERZINA: All right.

BY MR. CHHATRE:

Q. Now, as part of the training from Level 0 to 1, 1 to 2, and 2 to 3, are the analysts required to know the tool information -- how the tool is designed, how the tool works, or they simply look at the data?

A. For Level 1 it's not required to know how the tool works. They get a basic training, the fundamentals. But, yeah, really a basic one. So, for a Level 2 he needs to know more about it, yes.

Q. Okay. But they are familiar with the tool, the limitations of the tool?

A. Um-hum, yes.

Q. Okay. And in this case who did the QC of Enbridge's data? Was it a Level 2 or Level 3?

A. It was a Level 2.

Q. Okay. And there were no negative findings on that QC? That all the features reported by Level 0 were pretty much confirmed by Level 2, especially, particularly these (indiscernible)?

A. So, I'm not sure if we had the feedback form at that time, so I cannot really tell if there was any communication that something was reclassified or something; I cannot tell that. Um-hum.

Q. But based on your program, that person definitely looked at that particular feature?

A. Correct.

Q. And I guess since it was not upgraded to any higher level of concern, that means that was probably concurred with the check analysis, correct?

MR. FOREMAN: What do you mean by upgraded? A crack-like is the highest level.

MR. CHHATRE: Right.

MR. FOREMAN: In 2005, crack-like was the highest call. And undecidable or a weld defect. But crack-like and crack field have no hierarchy. They were the highest levels. So it wasn't upgraded or downgraded.

MR. CHHATRE: Okay.

MR. FOREMAN: It was confirmed at the same.

MR. CHHATRE: Same thing. Okay.

MR. FOREMAN: Right.

MS. SENF: Um-hum, um-hum.

BY MR. CHHATRE:

Q. So, I guess, let me rephrase the question again then. So, the person who did QC agreed with whatever the description the Level 0 has done?

A. This is what I can assume, because I don't have any communication that it's differently.

Q. And has GE gone back and talked to those two people after the incident?

A. Yes.

Q. And was this question asked of them?

MR. KILLORAN: What question?

MR. CHHATRE: Asked whether this person looked at this particular feature and agreed with the --

MS. SENF: What I did with them, so I showed them the feature without a classification on it and I asked them to classify that feature for me again.

BY MR. CHHATRE:

Q. Again?

A. So, I didn't tell them that they have done analysis in 2005 on that feature.

Q. Okay.

A. They might not even remember that.

Q. Right.

A. And, yeah, but I asked them to classify it again and both of them classified it as a cracked field.

Q. Again. Okay.

MR. NICHOLSON: This is Matt. Did they characterize it as a crack field using the new algorithms or are these new -- are they looking at it through 2005 eyes or are they looking at it with more recent procedures?

MS. SENF: They looked at them with 2011 eyes, I would say, yeah.

MR. NICHOLSON: Okay.

BY MR. PIERZINA:

Q. This is Brian. So when we talk about the QC, we're still talking about 1.5 kilometer sections --
A. Correct.
Q. -- at the QC being performed?
A. Yes. Um-hum, um-hum.
Q. And how many different individuals would be performing the QC back in 2005?
MR. KILLORAN: For what section?
MR. PIERZINA: For the -- well, we're talking from Griffith to Stockbridge.
MS. SENF: Um-hum. I would estimate about six, seven, eight analysts because this was the number of analysts we had at that time as Level 2 certified.
BY MR. PIERZINA:
Q. Okay. So --
A. Yeah.
Q. So, when you're doing the QC there's six to eight Level 2's that could be doing the QC --
A. Um-hum.
Q. -- on the Step 1?
A. Um-hum.
Q. Okay. And now, you said you did the QC on the Step 2 analysis for that section.
A. Um-hum.
Q. Would there be any reason that you didn't do the Step 1?

Was it -- did you do Step 1 QC of that tour?
A. I need to double check that.
Q. Okay.
A. I can find that out, if I've done that.
Q. All right.
BY MR. CHHATRE:
Q. This is Ravi again, NTSB. Who develops the test? I remember you said you had to take a test. You're one of the senior people there. So who is developing this test?
MR. KILLORAN: Are you asking for the name of an individual?
MR. CHHATRE: No. I'm just trying to find out the process as to -- does Enbridge -- I mean, does GE go outside?
MS. SENF: No, it was within GE and it was one of the team leads at that time.
BY MR. CHHATRE:
Q. Developed the test?
A. Yes, who developed the test, yes.
Q. And nowadays, how does -- how are these tests developed?
A. These days we have designated trainers, one for CD and one for WM, and they, yeah, revise the tests as required, yeah.
Q. They develop it, okay.
A. Um-hum, um-hum.
Q. And are there requalification tests or training required for Level 2 and Level 3, just to make sure they are keeping up

with the skills?

A. Sorry. Can you say that again? I didn't get the --

Q. Okay.

MR. KILLORAN: Requalification.

BY MR. CHHATRE:

Q. Requalification like --

A. Requalification. Okay, yeah, um-hum.

Q. -- you pass Level 2 and you are Level 3 now.

A. Um-hum, um-hum.

Q. Now, you remain Level 3, I guess, unless you are promoted; is that correct? That's the highest level in GE?

A. Level 3 is the highest level, yes.

Q. So what happens over the period of time, how do you keep current with the -- if you measure in GE?

A. So we have a recertification process. So every 3 years we have to pass a test again.

Q. Okay.

A. Yes, um-hum.

Q. You also mentioned that Step 1 and 2 is done by different analysts but not necessarily all the time?

A. Yes, right.

Q. It was then. Is it currently the same policy that it may be the same person doing Step 1 and Step 2?

A. It could be -- could be. So we ask them to -- we ask the analysts not to do the analysis of Step 2 if they have done analysis on Step 1 already. But if -- yeah, if there are only a few sections left and there is only the sections from one analyst left, then he should do Step 2 -- so it's not prohibited, let's say at this -- but we, yeah, we don't really like it.

Q. Like -- okay.

A. Yeah, um-hum.

Q. Now, going back to the corrections or modifications as reviewed by Level 1 -- or Level 2 for Level 0 or Level 1. Is there some kind of track kept as to who is making more mistakes? Is that an issue in getting them upgraded from 0 to 1, or 1 to 2?

A. Um-hum. So we ask the quality checkers, we ask them to contact us when they see that one analyst is performing not as good as others. So, and then he will get a direct training based on that.

Q. Okay.

A. So, but actually from a Level 1 to a Level 2, so he needs to pass a test.

Q. Right. But passing the test is the only requirement --

A. He needs to pass the test and then the team leader is responsible -- or we ask the team leader to supervise him for a while. And when the team leader says, okay, he's able now to do a Level 2 task, so -- which means it would be quality check.

Q. I see.

A. So it's up to the team leader to say, okay, he can do it now. So it's not just passing the test, so it's also some supervision to say, okay, he's doing well.

Q. But, so if I understand you correct, there isn't a formal process of documenting the errors made by individual analysts?

A. So meanwhile we track in our software when a feature has been changed during the QC. So we could extract it from the database to see is there one analyst is doing more mistakes or need to be corrected more than another analyst.

Q. Okay.

A. But, so it's in the software but we don't use it really.

Q. The reason I was -- the reason for that question was this particular analyst who looked at Enbridge's data, I'm just trying to find out what kind of track record that person had in terms of accuracy?

A. So --

Q. If he will have --

A. Yeah, so --

Q. -- is there a document related to that?

A. The analyst and the quality checker are one of our best analysts we have. So the quality checker had an experience of almost 10 years at that time.

Q. Okay.

A. The analyst was quite new, because we started with a team in 2004 or 2005, but he's still one of our best analysts.

Q. Okay.

A. Yes.

Q. Now, is the incident that happened at Enbridge is the only trigger that you will go back and talk to the analyst or there is some kind of an internal process of talking to the analyst frequently if there's an error made by them, either upwards or downwards, in --

A. Well, when we -- so, how can we figure out if they made a mistake? So, normally it is feedback from the client.

Q. Right.

A. For Enbridge, we receive outly analysis or when they find something in the field which was reported differently, and then it can be that we see that an analyst makes an error. And then we go back to the analyst and talk to him and show him what he has done wrong, yes.

Q. Okay. Now, in a situation like Enbridge and when there's actually an incident rather than just QC check finds error -- in this case there was an incident -- does that trigger GE Pii, to look at any more -- inspect them to see whether there could be any other features --

A. Um-hum.

Q. -- that could eventually, you know, create another situation?

A. Um-hum.

Q. Is that a process internally or do you have a --

A. Yeah. So it is -- it's not -- I wouldn't say that it's a fixed process, but -- it really depends on what kind of mistakes the analyst made. So when we see -- so he reported it or he classified a feature as non-reportable, but it failed, so we will go back and look at all these features from this analyst.

Q.   Okay.

A.   So, and in this case here, where the analyst classified it as a crack-like but it should have been a crack field or -- I went back and looked at all the crack-like features at the long seam to see if he made the same mistake before.

Q.   And what were your findings?

A.   I didn't find anything.

Q.   Okay. That was the only one?

A.   Yeah.

Q.   So, can you clarify just for the record the difference between a crack-like feature and crack field, what is the threshold for that?

A.   Um-hum.

Q.   How do you differentiate?

A.   Yes. So a crack-like indication should be displayed in the data as one individual cracking indication with a minimum length of 30 or 60 millimeter, depending on the analysis threshold. And so amplitude doesn't really matter. If it's high or low amplitude it doesn't matter.

Q.   Okay.

A.   So it's rather the shape of it.

Q. Um-hum.

A. So, it means an individual indication with varying amplitude.

Q. And that would be --

A. Pardon me?

Q. One indication with varying amplitude would classify it as?

A. As a crack-like.

Q. As crack-like. Okay.

A. And a crack field would mean that I see a colony of little -- many individual cracks. So, also with varying amplitude and also seen by several sensors. Well, that goes for the crack-like and the crack field; so they should have been detected by more than one sensor, I would say.

Q. What I'm trying to reconcile in my mind is --

A. Um-hum.

Q. -- if you have a crack-like feature, it's still an individual crack. Then why aren't you calling it a crack in crack field? Because crack-like feature, to me, as a non-ILI tool person --

A. Um-hum.

Q. -- crack-like field meaning, you know, it may not be a crack.

A. No, it's rather crack-like or it's crack field.

MR. FOREMAN: That's not the question.

MS. SENF: It's crack-like feature --

MR. FOREMAN: The question is why do we call it crack-like?

BY MR. CHHATRE:

Q. If you have -- I mean, you described it as 30 to 60 millimeter single crack --

A. Yeah, one single crack.

Q. -- and really does not matter -- it's a crack.

A. It's a crack, yeah.

Q. So then why we are calling it crack-like if it is a real crack? I'm just trying --

A. Yes. It's an ultrasonic background, so in the ultrasonics we -- this is a -- ultrasonics is so we see some signals. So, it is a crack-like appearance but we cannot really tell it's a crack, so it's what we see in the data. It looks crack-like.

Q. Okay.

A. But we cannot be 100% sure that it's a crack.

Q. So how do you differentiate a crack then? I mean, if a feature you are sure is a crack, so would you call it a crack or you would still would call it a crack-like feature?

A. Crack-like, a crack-like feature, yeah.

Q. Okay.

A. So it's either a crack-like feature or it's a crack field, and I don't have the feature type crack. Don't have that.

Q. Okay.

MR. FOREMAN: So, Geoff Foreman here. So in the contract, the definition is a crack-like feature --

MR. CHHATRE: Okay.

MR. FOREMAN: -- or a crack field feature.

MR. CHHATRE: Right. I understand.

MR. FOREMAN: That's what's in the contract. That's what's in the report.

MR. CHHATRE: Okay. And I understand and, Jay, correct me if I'm wrong, but Enbridge's book has crack-like features and crack field are treated the same way when you analyze it with your programs? Is that what I was led to believe?

MR. JOHNSON: I can't speak --

MR. CHHATRE: Okay. That's okay.

MR. PIERZINA: I don't believe that to be correct, based on the interviews.

MR. CHHATRE: Okay.

MR. PIERZINA: This is Brian. Based on the interviews that we've had.

MR. CHHATRE: Okay.

MR. NICHOLSON: In 2005, I would -- that's what Ravi's speaking to.

MR. PIERZINA: Even in 2005, I don't believe that their -- their dig selection criteria was the same.

MR. NICHOLSON: Okay. Based on (indiscernible) indication. That's what you're talking about?

MR. PIERZINA: Yeah.

MR. JOHNSON: If your question was, does Enbridge consider either of them cracks, no, we do not.

MR. CHHATRE: Okay. And, I guess, just briefly, so do most cracks (indiscernible) --

(Simultaneous speech.)

MR. FOREMAN: Geoff Foreman here. You're saying crack fields and crack-like are not cracks? That's what you just said.

MR. JOHNSON: Until the excavation.

MR. FOREMAN: Ah.

MR. NICHOLSON: Well, you can certainly analyze --

MR. FOREMAN: Didn't quality it then?

MR. JOHNSON: Yes. But until the -- it has to do with timing, dig timing and whatnot.

MR. CHHATRE: Okay.

MR. JOHNSON: So until its excavated and determined what it is. Does that answer your question?

MR. NICHOLSON: Yeah.

MR. PIERZINA: Actually, I -- one quick question for Petra --

MR. CHHATRE: Brian.

MR. PIERZINA: -- on the quality check review.

MR. NICHOLSON: This is Brian.

BY MR. PIERZINA:

Q. This is Brian. The quality check is done by a Level 2 or a Level 3?

A. Um-hum.

Q. And I just want to make sure I understand. So, and back in 2005, 5% of the non-reportable features were checked by a Level 2 or a Level 3 analyst?

A. Correct.

Q. And today is it still 5% of non-reportable features?

A. No, it's more than 5%, so it depends on the non-reportable feature type. So we have several non-reportable feature types. We have inclusions, geometries as non-reportables. What else do we have?

MR. GARTH: This is Clint Garth. It's irrelevant --

MS. SENF: Irrelevant, and the ones below the spec.

MR. GARTH: Yeah.

MS. SENF: So a crack-like indication if it's below .5 millimeters, we do not report it to the client because it's below our spec. We cannot really be sure that it's a real defect, so it's also a non-reportable. So we -- so, for instance, for a crack-like we check 100% of the reportables, which are above .5, and we check 5% of the non-reportables on these crack-like. So, I don't -- yeah.

BY MR. PIERZINA:

Q. Okay. So 5% of the non-reportable crack-like features are quality checked by a Level 2 or Level 3 analyst?

A. Um-hum, correct.
Q. Okay. So that could be somebody with two years of experience?
MR. FOREMAN: Five.
MS. SENF: At least --
BY MR. PIERZINA:
Q. Yeah, at least --
A. No, a Level 2 at least --
Q. At least two years of experience?
A. -- two years of experience, yes.
Q. And is there any back-up beyond that to -- in which a feature that is not being reported could be caught by some subsequent type of review?
A. I would say, no, because we have these two steps so that the analysis is done and then checked by an experienced analyst. But we do not have kind of a cert check of these data again.
Q. Okay. Thank you.
A. I guess that's what you asked for.
MR. NICHOLSON: Okay. Well, I've got some follow-up here I want to go through, because I think they're relevant to where we are.
BY MR. NICHOLSON:
Q. Ravi was questioning you a little bit about, you know, the QC. In fact, Brian was just talking about the QC-ing of the analysis performed at a Level 0. And I think this is what we

would call probability of indication? Is that how that's tracked by GE? I'm looking at Geoff as well. Is that -- when you characterize a defect as crack-like or a crack field, that's probability of indication, right?

MR. FOREMAN: POD.

MS. SENF: POI.

MR. NICHOLSON: POI?

MR. FOREMAN: Well --

MS. SENF: The classification is POI.

BY MR. NICHOLSON:

Q. POI?

A. Um-hum.

Q. Okay.

MR. FOREMAN: Right.

MR. NICHOLSON: And GE has a stated probability of indication that they give to the client?

MR. FOREMAN: Right.

MR. NICHOLSON: Okay. Is that probability of indication tracked per analysis -- analyzer or level or training -- do you know what I mean -- or the data analyst? Do you track a POI per person, per analyst? No?

MR. FOREMAN: No.

MR. NICHOLSON: Okay. So it's just overall. So, if you have an analyst that's outside, he's indicating things outside of your stated POI that's not correct, it's just tracked as a whole?

Do you know what I'm saying? So, there's no metric, it doesn't sound like, when the QC -- a data analyst's work, to track their performance against your probability of indication? They can be 70%. You --

MR. KILLORAN: What's your question?

BY MR. NICHOLSON:

Q. What -- is there any kind of tracking or metric for your data analyst on probability of indication?

MR. KILLORAN: You have to speak up.

MS. SENF: No. No.

MR. NICHOLSON: Yeah, nod doesn't --

MS. SENF: No, no there isn't.

MR. NICHOLSON: Okay.

MS. SENF: No.

MR. FOREMAN: Well, there's probability of detection and there's probability of indication. So, the probability that the tool saw something is the first one. Then the something being correct is the second one.

MR. NICHOLSON: And that's the one I'm asking about.

MR. FOREMAN: Okay.

MR. NICHOLSON: Right. And the answer's no?

MR. FOREMAN: The answer is there's always a percentage that the analyst could be wrong, which we would expect to be caught in the QC. If it doesn't get caught in the QC, then that's the number that ends up being our confidence level for the overall process, which is the one in the contract, which is 80%.

MR. NICHOLSON: Okay. So, how often -- I guess I'm trying to find out how often --

MR. KILLORAN: Hold on just a second, please.

(Whispered conversation.)

MR. KILLORAN: If you don't know, we'll check it.

MR. GARTH: We should check that.

MR. FOREMAN: We'll check it. We'll check it.

MR. KILLORAN: Check it during a break.

MR. FOREMAN: Yeah.

MR. NICHOLSON: Okay. So it seems --

MR. CHHATRE: For the record, can you repeat what you said in what context?

MR. FOREMAN: There is a percentage number. I'll check --

MR. CHHATRE: Okay.

MR. FOREMAN: -- whether its 80 or 90.

MR. CHHATRE: Okay.

BY MR. NICHOLSON:

Q. So, then you might not know, how often does a Step 1 reportable feature get mischaracterized by a trainee in a Level 2 QC? No one tracks this, right?

A. No, no, no.

Q. Okay. And then I'm kind of switching gears here. But going back to what the data analyst would have looked at in 2005, Geoff made the statement that crack-like would have been the worst case; there was no other thing to call it. So I'm trying to figure out, is it possible that they saw what you saw, which you said you saw two feature types: crack field, crack-like, and they would have just deferred to the worst case? Is that why maybe this would have been called crack-like?

MR. KILLORAN: Excuse me. I think you're mischaracterizing what he said. I think he --

MR. NICHOLSON: Well, let Geoff then clarify.

MR. KILLORAN: -- he said the crack-like and crack field were the highest classification.

MR. FOREMAN: Can I make a quick sketch just to -- I think a sketch could clarify this.

MR. NICHOLSON: Yeah.

MR. FOREMAN: I think I did it in the last, but just to -- so, and say that's a crack. When you look on the plane of view on the pipe it looks like this, right? One individual crack. The way it was called in 2005, we would give the peak depth and the maximum length.

MR. NICHOLSON: Right.

MR. FOREMAN: Okay? If it was SCC or crack field, the same length could be made up of a number of cracks, which may over -- may interlink or may not. It would be reported exactly the same. It would be a box with a length L and a peak depth D. So as far as the analyst is concerned it's equal.

MR. NICHOLSON: And that's the point I'm getting at. So we're not really sure that the analyst didn't see crack field in 2005, it just -- it made no difference to the Pii analyst --

MR. FOREMAN: Right. You still got the same depth --

MR. NICHOLSON: -- how he reported it.

MR. FOREMAN: -- and you've still got the same length in 2005.

MR. NICHOLSON: Right.

MR. FOREMAN: Now, from a fracture mechanic's point of view, when you put it in your diagram it has the same position. We aren't doing the integrity assessment. We don't know if Enbridge are treating it the same, right? We don't work on crack growth.

MR. NICHOLSON: Yeah.

MR. FOREMAN: In 2005 we weren't even doing repeat inspections. So we were just treating everything as what the tool sees. If crack growth mechanisms are different for the two types, that would drive an integrity decision to be different. But in 2005 that wasn't the case, even with Enbridge, who were using the tool the most for us. That's the first point. So, there was no difference in get D and L, a D and a L, right?

The second point is that this defect, SCC, has to interact to fail, right? That doesn't. So that -- that is a dead cert fail; this has to interact somehow. Right now we don't know the integrity of the pressure cycles or the growth mechanisms;

we're just reporting, in 2005, this. That's why I made the statement. In 2008 and beyond, having worked more closely with Enbridge, we understand the differences.

Now, because of the algorithm change, which is nothing on classification, just on depth, now in post-2008 that D will be D plus 1, right? So now we've got a deeper depth and the same length. That's why that now will be a priority call.

MR. NICHOLSON: Yeah. And I think you're getting exactly where I was going with this, but I wanted to hear it from Petra.

MR. FOREMAN: Sorry about that.

BY MR. NICHOLSON:

Q. You seem to understand the fracture mechanics relevance of what's being reported as an analyst. You don't know what Enbridge is doing. You don't know how calling it SCC or crack-like is going to impact their analysis; is that correct?

A. That's correct, yes. Um-hum.

Q. Okay. But did you understand everything Geoff -- do you understand enough about fracture mechanics; is that part of your training to know that you have interconnecting SCC flaws and -- how much of that --

A. I know of it, not in full detail, I would say, but I -- so, I know today of course, for sure, more about it than I did 6 or 7 years ago.

Q. So in 2005, it's safe to say that the GE analyst was operating independent of Enbridge analysis? You really don't know -- the two of you don't know --

A. Correct. That's correct.

MR. FOREMAN: What we're doing, we're just supplying to a contract data analysis.

MS. SENF: Correct.

MR. CHHATRE: So top will be a crack-like feature --

MR. FOREMAN: Yes.

MR. CHHATRE: And the bottom would be crack field?

MS. SENF: Correct.

MR. FOREMAN: Crack field. That's right.

MR. CHHATRE: And to GE, which is considered more damaging, if you would, to the integrity of the pipe?

MR. FOREMAN: Well, Geoff Foreman here, GE. So, that really depends on the pipe, the pressure cycles, the age of the pipe.

MR. CHHATRE: Okay.

MR. FOREMAN: So really that's an integrity engineering decision not an ILI tool prediction, which is a dimension.

MR. CHHATRE: Right. Okay. I understand.

UNIDENTIFIED SPEAKER: Is that GE's call?

MR. FOREMAN: It's not GE's call. No, it's not.

MR. CHHATRE: All right. Okay. Thank you, Matt. I did all my follow-up questions that I wanted to.

MR. NICHOLSON: Okay. Do we want to take a break here and go off record maybe and discuss --

MR. KILLORAN: We can get set-up, if you want or --

MR. NICHOLSON: Yeah. Let's go off record at this point.

(Off the record.)

(On the record.)

MR. NICHOLSON: Okay. This is the Petra interview at GE Pii, Part 2, and Petra is going to walk us through some of the B scan, C scan information that's got the actual 2005 USCD data.

BY MR. NICHOLSON:

Q. So Petra, if you'd like to take the floor?

A. Um-hum. So in the USCD analysis we have software which is called Primus USCD. And here on my screen I have the client portion. So, it means we can generate client database, which includes all the reportable features. And so all the C scans and B scans can be reviewed by the client itself when he wants to, to prioritize his features -- whatever he wants to do with it or get more details out of it.

And so right now we see the data of girth weld 217-720 and --

Q. I'm going to stop you for a second. Are we looking -- what is this a B scan?

A. No, this is the C scan.

Q. A C scan. Okay.

A. Yeah. Okay. A C scan displays the whole circumference of the -- of one pipe joint, or in this case, yeah, of one pipe joint. So on the Y axis you see the circumference. On the X axis it's the distance. So right now it's in meters but I also can show you that in imperial. Might make it easier for you.

Okay. And what else do we see here in the C scan? So this gray area, it's crack detection data. And the second window below the crack detection data, it's the wall thickness data. It's -- no, the first one, it's the wall measurement and the second one is the stand-off data, the distance between the sensor and the inner pipe wall.

MR. CHHATRE: This one is center?

MS. SENF: This is the distance between the sensor and the inner pipe wall. So distance between sensor and wall.

MR. CHHATRE: Inside?

MS. SENF: Inside, yes.

MR. CHHATRE: Okay.

MS. SENF: So, but off the -- so these two windows display wall thickness data where we have a few sensors on the sensor carrier. And this here is crack detection data.

BY MR. NICHOLSON:

Q. I'm sorry. This bottom window you said is distance between the sensor and the inner wall?

A. Um-hum.

Q. But I think of that as like a clearance but it looks like its displayed as degrees, so what am I not understanding?

A. So this is the whole circumference, so we only have a limited number of sensors. And here the colors itself show you the value.

Q. Oh, okay, I see.

A. So here the wall thickness we see here it's 669 mil. So, the black color displays 669 mil. When the pink color, it means -- so we have a decrease of wall thickness, a slight decrease.

MR. CHHATRE: I'm sorry. This is Ravi. But I don't think I clearly understand this bottom scan. I think the middle scan --

MS. SENF: Um-hum.

MR. CHHATRE: -- probably tells me that wall thickness is in different colors?

MS. SENF: Yeah, the wall thickness here, though the wall thickness here is 276 mil, for instance.

MR. CHHATRE: Right, most part, for the most part --

MS. SENF: Yes. And we call it the most measured value, which is given here. And here you also see the 285. This is the most measured wall thickness in this pipe joint here.

MR. PIERZINA: And this is Brian. Can you explain why it says 276 mil on the scale on the right-hand side but the value in the box is 285?

MS. SENF: So, it always depends on the content. So I have a big compression right now, so let's -- let's do uncompressed data and now it's almost similar. So, you know, this is really basically over the whole pipe joint and this is what we now see here on that screen. So, what is this right here so --

MR. PIERZINA: Okay.

MS. SENF: But this here is really the most measured value we have in this pipe joint.

MR. NICHOLSON: For the 18 to 22 distance?

MS. SENF: Yeah, uh-huh.

MR. PIERZINA: Okay.

BY MR. CHHATRE:

Q. And this pipe joint, how many feet or meters?

A. The whole pipe joint -- let's go back to -- no, let's see, where is the distance. Or, I can see it here. It's about 40, 40 feet.

Q. Forty feet. Okay.

A. Is that right? I can --

Q. And so all 40 feet are being displayed here on this bottom window? This is Ravi, NTSB.

A. Yes, that's right. Yeah, on the left, yeah, and also on the right, yes.

Q. So in the bottom scan --

A. Yes.

Q. -- is all 40 feet, is uncompressed, right?

A. No, right now all of it is compressed.

Q. Is compressed?

A. Yes.

Q. Okay.

A. On the white, it's always the same distance for all three scans.

Q. Um-hum.

A. And the circumference, yeah, this is really compressed. So we don't see that much as we see in the crack detection data. The wall measurement data we have less sensors and so therefore we have a smaller window for it, yes.

Q. Okay. But why are we only seeing 0 to 180 and what is happening to the other? I mean, it looks like we're only seeing half the circumference?

A. So, yeah, not really. So, we only have the two numbers. We only have the 0 and the 180. But let's go back to no compression. So, the numbers never change, right, we -- so this -- so this here, from 0 to the bottom here, it's also 180 degrees, right? It's just we have two numbers only. But it's -- this displays the data over the whole circumference.

Q. Okay. Where I got confused --

A. Um-hum.

Q. -- was that I look at the scale and I'm seeing one and two lines here.

A. Um-hum.

Q. And one and two and one more. That's 180.

A. Um-hum.

Q. So, I guess my question, you are saying from here to here is 180, from here to here is 180; is that correct?

A. Yeah. It's -- well, let's see. So, now it's getting -- when I make it bigger, the window, you see more, right?

Q. Oh, I see.

A. So, it's just in a compressed form that we see here.

MR. NICHOLSON: It's truncated.

MR. CHHATRE: Truncated.

MS. SENF: Yeah, it's truncated slightly.

MR. NICHOLSON: To make it fit?

MS. SENF: Yeah. Yeah, uh-huh.

MR. CHHATRE: That's truncated, okay.

MR. NICHOLSON: But you do have 360 degrees?

MS. SENF: Yes.

MR. CHHATRE: 360 also?

MS. SENF: Um-hum.

BY MR. CHHATRE:

Q. Okay. And how many -- when you say it's the largest number seen, do you have an average in that -- algorithm gives you an average number or just gives you the maximum wall and minimum wall?

A. Which value do you mean or --

Q. I'm looking at the bottom graph, for example.

A. Um-hum, yeah.

Q. You have pink (indiscernible), a little band, and if I look at the scale there it looks like it's telling me its 157, is it?

A. Um-hum.

Q. That's a wall in mils at that location?

A. Yeah.

Q. Or no -- how you look at -- how you interpret this graph? What is it telling me?

A. So it's just telling me that I have a slight decrease here and I can go over it and I see it exactly how much it is. So the black one here is 653 and here I have a slight increase that means one of the -- can I see it here? I guess I have to go back to compression 1 to make it better visible.

So it shows me, for instance, that I have a, yeah, a slight decrease which means that either the sensor is lifting off a little bit. So for some reason -- so normally it happens at the long seam that we have a slight lift-off because --

Q. Of the tool, tool sensor?

A. The tool sensor carrier has a slight lift-off, yeah.

Q. So all these colors are really all the data points?

A. Um-hum.

Q. Right? I mean, I don't see a data point; I see different colors. So --

A. Right. So we have a certain range for it, because if we would have different colors for each data point --

Q. I understand.

A. -- yeah, we would have way too much colors here.
Q. But they're not data points, the other --
A. Yeah.
Q. Okay.
A. Yeah. And so for what we use the wall thickness data really is for the identification of dents, because when there is a dent we have a lift-off of the sensor carrier.
Q. Um-hum.
A. And then we will see that for sure in the stand-off here. We also might see here the wall thickness data. So, this is for what we use of these two windows.
Q. Okay. So top window is going to tell you if there's a dent; is that correct?
A. The bottom window.
Q. It's also bottom window?
A. The bottom window.
Q. So what is the difference between the two?
A. So here it shows me the wall thickness of the pipe joint.
Q. Okay.
A. And the one on the bottom shows me the distance from the sensor to the pipe surface.
Q. Okay. So you --
A. I have always a defined distance between the pipe wall and my sensor, right? So with a (indiscernible) I can make sure

that it's always the same distance, and this is displayed here.

MR. NICHOLSON: Is that -- this is a relative scale then? This is Matt. The 669 being the black and this being plus, so this is plus 79 mils above the -- okay.

MS. SENF: Correct, yes.

MR. NICHOLSON: Okay.

MR. CHHATRE: Centerline?

MS. SENF: Correct.

MR. CHHATRE: Right?

MR. NICHOLSON: Well, above the most measured value is what it's saying.

MS. SENF: Yeah, above the 66, yes.

MR. NICHOLSON: So, your clearance is higher for the red and lower --

MS. SENF: Um-hum.

MR. NICHOLSON: I'm sorry. Okay. And the same for wall thickness. It's a relative scale based on its most measured?

MS. SENF: Um-hum.

BY MR. PIERZINA:

Q. And this is Brian. Petra, can you -- can you kind of scroll over the black area of the wall thickness screen there? No, in the wall thickness. One of the things I would like to see -- you know, because the wall thickness of the -- nominal wall thickness of the pipe was supposed to be .250 inches.

A. Um-hum.

Q. And your measured wall thickness is greater than that?
A. Um-hum.
Q. And so I'm just trying to understand how that might be. So, it looks like if you move your cursor over different values along there, it gives you the values that the sensor measured, right?
A. Um-hum, um-hum. Correct, yes. So then what was it? 250 nominal wall thickness?
MR. CHHATRE: Correct.
MS. SENF: Yeah. So we have 258 in some cases. Yeah. So this is a 30-inch pipe and we have -- in total, we have 30 wall thickness sensors. So we only make a kind of spot checks, right? We have only -- there is a distance between each wall thickness sensor. There are gaps between the wall thickness sensors, so we don't really measure the full wall thickness.
And this is an explanation from me why we do not measure the exact. When we do, we will do it with our WM tool, for instance, when we do real wall measurement. Here we only use these two sensors, either to identify the geometries and to do the internal/external discrimination of the features.
Q. But it's also reported on the ILI report as well?
A. Correct, yes.
Q. So, I guess that's not -- not Pii, that's using that value then, but it's being used by the client to determine, you know, remaining wall of a reported feature?

A. Well, but -- so, we don't give a tolerance to our wall measurement. So they -- it could be used for kind for reference if it's a thinner wall or a thicker wall if it's similar; if it's 250 or is it 500, but not really for -- yeah, measuring wall.

Q. Okay. So it's not your intent that it be used as a wall thickness value --

A. Correct.

Q. -- of the pipe?

A. Yes, yeah.

Q. I guess I was going to ask you -- this is still Brian -- are the wall thickness measurement sensors calibrated before a tool run?

A. No, they're not calibrated. They are calibrated in a way that they have to achieve 60 dB or that they deliver a signal of 60 dB, but that's it. There's no other calibration.

Q. Okay, so not for sizing? They're not calibrated for --

A. No, no.

MR. NICHOLSON: But that -- this is Matt. The tolerance is stated in the final report, isn't it? There's no tolerance stated for that?

MS. SENF: Not for the wall measurement, no. It's just stated for the crack detection features.

MR. NICHOLSON: Okay.

MR. CHHATRE: This is Ravi, NTSB. Are you using the same sensor for wall thickness as you would be using for the wall loss tool or metal loss tool? Are -- sensors are different?

MS. SENF: No, I'm not --

MR. KILLORAN: If you know.

MS. SENF: I'm not -- I'm not sure. Not sure.

MR. CHHATRE: Okay. Can you just check that out and get back to us --

MS. SENF: Um-hum, yeah.

MR. CHHATRE: -- on that one? Because the sensors are saying -- I can see it's a spot check but still --

MS. SENF: Um-hum, yeah.

MR. CHHATRE: -- where is the confidence, I mean, that the sensors are -- these are accurate?

MS. SENF: Um-hum.

MR. CHHATRE: Okay. I'm sorry. I didn't mean to interrupt. Go ahead and start explaining. You didn't get too far until we started asking questions.

MS. SENF: Yes, okay.

BY MR. NICHOLSON:

Q. Well, I want to interrupt. Let's get some basics here.

A. Um-hum.

Q. For instance, the blue diamond that we see -- can you?

A. The blue diamonds, you see it in all three windows. It's a longitudinal weld.

Q. Okay. And the area over here, because that's where your wall thickness -- what is -- area something you, a region you highlighted?

A. Yes. So let's start at the top. So area means it's always the box.

Q. Okay.

A. And depending where I click on it, which box I click I get the information of it: area number, the analysis that you -- so you see it was analyzed in Step 1 -- the absolute distance of that feature, circumferential position in degree and hour, the feature type, crack-like. This one here was below 12.5% wall thickness, external adjacent to the weld.

And then we have some data for -- relative to the girth weld. So this one here was 20.7 to the upstream girth weld and almost 20 to the downstream. The distance to the longitudinal weld. So in this case here there is not really a distance to the longitudinal weld. And a distance to upstream and downstream markers.

Attributes of this feature here: the length, the width, the maximum amplitude we received with this feature, the background amplitude and the overlap. And at the end so we have some info about the pipe joint: so the girth weld number, the distance -- the start distance of the girth weld number and the most measured value in that pipe joint.

Q. Okay.

BY MR. CHHATRE:

Q. What is overlap? This is Ravi.

A. That's -- so the data are projected on the circumference. So offline -- no, online each signal of a sensor is separate, is treated separately. And in data processing we project them on the right precision and then -- let's see -- and then we have kind of a grid we have over the whole pipe circumference and each signal gets kind of a number. And depending on the signals, when there are more signals at one spot we get a higher number or a lower number. So, yeah, it's using a grid and giving a number to each signal on that position.

Q. So all that means there are more signals at that location, more data at that particular location?

A. I wouldn't say more data but more indications detected, yes, um-hum.

Q. And more indication meaning what indications are we talking about?

A. Indication, I mean it's a reflection which was received by the sensor. And when it was received by one by two or by three sensors or the more sensors which have seen the one indication, the higher the overlap will be.

Q. Okay.

A. So it's kind of overlapping of sensors or -- yeah.

Q. So if there is no overlap, the signal is received only by one sensor? When there is no overlap, the signal is received by one sensor. Where there is an overlap the signal is received by two or three; is that --

A. The higher the overlap, the higher --
Q. -- is that correct?
A. Yeah, the higher the overlap, the higher the number of contributing sensors, yes.
Q. So what does that number mean to us when you say overlap of -- where did that go?
MR. KILLORAN: Twenty.
BY MR. CHHATRE:
Q. Overlap 20, what does that mean?
A. It's -- so, this -- can I make --
Q. Do you want to draw something or explain something? I'm not understanding what it means.
A. Um-hum, yeah, yeah. Maybe I can show you a little graph. Let's see. Okay.
Let's see where it is. Procedures, no, it's not on that computer now. Oh, that's too bad. I had it there before. I moved it.
Okay, here it is. Now, the principle of the overlap. It's -- okay. So this is one indication. So it was here selected or each indication gets kind of an X here.
Q. Okay.
A. Okay. This is indication. So what we do now in our data is -- so at that point where there is an indication we give a 2 to it, and on the top and on the bottom of it we gave a 1 to it. So one indication.

So it is one sensor right now and right now the overlap here would be -- 2, 4, 6, 7, 8, 9, 10, 11, 12. So, for this one here the overlap would be 12 right now. And now I have not only one indication so I have several indications. And then my overlap gets higher and higher, depending on the number of indications I have.

A. I apologize. I don't think I still understand.

Q. So, it's not really -- it's not really -- when I look at this one here I cannot really tell. So, let's see, 14 -- 14 doesn't mean it's 14 sensors have seen it, so it's just -- we put the indications on a grid. We put a filter over it and then we get this number here.

MR. NICHOLSON: But what does it mean to the analyst? What do you do with -- how do you --

MS. SENF: What we do with it is -- so, a feature needs to have at least an overlap of 20 to get into the analysis list. So this is one of the thresholds we use. An overlap of 20 is pretty low because an indication of one sensor normally gives me an overlap of 12 already. So two sensors means 24. Two sensors -- indications of two sensors would give me an overlap of 24 already, so -- yeah.

BY MR. CHHATRE:

Q. So in laymen's terms, I guess, is it reasonable to say that for you to classify something an, quote/unquote, "indication" at least two sensors must see it?

A. Correct, yes.
Q. Would that be a correct assumption?
A. Yes. And --
Q. Forget about the overlap, but the --
A. And this overlap helps me to get rid of all the features which were seen by one sensor only, right? There might still be a box, but I don't want to look at features which were seen by a one sensor only. I want to have two sensors, and this overlap helps me to get these features.
MR. NICHOLSON: And this would have been true in 2005?
MS. SENF: Yeah. That hasn't changed.
MR. NICHOLSON: That hasn't changed. Okay.
MS. SENF: Yeah, um-hum.
MR. PIERZINA: So and one sensor gets 12 because why?
MS. SENF: Because this graph here -- because when I have one indication here, so -- 3 means 10 millimeters here. I would give a 2 to that indication here and this one here and this one here, at least a 12.
MR. CHHATRE: I'm sorry. I still -- I don't --
MR. NICHOLSON: Yeah.
MR. CHHATRE: -- unless somebody -- I don't understand.
MS. SENF: Yeah, the grid --
MR. CHHATRE: I realize it's very, very clear to you as an analyst, but --
MS. SENF: Maybe I cannot explain it that well. So,

it's just that these --

MR. KILLORAN: That's why it takes 4 weeks.

MS. SENF: And even then, you know --

BY MR. CHHATRE:

Q. So, the first graph -- I mean, the first table --

A. Yeah, uh-huh.

Q. -- I see you have 6 X's, meaning there are 6 locations that analysts feels or computer program, whatever your program is --

A. Um-hum.

Q. -- gives you an indication there is something that your tool has seen.

A. Um-hum.

Q. And the tool doesn't know what it has seen. That part I -- is that correct?

A. Um-hum, yes.

Q. So that part is clear. The second and third tables, I don't think I understand it.

A. Yeah, we give numbers to it. So to somehow prioritize the indications itself, because so one indication might look like this. An indication or a reflection of the same indication but by a different sensor might not be projected exactly at the same position, because a crack is not really a linear thing.

Q. Right.

A. And a crack would walk like this here.

Q. Right.

A. And then we have to consider each indication and have -- need to prioritize each indication and then we can come up with --

Q. So how do you get these numbers: 1, 1, 1, 2, 2, 2? How is that developed?

A. It's just the -- this is the filter, the binominal filter we use for it. So this was developed somehow to get an overlap when -- so this was developed when we started with analysis of the data. So, we thought we need kind of a criteria of the number of sensors which were involved, right? And this is why we started with this simple filter, I would say. Just give a tool to the grid where we see an indication, but also consider the one here and the one here, because we know an indication would never be linear, so we might have some curves in it. And so we have -- give all the priority to the fields which are close to the indication.

Q. So this table -- all these tables, they are generated by your software or are they are generated by the analyst?

A. This is by the software, generated by the software.

Q. Okay.

MR. NICHOLSON: This is how they get the overlap number you see.

MS. SENF: Yes, um-hum. Yeah.

MR. CHHATRE: Yes. Okay, okay.

MS. SENF: Yeah. It's just projecting all the indications --

BY MR. CHHATRE:

Q. So, this is all software?

A. -- on the position where they are in the pipe joint.

Q. Okay.

A. And then using a filter and generate an overlap.

Q. This is all software (indiscernible) --

A. Yeah. (Indiscernible).

(Simultaneous speech.)

MR. NICHOLSON: So it's a weighting, and each row is a sensor?

MS. SENF: No, it's just one row in the middle, it's a sensor. And the other two here, it's just also considering these two because the next sensor might have seen the same indication but in this row here, not in this row. So having kind of a tolerance on the projection, so that's why we -- we don't consider these indications only, we also consider the surrounding of it.

BY MR. CHHATRE:

Q. And so what is the third table then? The third table's the same indication seen by two different sensors or -- what does the third table means? Yeah, that right there that says 1, 3, 4 then 2, 6, 8. What do those numbers mean?

A. So here this filter was used and now we also use this filter here. That means we take this one here.

Q. Um-hum.

A. And we add a 1 here; we add a 2 here and a 1 here. Okay. Then we come here. It's difficult to explain. Shall I do it in --

MR. PIERZINA: This is Brian. I was -- I thought -- is it maybe that there's three sensors where it goes from 1 to 3?

MS. SENF: No. No.

MR. PIERZINA: No? 3 to 4?

MS. SENF: So, okay, we have this indication here. The first we apply the sensor here: 1, 2, 1, 2, this indication here. Let's only -- let's only talk about that one pixel here.

MR. PIERZINA: Okay.

MS. SENF: This filter: 1, 2, 1. And then we take this one here and we add this filter. So when we just consider here the one here, this one, we add 1, 2, and 1. So we add a 1 here, we add a 2 here, and we add a 1 here.

We do the same with this one here. Can I? Yeah, I can. So, now I add this filter to this one here. So I have 1, 1, 1, okay. I add 1 here. I add 2 here, that's 3. And I add another 1 here too. Okay. I have to do the same here. I add a 1 here, 4. I add a 2 here; that's 4. And I add a 1; that's 2. So here I have to add a 1 here; that's 5. I add 2 here; that's 4. And I have to add a 1 here. So now this is -- the first row I'm done with it.

Now I go to the second row, this indication here. I add a 1 here. I add a 2 here, and I add a 1 here, 3. The same here.

I have to add a 1; 5. 1 here. I have to add 2 here; 5. And I have to add a 1 here; 3. Same here, 6 and 3, 5 and a 1 here, and so on. So I use these two filters on these indications here and then I come up with our value.

BY MR. NICHOLSON:

Q. And then you come up with a what?

A. And then I come up with the overlap value then.

Q. But the overlap is a single number so what are you doing to this matrix to get your single --

A. I add all the numbers.

Q. In rows or columns or --

A. I take -- let's see here. So this is only about one indication here. When I go to the overlaps and -- so you see in some cases, here I have an overlap one here of 3. So actually though this table here is displayed in colors here in my data. And the highest overlap I have here is about 14 with this here. Oh, that's a high overlap and here, that's another high overlap, 20.

So here I don't really have a lot of vectors which were selected by the tool. And to make it even more complicated is -- so --

MR. PIERZINA: That's what we need right now.

MR. NICHOLSON: Yeah. Please don't.

MS. SENF: No, no. When I look at the data -- so let's see where my crack-like indication is. Here I have a nice crack-like indication. That's a crack field for me, okay? This is the B scan now we look at. The B scan shows me the distance again and it shows me the time of flight of one sensor.

MR. KILLORAN: Just for the record, you're referring to the long -- to the horizontal and vertical --

MS. SENF: To the horizontal at the time of flight --

MR. KILLORAN: -- rulers.

MS. SENF: -- and the X axis is the distance. The blue black lines here, it shows the dimensions of the features or the start and the end distance of one feature. So I can -- not in this data set -- though this is how the analyst changes the length by just moving these two bars to the indication, and then he identifies or he determines the length of it.

And what else do we see?

BY MR. NICHOLSON:

Q. Do those bars come in initially through software?

A. Yes.

Q. Are they pre-set?

A. So, this is the dimension. The box we see in the C scan here though, this corresponds to the black bars here in the data.

Q. Okay.

A. Going back to the one sensor here. Though this here is the entry echo of the ultrasonic beam here. It hits the internal surface. And here at that position approximately we are at the external surface -- internal surface, external. So I guess it will make sense to --

Q. So these are the half skip, full skip?

A. Yes. This is just opening a little slide with the ultrasonic beam.

MR. CHHATRE: Do you understand, right? I'm still confused. I'm not -- it's not really clear to me.

MR. NICHOLSON: On the overlap?

MR. CHHATRE: No, the overlap I see is just software generated, obviously the program --

MS. SENF: Um-hum, yeah.

MR. CHHATRE: -- software is doing that. So, I'm not sure (indiscernible) the software, I think I understand the overlap. It's built into the software --

MR. NICHOLSON: Right.

MR. CHHATRE: -- and for each indication -- and correct me if I'm wrong -- each indication your computer program --

MS. SENF: Um-hum, yeah.

MR. CHHATRE: -- your software is going to give you overlap?

MS. SENF: Um-hum, exactly.

MR. CHHATRE: And the overlap, you said that will be -- you don't consider that as an indication -- more than 20, you will consider that as a valid indication?

MS. SENF: Yeah. It starts with 20, that at least two sensors have seen a feature, yeah.

MR. CHHATRE: Right.

MS. SENF: Yeah, um-hum.

MR. CHHATRE: So two sensors will be 24, so it has to be more than 20, is what you're saying. Am I correct or --

MS. SENF: Equal to 20 or more than 20. It starts with 20, yeah.

MR. CHHATRE: Okay.

MR. NICHOLSON: For -- this is Matt. The 20 criteria is just for the analyst to look at it. It still appears regardless of overlap?

MS. SENF: It still appears, yes. Right.

MR. NICHOLSON: Okay.

MR. PIERZINA: It won't get boxed unless there's an overlap of at least 20; is that right?

MS. SENF: No. We even box with a lower overlap. The overlap relates only to selected vectors. So, we record a shot online but only a few shots of it really meet our thresholds for detection, and lots of the signal don't do that. In this case here, so you see all these dots here now in the B scan. These are selected vectors.

MR. PIERZINA: Um-hum.

MS. SENF: So these features or these dots, pixels, met the detection criteria. But there is still a lot of pixels which do not really meet selection criteria, but they are still recorded because they are close to each other. And the overlap only considers these selected vectors. So that means we have still some features which were seen by two sensors but have a really -- a low overlap because they don't have really a lot of selected vectors in it.

MR. NICHOLSON: So do you use that in your Step 2 analysis or --

MS. SENF: The selected vectors or --

MR. NICHOLSON: The unselected?

MS. SENF: No, it's just for -- I guess I can say it's only for the off-line processing. We use it to make sure only the relevant features are suggested for analysis and not the irrelevant ones.

MR. NICHOLSON: Okay.

MS. SENF: Yeah.

BY MR. CHHATRE:

Q. So what is the color bar next to your graph, which is, I guess --

A. Um-hum.

Q. -- time scale and X axis, that gives you how many decibel, how strong the signal was? Does that indicate the strength or --

A. So this bar here shows me that all the pixels with an amplitude of 38 dB or higher are displayed in red.

Q. Okay.

A. But it doesn't necessarily mean that the red one here at

38; it can also be more than that, but it is at least 38 dB, yeah.
Q. Okay. And so with the different color coding, is there a threshold below which you won't be considering that an indication or -- what is the significance of this color coding, I guess, is what I'm trying to understand?
A. Um-hum. The significance is of the 38 here is -- tells the analyst, so everything which is red is at least 1 millimeter deep.
Q. Okay.
A. So, the color code somehow corresponds to our depth sizing.
Q. Okay.
A. And so we have a sizing curve and in our sizing curve, first we determine the saturation amplitudes or the maximum amplitude -- or the amplitude we think is corresponding to 3 millimeter depth.
Q. Okay.
A. And based on that we -- so in this case here -- the saturation amplitude was 50 dB. So when -- 50 dB is 3 millimeter so we say 44 dB corresponds to 2 millimeter depth and 38 millimeter corresponds to 1 millimeter depth.
Q. So it's a linear relationship?
A. No, not -- it's a kind of a curve we have here, yeah.
Q. Okay.
A. And though this is what we use in every data set in the

same way. Always indications with a depth of approximately 1 millimeter are displayed in red. So, when the saturation amplitude is higher we change this value here in the analysis data.

Q. Okay.

MR. PIERZINA: This is Brian. Just to repeat, so 50 dB correlates to 3 millimeters?

MS. SENF: Correct.

MR. PIERZINA: 40 dB relates to 2 millimeters?

MS. SENF: 44 dB.

MR. PIERZINA: 44?

MS. SENF: So minus 6 dB.

MR. PIERZINA: Okay. And then 38?

MS. SENF: Um-hum, to 1 millimeter.

BY MR. NICHOLSON:

Q. And that -- this is Matt. That's always the same? That's always 50 or --

A. No, no. It's -- it depends on the saturation -- on the medium attenuation.

Q. Okay.

A. Mainly, though the higher the medium attenuation, the higher the saturation amplitude is.

Q. Who determines the saturation?

A. It's our data control team.

Q. Okay.

A. So for USCD we have two very experienced analysts who do the DQA on the data to assess if the data is acceptable for analysis and they also -- they do the whole data processing and they also determine the saturation amplitude.

Q. And how do you know what the saturation was for this run?

A. I just have to add 12 dB to that value here.

Q. So you always deduct the 6. That's a constant -- that's always 6, regardless of what the saturation is determined to be?

A. Correct, yes.

Q. So that's all you have to do to figure out saturation?

A. Um-hum, um-hum.

Q. Okay. Do you want to stay on the B scan or are we going to go back to --

A. Yeah.

Q. What were we doing here?

A. Is it clear what -- how the signal is displayed in the B scan?

MR. CHHATRE: This is Ravi. Can you explain the difference between B and C scan as to what --

MS. SENF: Okay.

MR. CHHATRE: -- what they're -- just for the record?

MS. SENF: Okay. So, let's start with the A scan.

MR. CHHATRE: Okay.

MS. SENF: So the A scan, it's one shot of one sensor.

So this is what an A scan looks like. Here we see 4, 4 individual A scans. So this is one A scan. So the shot that's somewhere here, we don't have the pulse echo here in our data. The first what we see here is when it hits the internal surface. And though the vertical lines, the black lines you see are the individual vectors. All the reflections the sensor gets back. The green line displays the calculated entry point, because entry echo is always a wide echo, a few -- 4 or 5 microseconds wide. So we need to determine where's the middle of it somehow, and this is also done -- calculated by the software.

MR. CHHATRE: So, for the record, describe the graph and what is the X axis, what is the Y axis is scan?

MS. SENF: The Y axis is the amplitude.

MR. CHHATRE: Okay.

MS. SENF: And the X axis is the time of flight.

MR. CHHATRE: Okay.

MS. SENF: Um-hum.

BY MR. NICHOLSON:

Q. And there's 4 displays here and that's -- each is a different sensor?

A. It's the same sensor --

Q. Same sensor.

A. -- but at a different distance. So, there is always a difference of 3 millimeters between these. So, the tool or the sensors are shooting every 3 millimeters, so that's the scan picture we have.

Q. Um-hum.

A. Every 3 millimeters we get a signal back and, yeah, this is displayed here in the A scan. So, let me see if I have a -- yeah, so here you see in the little window the X -- no, that's wrong. That's wrong. Do I see a distance here? No, I don't see really a distance here. I should go back to the -- yeah, I just can see the distance in the B scan. So let's go back. I went to the A scan and this is the first A scan of this box, of this feature box.

Q. Um-hum.

A. Okay. And then 3 millimeters further down, 3 millimeters further, 3 millimeters further. So, we don't use the A scan for analysis. It's just there, but we cannot really use it. So we use the B scan and the C scan.

Q. Okay.

A. So, the individual shot doesn't give an idea. So, it might help in the field to find the maximum amplitude of a feature but not in data analysis, so we need to -- the signals of each shot, not only of one shot.

MR. CHHATRE: And does a different color mean something in A scan or --

MS. SENF: So, yeah, let's come back. So the green one was a calculated entry point. The black ones are all the vectors, which -- of that one shot, all these pulses. And the red ones are the selected vectors. So, because of the red lines the shot was recorded. So if -- because they exceeded the --

MR. CHHATRE: Threshold.

MS. SENF: -- the online detection thresholds. All the other shots didn't really exceed these.

Mr. CHHATRE: This is for one defect and one sensor?

MS. SENF: Correct.

MR. PIERZINA: This is Brian. The blue and red hashes at the bottom of the scale, what are the -- is that the inside wall/outside wall?

MS. SENF: Correct, yeah. So you see here this is the calculated entry point here it starts with blue, which means it's internal. External is red. Blue is again internal, external, internal.

MR. CHHATRE: And at this point the analyst would only know it's an indication meaning it could be a wall loss, it can be a crack, it can be anything, or it just can be a crack?

MS. SENF: Sorry. Can you say that again?

MR. CHHATRE: These indications, the one at the bottom is red and you said one is external, one is internal.

MS. SENF: Um-hum.

MR. CHHATRE: Red is external, blue is internal?

MS. SENF: Um-hum.

MR. CHHATRE: Are these indications of just a wall loss or that means it is a crack feature of some sort, or what is that indication tells the analyst?

MS. SENF: It just tells them it's an internal or an external indication. This is all.

MR. CHHATRE: So it could be anything? It can be wall loss; it can be a crack?

MS. SENF: Wall loss not because we don't see that in the crack detection data, but it can be a crack-like indication, a notch-like indication --

MR. CHHATRE: Okay. Gotcha.

MS. SENF: -- crack field. Yeah, uh-huh.

MR. PIERZINA: So this is Brian again. So if of the four graphs that we're seeing here are 3 millimeters apart --

MS. SENF: Um-hum.

MR. PIERZINA: -- why is the calculated entry point the same? Wouldn't it --

MS. SENF: So here it is the same. Let's go further down so you see it slightly -- should slightly -- now, it moved a little bit, I guess. It moved between here and here. Can't really see it.

MR. CHHATRE: Um-hum. Yeah, it has moved.

MS. SENF: So, I guess you wouldn't see the difference that much in the A scan but you would rather see the difference in the B scan here. The green line in the A scan is a black line here so you see it as a slight variation in the entry point. So this black line corresponds to the green line in the A scan.

MR. PIERZINA: So black line --

MS. SENF: But it's not -- it's not always at the same position, no.

MR. PIERZINA: Okay.

MS. SENF: Um-hum.

BY MR. CHHATRE:

Q. So A scan really is -- just happens to be there? You don't use it for any purpose per se?

A. Correct. So, technology is using them when they do some investigations on signal amplitude, but analysis is not using them at all, yes.

Q. Okay. So then you would use B scan. Now what is B scan?

A. Right. So you remember the A scan, so this was the amplitude; this was time of flight. Time of flight is here in the Y axis -- in the X axis. And in the B scan the time of flight is in the Y axis. So the amplitudes are displayed in colors now and so every line displays one A scan. So I have turned the A scan now like this, so every line, every pixel line here displays one A scan.

Q. Can you go back to A scan just for a second? I'm trying to -- okay.

A. So I take that A scan like this.

Q. Right.

A. And then the time of light is not in the X axis, now it's in the Y axis. The amplitudes are displayed in colors and I see one A scan next to the other.

Q. Okay.

A. And then I see the consecutive signals of one indication by one sensor.

Q. And that would be every 3 millimeters?

A. Every 3 millimeters, yes.

Q. So 3 millimeters still stays the same. So if you go back to B scan, then as I move along the X axis here, each color will be 3 millimeters apart on the pipeline, right? Or I'm wrong?

A. Say that again.

Q. When you turn the A scan --

A. Um-hum.

Q. -- what -- I guess rotation of 90 degrees?

A. Yeah, um-hum, right.

Q. So each vertical line here now --

A. Yeah.

Q. -- will indicate a 3 millimeter distance from the previous one?

A. Correct, correct.

Q. Okay.

A. Distance-wise, uh-huh.

Q. And so the analyst looks at this and then what is -- what does this scan, which is, I guess, time in Y axis, distance on X axis -- so, if an analyst looks at this, what does it tell him or her?

A. Um-hum, okay. So, yeah, a little more explanation before we start with it.

Q. Okay.

A. So the B scan -- there are several B scans and each B scan shows the data of one sensor only.

Q. One sensor?

A. Of one sensor. This is one sensor here. For instance, here this is 2-16.

Q. Sensor? Sensor -- okay.

A. Sensor 2-16, yeah. Let's go back to the C scan. So this is how the analyst starts data analysis. So he looks at -- he gets that feature and he looks at it, and first thing he sees, okay, this is at the long seam. So, here I have the blue diamond, tells him it's a long seam and also the black line here tells him you are at the long seam. So he knows somehow what to expect. So he needs to -- or he will expect some long seam reflections, but he knows there can be a toe crack at the long seam; there can be a crack field at the long seam, also some inclusions, so -- but the important thing is he expects the long seam reflections.

When he's in the base material somewhere, he wouldn't expect long seam reflections. Everything he sees when he's in the base material is a defect.

Q. Now, this 90 degrees, 270, how are you looking at the degrees? Looking in the direction of flow or --

A. In the direction --
Q. Well, 90, I can go in (indiscernible) --
A. -- in the direction of flow, yes, um-hum, uh-hum.
Q. Okay.
A. Okay. So first thing is he knows, okay, I'm at the long seam. I expect some --
Q. I'm sorry. And the top is -- top is 0? Going clockwise -- if I'm looking in the direction of flow --
A. Um-hum.
Q. -- going clockwise 30, 60, 90, 180, 270, 360.
A. Ninety, 180, 270 -- yeah, um-hum.
Q. Okay. All right.
A. Okay. So he goes into the -- and now the next step is to look at all the sensors in the B scan, all the B scan sensors. So the first one there is no indication at all, which is easy. Second one there isn't anything either. So, he needs to go through until these two lines turn into white.
Q. And these two lines are what? I'm sorry.
A. Then he knows --
Q. These two lines are?
A. So, these are the length dimensions, start and end.
Q. Of?
A. Of the one -- of this box here. Let's go back. So this box here --
Q. Um-hum.

A. -- or this dimension from here to here is displayed in black lines here.

Q. Okay, all right.

A. Okay. He needs to go through and, as I said, these ones, when he's at the end of the box they will turn into white. So, he knows I have to go through -- even if there isn't anything to see, I have to go through until it turns white.

Q. Okay.

A. So, another help to tell them how far they have to go.

Q. Okay.

A. Okay. Now, a few sensors are empty now for a good reason. And now he gets the first signal. So what do we see here? Here black line, you know, it's entry point. So, this is quite a wide signal of the internal surface. And then there are some weak reflections but not really. I cannot see some defect indications. It's just some noise which was recorded, which happens once in a while. And --

Q. So I'm going back -- so, at that particular time the analyst doesn't see anything of concern in that location, right?

A. Right. At that location he didn't see anything.

So, I just moved to the -- or switched to the selected vectors. So, these reflections here were responsible to detect -- to record the data for some reason but it's not really a defect indication; it's just the internal surface which gave quite a high reflection back. So, going back here though, this is the internal surface signal. There is no defect visible but it still was recorded.

MR. NICHOLSON: How do you know that's the internal?

MS. SENF: So internal is here, but --

MR. NICHOLSON: Oh, okay.

MS. SENF: -- I would expect a real signal somewhere here first time.

MR. NICHOLSON: Okay, okay.

MS. SENF: So it -- and you see here, the signal -- the internal surface is quite wide so here that entry point might not be the best one. I would say the calculated entry point is somewhere here, so -- but the software does also have some algorithms to identify the entry point. But sometimes, depending on the data, I guess this line here from the internal surface confused the algorithm a little bit.

So, the internal surface here is quite wide, and an explanation for it could be because we're at the long seam. And at the long seam the reflections we get are wider than in the base material.

Okay. The next sensor you just see a red line.

MR. KILLORAN: Do you want to just note for the record it's being depicted as 1-7, 95.1 --

MR. CHHATRE: Degrees.

MR. KILLORAN: -- degree LW-C?

MS. SENF: Yes. So and we look at feature 154-006749.

Okay. So this sensor 1-7, it's called LW-C. When the sensor hits the internal weld cap it gets quite a high reflection back, so it's up to 70, 80 dB, which can come back. And in the past we had to make sure that we record all data, but that we do not record data we don't really need. And it was assumed at that time that when we have a reflection from the internal surface -- from the internal weld cap, the data behind it doesn't really make sense.

So, what they did at that time, they had an algorithm: as soon as I have a high reflection at the internal surface -- means the internal long weld -- I only select the first five vectors and don't record all the reflections behind it. So it was kind of a data storage saving algorithm. So meanwhile, we got rid of this algorithm.

MR. CHHATRE: Do you know -- this is Ravi, NTSB. Do you know there's really an external cap of some sort, or you're assuming because the signal is so strong at the bottom?

MS. SENF: It's just assuming because the signal is so strong it's the internal weld cap.

MR. CHHATRE: Internal?

MS. SENF: Internal weld cap from the DSAW weld, um-hum.

MR. CHHATRE: Okay.

MS. SENF: Um-hum.

MR. CHHATRE: But could there also be a legitimate crack in there because of high amplitude? It's almost -- the way I look at it, it's 38 to 50?

MS. SENF: Yeah. So not necessarily a crack but we experience that for internal notches, wide internal notches that we also got a high reflection, and that it then was treated as an LW-C. Yeah, that's right. But, the good thing really is -- so, we don't use the signals from the internal surface. When there is a strong reflector we don't see it only at the entry, we would also see it with a second sensor in the first skip.

MR. CHHATRE: Okay.

MS. SENF: I guess we need to have -- we need a drawing sooner or later.

So, okay, now this here is the long seam sensor. So, this tells the analyst, okay, I'm at the long seam and he correlates somehow his virtual long seam. This helps him to identify toe cracks. Okay.

MR. PIERZINA: This is Brian. LW-C means what?

MS. SENF: Long weld center.

MR. PIERZINA: Long weld center?

MS. SENF: Um-hum.

MR. NICHOLSON: And that's the name of that transducer? Is that what it is?

MS. SENF: Not of the transducer. It's the name of the signal, I would say.

MR. NICHOLSON: Um-hum.

MS. SENF: Because the transducers are all the same. But when the transducer receives a very high signal, the data which are -- is recorded gets a (indiscernible) LW-C.

MR. NICHOLSON: Okay.

MS. SENF: And all the other data are recorded normally. Only this one here --

MR. NICHOLSON: I see.

MS. SENF: -- the data will be -- we use, it's a different data type, I would say.

MR. NICHOLSON: It's in the algorithm?

MS. SENF: It's in the algorithm, yeah.

Okay. Let's get rid of that line here. And then he goes to the next one and it's here again. So, we have quite a wide signal of the internal surface, but all the other stuff -- blue, dark blue and bright blue signals here of sensor 1-8, it's just some noise.

The next sensor. Now, it's getting more interesting. So, we see in sensor 1-9, we see some weak reflections here at the end. So these reflections can be caused by the long seam. So the long seam normally provides some continuous vertical indications. And we also see here at the right-hand side that we see some yellows and green clouds, but not really -- it's not really clear what it could be. Could be an inclusion. So, the sound was diffused a little bit so it's difficult to tell what it is, but it is with a very low amplitude, so it would be below .5 millimeters.

BY MR. CHHATRE:

Q. This is Ravi. Looking at this graph here.

A. Um-hum.
Q. You said it's because of long seam. But if I look at this degrees going up, it looks like it's almost one quarter of circumference away from the long seam.
A. No, no. So this is the time of flight here. This is the time of flight.
Q. Oh, time of flight?
A. Yeah. This is the time of flight. So we always -- so we are -- that's the wrong one. So we are in a range between -- what is it -- 102 and 90 degrees somewhere. So in a range of 10 or 15 degrees, yeah.
Q. Okay.
A. Yeah, um-hum. Okay.
MR. PIERZINA: This is Brian. LW-N means what?
MS. SENF: Okay. So, the LW-C means, okay, I have identified the center of it.
MR. PIERZINA: Uh-huh.
MS. SENF: And this triggers that the next two neighboring sensors record the data independent, if there is anything or not. So because the LW-C identified -- okay, here, this is the long seam. And now the next two have to collect all the data because there could be a defect.
So, the data compression algorithm isn't used at the long seam because at the long seam -- most of the defects are at the long seam and the long seam signals can be -- how can I say

that?

MR. PIERZINA: That's all right. I think I understand. Just because you're at the seam --

MS. SENF: Yeah, so --

MR. PIERZINA: -- you're not going to discard.

MS. SENF: So, some of the long seam reflections and some of the crack-like reflections might be next to each other so it's difficult for the algorithm to discriminate.

MR. PIERZINA: Sure.

MS. SENF: The algorithm cannot discriminate at all. So the LW-C triggers of the next two sensors, you have to collect all the data.

MR. PIERZINA: Okay.

MS. SENF: And this Y here, we don't see anything. We just see some noise. But it's only because it's LW-N. And here the next one here as well. So we don't really see a critical indication but it's recorded. And --

BY MR. CHHATRE:

Q. I'm sorry. Can you go back? This is Ravi. Can you go back and tell me what LW-N, -C, all those things, mean?

A. So, LW-C means it's a long weld center and LW-N means it's a long weld neighbor, and we have a Neighbor 1 and we have a Neighbor 2.

Q. And Neighbor 1 means how far away and Neighbor 2 means how far away?

A. Though the N1 is next to the LW-C and the L2 [sic] is next to the LW-N1.

Q. But there is no -- there is no degrees that you can identify --

A. Well, it's exactly the next sensor --

Q. Okay.

A. -- position-wise or degree-wise. So we can see here it's -- this one is almost at 92 and the other one 93.5. So 1.5 --

Q. So, the sensor reading. Neighbor means --

MR. FOREMAN: Yeah. Geoff here, Pii. The sensor carrier is rifled; it's spiral.

MR. CHHATRE: Right.

MR. FOREMAN: So the reason why we have a centralized set -- it's not a set -- well, if a -- a centerline sensor could be any one of them depending where that centerline hits as the sensor carrier goes by.

MR. CHHATRE: Um-hum.

MR. FOREMAN: So that sensor becomes LNC [sic] and it will force the two neighboring sensors, as I say, to automatically record whether it sees something or not in case there's something being masked by the weld.

MR. NICHOLSON: And it's rotating so it will be some other sensor then --

MR. FOREMAN: It will become --

MR. NICHOLSON: -- LW-C --

MR. FOREMAN: That's why she said it isn't sensor Number X.

MR. NICHOLSON: Exactly.

MR. FOREMAN: Because you never know which sensor it is and it could be of various --

MR. NICHOLSON: The algorithm grabs it and names it.

MS. SENF: Yeah, right. Yeah, yeah.

MR. NICHOLSON: Okay.

MR. FOREMAN: If we see -- we look at the sensor carriers you can --

MR. PIERZINA: Right.

MR. FOREMAN: -- specifically see the shape of the -- that nothing's linear.

MR. CHHATRE: Okay.

MR. PIERZINA: So this is Brian again. Would there be a same thing for the clockwise side and the counterclockwise side?

MS. SENF: Correct, yes.

MR. PIERZINA: So there would be a clockwise LW-C and a counterclockwise LW-C?

MS. SENF: Yeah.

MR. PIERZINA: And so you're getting -- so you get -- okay.

MS. SENF: So, so far when the analyst starts his analysis, first he gets a list off the clockwise sensors. So here he sees the list. So, it starts with sensor 1-9 and it ends with sensor 15-14. So let's go through it. And now you see it turns white. Now he knows, okay, I've been through all the sensors so I have completed my sensor list, at least the clockwise ones.

And now he has to go to the counterclockwise side. Look at these sensors as well and -- 16-30, sensor 16-30. So here we see -- these all look slightly different because it only is in a range where my black lines are, where my length lines are. And I see the internal surface is not as wide as before, so it looks much better here because I'm not really exactly at the long seam. And I see some -- I would say I see some little cracking indications with quite a low amplitude. But irregular indications wearing amplitude pretty short. So this would be the first indicator of a crack field, but not really clear. But with some experience, okay, you will get conscious now, okay, that could be more.

BY MR. CHHATRE:

Q. This is Ravi, NTSB. Go back to that.

A. Yeah.

Q. What made you decide that this is a crack -- there are some crack-like features? To me, you know, as a non-analyst --

A. Um-hum.

Q. -- to be honest, everything looks very similar to me. All the previous --

A. No, no, no, no, no.

Q. -- ones and this one looks similar to me.

MR. FOREMAN: Well, I was going to say, he had the (indiscernible) used by yourself.

BY MR. CHHATRE:

Q. Because we are -- (indiscernible) what features in this particular graph told you that there's a -- maybe an initial indication of a crack or crack field, or what's your classification?

A. So this is my sensor.

Q. Um-hum.

A. This is the pipe wall.

Q. Right.

A. And so there is a distance between -- there is a stand-off, the distance between the center and the pipe wall. And now it hits the internal surface somewhere here.

MR. NICHOLSON: That's the blue, right?

MS. SENF: Yes, that's the blue.

MR. NICHOLSON: Okay.

MS. SENF: And that's this range here. It's quite a wide range, sometimes more, sometimes less.

MR. CHHATRE: So that range is what on your graph?

MR. FOREMAN: Internal --

MS. SENF: That's the internal surface, yeah.

MR. FOREMAN: Yeah.

BY MR. CHHATRE:

Q. Okay.

A. Okay? And now it propagates diagonal. So, with a 17 degree here at the entry point, I will get a mode conversion and I will get a shear wave of 45 degree in the steel.

Q. Okay.

A. No, this is by now flaw, depending on the medium, depending on the steel grade, and depending on the angle here, I will have 17, and then I will have 45 in steel. With 45, my corner reflection or my corner effect will be as good as possible.

So now this was the entry point and now it propagates with 45 degree here.

Q. Um-hum.

A. And now -- at the external surface. And now there are some reflections. There's a little crack field at the external surface. So an external surface means this is somewhere this range here.

MR. FOREMAN: The red mark, yeah.

MR. NICHOLSON: We're looking at this little red pixel over here?

MS. SENF: There are a few pixels though.

MR. PIERZINA: Yellows, reds, and greens.

MS. SENF: This one here -- everything which is not blue, which is not dark blue is kind of a cracking indication, yeah, and the red line here.

MR. FOREMAN: External, external, external, internal,

internal, internal. That's the area you're looking in that window.

MR. NICHOLSON: Yeah, okay.

MS. SENF: Yeah. So all indications in this box here are little weak cracking indications.

MR. NICHOLSON: Okay.

BY MR. CHHATRE:

Q. I see yellow at the bottom also. I see yellow also --

A. Yeah, but that's the internal surface. And the signal you receive from the internal surface, it's always strong. It's always irregular. You cannot use it. You can use it here. You can use external or --

Q. Okay.

A. -- if there would be an internal crack. So the sound propagates like this through the pipe joint, right?

Q. Um-hum.

A. So let's assume that there is no external one. But then it propagates here to the internal surface again. And if there is a crack, I will get a nice signal of this indication here, and --

MR. NICHOLSON: Which would show up here?

MR. FOREMAN: That's right.

MR. NICHOLSON: Okay.

MR. FOREMAN: That's why we like to use the one skip for the internal and the half and one-and-a-half for external.

MS. SENF: Right, right, yes. So this sensor -- if there is a crack here -- let's say there is an internal crack here, which is not often the case.

MR. NICHOLSON: Um-hum.

MS. SENF: But if there's a crack here, this sensor wouldn't see it. Though the signals of the internal surface is so strong, it's really difficult to identify such a crack here. But a sensor, which is located here somewhere, this sensor would catch it.

MR. NICHOLSON: Okay.

MS. SENF: So, all the indications close to the entry point are not used for analysis.

MR. FOREMAN: This is Geoff again. The hardest thing to visualize when you're watching this -- and it took me years to get my head around this -- is it's really 3-dimensional and we're looking at a 2-dimensional plane.

MR. NICHOLSON: Um-hum.

MR. FOREMAN: So, you have sensors that are sitting behind it which are just off by a quarter to a half an inch. So when you look at a -- when she's going through the screen here in both directions, she's looking at a bank of sensors that are traveling through the feature 3-dimensionally.

MR. NICHOLSON: Um-hum.

MR. FOREMAN: And we're only seeing it 2-dimensionally. So the hardest thing the analyst has to understand is that this is a tunnel and not a flat screen and the sensors are coming up from behind and just to the side all the time, and bouncing sound around the circumference. That's why she'll see some in the one-half skip on one sensor and some in the one-and-a-half skip on another sensor. It's the same crack, but the other sensor is so farther away its catching it on the next time around.

MR. NICHOLSON: And that's all these sensors that you're going through?

MR. FOREMAN: Yes.

MR. NICHOLSON: They're actually back behind as well as circumferentially?

MR. FOREMAN: Yeah.

MR. NICHOLSON: Okay. That helps.

MR. FOREMAN: Maybe (indiscernible). Do you understand that?

MR. PIERZINA: Yeah.

MR. FOREMAN: Yeah.

MS. SENF: Okay. So, in this sensor though this gives me the first clue of what I can expect here. So there is some weak reflections. So either a crack field but also could be an inclusion, so it delivers similar reflections or a mil anomaly would give also similar reflections.

MR. NICHOLSON: A what anomaly?

MS. SENF: A mil anomaly.

MR. NICHOLSON: Oh, mil, okay.

MS. SENF: Kind of a sliver.

MR. NICHOLSON: Would give you this?

MS. SENF: Yeah.

MR. NICHOLSON: Okay.

MS. SENF: So there's irregular stuff at the external surface.

MR. CHHATRE: So if you were to see between 35 and, I guess, 45, ever see a whole bunch of red dots, that would tell you a crack field now or what would it tell you? All red. Let's just say these are all -- say, in the blue they are all yellow and red. What would that tell the analyst?

MS. SENF: That there is a severe indication, and depending on the shape, could be a crack field or a crack-like indication, yeah, uh-huh. So when you say dots or little lines around the crack field --

MR. CHHATRE: So the operator will be looking for the color then, rather than paying so much to detail attention?

MR. FOREMAN: Right.

MS. SENF: The color and the shape.

MR. FOREMAN: It's Geoff here. From the last testimony we gave with Clint, we talked about the saturation dB's. And if you look at the scale on the right-hand side, you see red down to gray. So anything that's red is going to be greater than 1 millimeter.

MR. CHHATRE: Right.

MR. FOREMAN: So anything that's red is of significance.

MR. CHHATRE: Right.

MR. FOREMAN: It's going to be greater than 1 millimeter. Anything that's less than red is less than the specification. It's in there. It helps the analyst see things like shadow effects and weld effects, but really they're looking for red pixels.

MR. CHHATRE: That's what I'm saying. They are looking for red color?

MR. FOREMAN: Yeah. Yeah, yeah.

MS. SENF: Yeah. So, the color and shape, yeah.

MR. CHHATRE: We are just looking at it for --

MR. FOREMAN: Ultrasound is normally dB's is depicted in a color band. Red is the target.

MR. CHHATRE: So, then how would the person, analyst will go and classify further? There is a 25 to 40, more than 40 --

MR. FOREMAN: Have you come to an SCC piece yet?

MR. KILLORAN: No, no.

MR. FOREMAN: I think if we go through the process --

MR. NICHOLSON: Right. Let's let her to do the process.

MR. FOREMAN: -- it will answer a lot of the questions.

MS. SENF: Um-hum. Um-hum.

MR. FOREMAN: If she steps through like an analyst would and then when we get to the real crack field she can explain.

MR. CHHATRE: Okay.

MR. NICHOLSON: But one more thing. Before, you were turning some of these colors off. You wouldn't look at it like this? Wouldn't you filter out some of that? Wouldn't you only look at your strong indications?

MS. SENF: No, I would look exactly like this to all the --

MR. NICHOLSON: Okay.

MS. SENF: -- to all the different scans. And so, I would go to the next one and here this tells me -- okay, it looks similar to the one here. Especially here in this area I got some strong reflections --

MR. FOREMAN: Something's going on --

MS. SENF: -- and I got all the -- I got them here at the same position and now it's getting red, and red means there was something serious, at least 1 millimeter deep, as Geoff mentioned. And so a crack field provides pixels of all colors, right? It provides some weak reflections, some stronger reflections. So, this is -- this is typical for a 1-millimeter crack field, I would say, so -- something like that, that we have some --

MR. NICHOLSON: 1-millimeter crack field?

MS. SENF: Yeah, so that we have some --

MR. FOREMAN: Yeah.

MS. SENF: -- some weak reflections but also some higher pixels here. And let's have a look at the next sensor. There is nothing, nothing. And here we have an LW-N sensor. So, we have a neighbor sensor, another neighbor sensor, and the LW-C. But so -- okay, so, this is all -- let's see. So, this is all the analyst got. And now out of these signals he needs to make up his mind what it is.

MR. CHHATRE: Will the analyst go and look at -- look at the original graph with all this indications, will he -- yeah, will the analyst go and create their own box? For example, if you go to the right-hand side, I see a whole bunch of red and yellow. Would he be able to create another box and look at those, or he or she is not -- the program will not allow --

MS. SENF: So, right now we look at the client database, means we only see the reported features. So, let's see. So, this is how it looks like --

MR. FOREMAN: That's better. This is the real data.

MS. SENF: -- in real analysis. So the little stars here means it's crack-like or crack field. Then we have a little -- what is it -- circle?

MR. CHHATRE: Um-hum.

MS. SENF: It's called geometry. We have the X, which is irrelevant; there was nothing. So you see all of these features have been classified. Most of them are non-reportables and only six of them are reportables in this pipe joint.

So, at the long seam, so almost -- I would say 90% of the long seam is covered with boxes. So because long seam reflections always deliver such a high amplitude, then we have to look at to see --

MR. FOREMAN: Um-hum.

MS. SENF: -- if there is a defect or not.

MR. KILLORAN: Just a second, Geoff. Let her finish.

MR. FOREMAN: Okay. So this is the girth weld, right?

MR. CHHATRE: Right.

MR. FOREMAN: The two weld seams are never in link because that's bad construction.

MR. CHHATRE: Right, yeah.

MR. FOREMAN: They're always 10 to 2, right?

MR. NICHOLSON: Um-hum.

MR. CHHATRE: Was that true, in place, when this line was constructed?

MR. FOREMAN: Pardon?

MR. CHHATRE: Was that true, in place, when this line was constructed?

MR. FOREMAN: Yeah. Well, I can see that it -- I don't know exactly what the orientation is. Maybe this is top of the pipe and this is one side and the other side.

MR. CHHATRE: No, I understand. I guess, my question was, did it happen by coincidence or the regulation at that time was that it was --

MR. FOREMAN: I'm not sure if it was regulation but it was good construction practice.

MR. CHHATRE: Right. I understand. I understand.

MR. FOREMAN: It's like if you build a wall --

MR. CHHATRE: Yeah. Yeah, I understand.

MR. FOREMAN: -- you never put a joint and two bricks together, you always have another one.

MR. CHHATRE: Yeah.

MR. FOREMAN: So this is the long seam of the joint in question that failed and this is the neighboring joint, the next one downstream.

MR. CHHATRE: Um-hum.

MR. FOREMAN: And as you can see, the job of the analyst is really -- the software is just about boxing everything on the long seam because more than two sensors are seeing it, right? So, the analyst's job is to try and get rid of the non-reportable and then really focus in on what is reportable, then what is it, then what's its length and depth? So, what we do in the client version of the software, which was shown before, is we only show the boxes that were actually analyzed and in the report, because there would be so much extra data that it would get confused by.

MR. CHHATRE: Okay.

MR. FOREMAN: So this is the actual analysis software we use.

MR. CHHATRE: Okay.

MR. NICHOLSON: This is Matt. So these are actually put in by the analyst after he's analyzed?

MS. SENF: Yeah, so --

MR. NICHOLSON: And 0 was, you said --

MS. SENF: Zero is geometry.

MR. NICHOLSON: Geometry. X is --

MS. SENF: Irrelevant.

MR. NICHOLSON: Okay.

MS. SENF: Um-hum, yes. And so, he goes through all -- through each feature and when he classifies it as a non-reportable anomaly we have some shortcuts. So for irrelevant we have hitting a V because -- to go through the data fast. And when there is a reportable feature, he has to open the notebook and do the classification and the depth sizing.

MR. CHHATRE: And what makes -- this is Ravi. What makes the analyst decide to mark some of those as O or X? What is the criterion for him or her?

MS. SENF: So we have certain rules. So what's the difference between a -- for instance, between an irrelevant and a geometry is. So, I'm just going through the next girth weld where we have such a O.

So, irrelevant would mean there is just long seam reflection. It means irrelevant to the pipeline.

MR. CHHATRE: Right. Well, how would -- what triggers him or her to make that decision?

MS. SENF: Yeah. Just some -- let's have a look at this irrelevant feature here. Oops.

MR. FOREMAN: It's basically you go in the B scans and you do --

MS. SENF: Yeah.

MR. FOREMAN: -- exactly what you were doing before. You're looking for the red pixels. You're looking for the target zones.

MS. SENF: I'm in an irrelevant feature. So, here there is some weak reflection from the long seam and here as well, and here. Though this is how the long seam reflections look like, some continuous line with -- sometimes with low amplitude, with stronger amplitude. It matters on the shape of the long seam, but there is no variation that we see additional indications or that it is as a -- at the edge of the long seam, so --

MR. CHHATRE: This is Ravi. If I look at this graph here --

MS. SENF: Um-hum.

MR. CHHATRE: -- and if you can match the colors, maybe it will be easier to ask the questions.

MS. SENF: Um-hum.

MR. CHHATRE: To me, anything which is 24 or 29 is also depending on the accuracy, or it could be a feature. But if you look at all these -- the same color that --

MS. SENF: It's slightly different.

MR. CHHATRE: I can see a whole bunch of that color here.

MS. SENF: Um-hum.

MR. CHHATRE: So why wouldn't that be considered as possible feature?

MS. SENF: So first, it's a continued indication, which does follow the shape of the internal surface so we assume that it's just a long seam reflection. And an amplitude of 40 -- 24 or 29 dB would mean it is a depth of .2, .3 millimeters maximum. Is that right?

MR. FOREMAN: Remember, the specification in the tool --

MS. SENF: Even below 0 it would be --

MR. FOREMAN: -- anything greater than 1 millimeter, which is red, is reportable.

MR. CHHATRE: Yeah.

MR. FOREMAN: Anything below red is not reportable. Why we say we do report metal loss at .5 and greater as --

MR. GARTH: Correction, not metal loss.

MS. SENF: Not metal loss.

MR. FOREMAN: Sorry.

MR. GARTH: Clint speaking. We don't report metal loss.

MR. FOREMAN: Okay. So what we used to call metal loss that we now call crack fields, but below spec, greater than .5 of a millimeter. This allows us to do that, right?

MR. CHHATRE: Right.

MR. FOREMAN: So, that it's not contractually an obligation of us to give the customer, but if they want to know where SCC is beginning --

MR. CHHATRE: Um-hum.

MR. FOREMAN: -- then we give them this, this --

MR. CHHATRE: Starting point.

MR. FOREMAN: -- starting point.

MR. CHHATRE: So, what is the accuracy of the tool plus/minus in this pixels language?

MR. FOREMAN: .4 of a millimeter; is that correct?

MS. SENF: .5 millimeters.

MR. FOREMAN: .5. That's why we're doing it at .5, because it could be 0 or 1 in the tolerance. So that's why we pick .5.

MR. CHHATRE: That's what I'm saying. For this like 24, 29, it can be anywhere in that range, right?

MS. SENF: It is below 0. So assuming 38 dB corresponds to 1 millimeter.

MR. CHHATRE: Right.

MS. SENF: So when I subtract another 6 dB, which corresponds -- 6 dB always corresponds to 1 millimeter.

MR. CHHATRE: Okay.

MS. SENF: I would be at 32. And everything which is below 32 is 0 millimeters. It doesn't give a depth.

MR. CHHATRE: Okay.

MS. SENF: Yeah.

MR. CHHATRE: But how accurate, I guess, the tool is in reporting the dB's?

MS. SENF: Um-hum.

MR. CHHATRE: And would the tool be plus or minus 5 dBs? Would the tool be plus or minus 10 dB's? I'm not sure I understand that. In other words, yes, it is seeing 24, 29, but is there plus/minus error for that sensor? It could be 5 dB or 10 dB, and that could very well be any of the regimes.

MS. SENF: Um-hum.

MR. CHHATRE: And my question is, what is the accuracy of the tool?

MS. SENF: So the accuracy we give, at least in depth sizing, is that we say its plus/minus .5 millimeter but on the depth bend, because we know that there is a tolerance. So a depth --

MR. CHHATRE: So in dB, what does that mean? I mean, I'm trying to --

MS. SENF: So a depth bend is 6 millimeters -- approximately 6 millimeters and at a tolerance plus/minus .5 is another millimeter. So 3 dB corresponds to a half millimeter.

MR. CHHATRE: Okay. So it's -- okay.

MS. SENF: Yeah. Something like that. So we -- there is still kind of a safety factor that, like we say, everything which is below 1 millimeter it's for sure below 0 millimeter. So everything which is below 32 it's below 0 millimeters. It's --

MR. CHHATRE: So anything below 32, you don't have --

report anything; is that correct?

MS. SENF: That's correct, yes.

BY MR. PIERZINA:

Q. And this is Brian. So if there are factors on your internal pipe surface that are absorbing more of your sound, your input signal than normal --

A. Um-hum.

Q. -- so that you're not achieving saturation, how can you -- how can an analyst tell that and how does that affect your sizing? I guess -- so what I'm thinking is that if surface roughness or other factors are --

A. Um-hum.

Q. -- taking some of your input signal, then maybe, you know, a 33 or a 29 dB could correspond to 1 millimeter?

A. Um-hum.

Q. Could you help walk us through how as an analyst you know if that's happening and what you do about it?

A. Analysts cannot see that.

MR. FOREMAN: No.

MS. SENF: So, he's just seeing the data on the screen. If this -- it's real data or if it was attenuated by a rough surface, he cannot really tell. So --

MR. PIERZINA: Couldn't you tell that by your entry signal on the inside surface? Couldn't you see -- wouldn't that show up darker or redder or stronger?

MS. SENF: Stronger -- yeah, so there -- so if there would be, let's say, an internal notch, you would see that internal notch but he couldn't really tell does it attenuate my medium in any way -- does that attenuate my medium in any way. So, he could also see that there is a strong signal of the internal surface but he cannot really tell from where does it come from. Does it come from a rough surface or is it just that I have a slight lift-off because of the long seam? He cannot tell. And for this we have our depth range, which covers 6 dB, and with a tolerance even more -- even 12 dB, because we cannot tell.

BY MR. CHHATRE:

Q. This is Ravi, NTSB. Do you do any calibration to make sure -- I guess, I'm just doing this follow-up. If I really have a crack on my pipe surface inside, if my pipe is not clean --

A. Um-hum.

Q. -- (indiscernible), okay, if it's not clean at locations and if somehow the sound is getting absorbed or defracted, would there be any way for either the analyst or the person running the tool to know that he is not getting the -- he or she is not getting full attenuation, meaning whatever information you are getting really is not accurate?

A. Um-hum.

Q. Sort of the diplomatic way of putting it.

A. Well, so if -- when you say that the internal surface is not clean, do you mean --

Q. Or whatever the reason may be for it.
A. -- it has debris, something like that?
Q. Yeah.
A. So -- or even if there is coating at the internal surface.
Q. Oxide layer. I mean, you pick anything that will prevent the tool from reaching the full attenuation --
A. Yeah.
Q. -- more than I think, what, 40 or 50, you said, or --
A. Yeah.
Q. -- anything more than --
A. So we wouldn't see it in the data but -- so, when there is an internal coating, for instance, over the whole -- on the whole pipeline, the signal would be attenuated in the same way, in the same way over the whole pipeline. Then, of course, we can adjust our saturation amplitude on it. But if it's just in particular spots, we cannot really see that, no.
Q. So, I guess, what I'm asking you is, there's a patch of sludge in a pipe joint --
A. Um-hum, um-hum.
Q. -- or a couple of pipe joints in a row.
A. Um-hum.
Q. And everything else seems to be okay.
A. Um-hum.
Q. So those two joints, you will be seeing something that

you consider as either mild or less than 1 millimeter. In fact, it could be higher.

A. Um-hum.

Q. Is there any way of -- there is no way to tell that. So you could have kind of an error in that interpretation. Is that --

A. We don't really see that in the data, no. No.

MR. FOREMAN: But what tends to happen -- this is Geoff here -- is if it's substantial debris, we'll lose the sensor altogether because nothing will come back or the (indiscernible) just didn't go.

MS. SENF: In the worst case could be that --

MR. FOREMAN: The worst case. The worst case we know --

(Simultaneous speech.)

MS. SENF: -- we don't get a signal back.

MR. CHHATRE: But that will be --

MR. FOREMAN: So you're talking about an interim case between -- you are getting sound but you're not sure you're getting the whole sound back?

MR. CHHATRE: Right. I mean, I think, there is a question --

MR. FOREMAN: And there is no way, there is no way --

MR. CHHATRE: Yeah. So, you could very easily miss interpreting for that particular pipe joint.

MR. FOREMAN: Which you'll still have your detection, but that's -- your sizing could be --

MR. CHHATRE: Right, I mean --

MR. FOREMAN: But then again you're hoping that the redundancy in the sensors -- the fact you've got hundreds of them is that it's not going to affect all of them. And some of them you might be looking at not even from the same sensor carrier, might have been adjacent.

MR. CHHATRE: Well, my question with that, Geoff, is so when you do the verification digs, do you guys look for the ID surface when there is a discrepancy?

MR. FOREMAN: No. Because on the dig -- when they dig, it's very rarely going to look at the inside surface of the pipe.

MR. PIERZINA: Right.

MR. FOREMAN: It's the outside surface of the pipe. Now you're relying --

MR. CHHATRE: I understand. But, I mean --

MR. FOREMAN: -- on ultrasonics in the field versus -- looking at the pipe from the outside in, where we're looking at the pipe from the inside out.

MR. CHHATRE: Okay. Right. But, see, that's a different technique what you are --

MR. FOREMAN: Yeah.

MR. CHHATRE: In a dig you are doing from outside where you can have a nice clean surface on the outside.

MR. JOHNSON: And this is Jay. We want to be careful here. With Enbridge, we don't do calibration digs, we do validation digs.

MR. CHHATRE: Okay.

MR. JOHNSON: And all of the digs are --

MR. CHHATRE: Sure.

MR. JOHNSON: -- go back and forth with GE Pii for that purpose.

MR. CHHATRE: I guess, what I'm really trying to find out is in these validation digs, if there's an error that you guys are not identifying a certain defect, whereas the field measurements can see that. My question is, do you guys go further and see why the error is there and maybe --

MR. FOREMAN: That's assuming there's an error. The feedback we had is not -- is such that wouldn't lead us down to the path of cleanliness, unless it was over a big area. What we -- we'll manage what they call -- or Enbridge calls outliers, because everything else has fallen into the spec. So we would look at did the tool perform well just before and just after that point? So how quickly could you pick something up and drop it? Is adjacent -- are we getting adjacent signals losing strength or whatever?

So there's a few things, but the majority of the feedback is usually because of the -- something to do with the geometry of the crack or the geometry of the pipeline at the point of the crack. Maybe the shape of the internal long seam weld or whatever has a bigger effect than debris -- so far out of the times we've run the tool, we either lose everything with a wax issue where you need to flush the sensors continually, or it's been good. We haven't really found individual pockets of debris as being that would cause -- but then again, we can't --

MR. CHHATRE: Right.

MR. FOREMAN: -- we can't tell. You know, it's -- there isn't anything on the tool that says I'm covered up; I'm not covered up. I have a different attenuation --

MR. CHHATRE: Right.

MR. FOREMAN: -- than I should have.

BY MR. PIERZINA:

Q. This is Brian. I'd like to ask Petra what -- what factors affect the analyst's confidence in their determination of, you know, a feature -- of a feature evaluation? If you could just in general terms, you know, what things lead you to say I'm very, you know, either very confident about my conclusions --

A. Um-hum.

Q. -- or I'm not too sure?

A. Um-hum. So the number of sensors which have seen the defect. So the more sensors I have which have seen the defect, the -- yeah, the better my feeling is. When there are only -- when there's only one sensor -- so, in the past we even said one sensor is no sensor. But even -- if I would have really a strong signal I would even use this signal for classification. But when

I have two or three sensors, and I have two or three sensors clockwise and counterclockwise, and the signals of these sensors are corresponding to each other. So, it's the same shape. It's a different amplitude maybe, but it's the same shape of indications. This is the criteria to have more confidence in a classification. Yeah.

Q. Okay. Does that also help you as far as your confidence in depth sizing?

A. Yes. So, I would expect a higher amplitude in the half skip and a lower amplitude in the one-and-a-half skip. And if this is the case, and having a similar amplitude clockwise and counterclockwise again, so my certainty or my confidence in the depth sizing would be higher, right.

BY MR. CHHATRE:

Q. This is Ravi. So when you say more sensor, does that reflect more overlap? I mean --

A. Well, at the end it's also higher --

Q. Or is that not related?

A. At the end it's also higher overlap. The more sensors I have, the higher the overlap will be.

Q. Okay.

A. Um-hum, yeah. Um-hum. Okay. Coming back to this feature here. So this was an irrelevant feature. It's just some weak reflections of the long seam and that's all. So also here it's the internal surface and some weak reflection.

Okay. Out of this the analyst would classify it as irrelevant. So, there is no cracking indication visible. Going back, there is a geometry. So, all the geometries -- so at a pipe joint -- or the long seam at the end of a pipe joint, at the beginning and at the end of the pipe joint, is ground off for the --

Q. Girth weld, right?

A. -- welding, for the girth weld welding. And this is displayed though -- this grinding is displayed like this, so it always looks the same. So, you see here, we don't have any reflections here. It's LW-C. But here, in this case, we have these -- how can I say that -- these lines here. It could -- looks a little bit like a crack-like but really a low amplitude. And let's see if I have it again.

So, I have here the same, and here. So several sensors give me always the same signal. So, this is the long seam and then it stops here and this is the grinding marks, I would call it. Yeah, the grinding marks. And so we ask the analyst to classify this feature as geometry, because we want them to be aware of it that they are at the -- right at the girth weld -- that they have to have a closer look at it, because also a cracking indication could be mismatched with this grinding mark.

And if something happens that there is a failure at the -- right at the girth weld, we want to go back. We want to have a chance to go back and look at these features again. So and that's why we ask them to classify it as geometry as long as you see these grinding marks right at the girth weld.

Q. And, of course, tool is not capable of looking at the girth weld cracks.

A. Right, right.

Q. Certain girth weld cracks.

A. Right, but -- so there was a case --

MR. FOREMAN: But still frame it in certain (indiscernible).

MS. SENF: -- so there was a case that we had, that we had a little crack right at the girth weld. So it was not in the girth weld; it was at the long seam, but it was close to the girth weld. So, and we want to, yeah, make the analyst aware that he is checking this feature more consciously at the girth weld and that he classifies it differently. Yeah.

So let's go back. So and for each feature type we have, we have certain rules, right?

BY MR. CHHATRE:

Q. And when you see -- and I'm looking at this graph at the bottom that you see a whole bunch of red marks in there.

A. Um-hum. So we are at the girth weld.

Q. Yeah.

A. And so here the girth weld is displayed in different colors because the girth weld is -- so, this is the -- we are at the girth weld between pipe joint 217-720 and 730, so -- this is

-- the width of the girth weld is always thicker than the width --

Q. Length.

A. -- of the pipe joint. So we get a different value here. So, it is 10 millimeters, 12 millimeters. So we have different measurements, wall thickness measurements at the girth weld. And depending on the width of the girth weld, we have a lift-off of the sensor carrier. And so this is displayed here that normally we have a lift-off of 17 millimeters and here we have of 19.

Q. Um-hum.

A. So a lift-off of 2 millimeters because of the girth weld, so --

MR. PIERZINA: Could you go back to imperial units?

MS. SENF: Sure.

MR. PIERZINA: I know it's probably easier for you to do --

MS. SENF: Yeah, yeah. Here you go. So the wall thickness here -- the stand-off here was 6-55 and here then it is 70-55, 70-86, 70-09, 70-64. So, yeah, quite a -- 2 millimeters or 80 mil of lift-off we have at the --

MR. PIERZINA: Um-hum.

MS. SENF: -- at the girth weld.

BY MR. CHHATRE:

Q. Now, will the tool see axially only the pits also as cracks?

A. Well, pits -- pits means for me something with 10 millimeters length, width.

Q. Well, it can be a small pit too, whatever your level of detection, maybe 1 millimeter or -- if I --

A. How many?

Q. If I were a pit, a corrosion pit --

A. Um-hum.

Q. -- axially --

A. Um-hum.

Q. -- could be near a weld or could be in the base metal for all that matters.

A. Um-hum.

Q. And if I see maybe, let's just say, one or two separate pits. Will this tool -- because they are actually only a pit, will it see anything or will it just be completely masked?

A. So, normally they would be too short. So, we have a criteria of 30 millimeters at least, of millimeter length.

Q. So, a pit has to be 30 millimeters in diameter --

A. Yeah, but the shape of it, when it's kind of a round pit.

Q. Yeah. That's what I'm saying, if it was --

A. Yeah. So the cross-section of that would be too short to be detected by CD tools. Yeah.

Q. So the tool would not see it?

MR. FOREMAN: No.

MS. SENF: No, normally not. No, no.

MR. CHHATRE: Okay. So, any indication, I think you are saying, is a crack or something. It's not really a small shallow pit you are seeing?

MR. FOREMAN: The only effect -- Geoff here from Pii. The only effect of external corrosion on the CD tool that could be adverse is if we don't get a corner effect. So if you have steep-sided corrosion -- sometimes we confuse steep-sided corrosion for a crack because it actually gives a corner effect between the surface of the pipe -- so if you had -- if somebody had actually -- that's why we call it notches. So if -- if you remember when we were talking about ERW pipe?

MR. CHHATRE: Um-hum.

MR. FOREMAN: There's a thing called a scarping tool that goes up the inside and takes the slag away from the upset on the ERW weld. Now, that gives a perfect corner effect, right, because it's vertical against the surface of the pipe. So if there is in deep corrosion or deep pitting, then the only concern that we would have is how does that affect the shape of the corner effect? I'm going to go back to the chart.

MR. CHHATRE: Right.

MR. FOREMAN: Because it's the corner effect that produces the amplitude, not the tip of the crack. So if we're in perfect pipe and we have a crack, then that 70 degrees becomes 45 degrees; we get a reflector back. If that surface is corroded --

MR. CHHATRE: Um-hum.

MR. FOREMAN: -- and you have a crack, then that -- well, just for argument's sake, let's say that's 90 degrees. Now this is 110 or 120 degrees.

MR. CHHATRE: Right.

MR. FOREMAN: That corner effect has opened up. It's not as -- it's not going to give you the same amplitude back. You're going to lose some sound, right? What we haven't got enough feedback and understanding, is finding cracks in deep corrosion. And stress corrosion cracking is in corrosion. If you look at the forensics report, I think there's a ligament where there's no corrosion and there's no cracking. But everywhere else where there's corrosion there's cracking, and the deeper the corrosion the deeper the cracking. So, so if there is any possibility of loss of attenuation, my biggest worry would be this corner effect and what effect does the corrosion have in the corner effect?

MR. CHHATRE: Now, would that also affect if the pit is internal, because now you have (indiscernible) angle maybe?

MR. FOREMAN: Well, pits internal --

MR. CHHATRE: I'm not saying they are, but if it is (indiscernible) --

(Simultaneous speech.)

MR. FOREMAN: I'm talking about external. SCC is very, very rarely on the internal surface.

MR. CHHATRE: If they are on the inside if there is water --

MR. FOREMAN: Because you haven't got the soil -- you haven't got the chemistry to form the crack. You've only got corrosion, right, so it would have to be extremely deep because you'd have to have enough stress to actually cause the cracking. So it would be very, very deep. But external corrosion causes where most SCC is found.

MR. CHHATRE: Okay.

MR. FOREMAN: So we -- the feedback we have from Enbridge is that in shallow corrosion the crack sizing bucket seems to still compensate and we still see about the same.

I'm not sure what deep corrosion effect is, especially if it's uniform. Then, you know, from what we're looking at we can see uniform signal changes. If it's a deep one, then it really depends on -- now, if it's a flat bottom then it's very similar to ordinary pipe. You're going to get an 80-degree corner effect. But if it was shaped like that, which I've never seen for any pipe -- but in theory, right, that would be a big problem because you wouldn't get a corner effect. I've never ever seen anything in reality like that.

MR. PIERZINA: Well, axial slotting is certain to approach that, right?

MR. FOREMAN: Yes. Yeah. Yes, I mean -- if you had very, very narrow neck. So, if you actually had a neck feature, which actually looked like that, with a crack in the bottom. And the tighter that gets, it becomes that with a crack in the bottom. And I haven't seen -- I haven't seen anything like a deep yet, but it's possible. But that would be my biggest worry about the physics of the tool. The physicist was looking for corner effects to get its amplitudes, more than, say, debris.

MR. NICHOLSON: I didn't -- this is Matt. Going back though earlier, Petra said she only saw two types of features in these six defects. I thought it was just crack-like and crack field. I didn't hear any mention of corrosion or --

MR. CHHATRE: Wall loss.

MR. FOREMAN: The tool can't see a corrosion. So we just see -- that's what I'm saying, we just see the corner effect and we determine the length of the crack or the depth of the crack, see, from the amplitude produced from that corner effect.

MR. NICHOLSON: Right.

MR. FOREMAN: So anything -- if it's corrosion --

MR. NICHOLSON: You can't see it.

MR. FOREMAN: -- we don't see that.

MR. NICHOLSON: Right, okay.

MR. FOREMAN: All right. So when we see it, the crack at that depth is X. That's what we see as the cracking, not anything else.

MR. PIERZINA: So why do we have -- let's see. So I'm looking at the right-hand scale there. So we got 33 dB, then 38. What if it's more than 38?

MR. FOREMAN: And it will be if it's deep.

MS. SENF: It's displayed in red. Just everything is red, but so -- let's go back to -- where is it? Okay. Just looking for a nice feature. Maybe I have to go through this one too (indiscernible) --

Okay. Well, this is in the same pipe joint 217-720 and here in sensor 1-4 we see some nice cracking reflections. And so lots of red reflections. And when I draw a box, then I can see -- a box. How can I do that here? I have the box and here I can see the maximum amplitude or the mean max five amplitude of that box. So mean max five means we take the mean of the five maximum amplitudes. We don't take -- in the past we didn't take the maximum amplitude. We didn't -- in the past we didn't take the maximum, we took the mean of the maximum five. Because if we only would take the maximum, that was the understanding in the past, then we might overcall a feature. So this changed as well.

So in this case here it's 41. Let's go through other sensors. Here its 40. What is here? 37. What else do we have on the other side? Okay. Here we are. 44, I guess that's the maximum. Here are some others -- 41.

MR. FOREMAN: So to answer your question, Brian.

MS. SENF: Yeah. So the 44 is the maximum amplitude we had in this feature and 44 means it's about 80 mil deep, so roughly.

MR. PIERZINA: About 2 millimeters, right?

MS. SENF: Two mil -- yeah, 2 millimeters. Am I right? No, it might (indiscernible). Okay. Um-hum.

MR. FOREMAN: So this ties back into what Ravi said. It's Geoff. We're not trying to analyze the depths with the color codes. The color codes take you to where the cracks are. You then box it and the algorithm then tells you the depth based on the amplitude. Okay? So we're looking for red and we box it and the box will tell us how many dB's.

MR. NICHOLSON: That was the algorithm, what we just saw, where she boxed it and the dialogue box came up? Or --

MS. SENF: No, this is just an information box.

MR. FOREMAN: So, the algorithm is giving you the dB's, right?

MS. SENF: The --

MR. FOREMAN: Well, it's picking up the dB's.

MR. NICHOLSON: So the algorithm is running in the background?

MR. FOREMAN: Yeah.

MS. SENF: In the background, yes.

MR. NICHOLSON: Okay.

MS. SENF: So, and --

MR. KILLORAN: Just for clarification on the record --

MS. SENF: Yeah.

MR. KILLORAN: -- weren't you just asked, what does the algorithm give you in terms of what you just did?

MR. NICHOLSON: I think we know what it gives you.

MR. KILLORAN: Okay.

MR. NICHOLSON: It gives you that depth.

MS. SENF: Yeah, so -- or, when I draw this box it just gives me some data about this box here. It gives me data that the maximum amplitude in this box is 41, so a manual drawn box. The sizing algorithm is running in the background, yeah.

MR. NICHOLSON: Okay.

MR. PIERZINA: So -- and this is Brian. So, I'm somewhat familiar with this feature, so this was a -- approximately a 9-inch long feature, 25 to 40% through the wall. How do you size your length, as an analyst here? Because I -- the box that you draw, I think I saw you called it 11 inch -- was 11 inches? So, as an analyst, how do you draw your box to come up with your length?

MS. SENF: Um-hum. So in 2005 and 2006, the rule was for crack fields from yellow to yellow. So the yellow and the red indication -- oh, so yellow, red -- yellow, brown and red. So these are the three deepest colors. These need to be included. So continued indication. So you see that as a little gap and then there is a yellow one, though this wouldn't be considered. So here from yellow to yellow, this needs to be boxed. But he needs to go through all the sensors to do that. So not only this one here. So, I have to go back to my other data set.

BY MR. CHHATRE:

Q. Go back, Petra, before I forget my question. Can we go back to that same box?
A. Yeah, yeah. Yeah, I'll go back to the same box. It's just easier to work with -- okay. It might take some time.
Okay. I'm back at that box.
Q. Okay. If you go yellow to yellow, I guess, and this may be subjective, but -- where do you stop? I see a red here too. Am I right?
A. Yeah.
Q. I mean, I can start with this.
A. Um-hum.
Q. And say, oh, there's a little bit of gap, but I have red, yellow, yellow, yellow, red, red. I can -- I mean, I can pretty much go up to any point --
A. Um-hum, right.
Q. -- I want and where do you stop? I mean, I can make this 9 inches. I can make this --
A. Um-hum.
Q. -- 25, if I want. I mean, I can -- depending upon my starting yellow.
A. Yeah, so --
Q. And what is the criteria?
A. -- so the first thing is you get a box from the software, right?
Q. Okay.

A. And so -- and the box -- the software is giving me one box after the other. So, when I have a continued indication, okay, then I can start with this box, make it 1.3 meter -- 1 meter long and the next box and the next box, so. But when I have an individual indication like this here -- well, first I look at the strongest indications and then I don't really accept any gaps like this -- a length of this.

Q. I guess my question is, is there a guideline for the analyst that if you don't see anything for the next -- I don't know -- maybe it is a half inch, 1 inch or -- then you stop? Is there something like that or analyst to analyst does it vary?

A. At that time it varied. So, we said so only the yellow ones, but we didn't really say a gap of 20 millimeter or so is accepted or 30 millimeters.

Q. In 2005?

A. We didn't have that, so -- but meanwhile we say it shouldn't -- what is the rule? I guess it's 25 or 30 millimeter rule. There shouldn't be a gap of 30 millimeters. If there is a gap of 30 millimeters, it should be treated as two indications. Right.

So -- and here the analyst started with the clockwise sensor. So, this is where he started. Okay.

Q. Um-hum.

A. Because you always take the first indication to adjust your length and then you go through the other sensors to see if it fits. And so he took this one, and this is one of the main since, I would say, some really nice reflections from yellow to yellow or red. And then he goes through and then, okay, there is something but it's not in the previous sensor. It's -- there is a gap between. I don't consider that. I only take -- consider that red one here. And there is nothing.

Let's go to the other side. And here -- yeah, that fits as well. Yeah, yeah. And you see here, so it's really this area here.

Q. Um-hum.

A. This is the main area. And when you -- when you start with analysis you will have exactly that problem: where to start, where to end. The more experience you have, the easier it will be, when you know more features. And a reflection like this here really shows you, okay, this is the main area. All the other noise is here. It's nothing.

Q. That one is visibly clear, but --

A. Um-hum.

Q. Now, in 2005, was analyst independent where they start and where they finish?

A. Um-hum, yeah.

Q. And the same thing right now as 2008?

A. No. As I said, so we have some rules now that we say, okay, if there is a gap really between two indications, you have to treat them as two indications. And we also changed the rule for crack field to say it's not from yellow to yellow anymore, because -- it's from green to green.

So, in this case here, I would even size it like this now, because when we go from red to red or from green to -- from yellow to yellow, we only would size indication which is a millimeter deep or half a millimeter deep. But in the field, what they see is different because they see the whole SCC, not only the one part which is 1 millimeter. And to come closer to the field length we said from green to green. This is because green -- blue always means its noise, background noise. But when it's green, then there is a signal and it might be minor SCC only, but we have to adjust the length to green to the whole SCC and not only to the deeper part of it.

A.   Now, do you still have guidelines as to what kind of separation there should be before you move from one box to another box, or do you not say -- I mean, there has to be a certain separation between yellow to yellow or, now today, green to green.

Q.   Um-hum, um-hum.

A.   What separation is recommended to identify that as two separate?

Q.   The 25 to 30 millimeters.

A.   Okay. So that --

Q.   Yeah, um-hum.

A.   -- guideline is there not to --

Q.   Yeah, the guideline is there, yes.

A. Okay.

MR. KILLORAN: Today.

MR. PIERZINA: Isn't there a standard -- this is Brian. Isn't there a standard of 6 times the wall thickness? If it's within 6T then it's interacting? I think there's --

MR. CHHATRE: But they're not talking about interacting. They are only talking -- I'm just talking --

MR. PIERZINA: Well, that's -- yeah, so that would be one of those, if they were -- I don't know what that would correlate to in millimeters.

This is Brian again. I have a question for her. So with this box that you've drawn with the green to green that you have used now -- so when, as an analyst, when you call this feature, are you giving it that size -- basically that length and width that you've drawn with the maximum depth of -- inside that as well?

MS. SENF: The box, the overall length, the overall width and maximum depth, yes. And a crack map.

MR. PIERZINA: And the maximum depth is the maximum depth not the five -- not the average of the five?

MS. SENF: The meanwhile it is the maximum, right. So we take the maximum amplitude of a crack field and use that as depth sizing, yes.

MR. NICHOLSON: So you talked about length. What about the width? How did -- is it still green to green or --

MS. SENF: So, normally the width is given by the software and there isn't really a need to change it.

MR. NICHOLSON: Um-hum.

MS. SENF: So, it could be -- or assuming -- let's see if I can go back to the other data set. Is that the other one?

Okay. So let's assume that there is another -- or that there are more pixels here in this area. Then the analyst could adjust it by -- can he do that? No, he cannot change the width field, which is strange.

MR. FOREMAN: Is that the client software?

MS. SENF: So, modify -- so, it's not, but it's the database. So with modify area he could also change the widths here if it's necessary. For wider crack fields we do that, yeah. And then it is not really green to green -- or it's what we see in the C scan. We use that and the C scan normally shows only green. Yeah, but -- some blue pixels here as well. But it also would be green to green in the C scan.

MR. FOREMAN: But from a -- Geoff here. From an integrity relevance point of view, it's the length and the depth. So, the only advantage of including other pixels is if you had a deeper amplitude in the outside extremity. That would give your overall depth deeper. But from a fracture mechanic's point of view, the width isn't that critical and it doesn't come in the calculation.

BY MR. NICHOLSON:

Q. Can you go back to the B scan? I want to -- I'm having a hard time seeing a -- the previous defect you looked at was the 14.1-inch defect and now you're on the 9.3. And on that 14.1 -- the first one we looked at -- you had mentioned, Petra, that you said to you those red marks were crack field. So I'm having -- and I -- to me, being a Level 0, I guess, at this stage, I say they're crack field as well.

I'm having a hard time seeing how this report would have called them crack-like. Can you talk to -- how do these -- they're obviously spaced apart. How would something like this get called a -- based on your definition earlier, you said crack field was multiple red dots on your screen, right?

A. Um-hum.

Q. And a crack-like is clearly a continuous run. I don't see anything continuous here. Can you help shed some light on how this would have been called a crack-like? What about it could be interpreted that way?

A. I read -- these indications here I would all of them -- maybe there is one -- it's not really a linear indication her, but I guess this is the most linear we have in this data set here. So, but I agree. I also would classify that as crack field, yeah.

Q. Okay.

A. Here there is just the long seam. The long seam. These indications I would interpret as long seam as well. Let's see here. Yeah, all of them I would classify as crack field.

Q. So can we find a crack -- a real crack-like maybe and would it be obvious?
A. Yeah, yeah. Give me a --
Q. Okay.
A. Not really obvious. So, I guess -- so, right now we're in the pipe joint that failed, right?
Q. Um-hum.
A. And I guess -- so the reason [sic] is why have we classified it as crack-like when we only see the crack field indications?
Q. Yeah.
A. Right.
Q. That is the question.
A. Okay. And --
Q. I mean, I'm not trained, but it sure seems readily apparent to me that these aren't joined.
A. Okay. Now, this is the feature that failed and that's one section, one -- area number 154-005567. When I look at that feature here, I see crack field indications, crack field indications again. So the first was on sensor 1-4. In sensor 1-5, here I see just some long seam reflections, long seam reflections. Here -- this indication here doesn't really correspond to the long seam. This is different, but it's very weak so I don't really need to consider that.
BY MR. CHHATRE:

Q. Can you back up? I need to go back. This is Ravi Chhatre, NTSB. I mean, we are looking right now at the joint that failed, right?

A. Right.

Q. And the indication --

A. The indication that failed, yeah.

Q. -- that was the cause. And go back to the indication on the question.

MR. NICHOLSON: If you go back to that sensor.

MR. CHHATRE: Right.

BY MR. CHHATRE:

Q. And so that is the one that failed?

A. Yes.

Q. Is that correct? Well, I guess, when you -- when couple of times when you said that this is not really indication. I'm still trying to struggle like as to what is the longitudinal seam effect versus the actual feature? I mean, they again, as you move, they look very similar to me and --

A. Okay. So let's -- let's start all over. So sensor 1-4 we see crack-like indications.

Q. Okay.

A. We don't see any long seam reflections. We just see some crack-like indications -- cracking indications, so crack field, yeah.

Q. Okay. But on this one now --

A. Yeah.

Q. -- this is a crack that eventually failed the pipe. Now, it is so close now to the longitudinal seam, why that is not considered --

A. It is --

Q. -- a seam effect? I mean, if I'm looking at -- previously if they're in few degrees, you classified that as a longitudinal seam effect or reflections or whatever technology. So what -- what is distinctly different in this one that changes from being effect of long seam versus actually being a feature?

A. Well, I don't see a -- so I'm -- when I go through the list of sensors, I need to know where I am in my data set. Right? So, I started with the first sensor, and the only thing I see are these indications here. I don't see any long seam reflections. So, I know right now I'm still in the base material. I'm close to the long seam but I'm still in the base material, and this indication cannot be caused by the long seam because there is no long seam reflection.

The next sensor here as well, I don't see any long seam reflections. I only see some cracking indications. And now -- so, now I'm at the long seam. So these continued indications here tell me now I'm on the long seam.

So the other two sensors were close to the long seam, but this one, now it starts getting to the long seam and now I know what to expect, because this kind of indication, these continued indications which are caused by the long seam.

Q. Can you go back to the other two -- the ones you just -- so where is the long seam on these?

A. There is no long seam.

Q. There is no long seam -- oh, okay. That's what I'm trying to understand.

MR. FOREMAN: Below -- okay, below black line. When she goes along, she'll see some below the black line. The black line is the point of entry. It's not the seam.

MR. CHHATRE: That's what I was trying to understand, yeah.

MR. FOREMAN: Right.

MR. GARTH: Yeah. It's inside the wall of the pipe, yeah.

BY MR. CHHATRE:

Q. Okay.

A. Okay. And so this is the same feature. This is the C scan of the same feature here.

Q. Um-hum, um-hum.

A. I zoom in. So when I start with my analysis I start here. So first I look at these features here.

Q. Um-hum.

A. And then I come to the -- and now I'm here at the long seam. The next thing I see is at the long seam. So, this reflector is somewhere here.

Q. Okay.

A. Is what we see here.

Q. Okay.

A. So it's at 99 degrees entry echo. So let's see -- and here I am at -- 99, 99 is somewhere here.

Q. 90 -- oh, yeah, you just missed it.

A. 90 degree, 99, 100 degrees somewhere here. So let's see, this indication here. No. It's at 101, 100 and this is -- oops -- 100 as well.

Q. Yeah, right there.

A. So I start here, look at these features, and then the next sensors -- so, this is again, it's somewhere here what we see. And the next sensor shows me the long seam reflection.

Q. Okay.

A. Now I look somewhere here in this area. And just -- what I see here is just some continuous lines, no deviation, long seam reflections.

Q. Okay.

A. And now I'm behind it. So now I'm somewhere here, somewhere here, and I see some weak reflections.

Q. Okay.

A. So, I don't have these continuous lines anymore. I see something weak. So, I would say this is caused by a toe crack but the low reflection tells me it's not really deep.

Q. Okay. So does the analyst need to look at both these

screens simultaneously, or --
A. No, no, because -- no, the analyst knows where he is, right.
Q. Okay.
A. So he knows when he starts with analysis that when he gets these features first, he knows he's still in the base material and he knows the long seam will come in the next sensors.
Q. Okay.
A. And so he's especially looking out for these features because toe cracks look like this.
Q. Um-hum.
A. And the next sensor shows me another -- the same reflector but at a different time. So here this one is in the half skip and going next -- so, a half skip more or less. Yeah, half skip. And the next one, it's in the one-and-a-half skip. So these two indications correspond to each other pretty nice.
Q. So --
A. So a weak toe crack is visible. Not really deep, but it's there.
Q. So, going back to 2005. I mean, you already talked to analyst. What is the reason he -- he or she said they classified that as a crack-like feature?
A. Yeah. I'm still --
Q. Oh, okay. I'm sorry.
A. -- trying to explain that.

Q. I'm sorry. Okay.
A. So, we get closer to it.
Q. Okay.
A. Okay. So, this was a clockwise side. I guess there isn't anything -- we have some weak reflections here. Maybe a weak -- yeah, weak SCC here I would say.
Okay. We are through with the clockwise and now we go to the counterclockwise. This is hard to tell what it is. So, we see here some weak SCC, I would say, but more -- and here. So this is -- this is at the same position as we had it here. So, it's again somewhere here visible. So -- I have to try -- yeah. So, red was clockwise sensors and blue are the counterclockwise. So maybe you might remember that the red sensors, or the indications from the clockwise sensors were pretty short. So here. And you see also here it's pretty short.
And for the counterclockwise sensors -- let's go back to the counterclockwise. It's longer. So, the reflection itself. So, what you see here -- this is -- these are the crack field reflections from the counterclockwise sensors.
Q. Can -- this is Ravi. Can you go back and explain the clockwise and counterclockwise sensors, again, too?
A. Um-hum. Okay. So, we have -- the sensors are arranged that we can detect a defect from both sides, because depending on the angle of a defect we might only get it with a clockwise or with a counterclockwise. So this is one of the clockwise sensors.

It penetrates into the wall in a clockwise direction and the counterclockwise would be located like this here.

MR. FOREMAN: Why don't you switch to the BMA (ph.) and show him that diagram that shows the sensor carrier with the two.

MS. SENF: Yeah. I tried to open the presentation and it didn't work.

MR. FOREMAN: It didn't work. Okay.

MS. SENF: Yeah. But I'll -- maybe I can -- do I have it on my computer here as well?

MR. CHHATRE: So on your tool --

MS. SENF: Yeah.

MR. CHHATRE: -- this is Ravi. Are the sensors like this?

MR. FOREMAN: Yes.

MR. CHHATRE: Is that what you are talking about?

MR. FOREMAN: Yes.

MR. CHHATRE: Okay.

MR. NICHOLSON: It's in the report, right?

MR. CHHATRE: Yeah.

MS. SENF: Yeah.

MR. FOREMAN: There's a better picture that actually shows the physical sensor, but that's really trying to show you the redundancy as well of the close proximities of sensors behind them. It's very difficult to draw.

MS. SENF: Let's see if go to one of these.

MR. FOREMAN: Yeah, go --

MS. SENF: No, it's not. No, it's not in there.

MR. FOREMAN: Oh.

MS. SENF: No, it's not in there, no. Oh, where's the other one?

MR. FOREMAN: So that one we saw this morning, it won't open?

MS. SENF: At least it doesn't open -- let's see, maybe I have it in a different folder, because I should have it also on my computer. So, NTSB -- yeah, here it is.

MR. FOREMAN: That's it. That's the one. The second one is the one I'm not interested in.

MS. SENF: The second one?

MR. FOREMAN: Yeah, that one.

MS. SENF: This one?

MR. FOREMAN: No, not --

MR. KILLORAN: The one above.

MR. FOREMAN: The one above.

MS. SENF: Okay. This one here?

MR. FOREMAN: Yes. That's the sensor carrier.

MS. SENF: Okay. Yeah, okay. So that's the sensor. That's the 34-inch sensor carrier, but so here we have the 32-inch, means we have one skid less.

MR. CHHATRE: What is that?

MS. SENF: One skid. So these -- we call them sensor skids.

MR. CHHATRE: Okay.

MS. SENF: And for 34-inch we have 16 skids. For 30-inch we have 15 skids only.

MR. CHHATRE: Fifteen?

MS. SENF: Yes. And we have -- on each skid we have two perpendicular sensors, which are these ones here.

MR. CHHATRE: Um-hum.

MS. SENF: And we have --

MR. NICHOLSON: Which are the wall thickness?

MS. SENF: Wall thickness, yeah. Yeah, wall thickness sensors. And we have 15 clockwise and 15 counterclockwise sensors.

MR. CHHATRE: Okay.

MS. SENF: They're arranged like this.

MR. FOREMAN: So -- this is Geoff here. There's 480 sensors in total on the 30-inch tool. The crack detection sensors.

MR. NICHOLSON: Oh, excluding the wall thickness?

MR. FOREMAN: No, there's -- plus 30 wall thickness sensors.

MR. NICHOLSON: It said 420 in the report.

MS. SENF: No, it's 450?

MR. NICHOLSON: Just reading the final report, it says 420.

MR. FOREMAN: I just had that number. I don't know.

MR. NICHOLSON: That's on the diagram. Maybe that's a generic diagram. I don't know.

MS. SENF: That could be.

MR. FOREMAN: Now, that picture, you need to think, that's in free space, so it's got springs underneath it to keep it to the pipe wall. When that goes in the pipe, those cups you see at the front and back will be on the pipe wall. So that will squeeze down and those flutes will close.

MR. NICHOLSON: Oh, okay.

MR. FOREMAN: So those -- so those skids will come together.

MR. NICHOLSON: Okay.

MR. FOREMAN: Right. The outside of the skids creates your stand-off. So, you know, Petra's --

MR. CHHATRE: Oh, (indiscernible) Geoff, I understood (indiscernible).

MR. FOREMAN: So, when this is in the pipe -- this is the real diameter of the pipe. This is about an inch bigger than what the real diameter of the pipe is. So when this goes into the pipe, these gaps close. Right? It's spiraled, so now we start to see the effect of the redundancy. When she talks about stepping through the sensors --

MR. NICHOLSON: Yeah.

MR. FOREMAN: -- on the either side of the long seam weld, they might or they might not be on the same skid. They may be on that skid, that skid and that skid, clockwise and counterclockwise.

MR. NICHOLSON: But Petra's not going through 420 sensors --

MR. FOREMAN: No, no --

MR. NICHOLSON: -- when she goes through this.

MR. FOREMAN: -- no, because she's only looking at a window that's --

MR. NICHOLSON: So the software does that? It cuts out all the sensors that didn't see it when it went through?

MR. FOREMAN: Well, on this scan -- on the C scan, you're seeing everything. It picks up the long seam weld because it's getting most of the reflectors.

MR. NICHOLSON: Okay.

MR. FOREMAN: If we had SCC in the body of the pipe you would see it's in the other areas as well. Right? And then you would create boxes in areas and go in and analyze those areas. So there's terabytes of data on the pig and the software is bringing into this format so that you can visualize everything in the right place.

MR. NICHOLSON: But when she cycles through it on the B scan she's only going through 30 sensors?

MR. FOREMAN: She's going through --

MS. SENF: Well, because --

MR. FOREMAN: -- she's going through the relevant sensors that are inside that box.

MR. NICHOLSON: Only the relevant?

MS. SENF: Because, yeah -- only the data of a few sensors is recorded.

MR. NICHOLSON: Exactly, okay.

MS. SENF: If there is no -- if the signals do not meet the requirements for recording, it's gone.

MR. NICHOLSON: Okay. I got you.

MS. SENF: Yeah. So the software doesn't suppress any data. Everything is there, which was online recorded. When it's not recorded online, it's gone forever.

MR. FOREMAN: That's why I wanted you to see the picture because my sketches don't do it justice.

MR. NICHOLSON: No, that's actually a good picture. I haven't seen that one. That helps.

MR. CHHATRE: And as we are seeing it, the pig is going -- going in the wall?

MR. FOREMAN: No, the pig is going towards Matt. It's going from right to left.

MR. CHHATRE: It will be going this way?

MR. FOREMAN: Yes.

MR. CHHATRE: And it's being rotated at the same time?

MR. FOREMAN: As it moves down the pipe it generally -- it gently rotates.

MR. CHHATRE: Oh, it gently rotates?

MR. FOREMAN: Yes, it isn't --

MS. SENF: No, no, no. No, no, no. We don't really want to rotate it.

MR. FOREMAN: No -- oh, sorry, it's CD.

MS. SENF: That's MFL.

MR. FOREMAN: MFL it rotates.

MS. SENF: CD is not rotating.

MR. CHHATRE: I'm sorry. Say that again?

MR. FOREMAN: I got -- picked the wrong pig. This one stays in one orientation. The MFL rotates.

MR. CHHATRE: Okay.

MS. SENF: So --

MR. CHHATRE: So this will go straight in the pipe?

MS. SENF: Yeah. Yeah. It can happen that it slightly rotates, but we don't force it to rotate, yeah.

MR. GARTH: It's not designed to.

MS. SENF: Not designed to.

MR. CHHATRE: It's not designed to rotate, but it may rotate a little?

MR. FOREMAN: But it can.

MS. SENF: It can, but it's not designed to, yeah.

MR. FOREMAN: But on the MFL tool we actually force it to rotate.

MR. NICHOLSON: The report says you have wall thickness sensors at both ends of the skid, I thought?

MR. FOREMAN: That was my error. That my error in the transcript. I thought they were front and back. It's only in the front on the 30-inch.

MR. NICHOLSON: Oh, okay, you're right. It says per skid, two.

MR. FOREMAN: I said there was two -- I said two per skid if there is two. I thought was one in the front, one in the back, but it actually --

MR. CHHATRE: But there are --

MS. SENF: It depends on the sensor carrier.

MR. CHHATRE: There are two, but they're on --

MS. SENF: Some sensor carriers have them on the front and on the end.

MR. FOREMAN: On the front. Yeah.

MS. SENF: It really depends on the size of it, um-hum.

MR. PIERZINA: What are the sensors on the back end, the two -- yes.

MR. NICHOLSON: Are they sensors or are they bolts? Right on that --

MS. SENF: This one here?

MR. PIERZINA: Yeah.

MS. SENF: These are bolts, bolts.

MR. PIERZINA: Oh, those are bolts?

MS. SENF: Um-hum. Yeah, um-hum.

So the sensor, so it stops -- ends -- from here to here.

MR. PIERZINA: All right, okay.

MS. SENF: Okay.

MR. KILLORAN: Can we take 5?

MR. NICHOLSON: Yeah. Why don't we go off the record for a little bit and take a break.

(Off the record.)

(On the record.)

MR. NICHOLSON: Part 3. Back on the record. And I think where we left off, Petra was going to walk through the C scans on the longer indication and explain to us how it might have been interpreted as crack-like versus crack field.

If you would continue, please?

MS. SENF: Yes. Right. So, what we have seen in the clockwise sensors, we saw some reflections caused by a crack field most probably, and we also saw some weaker reflections from a toe crack. And now we are at the counterclockwise side or counterclockwise sensors, and what we see here is, yeah, some weaker reflections of a crack field in sensor 16-30. It's rather reflections in sensor 2-16 and -- with some red dots in it. Sensor 2-17, they are more or less the same, maybe higher amplitude than before. And in sensor 2-18 we also have some nice red crack field indications. And --

BY MR. CHHATRE:

Q. This is Ravi. Can I interrupt and ask you a question now? Where in this, I guess, the window do you see any overlap or not? I thought, from my viewpoint, the simplistic approach was to look at the overlap. And is that overlap you are seeing when you do your different locations? Say, like when you are reading some numbers, does that give overlap also or it does not give overlap?

A. There is -- between the individual or between the neighboring sensors there is an overlap, yes. So, I would not see exactly the -- I wouldn't see one indication exactly in the same way with two sensors, but in a similar way. So I have overlapping data between the individual sensors.

Q. Okay.

A. Okay. And now I have this indication here and -- this indication in sensor 2-19 is -- it looks like a crack-like indication. So, what we see here is an individual indication with varying amplitude. It's in the -- I don't know, somewhere in one-and-a-half skip or second skip. It's difficult to tell. It's somewhere between the one-and-a-half and the second skip. And this indication corresponds to the crack-like indications of the clockwise sensor.

So, it's around 96 degrees, something like that. And, let's see, when I go here, 95, 95. So, there is a slight deviation or there is a tolerance between clockwise and counterclockwise sensors. But it looks like that this -- the indications of the clockwise and the counterclockwise sensors are these individual crack-like indications, were the reason for the analyst to call it crack-like. So, this is the only -- this is what I can see as the only reason why he choose the classification crack-like.

A. And how long is that individual one?

Q. That one is -- when I take all of it, it's 34-inch long.

A. Right.

MR. FOREMAN: And its depth?

MS. SENF: The depth would be 38, but it's in the one-and-a-half skip. So, between 1 and 2 millimeter, 40 to 80 mils somewhere.

MR. FOREMAN: So, that's quite a substantial single crack compared to the crack fields on the extremity. So, I think that that is what led them down the similar path in my diagram, LD, one long continuous crack versus a field of cracks.

MR. NICHOLSON: Well, okay.

MR. CHHATRE: But if you go back to the same -- now, if you can move farther --

MR. NICHOLSON: You're saying then they use the crack fields in addition to this -- this is clearly, I would call it a crack-like.

MR. FOREMAN: Right.

MR. NICHOLSON: So, then they just took everything and combined it in length, boxed it --

MR. FOREMAN: Right.

MS. SENF: Correct.

MR. NICHOLSON: Okay.

MS. SENF: Yeah. And, and --

MR. NICHOLSON: So, it's not that they didn't see this crack field, right?

MR. FOREMAN: No, no. No, they saw it but it --

MR. KILLORAN: Well, wait, wait. So you haven't talked --

MR. FOREMAN: Okay.

MR. KILLORAN: -- right?

BY MR. CHHATRE:

Q. This is Ravi. But this maybe -- I mean, I can see, so these are the same here, crack-like feature.

A. Um-hum.

Q. At the same time, these features here, do you consider that as seam reflection? Because I don't see a seam.

A. No.

Q. So, that -- these will be like a small crack, because if you saw it was yellow, to taking your analogy, they can go all the way up to here?

A. So, so these reflections here in that yellow box now, this is internal surface. So, it's not a defect, so --

Q. It's not a defect?

A. It's just internal surface. These reflections here could be caused by a crack field; that's right.

Q. Okay.

A. Or it's -- yeah, it's difficult to tell what it is.

Q. Yeah.

A. So, it's not really --

Q. But, I mean, just --

A. -- compared to the -- but everything in the yellow box is just internal surface.

Q. But how do you, I guess, mark these are internal and not all the way up to here internal, is what I'm trying to understand?

A. Well, the width of the internal surface I would say is about 5 microseconds wide. It's not wider than that.

Q. Okay.

A. So, and --

Q. So, that's the criteria for calling internal, if I might -- maybe I use that. Okay, 5 microseconds is --

A. So, it's -- the signal at the entry point is approximately 5 microseconds wide, so normally, 5 to 6 microseconds.

Again, here in this case, this box here shows me it is -- the box is 5.9 microseconds wide. So this would be -- yeah, almost 6 microseconds.

MR. NICHOLSON: I thought you were going by the half skip/full skip, because you're doing it by time of flight to figure out internal?

MS. SENF: So, this is internal. This is internal again, and here --

MR. NICHOLSON: Right.
MS. SENF: -- the blue one. So, and here, this one it looks like when I pick those up, indications here, it's somewhere between internal and external. But the farther I am with my time of flight, the more -- the bigger the tolerance, if it's internal or external. So, my widths get wider and wider so it's hard to tell if it's internal or external the wider I am -- or the farther I am.
MR. PIERZINA: Can you -- I don't suppose -- can you change that wall thickness on the right-hand side to .250?
MS. SENF: Uh-uh.
MR. PIERZINA: No?
MS. SENF: Uh-uh.
MR. PIERZINA: Okay. Because I guess I'm just wondering if you had an error in your wall thickness, because that's being used to calculate your time of flight, if that were more precise for that location, if it wouldn't land more on the external surface?
MS. SENF: Um-hum. Um-hum.
MR. GARTH: Yeah, it would.
MS. SENF: Yeah. But I would expect always to have --
MR. FOREMAN: (indiscernible) in microseconds.
MS. SENF: -- not only in the one-and-a-half, but also in the half skip, a reflection. And even if it's now 280 or 250, it doesn't really make a big difference. So, external/internal

discrimination will still be (indiscernible).

BY MR. CHHATRE:

Q. This is Ravi, NTSB. The wall thickness now, how -- what is the accuracy of these tool sensors? I guess, I'm still trying to figure it out, your report that you -- GE gave to Enbridge was percentage wall --

A. Um-hum.

Q. -- not -- and we are talking about the actual, you know, crack depth in actual numbers, right? And is it a standard practice for you guys to do the percentage wall or the actual numbers?

A. So, at that time the standard was to deliver it in percentage wall thickness. And so, meanwhile we have changed to millimeter.

Q. So, 2005, would be for all clients would be percentage wall?

A. Yeah. So, we were also able to deliver it in millimeters, but the standard really wasn't -- and also, in our spec we only stated percent wall thickness.

Q. Did your analysts knew that the nominal wall was .55 compared to the number that they are seeing here?

A. No. No, we didn't know that. So, we didn't have the nominal wall thickness. We don't even consider the nominal wall thickness because -- so, we measure it. We assume it to be right even if there's some variation. But there is -- yeah, no way to have that in our data that the nominal wall thickness -- or, having the nominal thickness in our data is kind of sections or -- or, it's kind of segmented, so, no, we don't have it.

Q. But, you know, if you look at the numbers, like .55, it says .29. It's really significant difference in the wall. And that can change the percentage between your --

A. Um-hum. Um-hum. No, and this was the reason why we have changed it, especially for Enbridge. Because Enbridge was using the nominal wall and we were using the lowest measured value and they saw differences.

The reason could be that we don't really have -- or that the measurement of the wall measurement sensor is not that precise. So we only have two of them. We don't measure the whole circumference. And so, they saw the differences and they asked what we can do against it. Because when we -- as I said, when we do it as percent wall thickness, we might be slightly wrong and that's why we decided to use millimeters only for Enbridge. So, we had that in our software already, so we were able to deliver that. But we didn't do that for most of the customers because most of the customers are used to percent wall thickness. From MFL side, they only use that.

Q. And calibration, before you're starting your run, do you calibrate all your sensors? And I meant the -- all sensors, not just wall thickness sensors?

A. Um-hum. No, it --

Q. And then it comes out, do you measure it to make sure that going in the tool was okay, coming out the tool was okay? Is that done or --

A. It's not really a calibration of the sensor. It's kind of a bug test that we check that all the sensors need to reach at least 60 dB amplitude. So, and if this is the case, the sensor is okay. If the signal is lower than 60 dB, it will be removed, the sensor. But no other calibration on it.

Q. So, how -- I guess, I'm still kind of -- with wall thickness, how do you know the wall thickness you are measuring, what is the accuracy of that really for you to do -- go through all this analysis?

A. Um-hum. Um-hum.

Q. Because you are just using the wall thickness your tool's giving you.

A. Yes.

Q. In terms of saturation, calculation, everything.

A. So, the wall thickness is only -- so at that time it was used for internal/external discrimination and for the sizing, yes. Only for these two things. So, we didn't use it for any other things.

Q. But you are recording the percentage of wall?

A. That's right. So, it's for sizing and internal and external discrimination. But we don't have a tolerance for the wall thickness measurements.

Q. Okay.

MR. NICHOLSON: So, just to clarify, make sure I understood you correctly. You said in 2005 the -- Pii's standard was to report in percent wall thickness?

MS. SENF: Um-hum.

MR. NICHOLSON: Okay. Unless asked to do otherwise?

MS. SENF: Yeah, we were also able to report in millimeter.

MR. NICHOLSON: But you wouldn't do so unless I said to you, Petra, I want these in millimeters?

MS. SENF: Yes, right. So, we have analysis requirement and the client can choose what he would like to have, yeah. And most of the clients choose at that time percent wall thickness.

MR. PIERZINA: This is Brian. Could you talk about the conversion for decibels to depth in the one-and-a-half skip range?

MS. SENF: Um-hum. I can open that.

MR. PIERZINA: And I guess also distinguish between maybe how it was done in 2005 versus how it would be done today?

MS. SENF: Um-hum. Okay. So, in 2005, we used a depth -- oh, maybe -- can I just finish --

MR. PIERZINA: Oh, sure.

MR. CHHATRE: Sure.

MS. SENF: -- the explanation of that feature here?

MR. CHHATRE: Okay, yeah.

MS. SENF: Because coming back, why it was classified as

crack-like, and then I will answer your question, Brian.
MR. PIERZINA: Sure.
MS. SENF: So, this one feature here, we see kind of a crack-like indication.
BY MR. NICHOLSON:
Q. And it measured, when you boxed it, 31.5?
A. No.
Q. 5, roughly.
A. You mean the length or --
Q. The crack-like, yeah, of that --
A. The length of that approximately 34 -- 33, 34-inch long. And so, but why did the analyst -- okay, it is an explanation why the analyst classified maybe that feature as a crack-like, but why did he also classify the other features as crack-like? So, when I do a compression of the data, I see that it's more like a continuous indication which goes through the whole pipe joint.
Q. Where is it on here? I'm sorry.
A. No, this is -- we now have a compression and this is --
Q. Right.
A. -- the indication we saw right now.
Q. That's our 51.6?
A. Yes.
Q. Okay.
A. And here it is more or less continuous. So, the only reason I can assume why he classified all of them as crack-like is

he saw that feature. He made a compression and said, oh, that goes through the whole pipe joint; I classify them all as crack-like.

Q. If I compress it enough, won't everything look crack-like?

A. I'm sure he went back and looked at the feature if he also saw the crack-like indication there. But --

Q. When you were zooming in, though, it looked to me like -- didn't -- it's not simply because he had a box around all these features, would it be? I mean, they all look like distinct entities, like you could have taken your 34-inch crack-like and called it a -- given it a feature ID and said that's a crack-like.

A. Um-hum.

Q. And then done your little onesie twosies and called them crack field.

A. Um-hum. Um-hum.

Q. That option was available, right?

A. That option was available.

Q. Okay.

A. Yeah, but it was not standard, I would say.

Q. Oh, okay.

A. At that time everything was visible and the box was used for sizing and most of it --

Q. Well, is it because it was all in a box that the analyst says --

A. Yeah. Yeah.
Q. -- oh, well, if it's all boxed, then I got to call it all one thing; is that --
A. Yeah. Yeah.
Q. -- true?
A. So, in this box we had the crack-like and we had some crack fields --
Q. Right.
A. -- right? In the other boxes the crack-like is not as strong, I would say, as crack field indication. But he considered the crack-like feature to have more -- this is what I believe -- as more severe than the crack field. Using all the amplitudes for sizing, which is -- but using the crack-like feature type because it seemed to be -- seemed for him more severe than the crack field feature type. Now, this is the only way I can explain why he used the feature type crack-like.
And we have a rule, which is still valid. We ask the analyst to have kind of consistency in their classification. And so, when you have similar features, you should also classify them in a similar way. In this case here, maybe he thought, okay, when this is a crack-like, all the others will be a crack-like as well, just for the sake of consistency.
Q. Okay. But if there's a box around multiple types of defects, I, as an analyst, I've got the option of changing that single box into two boxes, right?

A. Right.

Q. And breaking them out?

A. Yes.

Q. Okay.

A. And this is the standard rule we have now.

Q. Oh.

A. That have for a while already.

Q. Since 2008?

A. 2008, right.

Q. Right.

A. When we developed also the different sizing algorithm that each feature type get marked. Um-hum. We don't have any mix complex features. Um-hum.

Q. Thank you.

BY MR. CHHATRE:

Q. Question. This is Ravi. Now, this one yellow box is the feature that eventually ruptured, caused the rupture, 51-inch or -- is it 51 inch? 51.6?

A. No, this is the crack-like indication. It's not -- this is only one indication in that box.

Q. Is 51-inch long? That's what I want to find out. So, this --

A. Yeah.

Q. And this is the 51-inch on this one will be like, right? What I'm trying to --

A. This is the length, though this one here though. This is the length, the 51, from here to here.

Q. This is 51, right?

A. Yes, um-hum.

Q. Okay. And has the analyst who did that give you the explanation as to why he thought it was a crack-like rather than a crack field?

A. If he gave me that explanation now?

Q. No. I mean, when you guys after the accident talked to the analyst and the reviewer, I guess, what was their explanation for giving these features?

A. He couldn't tell me.

Q. Okay.

A. He couldn't tell me why it was classified as a crack-like.

Q. Okay.

A. He looked, there is a crack field, yeah. And meanwhile, so this reflection here and the reflection of the clockwise correspond to each other. I'm not sure if toe crack was even found there. If there was something, it was really weak and -- yeah. Not even sure if this really the reflection from a crack-like indication or from the weld cap, geometry from the weld cap.

Q. And I appreciate your comment, instructions to all analysts are to be consistent.

A. Um-hum.

Q. Now, was that particular analyst consistent in identifying or this was an aberration in his process or his reason?

A. Somehow -- he was consistent somehow, but he wasn't right, I would say.

Q. So, I guess what error he made, he was consistent in making that error --

A. Yes. Right.

Q. -- during that process?

A. Yeah. Um-hum.

Q. I guess what's still puzzling me is the Level 2 also did not catch that. And I guess my question is what is the QA/QC you have on these people who you are trusting to do 100% of review? And if you can explain a little bit these are the procedures to make sure these guys are doing what they are supposed to be doing?

A. Um-hum.

Q. Do you follow my question? Is there a process that you guys can say, okay, John Doe is Level 3 or Level 2 and he's supposed to check everything 100%, and he is probably one of the best -- he or she is the best qualified person. And here is my procedure to make sure that he or she is delivering what they're expected to.

A. So, the analyst receives the training and there is kind of a constant control by doing Step 1 and Step 2 analysis, and we look at features from Step 1, for instance, and when we do Step 2 analysis. But we do a -- we certify the people. So, we do a test with them and the test here -- we did our recertifications in 2005 and 2006. So, he was newly certified. So, in 2005 and '6, I knew that he is really capable doing the analysis, that he is able to discriminate the different features. And I -- but it's still -- it's not an automated process, right? So, it's still humans doing that and there is -- they can do an error or they can do a mistake, right? And this analyst here --

Q. But I'm trying to understand --

A. -- he has done a lot of analysis on crack fields, and he did right. I know that because when I look through the data I know that he did right. In this case here, he was -- maybe he was only confused by that one crack-like indication, but he still thought he -- how can I say that? Yeah.

Q. That's okay.

A. It's like driving a car. So, I -- yeah, I take some lessons to learn driving a car, and then I can do that car driving. And sometimes, yeah, I have accident because I wasn't concentrating, something like that. And there is no recertification -- or at least in Germany, there is no recertification for car driving, for the driver's license, not even -- you even can drive at 90 years. Well, you cannot analyze for 90 years. But even that -- so, I guess it's the same there. It's so people learn that. We control them, but there is still some room for error, yeah. Um-hum.

BY MR. NICHOLSON:

Q. Is there -- there's no documentation that he fills out that actually proves he looked at everything? Because the tendency would be on a Friday afternoon to just skip --

A. Well --

Q. -- over some of these, right?

A. Yeah. But that time --

MR. KILLORAN: Wait, wait, wait.

MS. SENF: At that time. Hum?

MR. KILLORAN: He asked you is there a tendency on a Friday afternoon to skip stuff?

MS. SENF: No.

MR. NICHOLSON: I mean, I was just talking --

MR. KILLORAN: You said yeah, yeah, yeah.

MS. SENF: No, no. No, it's not.

MR. NICHOLSON: No, I understood.

MS. SENF: So, in 2005, we didn't have our QC mode. In 2008 or -- I guess I was 2007, 2008, we invented the QC mode, which means they have to look at the feature. They have to confirm the classification and then it's stored in the database that they have done the work on it. Yeah.

BY MR. NICHOLSON:

Q. So, in 2005, there was nothing in place?

A. No. So, he had to sign that he has looked at that --

Q. Okay.

A. -- section, that he checked all the reportable features, that he checked 5% of the non-reportables. He even had to track how many crack fields there were before he started analysis, how many crack fields -- before he started the quality check and how many crack fields there were after the quality check. But we don't have that anymore because we didn't see a sense on it seeing how many crack fields we had before and after. But we have the quality check mode where we track if a feature was checked or not.
Q. Okay. So, that's still --
A. Yes, um-hum.
Q. -- if that still exists, we could request that for the 2005?
MR. KILLORAN: Could request what?
MR. NICHOLSON: The document you just said where he signs off saying how many crack fields were looked at and how many were changed from crack field to crack-like.
MR. KILLORAN: Would we still have that document?
MS. SENF: Yes.
MR. KILLORAN: Okay.
BY MR. NICHOLSON:
Q. Okay. I'm sorry, and, Petra, we keep sidetracking here. Are you still walking us through this 51.6-inch defect and how it was analyzed as crack-like?
A. Um-hum.
Q. Crack field. Or have you finished that one?

A. So, I guess -- so, you asked me that how it comes that all these features were classified as crack-like, right? And I guess this feature here, that indication here is the reason for it. So, we didn't look at all the other features. So, okay, this is a crack-like indication and then --

MR. KILLORAN: Let the record show that Petra was showing sensor 2-19.

MS. SENF: 2-19, yeah, where we see the crack-like indication and then in sensor 2-20, we see some nice reflections of the long seam. So, what you see here is we have varying amplitude, but the long seam is never really straight. It's kind of an irregular thing. And because that we also have some irregular reflections, but all in all it doesn't really -- there is no huge variation. We don't see any individual cracking indications.

And here in sensor 2-21, seam weld reflection is one, not a lot.

UNIDENTIFIED SPEAKER: You're talking (indiscernible) --

BY MR. CHHATRE:

Q. These are indications at the longitudinal seam. This particular crack you just showed will not show that. Is there any other sensor in the tool that will catch the indication on the seam?

A. Sorry, I didn't get that question.

Q. Okay. If you can go back to your previous slide there.

MR. KILLORAN: 2-20.
MS. SENF: This one here? Um-hum.
BY MR. CHHATRE:
Q. Yeah. Like there's a reflection on -- of the long seam --
A. Um-hum.
Q. -- that we are seeing. I guess my question, there is something on the outside just above the long seam that is caught -- I guess, the reflection is masking -- will the reflection be masking anything that actually exist? And if it would, is there anything in the tool to catch that?
A. Um-hum. So, the signals we receive here from the long one are really strong and lots of signals, and so we have kind of mode conversions in the long seam because of the structure of the long seam and if there would be a defect indication somewhere, somewhere here, it might be masked by the long weld reflection here. But the neighboring sensor --
Q. That's what I'm saying, yeah.
A. -- should see it, yes. Yeah.
Q. So, even if one sensor misses it, the next sensor should catch it.
A. Yeah. So that's why we have the redundancy of the sensors that one -- if one sensor is missing it or if it's masked by the long seam, it should be seen at least by another one. And that's why we also have the arrangement of clockwise and

counterclockwise sensors. If it's not seen by the clockwise side, it should be seen by the counterclockwise, especially at the long seam. So, in the long seam area we more or less blind, but clockwise and counterclockwise arrangement ensures that we see defects as from clockwise or counterclockwise.

Q. Do you have an example of how a defect in the long seam that can -- is seen by the sensor? I'm just trying to -- comparing that with this will kind of give an idea, yes, indeed, the long seam defects cannot be completely gone or not seen.

I mean, if you don't have it right now, that is fine. Maybe you can kind of send us an example. I mean, I don't want you to waste time on this one, but --

A. Um-hum.

Q. What we are trying to find out is how a long seam defect can be identified by this technique you are describing without getting confused with the long seam defect.

A. Let's see what I have here. So, here I have the long seam. And one crack-like feature at the long seam --

Q. Oh, beautiful.

A. -- is 25 to 40%.

Q. Okay.

A. And I get here one nice reflection at the external surface. And the second one, and then I don't get any reflection back. So, I would expect if I have a deep crack I see it from clockwise and counterclockwise. And here, I don't see anything in the counterclockwise data. So, it's shaded for the counterclockwise sensor. It's only seen in the clockwise sensor.

Q. Clockwise sensor.

A. Yeah.

Q. And I guess my question was --

A. Not the best example.

Q. No, but how would an analyst know -- and I realize I'm not even maybe 0 level at that point, but how would he know that this is not reflection from the --

A. It tells you --

Q. -- long seam or just being a long seam defect?

A. Um-hum. Well, because he gets the long seam reflections later. So, he is -- here he's still in front of the long seam, and then he gets -- then the long seam reflections come. So, but I guess that is one even -- why don't I get the next one. This is a little better --

Q. It looks like that can be tricky because he's only looking at the red color.

A. So, this is a -- I guess this is a nice example. So, here we have some reflections from the long seam and then we have also some additional reflections here. And these are different than the ones to the left and to the right. And pretty red and -- so, here we have really a crack in the middle of the long seam.

Q. But then you have nothing for the long seam at the bottom. And I can see the long seam red and then --

A. Yeah.

Q. -- kind of a gap in there.

A. Um-hum.

Q. And then you are seeing something on the top.

A. Um-hum. Yeah, it might be that the -- that there's something wrong with the internal weld cap. Because if I don't get any signals here, it seems that the internal weld cap was maybe ground off slightly or might even have kind of a geometry of the weld. And then I see -- but I see here then really nice reflections in the internal skip. So, when there is something wrong at the internal surface it's also -- always a heads up, okay? And when you also see here some reflections then in the internal skip, there is something severe going on.

Q. This one the middle indication would be the long seam defect or --

A. Um-hum. This one here. All these reflections are from the long seam defect. Um-hum.

Q. Okay.

MR. PIERZINA: So is that an internal?

MS. SENF: Yes.

MR. PIERZINA: Crack-like?

MS. SENF: No, he -- that's interesting. Here it is, rather, external and here it is external -- internal -- it's rather external. And it's difficult to tell because we also have some internal reflections, but it's -- I would choose the first one here; it's rather external.

BY MR. CHHATRE:

Q. Now, when you say it can be between internal and external, what does that mean? Does it mean that defect has gone deep to kind of mess you up with internal and external, or --

A. No, it's open to the internal or to the external pipe surface.

Q. So, it can be either of those. Is that what it means? Remember you said this can be either internal or external, but you have classified that as external.

A. I classified it as external. So, the main indication for me is external.

Q. Okay.

A. But here in this case, it could also be something wrong with internal. So, the weld cap is strange internally on there.

Q. But the depth of the defect would not be -- with signal like that, I mean, the defect is gone significantly inward when there's a 50% wall. When you get a signal like that, because it's neither internal nor external, or it always will be external? I'm just trying to find out why a signal will come in between and not fully internal or fully external.

A. It depends on if you get the defect with the a center beam or with a border beam. And if you get with a center, it should be exactly at the external side. If you get it with a border only, because the beam is quite wide, if you get it with a border only, it could slightly above (indiscernible).

Q. Okay. So, in some locations it will do that.

A. Um-hum.

Q. Not necessarily the depth of the beam.

A. Right.

Q. Okay. Thanks.

MS. SENF: Okay. So, I guess we are through -- so, that was a long seam reflection. This is also long seam reflection. Now we are back at the same feature and we also have some crack field reflections in sensor 2-22, but this is on the other side of the weld.

So, when I go back to -- where is that? Oh, I have to go back here. Where is it? No, that's not the one -- okay. Now, this is again the C scan of our same feature and we always looked at these features here before, but we also see some crack field indications here on the other side on the left-hand side of the weld. And also with some nice amplitude. In this case, it's, yeah, 45 dB. It's quite, quite high. And today --

BY MR. CHHATRE:

Q. Forty-five dB means 2 millimeter?

A. It's even more. Yeah, above 2 millimeters, yeah. And today what we would do is, we would have a box for this crack field because it's on the other side of the weld. So we would not box a crack field across a long seam because this is not one crack; it's two crack fields. So, there would be a box here.

Another box would be here for the crack field. And if there is a crack-like indication, that would be a third box here.

Q. Now, on this particular one, if you move it right to your box, would that be a weld seam indication or it will be just a reflection?

A. This one here?

Q. Right there, yeah.

A. Yeah, that's the seam weld reflection.

Q. Okay.

A. Um-hum.

MR. PIERZINA: So, and how do we know that this is on the other side of the long seam?

MS. SENF: So, I start again with the clockwise. So, with counterclockwise, so -- when I look at the counterclockwise I start here, always at the bottom of the feature. So, then I go through the sensors and I'm still in front of it. And now I get the long seam reflection now I'm somewhere in the middle. And now I'm behind the weld. So, I start looking here, look at these features first. Then the long seam reflections, or the sensors which detected the long seam reflections, and then at the end I look at this feature here. So, between these indications -- this indication here and these indications we saw the long seam reflections.

MR. PIERZINA: Okay.

MS. SENF: But it always -- it's always the same how the analyst looks at the data. He starts at the bottom of the feature and then he scrolls through the different sensors, so he knows -- he always knows the first indication I get is in front of my weld and then I should get the seam weld reflections, and when there are any other reflections, I'm behind the weld. So, this is the first thing the analyst needs to learn where he exactly is, that he can combine the data of the clockwise and the counterclockwise sensors.

BY MR. CHHATRE:

Q. This is Ravi. If there would be a seam indication on this one, how will it look like? Or, this is just one sensor or this is combined picture?

A. This one here?

Q. Um-hum.

A. No, this is a combined picture of all sensors.

Q. Right. So, if there is a longitudinal seam indication in this particular location, how would it look differently than what it is looking right now?

A. So, the long seam reflections are this here.

Q. Right. And this is a --

A. So, this is what we always see, reflections like this here --

MR. KILLORAN: Let the record --

MS. SENF: -- and we get small --

MR. KILLORAN: I was just going to say let the record show Petra's referencing approximately 95 on the Y axis and you've got the 3D scan screen up?

MS. SENF: Um-hum.

MR. FOREMAN: Can I make a suggestion? You showed a very good seam indication just 2 minutes ago. What does that look like in that view? That's what Ravi was --

MR. CHHATRE: Yeah. I'm trying to find out if, in this particular case -- let's just say there was a seam indication.

MR. FOREMAN: What would it look like?

BY MR. CHHATRE:

Q. How would an analyst describe it? How would it look like, that what I'm looking at? To me, I don't -- as an untrained eye, I don't really see a whole lot of difference in all these indications.

A. Yeah. So, in a perfect world, I would have the blue sensors on top in a nice line and the red sensors in the bottom.

Q. Of the seam?

A. Of the seam.

Q. And then that will mean a seam indication?

A. Yeah.

Q. Okay.

MR. NICHOLSON: That would be your clockwise, your counterclockwise --

MS. SENF: Um-hum.

MR. NICHOLSON: -- shooting the seam.

MR. CHHATRE: Right. Exactly.
BY MR. CHHATRE:
Q. But you -- if you look at middle -- I thought that's what I was looking at, something similar in this case, and maybe I'm not. I see some blue here.
A. Um-hum.
Q. And I see some red right below.
A. Yes.
Q. And your seam is right here. And so, would that be considered a seam indication?
A. Yes. So, and I guess this little part of it here, though, this really displays with the perfect seam weld.
Q. A seam weld, okay.
A. So, we detected it with clockwise and counterclockwise, but only the weld reflections, nothing else. Um-hum.
Q. But that would not be a reflection --
MR. FOREMAN: But a defect. It's a perfect weld.
MS. SENF: This here would be a seam reflection.
BY MR. CHHATRE:
Q. Oh, seam reflection?
A. Yes.
Q. Will not be a defect?
A. No, no. But the analyst is not using that screen to identify if there are any defects, so he can check where exactly is -- is he in front of it or behind it, but he should also know

it when he's going through the B scan.

One thing we use it for is to identify if there is a toe crack. Because in a perfect world, I would have again the blue indications on the top, the red in the bottom, and if there is a toe crack, it's either seen by clockwise or counterclockwise sensor. The toe crack means it is at the edge of a DSAW.

Q. Will be, yeah. Yeah.

A. Yeah. So, it's somewhere, somewhere here.

Q. Um-hum.

A. And it only can be identified by --

Q. Right. By (indiscernible) --

A. -- in this case here by the clockwise sensor. It couldn't be, yeah --

Q. Right.

A. -- it couldn't be seen really by the counterclockwise. So, in a perfect world, the toe crack would be on top of the blue indications. When it was detected with a clockwise sensor, a red sensor, it would be so like here at my pen, so --

Q. Okay.

A. This is the only reason for using the 3D scan here.

Q. Okay.

A. He also sees that in the B scan. But to make sure that it is a toe crack, he can use the 3D scan. It shows it a little better.

Q. This is Ravi, NTSB. When you were requested to look at this particular, I guess, data set, how long it took you to reach the conclusions you reached once you put this information on the screen?

A. So, you mean -- so, which conclusion do you mean?

Q. I mean, let's just say you are -- now that we are looking at this after the fact, because I realize there is some difference. But when you put the data on your screen, how long it took you to decide it's not really a crack-like feature, it was a crack field? I mean, essentially you analyzed the data from scratch.

A. Um-hum.

Q. How long it took you to finish this particular defect?

A. So, when I would leave it as it is here with not doing any separate boxes, so maybe a minute.

Q. No, I mean, once you get all the data. I'm sure you went through the entire process, right? You read your sensors to make sure. How long it took you once you get the raw data on the screen to look at however sensors and whatever steps you need to take, including the last one, to reach your conclusion about the type of defect classification?

A. So, when I'm an analyst, right, I go through all the sensors and I make up my mind. Half a minute, a minute, not more. It shouldn't take longer. If there are some complex features where I have to ask someone or the analyst asks me. So, but normally --

Q. That's not the question. If you do it like we are here talking about this for the last about 2 hours, okay.
A. Yeah. And I spent quite some time on this feature, yeah. Yeah.
Q. You know, I just want to make sure you are -- it's not taking that long to analyze what the features.
BY MR. NICHOLSON:
Q. This is a good one to back up to, because when you went to the B scans, on this 51.6, it no longer looks like a 51.6-inch feature to me at all. As you pointed out, the crack-like was 34 inches and then we have these pockets of crack fields. So, I want to back up. How did the box -- how did we get this first box here drawn around all those what seem like independent anomalies?
A. So, the 3D scan, again, shows me only my selected vectors. It doesn't show me the green dots or the yellow dots --
Q. Okay. Right.
A. -- all of them.
Q. The selected vectors.
A. Yeah, so I have to go to the B scan and really look at all the features. And let's see, here I would -- here it's too large. Too large. Here -- yeah, so he starts here with a feature. So, it's green, but -- yeah, okay, here. He start with it, which is right. On the right-hand side, so he's right doing that.
Q. But this box, I thought, was drawn by the computer?

Doesn't the computer first box of features?

A. Yes. But the analyst needs to adjust it --

Q. Okay.

A. -- to any indications always. So there is always a need to adjust features, especially the ones on the long seam.

Q. Oh, okay.

A. Yeah.

Q. So, this may or may not have been how the computer boxed it?

A. I'm sure that the analyst changed the length a little bit, yeah.

Q. Changed the length. But the computer even saw all these things as being one --

A. Well, the computer -- but the computer mainly sees these reflection here. These ones here. So, these reflections give the maximum amplitude and this is what is used for boxing.

Q. Okay.

A. So, not necessarily the small indications. But just going back. So, on the right-hand side, I guess, it's okay with the sizing. On the left-hand side, going through all the sensors -- so, he accepted these indications here also, but these are in the (indiscernible) --

Q. I want to cut it off right there. Why --

A. He should have --

Q. Why wouldn't he have cut it --

A. So, at least here. Yeah, here. I would say, yeah, should have been a little bit shorter. But it doesn't really make a huge difference, I would think. Let's see how much it is. So, it is 47, 47-inch now. So 4 inch less.

MR. CHHATRE: But the one indication at the bottom, which is red, that's not a reflection of the seam, is it?

MR. FOREMAN: No.

MS. SENF: It could be. I would say it's rather internal surface or it's close to the internal surface. I wouldn't really use it.

MR. CHHATRE: But that is seam, because it's external.

MS. SENF: Yeah.

MR. CHHATRE: It's a red dot.

MS. SENF: But that is not really a gap between internal -- between the internal surface and these reflections, so --

MR. FOREMAN: Just to draw -- back up the last question on the box. Remember when we went to the actual raw data and how many boxes had been turned to bad, like --

MR. NICHOLSON: Um-hum.

MR. FOREMAN: Right? So, the computer is picking up reflectors of the seam weld. That's why it has to be readjusted.

MR. PIERZINA: Yeah, right.

MR. FOREMAN: So, that's why there's such a big box there because there's such a strong reflection from the seam weld and it's got these bends to it. So, it's just, it's just crudely took the biggest box. Then that leaves it for the analyst to --

MR. NICHOLSON: To resize.

MR. FOREMAN: Right.

MR. NICHOLSON: So this final box was not the initial? This is -- this is the analyst box here?

MS. SENF: Yeah, it is -- I guess it was close to that size when the data was processed, but normally the analyst needs to changes it a little bit because of these reflections might not even be considered in the automatic boxing because they're too low. It only then selected vectors again considered for boxing. And the weakest signals might not be used for the box generation, just the ones which -- with significant (indiscernible).

MR. NICHOLSON: Okay.

MS. SENF: Um-hum.

BY MR. CHHATRE:

Q. Now, does -- do the analyst or that part of GE gets involved in the conforming of -- not conforming, the quality of detection, identification and the way the tool is run and the performance promised, or you guys are not involved in that at all? I mean, let's just say operator A has done the ILI using these tool. You analyze it. Now, who decides, yes, we did 95% probability of detection, 90% identification, and yes, we did meet --

A. Yeah.

Q. -- that criteria? Are you guys involved in making that decision? Who makes that decision?

A. So, we have a team called data control. So, they do the processing of the data, do the assessment. And there are three possibilities to rate the quality of an inspection. It's acceptable, acceptable would mean we can meet the spec of POD and POI 90%. So, a data loss of 2% would be acceptable.

Or they can rate the data as degraded and that would mean we cannot meet the spec. We cannot always give an assessment what kind of spec we would meet, so that we can say, okay, we meet 70 or 80%. It's difficult. Sometimes it's not possible to do that. But we can say we might not meet the specs, but the data can be analyzed.

And the third criteria would be it's unacceptable. We cannot analyze the data so we cannot generate a report.

Q. Okay.

A. Yeah. And this is --

Q. So that's an option?

A. Yeah, that's an option. Though this is done by data control and they're also part of the analysis team.

Q. Okay. So they are really part of the same supervision?

A. That's right. So, for instance, for the ultrasonic world, the team leader from data control is also reporting to Clint.

Q. Okay.

A. Um-hum.

Q. And what is the basis -- I'm sorry. What is the basis for making that determination that, yes, we can meet the --

A. Yes. So, we have software tools to assess the data. So, one tool is called IFDA, Infield Data Assessment. So at that time it was developed to do that assessment infield even, but we don't do that -- still don't do that. So, and -- so, we can generate statistics, so if the speed was okay, if the rotation of the tool was acceptable, if the amplitude statistics are okay, vector statistics. So, we have different statistics and we have thresholds for these statistics. And when these thresholds are met, we rate them as acceptable. Yeah.

Q. And that is done based on the internal statistics of the tool parameters and analysis --

A. Of statistics based on the data, yeah.

Q. Okay.

MR. FOREMAN: The data quality assessment.

MR. CHHATRE: Okay. But does that change depending upon the verification digs? Is that what they're called?

MR. GARTH: Validation.

MR. CHHATRE: Okay.

MR. GARTH: Validation (indiscernible).

BY MR. CHHATRE:

Q. Validation dig. Does that -- if the validation digs match or don't match, will that change the --

A. Not the data, not the data quality assessment, no.

Because this -- the data quality assessment is really done before we analyze the data. So, we might figure out when we get results from the field that we might undercall or overcall features. And then we have to look at what's going wrong. Have done our saturation point too conservative or not conservative enough? But really the rating of inspection itself to call it degraded or --

Q. I guess, my -- well, my question, Petra, was really if Enbridge or any operator goes and does a verification or validation digs and they find out that you identified this as, you know, below that 1 millimeter or like 2 millimeter, it turns out that it's actually more than 2 millimeters or no indication at all, so that would -- would or would not that information change your statistics of accuracy? It still be identified. You still might meet the identification statistics, but --

A. Yeah. So, I guess, I -- so, when we would see a tendency of undercalling, right, this wouldn't change my statistics or wouldn't change my assessment. It would change my thresholds for analysis or change my values for sizing, so --

Q. Maybe I'm confused you call quality of detection and identification maybe --

MR. FOREMAN: I think, first of all, to the first part of your question.

MR. CHHATRE: Okay. And that's --

MR. FOREMAN: How many digs -- so it's Geoff Foreman here. How many digs are Enbridge giving us? So, the first thing we need is a significant data set. One dig? No, no. Two digs? No, no. If you go on the back of 1163, there's an actual guide how many digs you need to do to be significantly -- and then how many digs need to be right out of them to have a confidence level of 90% or 80%.

MR. CHHATRE: Okay. Uh-huh.

MR. FOREMAN: That's the nearest I've seen of any document that actually tells you what to do --

MR. CHHATRE: Rigth.

MR. FOREMAN: -- to meet that. So, the answer to the first part of your question, if I get feedback from Enbridge, then the first thing I'm want to do is to test it. So, if I've given Enbridge 6,000 crack-like features and they give me 20 digs back, that's not a significant number. If I give them 60 or, say, 100 and they give me 250 back, that is a significant number. So, then you look at the trend that that is giving me. Am I undercalling, overcalling?

The most important thing for me, first of all, is to catch it. If they find something that I haven't seen, that's the number one. If we prioritize response, if you like, what is the biggest reaction we would have, is first of all detection; did we detect it? Why didn't we detect it, right? Now, that may take it down to the (indiscernible) rule or it may take it --

MR. CHHATRE: Um-hum. Um-hum. (indiscernible).

MR. FOREMAN: That's the first thing.

The second one is did we size it -- or did we call it what it is, and did we size it correctly? So, if he gives me 200 defects from Enbridge and 180 of those defects are undersized, right, then what Petra said is she would look at the dB scale and say we need to adjust all of these by 6 dB's or 7 dB's or whatever, because in this medium in this run for some reason we're not classifying them, we're not getting the strength of signal back we thought we should get, and therefore we'll calibrate based on the dB's, right?

MR. CHHATRE: And that will go back to analyst?

MR. FOREMAN: Yes, it will go back --

MS. SENF: Yeah. Yeah. Correct.

MR. FOREMAN: -- feedback would go back and they would say we need to go back and (indiscernible) area. In that case -- and I don't know a case we've ever done that, but in that case we would re-size everything we've given Enbridge and reissue the report based on the dig verification, or the recalibration we did following the verification.

MR. CHHATRE: Okay.

MR. FOREMAN: The biggest one for us, as I said, is detection. I mean, we don't want to miss a big crack.

So, when we go back to 2005 and we talk about QA/QC of defects, the most important thing for an analyst in his mind and the quality checker is that not to miss a reportable feature. So, if this feature -- this feature was reportable whether it was a crack-like or whether it was a crack field. It was reportable. So their number one priority is, is it a feature, right? Should it be in the report? Yes.

The next priority, what is it? Well, I'm not sure. Is it a crack-like, crack field? Will it affect the length and depth? No. It'll have the same length, the same depth, right?

So, we step forward to 2008 and we've learned a lot more with the use of the tool. Now it's -- the regulation, for instance, asks for POD and POI. In 2005 that didn't exist. So, all of a sudden now, it's important to classify features as well. So, now we introduce new software and new trend and new rules and new quality check. Shift in the emphasis not only detection, but on -- maybe more on classification as well as sizing. So, that's the kind of experience that I've seen from 2005 to today, based on -- merely based on feedback we get from -- because if we don't get this feedback, we might be sitting with crack-likes, thinking crack-likes and everybody's happy with crack-likes, when it has a different effect to the operator on how he evaluates how he's running his pipeline. So, that's where I believe it sits.

MR. CHHATRE: And so -- this is Ravi (indiscernible). So, the change really occurred because of the feedback you got from various operators, not just one?

MR. FOREMAN: Right.

MR. CHHATRE: Okay.

MR. FOREMAN: I mean, that was the whole reason we changed everything in 2008 was we were getting feedback -- more SCC between 2005 to today, we're getting more SCC. In the early days, we were getting -- most of our analysis was around toe cracks. And then all of a sudden -- or SCC in the body of the pipe.

MR. CHHATRE: Now, in you report, Geoff, you only report crack or crack field? You don't classify, well, one step further and say SCC or toe crack --

MR. FOREMAN: Crack field is -- crack field to us is SCC in the real world. It's a series of cracks that --

MR. CHHATRE: That's right.

MR. FOREMAN: -- that are a colony, I should say. Proper word for it is a colony of cracks. We, just for a copyright and for contractual reasons, we call it crack field.

MR. CHHATRE: Okay.

MS. SENF: Yeah, because we don't know if it's caused by, really be SCC, which means stress corrosion cracking, so we use the term crack field. Also, for crack-like we only use crack-like. We don't say toe crack or heel crack or whatever. So it's a crack-like indication.

MR. CHHATRE: Okay. I guess maybe this is a question for you or, whichever, Clint. Have you guys made any changes in terms of this verification that Level 2 or Level 3 is supposed to do for Level 0 since the Enbridge? In terms of how you make sure that somebody is supposed to verify has done it. Has any changes made in the policy?

MR. GARTH: Since 2005, Ravi, or since 2010?

MR. CHHATRE: No, since the accident. Since the accident. Oh, you are -- since 2005. It doesn't matter, really.

MR. GARTH: So, can you just repeat that?

MR. CHHATRE: Since Level 0 or Level 1 is supposed to be 100% verified by Level 2 or Level 3, and 5% non-reportable.

MR. GARTH: Right.

MR. CHHATRE: My question is has you as a supervisor or GE as a company has made any changes either since 2005 or since the accident to make sure that that is happening? From what I understand, you said that there is no record or some sort of documentation that clearly shows somebody has done 100% of what they're supposed to be doing. So --

MR. GARTH: Yeah, so -- Clint Garth here. So, she -- I think Petra said earlier, in 2005 we were checking 100% of all the reportable features regardless of the person's level, and a spot check of 5% of all the non-reportable features, right? Over time that has now grown into we check a higher percentage of the non-reportable features based on the non-reportable feature classifications. So, it's not just 5% of non-reportables. It's --

MR. CHHATRE: That was not the question. The question was how do you make sure that whatever you just told me is happening in terms of procedure?

MR. GARTH: It's in our software now. Petra mentioned as well, that's in the QC mode software, which tracks to make sure those percentages are checked and recorded.

MR. CHHATRE: Let me repeat again. Yes -- I mean, if I certify I have checked 100% and whatever initial percentage, how do you as a supervisor and GE as a company make sure that, yes, it has happened? What kind of documentation trail you are keeping?

MR. GARTH: We have a QMS document for every project that tracks all the checks for every section that's analyzed, who analyzed it, who's QC'd it, and that's how we review every project and track all the checks that are done.

MR. CHHATRE: Does the person who is QC-ing prepare some documents saying -- does initial, somehow --

MR. GARTH: He puts his initials, day when he finishes the QC, the date, and the section that he did, yeah.

MS. SENF: And it's marked as quality checked in the software.

MR. GARTH: Yeah.

MS. SENF: So, and so, the quality checker gets a list of features he has to look at. And so, when he's finished with the list, he's doing the query again to see have I checked all of them? And the result is zero when he has checked all of them, and the result is (indiscernible) when he might maybe --

MR. CHHATRE: Right. Well, maybe I'm not understanding this really well as I should. I don't see much difference between

-- I mean, earlier in 2005, the person who are doing QC did say that he or she QC'd it, right?

MS. SENF: Yes, he signed it.

MR. CHHATRE: So how is that any different than what you are telling me now? I mean, the person -- maybe it was before verbally and now he signs it saying he has done. But next level up, as a supervisor, how do you know that yes, indeed, that person has done it and not just signed it? And I'm not saying people will do that, but, I mean, just going back and see how you verify what they are supposed to be doing. You understand what I'm saying?

MR. GARTH: I understand exactly.

MR. FOREMAN: Is there anything in the software that actually registers the actual checks? Does it actually touch keys to do anything, that the software would actually be caught?

MR. GARTH: Yeah, everything --

MS. SENF: Yeah.

MR. GARTH: -- is recorded, as Petra said, in the software that this feature has now been QC'd, and if it's changed, it also says it's been changed during the course of --

MR. FOREMAN: So, it's automated now, Ravi.

MR. CHHATRE: But will the software make some kind of a note that yes somebody opened --

MS. SENF: Yeah.

MR. CHHATRE: -- this particular task?

MS. SENF: Yeah.

MR. GARTH: Yes. It's tagged --

(Simultaneous speech.)

MR. CHHATRE: And then (indiscernible), okay. That's what I was really looking for.

MR. FOREMAN: It's built-in software now.

MR. CHHATRE: Okay.

MS. SENF: It's part of the software.

MR. GARTH: And it's tagged in the (indiscernible) database, right, so it's very trackable and we can output it as well --

MR. CHHATRE: Okay.

MR. GARTH: -- and look into it.

MS. SENF: Yeah.

MR. CHHATRE: So that -- okay. So, now you can go back and verify that yes, indeed, John Doe did look at this feature; he opened it. He may have missed it, but --

MS. SENF: Right. But he opened --

MR. CHHATRE: -- you knew he opened it.

MS. SENF: Yeah. Um-hum. Yeah.

MR. CHHATRE: And opened on that particular day. Okay. That's what I was really asking for in that question.

MS. SENF: Okay.

MR. PIERZINA: This is Brian. Petra --

MR. KILLORAN: Excuse me just a second, Brian.

(Whispered conversation.)

BY MR. PIERZINA:

Q. Let's go back to that question that I asked you sometime ago about sizing the defect at the skip and a half.

A. Um-hum. Okay. So, in 2005 --

Q. As it was then and now, yeah.

A. Yeah. In 2005, we had -- we used a sizing -- we had sizing algorithms for crack-like and -- crack-like features and crack fields and a similar one for notch-like indications. So, a notch-like indication is normally reflected with a higher amplitude than a crack-like indication because of its shape. So, when we see a notch-like indication, so we subtract 5 dB from the maximum amplitude and use then this amplitude for sizing.

Q. Okay. And so I want to jot that down. So, notch-like, and this -- are we talking back then?

A. We're talking back then, yes.

Q. So 2005, you would subtract 5 dB from the maximum amplitude --

A. For notch-like indications, yes.

Q. Okay.

A. And for crack-like indications -- so talking about, let's start with the half skip. And for crack-like indications we took the amplitude we see in the data. For the one-and-a-half skip --

Q. I'm sorry. Hold on one second.

A. Um-hum. Yeah. Um-hum.

Q. In 2005, in the half skip you took the max or the five -- the average of the --

A. The mean max five.

Q. Mean max five?

A. Mean max five.

Q. Okay.

A. For crack-like, for crack field, and for notch-like, um-hum.

Q. Okay.

A. Okay. And --

Q. Was that also the same for crack field?

A. That was also the same for crack field, yes.

MR. FOREMAN: Notch-like was it from -- is that because you were -- why you were subtracting for notches or --

MR. NICHOLSON: That was the original question. I was thinking to myself why are you subtracting for the notch-like, but --

MS. SENF: So, the notches, it normally, it does have a regular shape and a regular shape will you give stronger reflections than an irregular shape. So, our tool is designed to identify cracks. So, we would overcall or we did overcall notch-like indications because we took the same amplitude as the crack-like indications. So this is what we learned, I guess, 10 years ago, that we always slightly overcall the notches and that's why we added the 5 dB. Um-hum.

BY MR. PIERZINA:

Q. Okay. So, now, then, back in 2005 on the skip and a half --

A. Um-hum.

Q. -- how did you -- how do you size or did you size?

A. Um-hum. I don't want to say anything wrong. Let's see if it is somewhere here. No. I'll find it. No. Let's see now -- yeah, okay. For -- okay, that's interesting.

MR. FOREMAN: This is probably something you asked for.

MR. NICHOLSON: I was about to ask for it.

MS. SENF: Okay. So, in the out sizing (ph.) algorithm, so we haven't done any correction on the half skip, so we took the amplitude as it was for crack field and also for crack-like, and we added 3 dB to the one-and-a-half skip.

BY MR. PIERZINA:

Q. All right. So notch-like and the skip and a half, you're doing --

A. So, for all feature types in 2005 we added 3 dB to the indications in the one-and-a-half skip.

Q. Add 3 dB to the mean max five?

A. Yes.

Q. Okay. So, could we go to that sensor that showed the feature in the skip and a half that it looked like a -- you know, very much like a crack-like?

A. This one here?
Q. Yeah. All right. So --
A. So, we have an amplitude of -- oh -- of 38 dB. So, in this case it would mean we have to add 3 dB because it's somewhere in the one-and-a-half skip, which would go to 41 dB. So it's --
Q. 41 dB. And that would have been the way it was done in 2005 for basically any type of feature in the skip and a half?
A. Um-hum. Yes.
MR. NICHOLSON: And that's how you would apply it? You would draw your box and the analyst would have to just add it? Or was it built in to the --
MS. SENF: In 2005, it wasn't built in.
MR. NICHOLSON: Okay.
MS. SENF: Meanwhile it is built in.
MR. NICHOLSON: Okay.
BY MR. PIERZINA:
Q. So, and that's from sensor 2-19. So, when you're seeing this from, let's say, four different sensors, this defect, how do you combine the sizing that you get from all four sensors? Do you just take the largest?
A. Um-hum. I take the max -- yeah, I take the largest one. Yeah, um-hum. So, I measure all of the four. Let's say there are four sensors. I take the measurement of all of it and, yeah, take the maximum value out of it. Um-hum.
Q. Okay. And how would that be different today on that

very same feature?

A. So, we wouldn't do anything different in the -- for a crack-like feature, but for crack fields everything would be different. So, for a crack field we would not take the mean max five anymore. We would take the maximum amplitude. We would -- we wouldn't do a correction in the half skip, but we would do a correction of 8 dB in the one-and-a-half skip --

Q. You would add --

A. -- for crack.

Q. -- add 8 dB?

A. Yeah, 8 dB for crack fields.

MR. NICHOLSON: Like a normal and a half, right?

MS. SENF: Almost, yeah.

MR. NICHOLSON: Yeah.

MS. SENF: Yeah.

BY MR. PIERZINA:

Q. So, can we do that for that feature that we have up for that sensor or --

UNIDENTIFIED SPEAKER: The crack field.

MS. SENF: I'm not sure if we have even any indications in the one-and-a-half skip. So, this is the first on the clockwise.

BY MR. PIERZINA:

Q. Oh, what about the one that we were just looking at?

A. Well, yeah. So, this indication is a crack-like indication. We would not consider it for the crack field, right? For this we still would add the 3 dB.

Q. Okay. I thought we had agreed that we would classify this feature as a crack field feature?

A. Um-hum. But whether I would classify it as a crack field, I would exclude this one here because this is a crack-like. I would have to create a separate box for it.

Q. Okay. So, I might have misunderstood. So, today that signal response would result in you reporting two features: a crack-like feature and a crack field feature?

A. Two crack field features and one crack-like feature.

Q. Two crack -- one crack field below the long seam, one crack field above the long seam, and the crack-like feature below --

A. Yeah.

Q. -- the long seam? And this particular feature that we're seeing from sensor 2-19 in the skip and a half would be a crack-like feature in your opinion?

A. Meanwhile I would say it's rather the geometry of the long seam. So, here I have a drawing of a DSAW weld. And I have got two sensors from the clockwise side which have seen -- let's go and look at them. So, here, this sensor 1-8 and sensor 1-9 have seen some reflections from a toe crack. And this has -- these have seen it in front of the weld here at that position. The counterclockwise sensor saw the same -- something like here, this one here saw the same indication, but with kind of a high reflection. But this counterclockwise sensor cannot really see it because it propagates through the weld, and what he rather has seen is the weld cap itself than the cracking indication. And so, the two indications from the clockwise sensors are quite weak, below 1 millimeter, and this one here from the counterclockwise, it's just the reflection from the geometry. This is my opinion today.

Q. Okay. Well, can we go back there because that -- I don't see where -- so, are you saying that you believe this feature is at the seam? Or at the toe, at the toe of the seam?

A. At the toe, yes. So, this is really a lesson we have learned many, many times with toe cracks. We need to see a toe crack in front of the weld. So, the sensor is here, it's in front of the weld and sees an indication here. When the same indication is seen from the counterclockwise sensor behind the weld, it's not the toe crack, it's just a reflection from the weld cap. So, this is, I guess, verified by many digs where we have reported toe cracks here which turn out to be geometry because it was seen behind the weld, and only the ones which are in front of the weld were also verified in the field as such. So, this is really, let's see, something we are really sure about how to identify a toe crack. And this indication is detected by a sensor behind the weld.

Maybe the weld looks like this here. Because, as I said, I'm not sure -- or I don't know if a toe crack has been found here in the field, really. Maybe there's a little edge and this edge was detected by the clockwise sensors with a weak signal and the shape here, the -- the weld cap does have a strange -- or does have a shape which is reflected with high reflections from the counterclockwise, but the counterclockwise cannot see a crack-like position really.

Q. But what if that feature is an inch off the long seam?

A. An inch off the long seam, then I would see that not that close to the seam weld reflection, so --

MR. CHHATRE: What is the distance -- this is Ravi. What is the distance between that feature and the seam weld?

MS. SENF: Yeah. So, here -- let's see where we are. Oh, where's my -- oops -- okay, there is no window. Let's go back. So, my indication here is at 95.7 degree. So, I can see it here, 95.7 degree. And now I go to the 3D scan, 95.7 is over here. No, this is --

MR. FOREMAN: Right on the weld?

MS. SENF: Right at the weld.

MR. CHHATRE: So, the distance between those two indications really is not even a millimeter? On that right-hand side screen, the weld seam and the indication, how far apart they are? Center of the weld seam, rather. Center of the weld seam and --

MS. SENF: This is part of the weld seam, so --

MR. CHHATRE: Oh, this will be part of the weld seam? This looks like -- okay. That's fine. Okay.

MS. SENF: This is part of the weld seam, yeah. And when I go to the next reflection, then these are all the seam weld reflections and they are at 96, 96.4, 96. So, these are the weld reflection and this is just another weld reflection in the one-and-a-half skip and half skip.

MR. PIERZINA: Okay. Now, I guess, and maybe I misunderstood. I thought when we were going through that, that we were saying that that was the failure feature at the skip and a half and it looked like a crack-like feature?

MR. NICHOLSON: Yes. I said I thought it looked like a crack-like in that part.

MR. CHHATRE: That's what I thought.

MS. SENF: It is classified as a crack-like and this indication is the reason for the classification, most probably.

BY MR. NICHOLSON:

Q. But now, you almost --

A. For the analyst.

Q. -- talked yourself out of it being a true crack-like feature saying it was being -- it was just the geometry of the weld cap.

A. So we get some weak reflections from a crack here. Now, this one --

Q. Um-hum.

A. -- and this one.

Q. Right.

A. Below 1 millimeter for sure, below half a millimeter for sure. And we get at the same position this reflection here. When it comes from the clockwise, it's a crack. When it comes from the counterclockwise, when it's located here, that position. So, we have three different indications from that location here. The clockwise see a weak crack, but the counterclockwise doesn't see a weak crack; the counterclockwise can only see the geometry of the weld.

Q. Right. Okay.

MR. CHHATRE: So -- this is Ravi. How would you classify it now? Would that be a crack-like feature or will that be --

MS. SENF: I wouldn't -- I would disregard this as a long seam reflection. Yeah.

MR. FOREMAN: Right.

MS. SENF: I guess this is what I mentioned at the beginning, so -- so this is the reason for the classification, but I'm meanwhile sure that it's not really a crack-like --

BY MR. NICHOLSON:

Q. Nowadays you would write it off?

A. -- indication. Yeah. There are some weak reflections, but --

Q. So then you're just left with the two crack fields at that point?

A. Yeah. Right.

Q. Can we go back to the -- what we were just talking about, that crack-like picture? I just had an overall question. The one sensor -- that one right there. If you didn't have the green and yellow, if you had a red there, no green and yellow, red, red, no green and yellow, what would you call that? I mean, they're all in that one-and-a-half skip, but they're -- they would be broken. Would that be a crack field or -- if you didn't have these, you know what I mean, none of these shallow indicators, just the reds?

A. Yeah. So --

Q. So they're spaced but they're --

A. Yeah. And that will make it difficult for me because the analyst needs a context to discriminate at the long seam between a crack and the long seam reflection.

Q. Um-hum. Oh, okay.

A. And not having the context, yeah, I would rather say --

Q. Well, even if it weren't on the long seam, what would you -- what would that be?

A. Yeah.

Q. Forget it. Say we're in the base metal and you had an indication where it's a red?

A. Crack-like.

Q. Crack-like? Did you say crack-like?

A. Crack-like. Because -- no, this is an individual indication. We don't have multiple reflectors.

Q. Okay.

A. Yeah.

Q. So, they'd be individual crack-likes?

A. Um-hum.

Q. Okay.

MR. FOREMAN: Can I just make one interjection here? Because I know where Brian's going and we're going down a blind alley and I know why. So, the first feature we recorded, right, which was 51 inches and whatever, incorporates SCC toe crack, SCC. Looking at the forensics, now I have the forensics, the failure looks like here. And it incorporates -- the crack face, that's been -- incorporates this box, which actually I don't need to look at, and this one. And this part is still intact. That doesn't hasn't actually ruptured at all. The rupture is on this side of the weld. The weld's here. The rupture on one side and it incorporates these two defects.

MR. NICHOLSON: That's true.

MR. FOREMAN: And we're looking at this and it didn't fail. And I believe it's -- when forensics look at it, hopefully, will find a toe crack here and you'll find an SCC on the other side of the weld that didn't actually rupture.

MS. SENF: Yeah, I would assume that they see a toe crack or at least a sharp edge, but they wouldn't see something which would correspond to a depth of 1 to 2 millimeters.

MR. KILLORAN: May I, just as a process question, I don't know how long you guys were planning on going, but --

MR. NICHOLSON: Why don't we go off the record here. Why don't we take a break?

(Off the record.)

CERTIFICATE

This is to certify that the attached proceeding before the

NATIONAL TRANSPORTATION SAFETY BOARD

IN THE MATTER OF: ENBRIDGE - LINE 6B RUPTURE IN MARSHALL, MICHIGAN
Interview of Petra Senf

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was held according to the record, and that this is the original, complete, true and accurate transcript which has been compared to the recording.

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Cheryl Farner Donovan
Transcriber (Parts 1 and 2)

____
Kay Maurer
Transcriber (Part 3)