

DAY 10

NOVEMBER 22, 1995

**WESTRAY MINE**

**PUBLIC INQUIRY**

HEARD BEFORE: The Honourable Justice K. Peter Richard,  
Commissioner

PLACE: Stellarton, Nova Scotia

COUNSEL:

**Solicitor for the Commission:** Mr. J. Merrick, Q.C., and  
Ms. Ena MacDonald, document coordinator

**Solicitors for the Department of Justice Canada:** Mr.  
John Ashley and Ms. Lynn Gillis

**Solicitors for the Department of Justice Nova Scotia:**  
Messrs. R. Endres, Q.C., J. Traves, and Wm. Wilson, Q.C.

**Solicitor for the United Steelworkers of America and the  
Nova Scotia Federation of Labour:** Mr. David Roberts

**Solicitor for the Westray Families Group:** Mr. B. Hebert

**Representing the Town of Stellarton:** Mr. Clarence  
Porter, Mayor and Mr. Art Fitt and Mr. John Murphy, Town  
Councillors

**Representing the Canadian Union of Public Employees:** Mr.  
Robert Wells

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1 November 22, 1995 - 9:31 a.m.

2 COMMISSIONER Good Morning.

3 ALL Good Morning.

4 COMMISSIONER Dr. McPherson, if I might before I pass  
5 you over to Mr. Merrick, maybe you would help me with  
6 something.

7 **DR. MALCOLM J. MCPHERSON**, previously sworn, testified as  
8 follows:

9 EXAMINATION BY COMMISSIONER

10 Q. My understanding of your evidence yesterday with  
11 respect to the picks cutting into the coal face, the  
12 picks on the continuous miner cutting into the coal face  
13 was that the water from the continuous miner flooding out  
14 would only be effective if it was directed toward the  
15 back of the picks. Is that -- Have I got that part of it  
16 correct?

17 A. It would only be effective, Mr. Commissioner, with  
18 respect to the suppression of that incandescent streak,  
19 as distinct from being effective for the primary purpose  
20 and that is, dust suppression.

21 Q. So it would still suppress the dust?

22 A. It would still suppress the dust to an extent.

23 Q. But to an incandescent streak, it wouldn't be  
24 effective.

25 A. To an extent. The incandescent streak is obviously

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1 formed at the back of the pick, at the trailing edge of  
2 the pick, and if water is to be used to suppress that  
3 incandescent streak, then it should be directed in that  
4 same location at the back of the pick.

5 Q. The incandescent streak forms at the back of the  
6 pick?

7 A. Yes.

8 Q. Oh.

9 A. As the pick is moving through the coal, the streak  
10 is behind it.

11 COMMISSIONER Oh, I see, okay. Well, that makes sense  
12 then. Okay, thanks very much.

13 EXAMINATION BY MR. MERRICK

14 MR. MERRICK I take it, Doctor, just on that point that  
15 you don't have any evidence yourself as to where these  
16 sprays may have been directed on the picks on this  
17 particular machine that was in that heading?

18 A. No, I do not.

19 Q. All right. Just a couple of things I wanted to  
20 finish off with you this morning. When you were  
21 describing yesterday your opinion as to how the explosion  
22 initiated and then propagated through the mine, you  
23 talked about there being ignition of perhaps a layer in  
24 that heading. Let me get my map out. This would be the  
25 Southwest 2-1 Road. What effect or what extent or what

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1 kind of a factor might it have been in the mechanism of  
2 the explosion as you have described for the roof of that  
3 particular heading, the heading is on strike, the roof of  
4 that particular heading to have been sloped, as we see in  
5 the photograph on the wall. David, what's the photograph  
6 number that we're using?

7 MR. ROBERTS 25.

8 MR. MERRICK Photograph 25, which is, in fact, a  
9 photograph looking into the heading at the back of the  
10 miner with a section of vent tubing still coming along.

11 A. Yes.

12 Q. To what extent might that have been a partial factor  
13 in the mechanism?

14 A. As we indicated yesterday, because methane is  
15 lighter than air, it will migrate to the highest point  
16 that it can in the workings. Therefore, in that  
17 situation that we're looking at on the photograph, the  
18 methane layering would commence at the upper left-hand  
19 side of that roadway because it is the highest point, and  
20 would accumulate from that upper left-hand corner. As  
21 the methane layer thickened, it would thicken from that  
22 point downwards.

23 Q. What are your comments on where we see the vent  
24 tubing in this particular photograph, that being on the  
25 low side of the roof?

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1 A. It would have been preferable to put the vent tube  
2 on the left side; that is, the upper left-hand corner,  
3 because of the reason I mentioned. That is where the  
4 methane will begin to accumulate first.

5 Q. Now in that photograph we see that the vent tubing  
6 coming back from the -- up in the vicinity of the  
7 continuous miner is still intact. I'm going to show you  
8 another photograph, again taken by the RCMP during their  
9 entry into the mine. This is Police Photograph 234,  
10 which is taken just a little further back than the  
11 photograph on the wall that we were looking at just a few  
12 minutes ago. You'll see in the photograph I've just  
13 shown you that same piece of vent tubing, but also now in  
14 the foreground of the picture, there appears to be  
15 remains of the next section of the vent tubing as you  
16 come out of the heading. Is that what we see there?

17 A. Yes.

18 Q. In fact, describe for me what we see in that  
19 additional section of tubing?

20 A. The forward section of tubing appears to be intact;  
21 that is, unburned, and the section of tubing on the  
22 outbye end as shown on this photograph is burned.

23 Q. How is that consistent with the mechanism of the  
24 propagation of the flame and the methane ignition that  
25 you were describing yesterday?

DR. MCPHERSON, EXAM. BY MR. MERRICK

1 A. If I may use the board again, sir?

2 Q. Please.

3 A. The photographs we've been looking at have been  
4 looking towards the face as if one were standing in the  
5 entry looking towards the face and we see --

6 Q. You're now drawing on Chart No. 5.

7 A. We see this kind of pattern with the sloping roof  
8 and, in answer to your previous questions, I indicated  
9 the methane layering would start at this point and  
10 thicken downwards as the gas accumulated. Now if we  
11 imagine ourselves going over the top of this entry and  
12 looking down on it in a plan view, we'll draw the vent  
13 ducting as it was on the right-hand side. Remember that  
14 this side of the roof is higher than the right-hand side.  
15 In this situation, it is very possible that methane  
16 layering caused by streaming up the sides, up the rib  
17 sides and the standing face -- it was actually like this,  
18 the machine was in here -- accumulating on the left-hand  
19 side, would accumulate in this fashion.

20 Q. And you're drawn a dotted line on your chart, or a  
21 broken line.

22 A. Indicating the possible lateral extent, let me use a  
23 different colour, of the methane layer. So the methane  
24 in this scenario would be at roof level up here but  
25 spreading across the entry as we come outwards. Now

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1 recalling the sequence of events I described yesterday,  
2 flaming along that interface would cause the flames to  
3 propagate along that interface, along here, along this  
4 interface over that expanding area. This is one  
5 explanation why the tubing inbye was unburned but outbye  
6 was burned. And it is --

7 Q. Can I -- Go ahead.

8 A. I was just about to add, Mr. Merrick, that this is  
9 in line with the scenario we looked at yesterday of the  
10 propagation of flames along the methane layer interface.

11 Q. And I would assume as well that under this scenario  
12 that the flames would be beginning -- The methane layer  
13 would be widening out as it came back out by the heading,  
14 but, once ignited, the flames would be not only spreading  
15 to the width of the heading in the manner you've  
16 described but would also probably be coming down into the  
17 roadway deeper and deeper.

18 A. Because of the thermal turbulence we again talked  
19 about yesterday.

20 Q. All right. Now there's just one other part of the  
21 evidence that I would like you to comment on in dealing  
22 with the mechanism of the explosion. We know that the  
23 automatic monitoring system that was being maintained by  
24 the mine was providing readings from the four sensor  
25 locations immediately prior to the mine. In your report,

DR. MCPHERSON, EXAM. BY MR. MERRICK

1 you have summarized certain of those readings. Let me  
2 just find the page.

3 A. Page 17.

4 Q. Thank you. Now you had an opportunity, I take it,  
5 to look at the actual rolling logs of the printout of  
6 that machine?

7 A. Yes, sir.

8 Q. Exhibit 33 is the book in which the rolling logs are  
9 maintained. 33 may not have been reproduced because  
10 there's just a bulk of rolling logs that are not what you  
11 call the most interesting reading. I just want to  
12 identify that that is the source of the entries that you  
13 made in your report on page 17.

14 A. Yes, it appears to be so.

15 Q. Can you find the portion in the rolling logs that  
16 deals with the time frame that we're talking about; that  
17 is, the hour approximately just before the explosion?

18 A. Now these pages are not numbered but it is in  
19 section 3, tab 3. Actually one can use the date on the  
20 left-hand side of the page. And if you flick through the  
21 pages behind tab 3 until we get to the end of 8th May,  
22 beginning 9th May, this is the section we're looking at.

23 Q. Yes. Can you just read out for me -- Well, I guess  
24 there's not much point in reading it out for me because  
25 there are a number of these things. But let me just get

DR. MCPHERSON, EXAM. BY MR. MERRICK

1 your explanation. Starting on the 9th of May at the  
2 bottom of that page, or the page that starts at the  
3 bottom with 9 May.

4 A. Yes.

5 Q. There are a series of entries. Just explain to me  
6 the information we're looking at. The first column is  
7 the date, I assume. Or the second column. What's the  
8 first column?

9 A. The first column is partially obliterated, Mr.  
10 Merrick. It would appear to be code letters indicating  
11 what is being received at that moment in terms of alarm,  
12 healthy, out of range. It looks as if that left column  
13 is an acronym of the far right column.

14 Q. Okay, and then we have the date column.

15 A. Yes.

16 Q. Then we have the time column.

17 A. Yes.

18 Q. And it looks like this particular rolling log was  
19 printing off information from the sensors every few  
20 seconds but without any specific regularity to it.

21 A. May I add something to that, sir? There are blocks  
22 of data where information is being printed out every few  
23 seconds. There are also areas, and if you look at the  
24 bottom fifth or so of this page, you'll see one of these  
25 places where there is a sudden jump. We go from -- after

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1 having gone through a period for the major three-quarters  
2 of this page every few seconds, hour 23 26, and then a  
3 second, we suddenly jump to 2:38 a.m. We have two  
4 readings there within four seconds. And then we jump to  
5 4:24 a.m. This is an illustration, Mr. Commissioner, of  
6 the type of thing I was talking about yesterday with the  
7 intermittent nature of these signals, the recording of  
8 these signals.

9 COMMISSIONER Due to electrical interference, basically.

10 A. It could be due to a number of things. It could be  
11 damage to the line. It could, indeed, be electrical  
12 interference. It could be hardware or software problems  
13 with the computer in the control centre. They could have  
14 been switched off manually. There's a number of reasons,  
15 and it is impossible, at least for me looking at this, to  
16 say what the cause of those breaks were.

17 COMMISSIONER But you still maintain that if a reading  
18 comes through, it's going to be accurate.

19 A. If a reading comes through and is maintained for a  
20 period of time. But, again, seconds after switching on  
21 the system, you will get transients.

22 COMMISSIONER Get a fluctuation.

23 A. At that time, yes.

24 COMMISSIONER Okay.

25 MR. MERRICK All right. You've gone through and if we

DR. MCPHERSON, EXAM. BY MR. MERRICK

1 look at the May 9th entries, we'll see the various  
2 readings that were reported. I would just like your  
3 comment on the last two columns. The second last one  
4 purports to be where it appears as a reading of gas,  
5 methane or carbon monoxide. There are times when we just  
6 get the little starred line across. Are you able to make  
7 anything out of that?

8 A. No, sir.

9 Q. And the last column, which has a variety of comments  
10 on it, depending on the reading: out of range, healthy,  
11 in transmission, healthy, fault, CO detected. Are you  
12 able to make anything out of that?

13 A. Let me say about, as I said yesterday, I am not  
14 personally familiar with this system, hardware or  
15 software. Therefore, I am simply making a judgement on  
16 what we see before us, and I would assume that the word  
17 "Healthy" means just that, that the transducer is  
18 operating in a proper manner. "In transmission"  
19 presumably means just that, that signals are being  
20 received. Similarly for "on air." Looking down, a  
21 "fault," again presumably, this is simply my judgement,  
22 would mean that there is some difficulty with a  
23 transducer or the line. And where carbon monoxide is  
24 indicated to be above 12 parts per million, this would  
25 result in the "CO detected" message. And, similarly, for

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1 the methane. If this exceeds 1.25 percent, then  
2 presumably this is when we would get a "CH<sub>4</sub> detected"  
3 message.

4 Q. Now the fact that we see, as we go down through  
5 here, everything seems -- The first time we see in the  
6 right-hand column gas being detected is at 4:45:20 and we  
7 get two readings that come in at that point, both at  
8 4:45:20, one detecting carbon monoxide, one detecting  
9 methane.

10 A. Yes.

11 Q. Do you give much significance to those readings at  
12 that point in time?

13 A. No, sir.

14 Q. And is that for the reasons you give in your report?

15 A. Yes.

16 Q. That essentially these readings both -- both blips  
17 come through on both gases shortly after the system came  
18 back on line after having been off for awhile.

19 A. Exactly.

20 Q. Then we get "healthy healthy," and then it's "off  
21 air," then "in transmission on air." We get "fault" at  
22 4:45:31. That, I assume, does not necessarily indicate a  
23 gas reading. It indicates a fault.

24 A. Yes.

25 Q. And then we get 4:45 "methane detected."

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1 A. Yes.

2 Q. Do you give much significance to that?

3 A. Again, these could well have been transients on the  
4 line, Mr. Merrick.

5 Q. Yes, and then we continue to get readings until 5:18  
6 when they go off air.

7 A. Yes.

8 Q. And that would have been at approximately the time  
9 of the explosion?

10 A. Yes, sir.

11 Q. All right. So on your review of those readings, you  
12 haven't been able to derive much assistance in developing  
13 your opinion as to the mechanism of this explosion.

14 A. That is correct.

15 Q. Now just for record purposes, I just want to direct  
16 you to Exhibit 37-A at page 176.

17 A. Yes.

18 Q. You've had an opportunity to look at that in the  
19 course of your investigation?

20 A. Yes.

21 Q. That purports to be -- That's a letter from the, I  
22 guess the manufacturers of the system?

23 A. Yes.

24 Q. In which they purport to analyze data or readouts  
25 from the system.

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1 A. Yes.

2 Q. I notice in their letter that they talk about, in  
3 the second paragraph, or in the first paragraph, they  
4 say: "In reply to your request for analysis of the PC  
5 Master Station, archived data from Westray Mine..." And  
6 if we read their letter, they refer to the "archived  
7 data" and then further along, they refer to what the  
8 "rolling log" shows. I'm going to suggest to you that  
9 they were looking at two sets of data, one the one that  
10 we looked at a minute ago, "the rolling log"; and the  
11 other which was referred to as "archived data."

12 A. Yes.

13 Q. Looking at their analysis that they've given you in  
14 that letter, has that information been of much assistance  
15 to you in determining the mechanism of the explosion?

16 A. Well, they clearly have additional information with  
17 respect to the actual concentrations. There are numbers  
18 given of gas concentrations in this letter which are  
19 clearly not given on the tables that we have just been  
20 looking at. So they have that additional information.  
21 Presumably that is from the rolling log. Those actual  
22 values of gas concentration are, of course, more helpful  
23 than a simple "gas detected" message.

24 I'm sorry, could you repeat the point of your  
25 question?

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1 Q. Having now read that information and seeing the gas  
2 levels, is this information of much assistance to you in  
3 arriving at your opinion on the mechanism?

4 A. Okay. We do see that at about 4:20, 4:24 a.m.,  
5 there was an average reading of methane in the North  
6 intake monitoring station.

7 Q. Where are you looking at now in the letter?

8 A. Actually I was looking at my report, which is a  
9 synopsis of the material here.

10 Q. All right.

11 A. I'm looking at paragraph A, Sub 2 on the first page  
12 of the letter. At about 4:20 a.m., this channel became  
13 healthy, and I was about to point out where that channel  
14 was, where that transducer was. It is in the North  
15 workings at approximately this location.

16 Q. The very northern portion?

17 A. Yes, sir. Continuing reading from the letter:

18 "This channel became healthy and the methane level was an  
19 average of .16 percent. At 4:46 a.m., the methane alarm  
20 indicated, which must have been transient since the  
21 average level on the graph (they were looking at a graph)  
22 was not significantly affected; i.e., an average of .2  
23 percent." This is the same reading that presumably that  
24 gave rise to that short-lived methane alarm which I would  
25 assess would be caused by a transient having just

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1 switched on the system.

2 COMMISSIONER "Transient" means sort of --

3 A. Electrical transient.

4 COMMISSIONER Yeah, okay, so it would be equipment  
5 driven.

6 A. Yes, sir.

7 MR. MERRICK Okay?

8 A. So we have an increase of .04 percent; that is, .16  
9 percent to .2 percent with a rider that neither the  
10 manufacturers nor myself put much credence in the  
11 significance of these methane readings.

12 Q. All right.

13 A. Somewhat later, the No. 2 out station in the main  
14 return, that was a monitor. There were two monitors in  
15 the belt conveyor, one approximately in this position and  
16 one further out. One of these on the No. 2 conveyor  
17 showed an increase from what had been .3 percent to .35  
18 percent. That increase occurred at 4:40 a.m. and  
19 remained at point --

20 COMMISSIONER That's C-triple-i? Is that where we're  
21 looking at? Conveyor No. 2?

22 MR. MERRICK Page two of the letter.

23 A. Yes, sir. That is correct, Mr. Commissioner.

24 COMMISSIONER Okay, thank you.

25 DR. MCPHERSON So we're seeing an increase there from

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1 approximately .3 percent to .35 percent and then remained  
2 at that level until the explosion at 5:20, approximately.

3 MR. MERRICK All right.

4 COMMISSIONER And that's the return.

5 A. That is the main return.

6 COMMISSIONER The main return.

7 A. Yes.

8 MR. MERRICK And is that of much assistance to us, in  
9 your opinion?

10 A. In my report, Mr. Merrick, I have referred to these  
11 two small increases in indicated methane; that is, the  
12 1.6 moving up to .2 in the North, and the .3 moving up to  
13 .35 in the main return. These increases in monitored  
14 indication on a purely numerical basis imply increases of  
15 25 percent and 17 percent, respectively, for the two  
16 increases in methane concentration within that 40-minute  
17 period preceding the explosion. Now a 25 percent  
18 increase or a 17 percent increase may be interpreted as a  
19 significant increase in methane output from one or more  
20 sections of the mine.

21 My interpretation is somewhat more muted than that  
22 because an increase of .04 percent in the first instance  
23 and an increase in .05 percent in the second instance,  
24 again without being cognizant of the details of this  
25 particular hardware and software, these are very small

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1 changes in absolute values, and I question whether the  
2 system was capable of accurately reflecting 100th of one  
3 percent, the second decimal place that is in the  
4 concentration.

5 Q. You say, however, that it may be an indicator of a  
6 significant increase, and the reason for that, I take it,  
7 is that these stations, the two that you have identified  
8 for us, would be measuring the general body of air in the  
9 mine, and if in fact there was that increase, then it  
10 might well reflect that back in wherever that methane was  
11 coming from at that location, it was in somewhat higher  
12 concentrations?

13 A. It certainly would be, yes.

14 Q. And was being blended through the general body of  
15 air by the time it got to these measuring stations?

16 A. Yes.

17 Q. All right. Okay. A couple of -- well, let me ask  
18 you this, Doctor, you -- we've heard evidence about  
19 barriers, stone dust barriers, water barriers, that sort  
20 of thing.

21 A. Yes.

22 Q. You're familiar with that?

23 A. I am, yes.

24 Q. What is your opinion as to whether such barriers can  
25 be practically used in a room-and-pillar operation?

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1 A. They can be used in any mining layout. Their use  
2 becomes more expensive as a number of airways increases  
3 and in a fully developed, a large room-and-pillar  
4 operation, as occurs in many other coal mines, then the  
5 number of airways involved can and does become quite  
6 large. And at that stage the implementation of stone  
7 dust barriers in each and every one of those entries may  
8 become somewhat impracticable.

9 In Europe and the United Kingdom stone dust barriers  
10 are used widely in longwall systems because the number of  
11 entries is somewhat smaller. With respect to Westray, we  
12 did not have a large number of entries. This was a  
13 fairly small mine at the time of the explosion, and if we  
14 look at the layout here, we had simply two entries going  
15 into the Southwest. We only had two slopes. Into the  
16 North we only had three entries. So this is not a large  
17 number of entries. And it would have been practicable to  
18 employ stone dust barriers in that situation.

19 Q. Should they have been used in this mine?

20 A. Let me add one thing to my previous answer, Mr.  
21 Merrick. These are particularly applicable in conveyor  
22 roadways. So had the stone dust barriers been used at  
23 all, the preferred location and the if they had to be --  
24 if they were to be used in a limited fashion, then the  
25 preferred locations would have been in the belt entries,

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1 and that brings the number of required stone dust  
2 barriers down even more.

3 Q. Let me back up and ask a slightly different question  
4 in light of that. In your opinion, if stone dust  
5 barriers had been in place here in Westray, what impact  
6 might they have had on the events that occurred on May  
7 the 9th?

8 A. Stone dust barriers are intended to suppress the  
9 propagation of coal dust explosions and they have been so  
10 successfully employed in this way in other countries.  
11 There is no absolute guarantee that a stone dust barrier  
12 will in fact suppress an explosion. It obviously depends  
13 on the good maintenance of the stone dust barrier and  
14 also depends on the power -- the energy level of the  
15 shock wave and the following flame front that we talked  
16 about yesterday. They are not an absolute guarantee.  
17 They are certainly very helpful and have been successful  
18 in other locations to suppress gold dust explosions.

19 COMMISSIONER Can I just expand on that just a moment?  
20 Doctor, is there a critical distance between the face and  
21 the positioning of your dust barrier or water barrier,  
22 whichever?

23 A. Yes, sir. And this has been a matter of study by a  
24 number of investigators. The operation of the simplest  
25 type of stone dust barrier is the stone dust is piled on

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1 top of a series of timber boards, is the very simplest  
2 way, and those boards are supported at their ends on  
3 pivots in such a way that they are relatively easily  
4 dislodged. They are intended to be fairly easily  
5 dislodged. And the mechanism is that the shock wave we  
6 talked about yesterday coming along in front of the flame  
7 wave would dislodge those panels covered with stone dust  
8 and so -- there's a number of these boards, and so fill  
9 the entry with airborne stone dust such that the  
10 following flame front would not be able propagate through  
11 that zone of airborne limestone dust.

12 COMMISSIONER So your barriers would have to advance  
13 with your face?

14 A. I'm sorry, I didn't finish my answer.

15 COMMISSIONER Okay.

16 A. You are correct.

17 COMMISSIONER Yeah.

18 A. Thank you for prompting me. It therefore follows  
19 that there must be sufficient distance between the  
20 initiation point for the shock wave to have developed, so  
21 there is indeed a minimum distance that the stone dust  
22 barriers may be located from the face.

23 COMMISSIONER Do you have any preference between stone  
24 dust or water barriers?

25 A. Both are used. Do I have a preference?

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1 COMMISSIONER Oh, I mean are they of equal benefit or  
2 value?

3 A. Both have been used. Stone dust barriers have been  
4 used more widely and for a longer period of time. These  
5 were initially developed, Mr. Commissioner, in Poland  
6 before World War II. So these have been around for a  
7 long time, and several other countries are very well  
8 experienced in using them.

9 COMMISSIONER I see. Okay, thank you.

10 MR. MERRICK Just to finish that point though, you said  
11 that there must be a minimum distance between the face  
12 and the barriers. But as your face advances, must there  
13 also be a maximum limit such that the barriers must be  
14 advanced with the face?

15 A. Well, clearly, if they are too far outbye, then  
16 they're going to, even if they work, they're going to  
17 suppress the explosion at a sufficiently long distance  
18 that that explosion may have done its damage before it  
19 gets to them.

20 Q. But I take it, in your opinion, stone dust barriers  
21 could, with reasonable hope for effectiveness, been  
22 placed at the entries of the Southwest district?

23 A. Yes, sir. And particularly in the belt entries.

24 Q. And the reason for their usefulness in the belt  
25 entries is that that is often the path of an explosion

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1 because of the ready availability of fuel, that being  
2 coal dust, in those entries?

3 A. Exactly.

4 Q. And had stone dust barriers been placed in the  
5 entries to the Southwest district or indeed the mains  
6 going -- the entries going down into the North, the main  
7 entries, and if they had worked as they are supposed to  
8 work, then we could have expected or hoped to see the  
9 explosion snuffed out at that point?

10 A. Yes, sir.

11 Q. All right.

12 COMMISSIONER So just to carry that scenario a little  
13 bit further, if stone dust barriers had been placed in  
14 the Southwest district, then the probability of the North  
15 district having been -- having been also a victim of this  
16 explosion may have been considerably lowered?

17 A. Yes, sir.

18 COMMISSIONER Yeah. That's what I -- yeah. Okay, thank  
19 you.

20 MR. MERRICK All right. Now just a couple of -- one  
21 follow-up question from yesterday and your comments  
22 particularly at the end of your evidence, yesterday  
23 afternoon. And you may or may not be able to answer this  
24 question for me, but based on what you saw as to how  
25 Westray was performing the ventilation function, of how

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1 management at Westray was ventilating the mine, based on  
2 what you saw as to their attempts or lack of attempts  
3 certainly earlier in the mine life, to plan for  
4 ventilation in an appropriate way, and looking at the  
5 plans that they did do and the measurements that they  
6 were taking, what is your opinion as to whether, from the  
7 evidence you have seen, there was somewhere in Westray  
8 management a level of competence -- the required level of  
9 competence to do ventilation of this mine?

10 A. [No response].

11 Q. I'll put it to you this way while you're pondering  
12 your answer, on everything that I've seen as a lay  
13 person, it strikes me that there's nothing indicating  
14 that Westray management had available to them the  
15 required level of competence to properly ventilate that  
16 mine.

17 A. Let me answer you this way. There were obvious  
18 discrepancies, weaknesses, on matters pertaining to  
19 safety and health in this mine. And we talked about  
20 these in the past two days. There was the visually  
21 obvious problem of high combustible content in the dust.

22 There were the concentrations of methane in headings  
23 that were above those mandated in the Manager's Safe  
24 Working Procedures at which series ventilation should  
25 cease.

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1           There was intake air being taken past all old  
2 workings inadequately sealed off.

3           There was recirculation taking place in the North  
4 certainly.

5           Any or all of these matters should have given rise  
6 to concern in anyone's mind who had experience or was  
7 experienced in matters relating to ventilation in a coal  
8 mine.

9           My slight pause before I answered you was pondering  
10 the question did that lack of appropriate action result  
11 in -- did it result from a lack of knowledge, a lack of  
12 competence, or were these dangers that were recognized  
13 but nevertheless no appropriate action was taken. In  
14 other words, I don't know whether the lack of action was  
15 due to lack of competence or some other reason.

16 Q.    Or foolhardiness?

17 A.    [Nods yes].

18 Q.    You nod. That's a pretty -- I guess the word  
19 "scary" is a little too strong, but that's a very  
20 disturbing thought if mine management would have to be  
21 described in one of those two terms.

22 A.    Mr. Merrick, let me refer just to the coal dust  
23 problem and the lack of rock dust problem. That was so  
24 obviously a danger that I would imagine that even people  
25 with very little experience in coal mining would have

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1 recognized that danger.

2 Q. Well, the reason I had also asked the question is  
3 we've heard other evidence as well as far as ground  
4 control efforts and an apparent inability to come to  
5 grips with those, et cetera. All right, I take your  
6 answer.

7 One other question that I would be interested in,  
8 based on everything that I have heard from witnesses and  
9 people involved in the investigation of coal mine  
10 explosions, one of the distinct features of Westray that  
11 struck me as being unique was that in almost every other  
12 case that I've heard about, when an explosion has  
13 occurred, the operator has immediately not only initiated  
14 rescue efforts but also immediately initiated a full-  
15 scale investigation as to the cause, carrying out, if  
16 necessary, the stabilization work or the restoration work  
17 necessary to get back into the areas and has taken  
18 effective steps to at least complete the investigation  
19 and usually put the mine back in operation. Have you  
20 ever run into a situation before where, as a result of a  
21 mine disaster, once the rescue efforts are completed,  
22 nothing then takes place?

23 A. Not in my experience. It would be expected that the  
24 mine management and mine ownership would have a  
25 compelling interest to determine the cause of the

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1 explosion and to carry out their own internal  
2 investigation, yes.

3 Q. And knowing what we know of the events of May 9th  
4 and knowing what we know of the condition of the mine  
5 following that explosion, I take it that while it would  
6 have required a tremendous amount of effort, it certainly  
7 was possible to secure the Southwest district, indeed, if  
8 necessary, rehabilitate the North Mains. Was that a  
9 possibility or can you express an opinion on that?

10 A. The condition of the mine -- let me first say that  
11 I, of course, was not in the mine at that time before or  
12 afterwards, so I am responding to my reading of reports,  
13 reading of transcripts. And from that -- from those  
14 readings, the mine was -- oh, and from the photographs,  
15 we can see that the mine was obviously in a devastated  
16 condition.

17 Now rehabilitation of the mine would obviously have  
18 been a somewhat hazardous, timely, and expensive  
19 operation. Whether it could have been, should have been  
20 done, I am not sure I can answer that, Mr. Merrick. In  
21 some cases it is -- the mine is left in such a state that  
22 the less expensive option would be to seal it off and  
23 start again somewhere else.

24 Q. But would it be fair to make the general statement  
25 that if an entity takes on the responsibility of coal

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1 mining, as a general rule they also take on the  
2 responsibility in the event of a disaster to do their  
3 utmost to answer the questions raised by the disaster  
4 and, if possible, to commit to re-establishment of the  
5 mine?

6 A. Yes, sir.

7 Q. I'm not talking about the economics of coal mining  
8 here at this point; I'm just talking about the fact that,  
9 unlike any other investigation I've heard of, once the  
10 rescue effort was over, nothing much happened.

11 All right, let me bring you back to, I think, the  
12 last topic I want to address with you. In your report  
13 you make comments about recommended changes to the  
14 legislative requirements in this jurisdiction. Can you  
15 quickly take me through those?

16 A. Yes. These are referred on page 37, starting on  
17 page 37 of my report. And, Mr. Merrick, you are aware, I  
18 know, that there is more than one version of these  
19 regulations. The differences would seem to be a matter  
20 of the numbering of the chapters as opposed to substance,  
21 so the numbering system that I am using here may not tie  
22 up completely with the copies that other people have.

23 In my copy of the Nova Scotia Regulations which is  
24 entitled "Chapter 73, An Act Respecting the Regulation of  
25 Coal Mines," my comments, of course, are restricted to

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1 matters with respect to ventilation and not to other  
2 matters.

3 Q. Yes?

4 A. Section 71(7) in my version, this has a subheading  
5 of "Inadequate Current" and reads, "At the moment in  
6 every working place in a mine where the current of area  
7 is not sufficient to keep the place clear of inflammable  
8 or noxious gases, brattice or some other method approved  
9 by an inspector shall be used to conduct the air to the  
10 working face." My suggestion here, without going into  
11 fine detail, is that this be made a little more specific  
12 and, in particular, that a minimum velocity be specified  
13 rather than just saying "Where the current of air is not  
14 sufficient to keep the place clear, inflammable gases..."  
15 et cetera. Rather than just leaving it vaguely at that,  
16 specify a value of minimum air velocity. As in the case  
17 in the United States regulations where 60 feet per minute  
18 is specified. Perhaps a value in Nova Scotia of naught  
19 point four [0.4] meters per second may be appropriate.

20 COMMISSIONER Is that 60 feet per second generally or at  
21 the face?

22 A. 60 feet per minute in all places where people are  
23 required to work or travel.

24 COMMISSIONER Okay.

25 A. So that's a minimum, overall minimum --

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1 COMMISSIONER Okay. Thank you.

2 A. -- air velocity.

3 MR. MERRICK So you are recommending that in Nova  
4 Scotia there be a higher velocity, I assume, based on the  
5 safety factor and also to cover any additional gas make  
6 or problems?

7 A. I think we learn -- unfortunately, much mining  
8 legislation around the world has been amended and  
9 upgraded because of disasters like this. We should learn  
10 from them.

11 Had there been an air velocity of .4 meters of a  
12 second or greater in the headings, then the tendency to  
13 layering would have been considerably reduced.

14 Q. All right, thank you.

15 A. In my version of the Act, Section 71, Paragraph  
16 9(d), this is the section that refers to a mandated  
17 forcing system. Now we've spoken of the advantages of  
18 forcing systems in gassy headings, and it would indeed  
19 have been preferable for a forcing system to have been  
20 used in the headings at Westray because they were gassy  
21 headings.

22 Nevertheless, as we also indicated, there are  
23 circumstances in which exhausting system is preferred,  
24 particularly where the major problem is dust rather than  
25 gas.

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1           So my suggestion here is that both exhausting and  
2 forcing systems be permitted in appropriate  
3 circumstances.

4           This would seem to be something that is in  
5 opposition to a lesson learned at Westray where forcing  
6 systems would have been preferred. But, nevertheless,  
7 there are those circumstances of dusty but not gassy  
8 headings where an exhaust system is to be preferred and  
9 would improve matters with respect to worker health.

10          May I move on?

11       Q.    Yes, please.

12       A.    I would like to add one further recommendation while  
13 we're in Section 71 that is not in my report, Mr.  
14 Merrick. And I would like to refer to this verbally here  
15 and that is Section 71(11) under the subheading  
16 "Explosive Gas."

17       Q.    Yes?

18       A.    This states, "In mines giving off explosive gas, all  
19 stoppings between main intakes and return airways shall  
20 be of ample strength and built of masonry, concrete, or  
21 other substantial material." My recommendation is that  
22 this sentence be strengthened, that it should also  
23 include these provisions with respect to stoppings.  
24 First of all, that the stopping be constructed of  
25 nonflammable material; secondly, no materials shall be

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1 used in stoppings that emit toxic fumes when heated; and,  
2 thirdly, that no materials in stoppings or air crossings  
3 shall be used that have a melting point below some  
4 specified value.

5 Q. Why do you make that recommendation?

6 A. I made that recommendation, sir, because, again, of  
7 experience of previous investigations and disasters. I  
8 refer to the Wilberg fire in Utah, December, 1984, where  
9 aluminium was used in the construction of air crossings.  
10 That aluminium failed because of melting, aluminium  
11 overcasts, three of them, collapsed very rapidly after  
12 the start of the fire, allowed a direct short circuit  
13 between intake and return, and I believe 28 miners died  
14 in that fire.

15 Q. All right. Thank you.

16 A. Moving on to Section 71(14) and in some of your  
17 copies and indeed in my report here there is referred to  
18 as "72(14)" but it's under the subheading "Gas Testers."

19 Q. Yes.

20 A. There is a reference in this paragraph to "Marsh  
21 gas"

22 Q. Yes?

23 A. -- which would seem an absolutely antiquated term.

24 I would simply suggest that that be changed to

25 "flammable" or "inflammable gas," whichever is the proper

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1 word.

2 COMMISSIONER Is that not a term that's interchangeable  
3 with methane, you know, I suppose in archaic terms but --

4 A. It is indeed in antiquated terms. "Marsh gas," as  
5 I'm sure you're aware, is the gas that is sometimes found  
6 bubbling out of marshes, and it is a mixture of hydro  
7 carbons, a large -- hydro carbon gases, and it is often  
8 the case that methane is the predominant constituent.

9 COMMISSIONER Yeah, okay. Okay, thank you. Would you  
10 go further and in that subsection 14 on gas testers and  
11 have some comment to upgrade from locked flame safety  
12 lamps to methanometers?

13 A. Yes. This is a matter that certainly was in my mind  
14 in going through all of these regulations where flame  
15 safety lamps are referred to and in some paragraphs later  
16 on, it refers to "or alternative means" or words to that  
17 effect, methanometers.

18 Flame safety lamps have a long and honourable place  
19 in the history of mine ventilation from their invention  
20 about 1811. They're used for life and they've done a  
21 tremendous job. They have saved an uncountable number of  
22 lives. Their useful life is almost over. We now have  
23 much better equipment, electronic equipment, for  
24 measuring both flammable gas concentrations and also  
25 oxygen deficiency, which are the only two purposes that

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1 flame safety lamps have any more.

2 It has been suggested from time to time and rarely  
3 that damaged flame safety lamps could be dangerous in a  
4 mine. I think we shall see -- and some countries have  
5 abandoned them.

6 COMMISSIONER Or poorly trained users of them, I  
7 suppose, too?

8 A. Some countries have already abandoned them. I think  
9 we're seeing the last few years of useful life of flame  
10 safety lamps. For the time being I have no objection to  
11 them remaining in the Act as they are in the United  
12 States legislation at the present time.

13 COMMISSIONER As a backup though, aren't they?

14 A. As a backup.

15 COMMISSIONER Yeah.

16 A. Yes.

17 COMMISSIONER Just an anecdotal point on locked flame  
18 safety lamps, I read somewhere that the lower limit of  
19 methane permissibility in a mine was based upon -- was  
20 based only on the fact that that was the -- like, that  
21 1.25 was the lowest concentration of methane that could  
22 be detected by one of these lamps.

23 A. Yes.

24 COMMISSIONER Is that correct?

25 A. That is correct.

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1 COMMISSIONER Yeah, okay.

2 A. Section -- and then again, I'm going to change the  
3 numbering on -- I'm on the top of page 38, Mr. Merrick.

4 MR. MERRICK Of your report, yes.

5 A. Of my report. There's a reference there to 74(4).

6 Q. Yes.

7 A. Let's make that 72(4). This is under the general  
8 heading of withdrawal of workers and the subheading is  
9 "While gas being removed."

10 Q. Yes.

11 A. "When an accumulation of gas is being removed, the  
12 official in charge shall see that no person or persons or  
13 light of any description are allowed on the return side  
14 of the gas being removed unless at a sufficient distance  
15 away to allow a proper diffusion of the gas to a  
16 percentage lower than the withdrawal point to take place  
17 before it reaches them."

18 My suggestion here is two things. First of all,  
19 that the word "diffusion" be replaced by "dilution." The  
20 word "diffusion" has, clearly, since this Act was drawn  
21 up taken on a much more specific meaning. What is  
22 referred to here is dilution of the gas in the same sense  
23 that we've been using the word "dilution" in these  
24 hearings.

25 I also had to read this several times before I

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1 realized what was being meant by "the withdrawal point,"  
2 and it's referring to that concentration of the gas at  
3 which personnel must be withdrawn. So perhaps that could  
4 be made a little clearer.

5 Q. Okay.

6 A. Turning on now to Section 84, diesel locomotives,  
7 this section covers several pages, all concerned with  
8 diesel locomotives. Do you have that?

9 Q. Yes.

10 A. This is a general point here. I would suggest that  
11 this section should be made applicable to all types of  
12 diesel equipment and not simply to diesel locomotives.  
13 Again, since this Act was drawn up, the use of diesels  
14 has expanded tremendously beyond railed equipment and is  
15 now used dominantly in rubber-tired equipment. So there  
16 are parts of this section that may be looked at  
17 specifically with that in mind, as it should now be  
18 upgraded to refer to all types of diesel equipment and  
19 not just locomotives.

20 COMMISSIONER In fact, locomotives in new mines are  
21 rather an anachronism now, are they not, Doctor?

22 A. They are still used fairly widely in metal mining,  
23 Mr. Commissioner.

24 COMMISSIONER Oh, metal, oh, yes, okay.

25 A. Both diesel and electric locomotives.

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1 MR. MERRICK All right.

2 A. Again, before leaving matters pertaining to the  
3 condition of the air, I found it a little surprising that  
4 there appear to be no threshold limit values given in the  
5 Act for gases other than methane. The two threshold  
6 limits given for methane, as we have mentioned before,  
7 are 1.25 percent for isolation of electrical power and  
8 two and a half percent for withdrawal of workers. Apart  
9 from that, one gas, and there are no threshold limit  
10 values specified for other gases, and I would recommend  
11 that threshold limit values be chosen in Nova Scotia and  
12 be specified in the Act.

13 Q. And this would be for more than just methane or even  
14 more than just carbon monoxide?

15 A. I would suggest at least oxygen, carbon dioxide and  
16 carbon monoxide, in addition to methane. There are  
17 fairly lengthy lists of other gases that now do appear in  
18 the underground because of the use of diesels. There's a  
19 whole host of gases emitted in the exhaust of diesels.  
20 And also the fact of the matter is that nowadays we are  
21 taking more and more different types of materials  
22 underground. Lubricating oils, different kinds of fuels,  
23 plastics, a whole range of plastics, and these can and do  
24 emit varieties of gases, mixtures of gases. Therefore,  
25 it would seem to be appropriate that those gases be given

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1 threshold limit values.

2 The way this is handled in the United States is the  
3 threshold limit values for the gases I've specified by  
4 name, carbon dioxide, carbon monoxide, oxygen and  
5 methane, those threshold limit values are specified as  
6 numbers in CFR 30. The threshold limit values for the  
7 range of other gases are specified by reference to those  
8 guidelines given by the American Conference of  
9 Governmental Hygienists.

10 Q. And in setting these limits, I take it from your  
11 answer that it's implicit that the criteria be not only  
12 things like prevention of explosions but basically the  
13 health of the worker.

14 A. Yes, sir.

15 Q. All right. Explain to me what you mean by time  
16 weighted average threshold limit values?

17 A. Within industrial hygiene, there are three levels of  
18 threshold limit values. The term "threshold limit"  
19 simply indicates maximum or, in some cases, minimum  
20 values of certain gases or dusts that should be  
21 maintained within the industrial atmosphere. The time  
22 weighted average, TWA, threshold limit value, refers to a  
23 limiting concentration that is deemed under present  
24 medical knowledge to be safe for workers over an eight-  
25 hour shift and a 40-hour week. So that provided the

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1 concentrations are maintained under -- the average  
2 concentrations remain under this time weighted average  
3 threshold limit value, then people can work continuously  
4 through their eight hours and up to a maximum of 40 hours  
5 per week. The short term -- That was the answer to your  
6 question.

7 Do you wish me to go on and define the others?

8 Q. No, I think I have it. Then in setting the  
9 specified values, you do it with reference to the fact  
10 that an employee is going to be exposed to that substance  
11 for a specific period of time.

12 A. Yes.

13 Q. All right, I've got it. All right, thank you. What  
14 about your recommendations on the sections dealing with  
15 dust?

16 A. The section dealing on dust, we did, in fact, look  
17 at, Mr. Merrick, yesterday and that section, which is  
18 Section 70 in my copy, mandates on matters relating to  
19 dust explosions and those sections clearly and obviously  
20 should be maintained.

21 My recommendation here is that I found surprising  
22 that there is no reference to health matters relating to  
23 dust; that is, the long term health of the mine  
24 personnel. There is no reference to threshold limit  
25 values to minimize the probability of coal workers

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1 pneumoconiosis developing, commonly known as "black lung  
2 disease."

3 My recommendations on this matter are given on the  
4 bottom of page 38 of my report and that is that threshold  
5 limit values for airborne respirable dust -- respirable  
6 dust refers to particle diameters of less than five  
7 microns, five-millionths of a meter. I suggest that TLV  
8 threshold limit values for airborne respirable dust be  
9 specified in terms of mass concentration, milligrams of  
10 respirable dust per cubic meter of air. We know now it's  
11 quite important that this be made with reference to the  
12 quartz content of that dust.

13 Number two, that the types of dust-measuring  
14 equipment and the ways in which that equipment should be  
15 used should be specified. The reason behind this  
16 particular recommendation is that there are on the market  
17 these days quite a variety of instruments for measuring  
18 respirable dust concentration in the air, and these do  
19 give differing results from instrument to instrument,  
20 different types of instrument; that is, and also with  
21 respect to the timing of samples and the rate at which  
22 the dust-laden air is drawn through the instrument. For  
23 this reason, it is necessary for any given legislation to  
24 specify or refer to an instrument that they have chosen  
25 to be standard. Then all other instruments can be

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1 calibrated to that standard. And different countries use  
2 different instruments as their standard.

3 Number three, the times and places at which samples  
4 of airborne respirable dust should be specified.  
5 Clearly, unless this is done, when a sampling is taken on  
6 a Sunday afternoon when nothing is happening in the mine,  
7 then you're going to get lower dust concentrations than  
8 if the mine is in full operation. So specifications on  
9 time and place.

10 Lastly, I would deem it appropriate for the Act to  
11 include specifications of the procedures through which  
12 the samples are taken and analyzed for these matters  
13 referring to coal workers' health.

14 This has been a matter of controversy, as you  
15 probably know, in the United States in the last few  
16 years, arguments about how the samples have been  
17 analyzed.

18 COMMISSIONER And some "cooking of the books" in several  
19 instances with respect to dust sampling?

20 A. The charge was made, Mr. Commissioner, that dust  
21 samples had been interfered with between the time of  
22 sampling and the time of analysis. That was the charge.  
23 It was subsequently refuted.

24 MR. MERRICK And those are your recommendations to us  
25 on changes to our regulatory regime?

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1 A. Yes, sir.

2 COMMISSIONER May I ask just one broad question here,  
3 and I don't need a detailed answer, but in a regulatory  
4 scheme, I use two phrases. One is sort of an intrusive  
5 regulatory scheme, and I use an example of that like the  
6 MSHA regulations under CFR 30. Or a more discretionary  
7 regulatory regime such as perhaps the old South African  
8 system of regulation. Which, in broad terms, is  
9 preferable, in your view?

10 A. I think it probably has to be a combination of the  
11 two, Mr. Commissioner. With respect to numerical values  
12 such as the threshold limit values we've just been  
13 talking about, I think those should, indeed, be specified  
14 by value as an insurance that if they are complied with,  
15 that the matters of safety and health of the mine workers  
16 be properly addressed in the law.

17 On the other hand, there are examples, and I've  
18 given one here, what might be regarded as a relaxation of  
19 the law to allow both exhausting and forcing auxiliary  
20 systems, allowing that discretion to be given to the mine  
21 operators to choose that system that is most appropriate  
22 for the particular circumstances, and then have the  
23 enforcement agency or agencies insure that, indeed, the  
24 safety and health of the workers are properly addressed  
25 in the application of the mine choice.

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1 COMMISSIONER Could that be done under the sort of  
2 special permit regime that's used at MSHA, or it should  
3 be something more than that?

4 A. It could, indeed, be done through a special  
5 permission, yes.

6 COMMISSIONER Okay, thank you.

7 A. As recirculation is permitted under special  
8 exemption in a number of countries.

9 COMMISSIONER Okay, thank you.

10 MR. MERRICK Those are all the questions I have for  
11 you, Dr. McPherson. Thank you.

12 COMMISSIONER Thank you, Doctor. In order to  
13 regularize, I suppose, the cross, perhaps we should have  
14 our break now. So we'll take 15 minutes now and then the  
15 ball will be in your court, sir. For a few minutes,  
16 anyway.

17 INQUIRY RECESSED (TIME: 10:45 A.M.)

18 INQUIRY RESUMED (TIME: 11 A.M.)

19 COMMISSIONER Mr. Roberts?

20 MR. ROBERTS Thank you, Mr. Commissioner.

21 EXAMINATION BY MR. ROBERTS

22 MR. ROBERTS Dr. McPherson, I want to go back to where  
23 you ended off your testimony yesterday afternoon, or at  
24 least towards the end of your testimony where you talked  
25 about the failure of the regulators of this mine to

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1 respond to what you described as a series of red flags  
2 that were apparent both in the planning and operational  
3 stages of the mine. I want to begin with what I heard in  
4 your evidence as being one of the first red flags and  
5 that would be the manager's auxiliary ventilation plan  
6 which, if you wish to refer to it, is Exhibit 37-A at  
7 page 118. Now you've testified that you, in reviewing  
8 that plan yourself, you found it to be completely  
9 inadequate to deal with the question of gas layering.

10 COMMISSIONER What were the numbers there again?

11 MR. ROBERTS 37-A, page 118. You recall, Dr.  
12 McPherson, describing that as "completely inadequate," I  
13 think was the phrase you used.

14 A. Yes.

15 Q. I take it that that fact that it was completely  
16 inadequate to deal with the question of layering should  
17 have been obvious to anyone who would have been  
18 knowledgeable of issues of ventilation and who took the  
19 trouble to do the calculations that you did yourself?

20 A. I would have thought so, sir, yes.

21 Q. And we know from the evidence that this plan was  
22 submitted to the Department of Labour on the 15th of  
23 December, 1988, and that's at page 107 of that volume.

24 A. Yes.

25 Q. Now would you have expected some response from the

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1 Department of Labour based upon the obvious inadequacies  
2 of this plan?

3 A. Had they calculated the velocities that correspond  
4 to the 2.5 cubic meters per second that are specified on  
5 page 118, then it should have been clear that those  
6 velocities were, indeed, I repeat the phrase, "completely  
7 inadequate" to prevent methane layering.

8 Q. And it's fair then to describe that as one of the  
9 red flags that you have identified?

10 A. Yes, sir.

11 Q. From your review of the record, are you aware of any  
12 response from the Department of Labour to this  
13 ventilation -- I guess you don't like to call it a plan,  
14 but a summary, perhaps, indicating a concern about the  
15 adequacy of the velocity of air in the layering question?

16 A. I personally am not aware of any such response.

17 Q. You testified as well that the inadequacy of this  
18 ventilation at the face was reported in anecdotal  
19 evidence of the miners who talked about stagnant air at  
20 the face. Do you recall that?

21 A. Yes.

22 Q. I'm wondering, wouldn't this issue of stagnant air  
23 at the face be obvious to anyone who was present at the  
24 face, and again, who was knowledgeable about coal mining?

25 A. I would have thought so, sir, yes.

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1 Q. And you would include in that a mining inspector?

2 A. Anyone who is knowledgeable about ventilation  
3 matters or mining matters.

4 Q. @Have you found any evidence in your review of the  
5 documentary record of the Inquiry to indicate that there  
6 was any concern expressed by the mining inspectors about  
7 stagnant air or lack of air movement at the face of this  
8 mine?

9 A. I have seen no such concern. #

10 Q. Now another element in the approval process for the  
11 Westray Mine was a mining permit which was issued in  
12 August of 1991. Now there's perhaps an issue between the  
13 parties as to just what the legislative regime was that  
14 was appropriate. But I want you to assume for a minute  
15 that it should have been issued under the current  
16 legislation, which is now in effect, the Mineral  
17 Resources Act, and, in particular, Section 91 of the Act,  
18 which, if you wish, Section 91(1), if you wish to refer  
19 it, but I'm going to quote to you the relevant element of  
20 it and that is that "in order for a mining permit to be  
21 issued, the Minister of Resources must satisfy him or  
22 herself that the project will result in safe and  
23 efficient mining." That's the statutory requirement.

24 From the point of view of ventilation, have you seen  
25 anything in the record that would tell you that the

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1 Minister had any basis at all in which to conclude that  
2 this project would be safe?

3 A. @From the examples you've already given, Mr.  
4 Roberts, it would appear that had those calculations been  
5 done, as I have done, that the velocities in the headings  
6 should have been shown to be inadequate, number one.  
7 And, number two, as we've talked in the past two days,  
8 ventilation plans, such as they were, were not only fully  
9 quantified, fully analyzed by modern methods for the  
10 initial construction of the mine but did not seem to  
11 exist for the long term life of the mine.

12 Q. And should these facts have been obvious to anyone  
13 who was trying to assess the safety of these ventilation  
14 plans?

15 A. I would deem it to be so.

16 Q. Another red flag, I guess, that was raised early on  
17 in this process was the issue of exhausting versus  
18 forcing auxiliary ventilation and your evidence, I think,  
19 is that the use of the auxiliary ventilation in the  
20 exhausting mode militated against the effective  
21 ventilation of the face. Is that fair?

22 A. Yes, and more specifically, mitigated against the  
23 efficient dilution of methane that was produced at the  
24 face.

25 Q. And thereby allowed the layering to take place that

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1 was so critical in the final explosion of this mine?

2 A. Yes, sir.

3 Q. This is not one of those circumstances, I take it,  
4 that you spoke of this morning where exhausting  
5 ventilation might be preferred?

6 A. It is not.

7 Q. And you've also said many times that the law of Nova  
8 Scotia as it stands today, in fact, does require that  
9 auxiliary ventilation be forcing and not exhausting.

10 A. Yes.

11 Q. And you referred us this morning, I think, to  
12 Section 71(9)(d) which talks about a placement of the  
13 ventilation fan which could only be in a forcing mode.

14 A. Yes.

15 Q. And the second subsection of that clause talks about  
16 air ducts and tubing that conducts air to the place being  
17 ventilated. That also implies that it would be forcing  
18 ventilation?

19 A. Yes.

20 Q. So taken together then, you have no doubt in your  
21 mind reading that Act that this Act requires forcing  
22 auxiliary ventilation.

23 A. That is what it says.

24 Q. Okay. Now Exhibit 75, which was the plan that was  
25 not, I think, hadn't been distributed to the parties yet

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1 but you reviewed yesterday. That was a plan submitted to  
2 the Department of Labour in October of 1991? Do you  
3 recall that?

4 A. This is the blueprint?

5 Q. That's right.

6 A. Yes.

7 Q. That plan, as you testified, was submitted with a  
8 covering letter that's in your exhibit book in October of  
9 1991.

10 A. Yes.

11 Q. And it clearly shows that the auxiliary ventilation  
12 is to be exhausting. Do you recall that?

13 A. Yes, I do.

14 Q. And anyone looking at that plan would have no doubt  
15 that this was exhausting auxiliary ventilation.

16 A. That is correct.

17 Q. And anyone in the mine itself who looks at a fan,  
18 these fans that we've been describing for the last two  
19 days, would have no doubt that they were working in an  
20 exhausting mode. It's an obvious feature of the  
21 operation of the fan.

22 A. Yes.

23 Q. So there can be no doubt then that the inspectors  
24 who we know were in Westray frequently in the life of the  
25 mine would have known that these fans were exhausting and

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1 not forcing.

2 A. I agree.

3 Q. And you've seen no evidence in the records that any  
4 permission was ever granted to Westray for the auxiliary  
5 fans to be used in an exhausting mode?

6 A. I recall permission being given to use auxiliary  
7 fans, a permission that is required by the law. I do not  
8 recall there being specific permission for them to be  
9 used in an exhausting mode.

10 Q. That's right. If I recall, the document you're  
11 referring to, it allowed the use of specific fans without  
12 in any way specifying how they were to be used.

13 A. Right.

14 Q. So from the perspective of exhausting versus  
15 forcing, there doesn't appear to have been any permission  
16 granted by the Department of Labour to use the fans in an  
17 exhausting mode?

18 A. That is so.

19 Q. Now I want to be fair to the inspectorate and not  
20 imply that there was never any sensitivity to some  
21 ventilation issues, and I want to turn to your book, page  
22 37-A, page 27. Do you have that?

23 A. Page 27?

24 Q. Yes.

25 A. Yes.

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1 Q. That's a letter that's signed by Mr. Phillips to the  
2 Director of Mine Safety. Mr. Phillips is sending along a  
3 ventilation survey for the date June 19. I believe it's  
4 correctly 1991 and not 1990, as stated on the survey,  
5 1991 being the date of the covering letter.

6 A. Yes.

7 Q. And Mr. White, the Director of Mine Safety, writes,  
8 apparently, on the front of the letter to someone, a  
9 colleague of his: "For your review. The velocities  
10 beyond last open crosscut are low. Minimum velocity to  
11 prevent methane layering is, I believe, around 150 feet  
12 per minute. Please check." So you'd agree --

13 A. I see that.

14 Q. -- that at this early stage in the life of the mine,  
15 there seemed to be some awareness that perhaps the  
16 velocities were not sufficient to deal with the layering  
17 of gas?

18 A. This comment would indicate that, yes.

19 Q. To your knowledge, was any action ever taken by the  
20 Department of Labour to follow up on this and to  
21 determine whether, in fact, as the mine proceeded -- We  
22 must remember that in July, June, and July of 1991, the  
23 mine was still in the very early development stages.

24 A. Yes.

25 Q. Have you seen any evidence in the file that would

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1 indicate that the Department maintained any vigilant  
2 observations of the development of this mine to see, in  
3 fact, if layering was going to be dealt with  
4 appropriately by the ventilation system?

5 A. I do not recall any such evidence, sir.

6 Q. Do you recall any reference to gas layering in any  
7 correspondence involving the Department of Labour other  
8 than this note here?

9 A. I do not recall it, no.

10 Q. Just for my own information, is Mr. White's figure  
11 of 150 feet per minute, is that, in fact, as he expresses  
12 it, the minimum velocity to prevent methane layering?

13 A. The minimum velocity specified in U.S. mining law is  
14 60 feet per minute. So Mr. White's figure is more than  
15 twice that. So this would be a very safe figure, I would  
16 suggest.

17 Q. And if, in fact, the Department had enforced that  
18 figure in the development of the mine, the layering issue  
19 that we had talked about might not have arisen.

20 A. That is correct.

21 Q. Now --

22 A. May I add one rider to that? We are talking about  
23 the headings in this context and not methane emissions  
24 from old workings.

25 Q. That's correct, and thank you very much because I

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1 want to move on to the next issue and that is the  
2 layering that developed from the old workings. We know,  
3 first of all, from other evidence that the Southwest 1  
4 section was abandoned completely or finally at around the  
5 28th of March, and we know that the stoppings that we  
6 have discussed were erected around or about the 13th of  
7 April, which would leave a little over two weeks for the  
8 ventilation to go through this abandoned section, and  
9 then they put up plywood stoppings. Now it was a little  
10 unclear to me from your evidence yesterday as to what was  
11 the more dangerous condition in the mine, before they put  
12 up the stoppings or after. I'd just be interested in  
13 hearing your comments on that.#

14 A. When the Southwest 1 workings were abandoned and  
15 before the stoppings were completed, then ventilation  
16 would be proceeding around the Southwest 1 workings at a  
17 reduced level. A reduced level because the -- If I can  
18 get this to work. Now let's use the bottom plan here.  
19 Last operations were, mining operations, were taking  
20 place in Southwest 1. Then stoppings would be included  
21 in these crosscuts all the way up in order to give an  
22 intake and a return route, and that is how ventilation  
23 was supplied to the Southwest 1.

24 Once the workings were abandoned and the Southwest 2  
25 was commenced, then the intake air came around the route

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1 that I'm indicating here. So this one was opened up for  
2 that intake air to come around there. In other words,  
3 there was no longer any significant ventilating pressure  
4 across what had been the intake and returns of Southwest  
5 1. So there would be some ventilation at a greatly  
6 reduced level entering and leaving the Southwest area.

7 That reduced volume of ventilation would be reduced  
8 further, would have been reduced further by properly  
9 constructed stoppings.

10 So we've got a reduced ventilation system in the  
11 Southwest 1. Your question was: Would it have been  
12 safer to leave that fully ventilated and hence keep the  
13 gas concentration down? That would have been somewhat  
14 difficult to do, Mr. Roberts, at the same time as the  
15 Southwest 2 workings were being advanced and rock  
16 winning, coal-winning operations and the inherent gas  
17 emissions were building up in there. So that would have  
18 been rather difficult. What would have been appropriate  
19 to do, however, as we talked about over this last two  
20 days, is to formulate a scheme for the gas make from the  
21 old workings to be conducted directly into that return  
22 and so not polluting the intake route for Southwest 2.

23 Q. So in view of the fact that they were mining in the  
24 south -- developing the Southwest 2 section and then  
25 beginning to mine it, it would not have been appropriate

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1 to leave it as it was for those two weeks in the first  
2 two weeks of April?

3 A. I would think not, sir, no.

4 Q. Now I want to refer you to the Coal Mine Regulations  
5 Act, which I believe you have in front of you. For those  
6 who don't have it, there were excerpts that were given to  
7 the other parties. And I'm looking at in this case at  
8 Section 71(6) of the Act.

9 COMMISSIONER Conduct of Air?

10 MR. ROBERTS Yes, thank you.

11 COMMISSIONER Top of page 60.

12 MR. ROBERTS Do you have that, Dr. McPherson?

13 A. Yes, sir.

14 Q. Would you agree with me that in either state of the  
15 Southwest section for that two weeks plus period when the  
16 air flowed without the stoppings in a reduced ventilation  
17 and then for the period following the erection of the  
18 stoppings which were, as you testified, clearly  
19 inadequate, that either of those conditions were in  
20 breach of that clause?

21 A. They would -- I'm sorry?

22 Q. The clause, I'm sorry, I just wanted to refer you to  
23 the specific portion that requires that old workings in  
24 other places likely to contaminate the air that the air  
25 shall travel free from those workings.

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1 A. That's what the Act says and this seems not to have  
2 been complied with.

3 Q. This would have been obvious to anyone viewing the  
4 entry to the old Southwest section either before or after  
5 the stoppings were erected?

6 A. Yes, sir.

7 Q. Have you been able to find any evidence that the  
8 Department of Labour made any comment about the condition  
9 of the stoppings in the Southwest 1 section?

10 A. I have seen no such reference.

11 Q. And, again, you say that these stoppings would not  
12 even have inhibited, I think was the word you used, the  
13 flow of methane out of that section? Do you recall  
14 saying that?

15 A. That is what I said, yes.

16 Q. Just for my own benefit, what was inadequate? I  
17 mean what would I see looking at those stoppings that  
18 should be a red flag to me that they wouldn't do the job  
19 that they were supposed to do, required to do by the law?

20 A. Let me answer that in two ways. First of all, I  
21 understand that these stoppings were constructed out of  
22 plywood and plastic. One of the sections we referred to  
23 earlier this morning required that stoppings be  
24 constructed out of, I forget the wording, mortar, masonry  
25 or substantial material. I would hardly regard plywood

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1 and plastic as substantial material, one.

2 Number two, the construction of such flimsy  
3 stoppings, whilst inhibiting a ventilating current of  
4 air, would be rather ineffective at preventing the  
5 seepage, the flow of methane, coming out at roof level.  
6 To give you an analogy, had there been water, I'm using  
7 this purely as an analogy, had there been water coming  
8 out of those old workings, then the plywood and plastic  
9 stoppings would hardly have prevented the water flowing  
10 out along the floor. A similar thing is true concerning  
11 methane flowing out along the roof.

12 COMMISSIONER Just half a second, Doctor, am I correct  
13 then to assume that perhaps as far as that area is  
14 concerned, it would be better to have done nothing rather  
15 than to have put up that inadequate stopping?

16 A. The stoppings were necessary, Mr. Commissioner, in  
17 order to prevent the ventilation or the partial  
18 ventilation of those workings. So I would suggest that  
19 it was completely appropriate to put stoppings in the  
20 places they did put them, but I would go on to suggest  
21 that those stoppings should have been of a very much more  
22 substantial nature than they were.

23 Q. The only thing that prompted me to ask that was  
24 because you said the stoppings did nothing but prevent  
25 the circulation of air, and I concluded from that that

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1 the circulation of air may have dissipated the amount of  
2 methane.

3 A. Had there been sufficient ventilation going around  
4 there, then that would have been the case. In my  
5 previous answer to Mr. Roberts would had that been  
6 continued, then it would have been somewhat difficult to  
7 simultaneously ventilate the Southwest 2 workings which  
8 were then being developed.

9 COMMISSIONER Okay, thank you. Sorry.

10 MR. ROBERTS I want to take you back though for a  
11 moment to the period of time before the stoppings were  
12 put up and ask you to look -- you have a binder in front  
13 of you which I think is Exhibit 73. It should be a black  
14 binder and I'd ask you to look at tab 4 of the binder.

15 A. Yes.

16 Q. This is a letter from a Mr. MacLean, the Department  
17 of Labour inspector, to his superior having visited the  
18 Southwest 1 section on the 31st of March after it had  
19 been abandoned, and I'm going to read the second  
20 paragraph:

21 "On Tuesday, March 31, 1992, I travelled underground  
22 accompanied by Mr. Parry to the Southwest section where  
23 the area had taken weight and came down. The methane  
24 readings in this area have been recorded from one to four  
25 percent. The methane is coming in waves. There is

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1 ventilation going throughout this area."

2 Now I'm interested, first of all, in the phrase "The  
3 methane is coming in waves."

4 A. Yes.

5 Q. To a lay person, that sounds somewhat ominous; would  
6 you agree with that?

7 A. I would agree that to a lay person, this would,  
8 indeed, sound ominous. Whether, in fact, it was ominous  
9 or not, really depends on whether we had those higher  
10 concentrations up to four percent in the actual places  
11 where machines and men were working. If one reads on to  
12 the next sentence: "Where the methane readings are high,  
13 (presumably approaching four percent) 50 feet out, the  
14 readings are nil."

15 May I use the board to illustrate a point here? I'm  
16 out of paper. Okay.

17 MR. MERRICK Reinforcements are on their way.

18 A. I can use this side here for the time being. We may  
19 need some later though.

20 MR. MERRICK This is still Chart No. 5.

21 A. Okay, another picture. This refers to a time when  
22 depillaring was taking place, according to the letter.

23 MR. ROBERTS In fact, depillaring, this was after the  
24 area had been abandoned, depillaring had stopped in that  
25 section and was taking weight, and they were about to

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1 start into Southwest 2.

2 COMMISSIONER They came down.

3 MR. ROBERTS That's right.

4 COMMISSIONER The pillars had come down at this point.

5 A. So we're looking up in this region and they're about  
6 to pull out and start Southwest 2.

7 MR. ROBERTS They, in fact, had pulled out, I believe.

8 A. Okay. So here we have a situation where, and I'm  
9 going to make a cartoon of this, where we have a series  
10 of entries, these, and ventilation is coming up the  
11 intake, presumably coming around one or more of these  
12 loops. Let's put the crosscuts in. Okay, they are  
13 pulling out of this region. Ventilation is coming in and  
14 returning. The letter could be interpreted two ways, I  
15 think, Mr. Roberts. One is an indication of exactly what  
16 one would expect. Back here, it is non-ventilated  
17 because it's collapsing. The pillars are being taken  
18 out. So this is, let us call it then, essentially  
19 stagnant area, which will, of course, be filling up with  
20 methane. Back here, the ventilation will be continuing  
21 across the places where presumably men are still working  
22 and pulling out. I think what the letter is saying is  
23 that in the fringe here, the methane is breathing.

24 We talked yesterday, Mr. Commissioner, or the day  
25 before, about the barometric effect of expansion. This

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1 happens over short time periods as well, particularly  
2 when we've got gas emissions taking place. So this  
3 breathing effect would result in methane wafting forwards  
4 and backwards. And here we have a fringe area. A fringe  
5 area between the properly and fully ventilated last open  
6 crosscut and the abandoned area behind it where there is  
7 essentially no ventilation, and this is a dangerous zone  
8 because, obviously, we're going through an explosive  
9 range somewhere back in there.

10 So I think what the letter is saying is that that  
11 phenomenon was taking place. That we had this breathing  
12 effect with the methane fluctuating along the interface,  
13 along the fringe there, but the ventilation quite close  
14 to that, 50 feet back, was sufficiently good to keep  
15 everything happy.

16 Q. Would you consider nonetheless the information  
17 that's contained in that paragraph to be one of those red  
18 flags that you referred to yesterday?

19 A. I'm not sure I would put it in the same strength of  
20 that category because this is what one would expect in a  
21 situation like that.

22 Q. What would you expect an inspectorate, if I could  
23 use that phrase, to do having knowledge of the condition  
24 that's described in that letter?

25 A. I would expect him to ensure that men and equipment

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1 are not exposed to those areas where the methane is,  
2 indeed, fluctuating up to close to the lower flammable  
3 limit.

4 Q. And what about preventing the flow of methane out  
5 from that area into the other working sections of the  
6 mine?

7 A. Again, we have already spoken to this and there are  
8 means by which that could have been done initially in  
9 planning the layout of the mine is one method. We talked  
10 about the back bleeder system and that is the initial  
11 planning of the mine.

12 And, secondly, the shorter term methodologies of  
13 ducting, diverting, or using an air crossing to conduct  
14 that polluted air into the returns directly, without it  
15 polluting the intake to Southwest 2.

16 Q. And we see that Mr. MacLean writes, "The manager has  
17 the situation under control and is monitoring it on a  
18 daily basis. The manager will send a report of the  
19 incident," and by that I take to mean the failure of the  
20 Southwest 1 section to the Department, as he eventually  
21 did. Are you aware of any other steps that were taken by  
22 the Department of Labour in relation to this -- the  
23 ventilation issues raised by this failure?

24 A. I am not personally aware of any such actions.

25 Q. I want to refer you to another section of the Coal

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1 Mines Regulations Act, and I apologize to the parties in  
2 that this is not one of the ones that was excerpted, but  
3 I believe you have it in your Act. It's Section 63(2).  
4 These are relating to the powers of inspectors. Page --  
5 would be at page 44.

6 Q. Yeah.

7 A. Section 63.

8 Q. Yes.

9 A. Subsection 2, "Duties of Deputy?"

10 Q. Yes. That reads, "The Deputy Inspector shall visit  
11 every mine in the district for which he is appointed and  
12 every working section thereof and all underground  
13 travelling roads at least once every month and he shall  
14 also examine all accessible stoppings in every mine in  
15 his district as often as possible." Would you agree with  
16 me that that appears to place a particular duty on  
17 inspectors to play close attention to stoppings that  
18 would present a potential hazard in a coal mine?

19 A. He has the duty to do exactly that, to examine all  
20 accessible stoppings.

21 Q. And is there any evidence in the file that the  
22 inspectorate took any particular -- paid any particular  
23 attention or took any particular action in relation to  
24 these stoppings that we've been talking about?

25 A. I have seen no such documentation.

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1 Q. Now you talked yesterday and, again, you alluded  
2 this morning to a bleeding system that can be developed  
3 to -- when you pull out of an area in order to prevent  
4 the gas from accumulating, and you indicated that wasn't  
5 appropriate here because it had to be planned for and it  
6 wasn't planned for. Now I'm -- the evidence of the  
7 miners is going to be that the management of Westray, in  
8 fact, referred to these plywood stoppings as "bleeder  
9 stoppings." I take it that's not what you were referring  
10 to?

11 A. No, it is not.

12 Q. But it does, I think you'll agree, indicate that the  
13 management of Westray certainly was aware that these  
14 stoppings, as bleeder stoppings, were not going to  
15 prevent the outflow of methane from that section?

16 A. I would assume, without direct knowledge from having  
17 spoken to them on this matter, but I would assume the use  
18 of the word "bleeder" would be in the context you  
19 describe, that they -- if they had used that word and  
20 then this would indicate that these are leaky stoppings.

21 Q. And they were aware of it?

22 A. They used that word, and if that is what they meant  
23 by that word then they would have been aware of it.

24 Q. And I take it it wouldn't surprise you if you were  
25 to learn that the men who actually erected the stoppings

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1 experienced a lot of difficulty with either gas or lack  
2 of oxygen in the process of erecting them? That wouldn't  
3 surprise you to learn that?

4 A. It would not surprise me. I've seen no evidence  
5 that that was the case.

6 Q. All right. There will be testimony that in fact one  
7 of the workers who was up on a platform putting the  
8 stopping -- putting the upper portion of the stopping up,  
9 actually lost consciousness and fell from the platform.  
10 Would that surprise you?

11 A. Could you tell me where the location of that  
12 particular incident --

13 Q. It was in the first one. It was in the number --  
14 the one in front of No. 3 Crosscut.

15 A. Okay, so we are talking about the stopping --

16 Q. Oh, yes.

17 A. -- erected in the Southwest 1?

18 Q. That's right.

19 A. In that case, it would not surprise me.

20 Q. And that the men who were putting them up had to, in  
21 fact, take frequent breaks, sit down at floor level  
22 because of the gas they were encountering up in the roof?

23 A. Again, I would not be surprised by that.

24 Q. Okay. Now on another issue, you testified yesterday  
25 that the -- in your view, these 12-hour shifts that were

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1 being worked at Westray were unsafe and that were one of  
2 the -- in the list of safety hazards they were  
3 appropriately included as a problem in the mine?

4 A. Yes.

5 Q. And your evidence, I think, is that generally the  
6 industry is moving away from lengthy shifts and, in fact,  
7 is favouring shifts as short as six hours?

8 A. I'm not at all certain, Mr. Roberts, that for many  
9 decades that 12 hours has been regarded as a normal  
10 working shift. Seven or eight hours has certainly been  
11 the norm in the majority of countries since at least the  
12 '50s and perhaps before that.

13 Q. No, perhaps you misheard me. I'm not suggesting  
14 that 12 hours was accepted anywhere. I do want though to  
15 refer you to the Coal Mines Regulations Act again in  
16 Section 128 which you may or may not be familiar with.

17 A. I have it, yes.

18 Q. That reads, "Subject to this Act, a worker shall not  
19 be employed at his working place below ground in a mine  
20 for the purpose of his work for more than eight hours  
21 during any consecutive 24 hours?

22 A. Yes.

23 Q. From your evidence, would I take it that you agree  
24 that limitation is appropriate?

25 A. That limitation is appropriate under normal routine

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1 conditions. Obviously, in cases of emergency, then a  
2 working period of more than eight hours would be  
3 appropriate under conditions of emergency.

4 Q. And that is, in fact, is the exception that is  
5 referred to in the section. Now assuming for a moment  
6 that the Department of Labour was aware of the 12-hour  
7 shifts at Westray, and I think the evidence will be that  
8 it was, what would you have expected the Mine Safety  
9 Branch to do knowing, first of all, what the law says  
10 about the length of shifts and, secondly, what they were  
11 doing at Westray?

12 A. I can only repeat what I said yesterday, Mr.  
13 Roberts, and that is that in my opinion 12 hours is too  
14 long to expect workers to operate in a coal mine in a  
15 routine manner.

16 Q. And you will agree with me as well it appears to be  
17 illegal in Nova Scotia?

18 A. Yes, sir.

19 Q. Now --

20 COMMISSIONER That's pretty obvious.

21 MR. ROBERTS Yeah. Now I want to just touch on some of  
22 the equipment that -- the monitoring equipment that you  
23 referred to over the last couple of days. First of all,  
24 you testified that you had found no evidence that anybody  
25 was taking any regular barometer readings at the mine,

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1 barometric pressure readings?

2 A. I have seen no evidence that they were taking  
3 regular barometer readings.

4 Q. And I take it that it's pretty standard in the  
5 mining industry that such readings are taken?

6 A. In coal mining, yes.

7 Q. And that's to allow the operator to track conditions  
8 such as exactly those that prevailed in the hours before  
9 the explosion?

10 A. Yes.

11 Q. Now the evidence that you've presented or that's  
12 been presented along with your report in Exhibit 37  
13 indicates that there were only two such readings taken in  
14 all of the ventilation surveys done and those were on  
15 July 9th and July 23rd of 1991. And for reference there,  
16 at pages 36 and 37.

17 A. We're looking at 37(a)?

18 Q. Yes, sorry.

19 A. Pages 36 and 37?

20 Q. Yes.

21 COMMISSIONER Is there a question there?

22 MR. ROBERTS There will be.

23 COMMISSIONER Oh.

24 A. Yes, I have them.

25 MR. ROBERTS As I read it, those were the only readings

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1 taken. Are you aware of any others, other than those two  
2 -- the readings taken on those two days?

3 A. Without going through all of these again looking  
4 specifically for barometric pressures, those are the only  
5 two that I see in this part of the exhibit is the answer  
6 to your question. May I make one further comment?

7 Q. Yes.

8 A. You referred to these as "readings." What we have  
9 in front of us is a record of barometric pressures. And  
10 I notice on page 36 this is incorrectly stated as  
11 "barometric temperature" and it's obviously "pressure."  
12 But we do not know that these were readings taken at the  
13 surface of the mine. All we have is an indication of  
14 barometric pressure, in parentheses, "(surface)." Maybe  
15 you can help me, but I don't know where these readings  
16 were taken on the surface or whether it was even at the  
17 surface of the mine.

18 Q. All right. Now there doesn't appear to be in the  
19 record any evidence of any readings taken after the 23rd  
20 of July of 1991?

21 A. Well, if you wish me to go through --

22 Q. No.

23 A. -- all of the surveys looking for them --

24 COMMISSIONER I don't wish you to. I don't know what  
25 Mr. Roberts' views are.

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1 MR. ROBERTS That's fine. Now another point, could you  
2 tell me what a water gauge is?

3 A. Yes.

4 Q. And what is it used for?

5 A. Yes. This is one of the ways of measuring  
6 differential pressures, differences in pressure. A water  
7 gauge is -- did the new paper turn up? [Witness  
8 referring to flip chart].

9 COURT CLERK Yeah.

10 COMMISSIONER I think perhaps we need more qualified  
11 mechanics, don't we?

12 MR. ROBERTS I think that was a reflection on myself.  
13 I thought it was going great.

14 A. Thank you.

15 COMMISSIONER That will be drawing No. 6 then, won't it?

16 A. Uh huh. If you have -- imagine a glass tube just  
17 vent into a "U" tube, this size, literally this size, and  
18 you put water into the "U" tube and the water level is  
19 going to be the same on both sides of the limbs. Now  
20 supposing we connect this through tubing, pressure tubing  
21 of some kind, low pressure tubing, to two positions where  
22 one is at a higher pressure than the other, such as the  
23 outlet of a fan and the inlet of a fan, for example.  
24 Then, in that case, because of the increased pressure on  
25 the left-hand side over that on the right-hand side, this

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1 water will be displaced. It will move downwards a  
2 certain distance and move upwards the same distance,  
3 assuming the cross section of the two remains constant.  
4 So we've now got a situation where we have a difference  
5 in the levels of the water. That is referred to as the  
6 "water gauge" and is simply an indication, a measure of  
7 pressure difference.

8 Q. And it's used in a coal mine to, as I understand it,  
9 to measure the performance of the main fan?

10 A. It is one of the methods that can be used to  
11 indicate the pressure difference adduced by the fan.

12 Q. And it's a standard piece of equipment again in a  
13 coal mine?

14 A. Yes, sir.

15 Q. And you will agree with me that there's no evidence  
16 that Westray, in fact, had a water gauge at this mine?

17 A. The recordings of the water gauge are normally made  
18 on a circular chart. This is the conventional way, a 24  
19 or seven-day chart showing the variations in water gauge  
20 from minute to minute and hour to hour. That is a useful  
21 piece of evidence following any unusual mine incident.  
22 Westray is different inasmuch as I have not seen any such  
23 water gauge charts.

24 Q. And you would have expected it, I take it?

25 A. I would have expected it.

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1 Q. And you will agree with me and, just to save time I  
2 won't take you to the text, the Coal Mines Regulation Act  
3 requires the officials of Westray to take both regular  
4 barometric pressure readings and water gauge readings?

5 A. I would have expected that to be appropriate, yes.

6 Q. And would it be obvious to someone visiting a mine  
7 on a regular basis, such as a mine inspector, to  
8 determine that, in fact, these facilities, the water  
9 gauge and the barometric pressure, barometer, sorry, were  
10 not present and these readings were not being taken?

11 A. Had that inspector visited the location of the main  
12 fan, then if those matters had been absent, then he would  
13 have made a note of that.

14 Q. Now just one other piece of the ventilation or  
15 monitoring equipment, obviously, is a methanometer on the  
16 miner. We've had some evidence on that. I just want to  
17 -- my understanding that the methanometer on the cutting  
18 head of the miner would not, in fact, read layered gas  
19 but in fact would just be reading the gas coming from the  
20 face?

21 A. It would be reading the gas concentration at the  
22 location of the monitoring head.

23 Q. Which would not normally be up in a layer of  
24 methane?

25 A. No, it would be fixed to the machine.

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1 Q. And so the person who would be operating that miner  
2 would have no idea that above his head was this layer of  
3 methane?

4 A. Not from those readings, no.

5 Q. Okay. In your report dealing with roof cavities you  
6 make reference to the fact that in the industry they're  
7 often filled. Do you recall --

8 A. Yes.

9 Q. I just -- how common is that that operators of coal  
10 mines, when observing cavities in the roof, will take  
11 some action to fill them?

12 A. They fill for two reasons, Mr. Roberts. One is the  
13 -- for the purpose of supporting the roof, broken roof in  
14 that cavity, above that cavity, number one. And, number  
15 two, of particular importance in gassy mines, they're  
16 filled in order to prevent them filling up with  
17 accumulations of high concentration methane.

18 Q. But is that a common procedure or is that something  
19 that's fairly new?

20 A. No, it's not new at all. This has been practiced  
21 for many, many years.

22 Q. Okay. On the coal dust issue, I take it from your  
23 evidence yesterday when you talked about the amount of  
24 coal dust that had to be in the air body in order to be  
25 explosive that the overall amount of dust on the floor is

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1 significant?

2 A. It would seem to have been the case at Westray. It  
3 was indeed significant.

4 Q. And that's why it's important that dust be removed  
5 as well as stone dust be applied, that there are efforts  
6 be taken to remove the coal dust from the mine?

7 A. In particular locations. And I'm thinking now of  
8 belt conveyors. Quite apart from the dust explosability  
9 problem, if dust is allowed to build up underneath and  
10 around conveyors, then there is a danger that that dust  
11 may be ignited purely by frictional heating at the  
12 rollers. So in those locations it would be usual -- it  
13 would be necessary to remove that coal dust.

14 On the other hand, in return airways and  
15 nontransportation, coal transportation entries, then  
16 stone dusting, without removal of the dust, would be the  
17 normal practice.

18 Q. Okay. Just one final point and I want to follow up  
19 from something the Commissioner was asking you at the end  
20 of your direct examination when he asked you about  
21 discretionary versus intrusive systems of regulation.  
22 You went through a number of proposed reforms of our laws  
23 in your examination with Mr. Merrick. You didn't mention  
24 anything about enforcement, and I want to put to you that  
25 the evidence is that there were a number of obvious

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1 violations of the Coal Mines Regulations Act as it exists  
2 today which were not being enforced at Westray and that  
3 the improvements that you have recommended would also be  
4 of no value unless measures are taken for enforcement.  
5 And I'm wondering what your view is on that?

6 A. I constrained my suggestions to the technical issues  
7 in the Act, that is true. And I agree with you that  
8 unless appropriate enforcement is engaged in, then no  
9 regulation will be helpful. It does have to be enforced.

10 COMMISSIONER That applies to any regulation or any law  
11 anywhere, doesn't it?

12 A. Yes, indeed, sir.

13 MR. ROBERTS Thank you.

14 COMMISSIONER Mr. Hebert?

15 MR. HEBERT Thank you, Mr. Commissioner.

16 EXAMINATION BY MR. HEBERT

17 Q. Mr. McPherson, just a couple of, I guess, technical  
18 points or clarification points. When you mentioned --  
19 you and I discussed this during your break yesterday,  
20 your reference to an "ascending" airway, if you will, and  
21 "descending" in the context of ventilation, that's a  
22 reference to the direction of the air flow?

23 A. Yes, sir.

24 Q. Okay. It has nothing to do with the way the  
25 development is being planned? In other words, if we look

DR. MCPHERSON, EXAM. BY MR. HEBERT

1 at the two main slopes, they're going -- both of them are  
2 descending, and we would expect, in the normal case,  
3 there would be air flowing down one and flowing up the  
4 other. And in the intake where it was going down, that  
5 would be the descending tunnel, if you will, or entry,  
6 from a ventilation point of view, and the other would be  
7 the ascending?

8 A. That is correct.

9 Q. Okay. Now I just wanted to clarify some points with  
10 respect to the old Southwest 1 workings. And it's my  
11 understanding that the emission of the methane in that  
12 section, because it is a closed section, except for the  
13 openings coming into the other areas of the mine, that in  
14 fact the pressure to move the methane from that section  
15 results primarily from the release of the methane in a  
16 more -- from one pressure area to a less pressure area in  
17 the mine which allows the gas to expand. Is that -- is  
18 that the main driving force, assuming that it's  
19 unventilated, from moving that methane from the Southwest  
20 1 section into the other area of the mine?

21 A. We talked about two mechanisms. The one I believe  
22 you're referring to is the emission of gas from the coal  
23 substance itself --

24 Q. Yes.

25 A. -- into the surrounding gaseous atmosphere, whatever

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1 that atmosphere might consist of. And that is dependent  
2 on the factors that we talked about, the initial gas  
3 content of the coal. Number two, of the permeability,  
4 the presence of fracture paths to allow the gas to move  
5 through the coal. And, thirdly, the pressure gradient,  
6 the driving gradient. That is the mechanism, I believe,  
7 you're referring to.

8           Additionally, we have spoken about the expansion of  
9 the gas once it has got into those voids --

10 Q. Yes.

11 A. As influenced by barometric pressures.

12 Q. So there's two factors, but I guess if we assume  
13 that the barometric pressure or the atmospheric pressure  
14 remains the same --

15 A. Yes.

16 Q. -- just the very fact that you're dealing with a  
17 closed or a defined space, volume, and you're having gas  
18 emitted into that at a certain rate --

19 A. Yes.

20 Q. -- will tend to increase the amount of gas within  
21 that space and push other gas out at the exit.

22 A. After the openings, that is correct.

23 Q. All right. And is that, again, aside from the  
24 barometric atmospheric pressure, is that why the gas  
25 would come initially from Southwest 1 without the

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1 ventilation?

2 A. Yes, indeed.

3 Q. All right. So when you refer to a -- the plastic  
4 barrier being insufficient to maintain or to inhibit that  
5 leak, the leak you're referring to is the pressure  
6 differential -- caused by the pressure differential. Is  
7 that the -- as opposed to a ventilated --

8 A. That is the overriding mechanism that provides for  
9 methane to be emitted from the old workings. There is a  
10 secondary mechanism that we have not talked about and  
11 that is the mechanism that encourages that gas to come  
12 out at roof level rather than as a single plug. And I'm  
13 happy to explain that second mechanism if it is of  
14 importance to you.

15 Q. Yeah, okay. Please do.

16 A. Right. Again, I'm going to use the board. We're  
17 looking at this sideways as a section. Here are the old  
18 workings, the entrance into the old workings, old  
19 workings back here. Here is our plywood, plastic  
20 stopping. Here is the ventilated part of the mine, air  
21 coming this way. As we said a number of times now,  
22 methane is considerably lighter than air. What will  
23 happen, superimposed upon the general movement of  
24 methane, which you have accurately described,  
25 superimposed upon that will be a second matter and that

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1 is that the methane will tend to move out at top level  
2 and this will tend to draw air in at floor level. Like a  
3 big, natural sweeping effect. So we've got air coming in  
4 here and we've got gas -- this is very sluggish flow,  
5 very slow flow, gas coming out predominantly at roof  
6 level.

7 And you may recall that yesterday when we were  
8 speaking -- towards the end of yesterday -- we were  
9 speaking about the possibility of flaming of the methane  
10 layer coming back down here and perhaps reaching into the  
11 old workings where it would meet an explosive mixture.  
12 This is what I have in mind. In this region, in this  
13 sluggish region, this is where we would have that five to  
14 15 percent. Is this helpful?

15 Q. Yes, thanks. Now would it be fair to say that the  
16 amount of methane which is leaking through the stoppings,  
17 because that's really the only place it has to go --

18 A. Yes.

19 Q. -- once it expands into that void, would be equal to  
20 the amount that's being emitted?

21 A. Taking both mechanisms into account, it will be  
22 equal to the rate at which is being emitted amended by  
23 the influence of barometric pressure.

24 Q. Okay. Now this may be an obvious point, but I guess  
25 I'm -- it was my understanding that the actual

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1 ventilation itself through the tunnels would create some  
2 kind of a pressure just as you described the auxiliary  
3 fans creating a pressure along the duct --

4 A. Yes.

5 Q. -- looking at the tunnels as the duct. There would  
6 be some pressure. Would that have any bearing on the  
7 rate of methane leakage into the ventilation system?

8 A. No.

9 Q. Because it's a closed system within the --

10 A. Because the pressure gradients between the gas in  
11 the coal and the ventilated and the void will typically  
12 be several atmospheres --

13 Q. All right. Where --

14 A. -- whereas the changes in the ventilation system  
15 will be very, very small fractions of an atmosphere.

16 Q. Okay, all right. I think you, in your earlier  
17 testimony you indicated that it would be the ratio of  
18 1:10 pressure to the atmosphere?

19 A. Typically.

20 Q. Okay. Now with respect to the barometric pressure  
21 changes, and this -- I perhaps, trying to relate this to  
22 your calculation of the volume of gas coming out of the  
23 Southwest 1 section, would you not have -- in order to  
24 make comparisons over time with rates of emission, would  
25 you not have to account for the barometric pressure at

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1 each date that you make your measurements? In other  
2 words, if barometric pressure is up here, when you take  
3 one measurement you're going to get a certain volume  
4 coming through. If you measure it again and the  
5 barometric pressure is lower, there could be the same --  
6 could be a different -- the same volume, but there would  
7 be a different rate of emission from the Southwest 1 coal  
8 itself?

9 A. This is the reason that barometric pressures  
10 normally and should be measured shift by shift at the  
11 surface of a coal mine. Let me make one further point  
12 here for clarification. It is not the value of the  
13 barometric pressure that causes this phenomenon, it's the  
14 rate of change of barometric pressure that causes the  
15 compression or expansion of those void gases.

16 Q. In your report you indicated that the barometric  
17 pressures could -- you, I guess, intimated that these  
18 could be offset, that measures could be taken to  
19 counteract that effect.

20 A. You're referring to the pressure balance chamber  
21 technique?

22 Q. I'm not sure. You didn't refer specifically to what  
23 that was, but I think you prefaced it by saying that  
24 unless steps are taken, these barometric pressures could  
25 cause the influx of gas.

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1 A. That's right. It's often referred to as "breathing  
2 of the stoppings." As the barometric pressure rises and  
3 falls on the surface, then the stoppings breathe. Gas  
4 moves one way and/or air, and out the other way.

5 Q. So the remedy then would be those pressure chambers  
6 that you described earlier in your testimony?

7 A. That is one of the remedies, yes.

8 Q. Are there others?

9 A. Well, we talked about the back bleeder system which  
10 allows a continuous flow of air in and, therefore,  
11 preventing gas coming out. For example, we talked about  
12 the possibility of air crossings and ducted systems and  
13 so on.

14 Q. So it would be the same remedies as you generally  
15 contend with.

16 A. Yes, sir.

17 Q. There was no special steps that you would take to  
18 deal specifically with the barometric changes?

19 A. No, those should handle it.

20 Q. Thank you. There were some changes to the plan that  
21 you identified earlier to the main intake and return  
22 tunnels which originally were planned to be fairly  
23 straight initially, but then there were two or three  
24 kinks introduced. What effect, if any, would that have  
25 on the long-term resistance and demand on your

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1 ventilation system?

2 A. You're referring to these bends here and here?

3 Q. Yeah.

4 A. Those bends, like any other bends, would cause  
5 additional shock losses within the ventilation system.  
6 The angle of those bends would indicate that shock losses  
7 would be very small. So my answer is that these would  
8 have negligible effect on the ventilation.

9 Q. Thank you. I think there was a comment made early  
10 on that once gas or methane is intermingled, if you will,  
11 or mixed with the general body of the air that it stays  
12 mixed.

13 A. Yes.

14 Q. And would that be only because of the continuing  
15 velocity of the air volume? In other words, if you  
16 stopped the air flow, would the methane then rise again?

17 A. No, it will remain mixed. Even stagnant air, once  
18 it is mixed, it will remain mixed.

19 Q. What principle comes to bear on that?

20 COMMISSIONER Well, do we need to know the principle as  
21 long as we have the expert opinion as to the fact that  
22 that's what happens?

23 DR. MCPHERSON Do you wish me to continue, Mr.  
24 Commissioner?

25 COMMISSIONER Well, if it's a brief answer.

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1 DR. MCPHERSON I'll make it a very brief answer. The  
2 molecules of the elements or the gases in any mixture are  
3 moving at fairly high velocity, approximately the  
4 velocity of sound in that particular mixture. Those  
5 velocities are such that once gases have been mixed, that  
6 intermolecular interactions, those intermolecular  
7 interactions, will insure that they remain in a mixed  
8 situation. I'm trying to make this as brief as possible,  
9 sir.

10 COMMISSIONER That made my day.

11 MR. HEBERT You discussed the degassing process in a  
12 heading.

13 A. Yes.

14 Q. And you indicated that it was a rather delicate  
15 operation.

16 A. Yes.

17 Q. That you couldn't just switch on the fan and start  
18 sucking out the methane?

19 A. Right.

20 Q. And you indicated that would have to be done over a  
21 period of time.

22 A. Yes.

23 Q. Generally, and we've seen evidence that I think some  
24 of these processes that Westray took 20 minutes and  
25 perhaps one took an hour.

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1 A. Yes.

2 Q. What can you say about the adequacy of those times?  
3 Was that consistent with what you would expect?

4 A. The greater the volume of gas to be moved out of the  
5 heading, then the longer it will take. If the rise  
6 heading, for example, the continuation of Southwest 2-B  
7 rising heading, if that had been gassed out fully from  
8 the end to the last junction, then that would have taken,  
9 I would estimate, several hours. If, on the other hand,  
10 it was just the end of the heading, the last few meters,  
11 then that would take correspondingly less time. So I  
12 cannot give a specific answer in terms of minutes or  
13 hours. It depends on the amount of gas to be moved out.

14 Q. In your report at page 32, you refer to unauthorized  
15 interference with sensors, and in particular, the  
16 methanometers on some of the equipment. And I just  
17 wanted to clarify, when you referred to "unauthorized,"  
18 are you referring to authorized by regulation or a  
19 policy? We're looking at page three, third paragraph  
20 down.

21 A. Yes. There are situations in which adjustment of  
22 those sensors is necessary. Recalibration of the sensors  
23 is necessary from time to time, according to the  
24 manufacturer's recommended procedures. Those would be  
25 authorized adjustments to the sensor. What I'm referring

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1 to here are adjustments that were possibly made to the  
2 sensors without such authorization.

3 Q. So we could substitute "unauthorized" by "uncalled  
4 for" or "inappropriate"? In other words, you're not  
5 suggesting that the person who is doing the work was not  
6 authorized to do that, for example, by his supervisor.  
7 That's not the sense that we should take that comment?

8 A. Perhaps the word "inappropriate" might be  
9 appropriate here.

10 Q. Okay.

11 A. I would leave it at that, sir.

12 Q. It's in reference to standard technical or  
13 engineering, if you will, principles. Would that be fair  
14 to say?

15 A. Or routine maintenance, that's fine, yes.

16 Q. Okay. And I don't think we've had any evidence on  
17 it to date, but in terms of calibrating a methanometer,  
18 when is that done, why is it done, and how is it done?

19 A. The methanometers of the type that were being used  
20 in this mine and on these machines are subject to a drift  
21 of calibration. This means that over time the  
22 sensitivity of those sensors will change. So at periodic  
23 intervals, again according to the manufacturer's  
24 recommended procedure, the calibrations of those  
25 instruments should be checked. The way this is done is

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1 as follows: First of all, the sensors are exposed to  
2 completely uncontaminated fresh air sample and the zero  
3 is checked and adjusted for, if necessary.

4 Secondly, in a similar way, the sensor is exposed to  
5 a known concentration of methane. The reading is taken  
6 and, again, the adjustment used to bring the reading up  
7 to the actual known concentration. So we calibrate in  
8 both those ways a zero correction and what the  
9 manufacturers sometimes refer to as a "span correction."

10 Q. In practice, is that, for example, a methanometer  
11 which is mounted on a piece of equipment, is it removed  
12 to the surface to conduct those calibrations or is it  
13 done on the equipment underground?

14 A. Those calibrations can be done on the equipment.

15 Q. They can be?

16 A. Yes, sir.

17 Q. Now you mentioned anemometers as well and were you  
18 aware of how many anemometers were in use at Westray?

19 A. I have not made account, no.

20 Q. There seemed to be some suggestion that there were  
21 maybe an inadequate number, given that one was out of  
22 commission and another was being calibrated or some such  
23 thing, and it appeared that they didn't have any other  
24 back-up.

25 A. What we can say, and this is a point Mr. Merrick

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1 raised, there was at least one period of time when an  
2 anemometer had to be returned to the manufacturer for  
3 adjustment, repair, and calibration. During that time,  
4 the air flow measurements in the ducts could not be  
5 taken.

6 Q. Would that be unusual, in your experience, that  
7 there would be no working anemometers available in a mine  
8 operation?

9 A. That should not be a situation that one would  
10 expect.

11 Q. And in terms of the cost of these devices, can you  
12 give us some general sense? Are we talking hundreds of  
13 dollars or thousands of dollars or tens of dollars?

14 A. Hundreds of dollars.

15 Q. Okay. Now you discussed the stoppings which were  
16 placed at the entrances to the old Southwest 1 section,  
17 and I take it from your comments this morning that a  
18 stopping designed and effective in directing air through  
19 a ventilation system for ventilation purposes may be  
20 adequate, but not adequate to prevent the methane from  
21 being pushed through the two pressures that you described  
22 today through the stoppings.

23 A. Yes, sir.

24 Q. Okay. Are there other considerations with respect  
25 to stoppings in the Southwest 1 area? For example, the

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1 fact that there could be a collapse of the roof. Would  
2 that itself cause a pressure which could force gas out to  
3 any degree?

4 A. You're thinking of a sudden collapse of pillars in  
5 the old --

6 Q. Southwest 1.

7 A. Section that could suddenly -- that could result in  
8 a sudden expulsion of gas?

9 Q. Yes.

10 A. That is a possibility, yes.

11 Q. And, in your opinion, would the stoppings in place  
12 that were in existence as described to you be sufficient  
13 to, I guess, guard against that risk?

14 A. It clearly depends upon the extent to which that  
15 collapse has taken place. If we have a single pillar  
16 failing, then the pressure pulse would be fairly low.  
17 If, however, we have a number of pillars failing  
18 simultaneously, which is often the case, then the  
19 pressure pulse could well be far more than necessary to  
20 blow those stoppings out.

21 Q. And is there some rule of thumb or engineering  
22 principles involved in designing the length of the  
23 barriers which form the stoppings? I've heard one, for  
24 example, where it was related to the dimension of the  
25 entry.

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1 A. There are guidelines. You're referring to the type  
2 of stopping that I had on the board yesterday.

3 Q. Yes.

4 A. Where we have, in fact, two stoppings with an in-  
5 fill in between.

6 Q. Yes.

7 A. Yes, okay. There are indeed guidelines, and they  
8 vary quite widely. They vary from, oh, one meter to five  
9 meters apart from the walls and some ventilation  
10 engineers relate it to the size, the cross-sectional  
11 area, the height, and the width of the entry. So you  
12 might see, and this will vary from place to place and  
13 according to experience, from two times to five times the  
14 width or the height, whichever is greater, of the entry.

15 Q. So the stopping then really serves a number of  
16 purposes. For example, if we look at the stoppings into  
17 the Southwest 1 area, it would serve to restrict the flow  
18 of methane into the ventilation system. It could also  
19 serve to prevent the expulsion of gas caused by a  
20 collapse of the roof. And I would suggest that if,  
21 indeed, spontaneous combustion were a problem, then it  
22 could provide some protection from that source of  
23 ignition as well.

24 A. If those stoppings were constructed properly, that  
25 is all true.

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1 Q. And are those the three reasons then? Are there any  
2 other reasons to put a stopping, substantial stoppings in  
3 those areas?

4 A. I think you've covered that quite adequately.

5 Q. Have you seen any evidence --

6 A. There's one further point that I should add for  
7 completeness, and this is true of any kind of stopping or  
8 fence, and that is simply as a barrier against  
9 unauthorized personnel entering them.

10 Q. All right, but that wouldn't require a substantial  
11 stopping, as you've indicated earlier. The plastic could  
12 have well prevented people from passing.

13 A. Oh, a simple fence would have done that, yes.

14 Q. Okay. With respect to your calculations as to the  
15 volume in the Southwest section, there is evidence that  
16 some of the area had collapsed.

17 A. Yes.

18 Q. What do you say about the effect of that on the  
19 volume available? Does that tend to decrease the volume  
20 in that area, or would it create cavities or crevices or  
21 pockets within the debris, if you will, which could be  
22 filled with the gas?

23 A. The actual voidage that we are referring to, and  
24 you'll notice I have used that word "voidage" rather than  
25 "open space," advisedly. The actual volume of the

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1 voidage would remain unchanged despite the fragmentation  
2 of the pillars and the roof until and unless that  
3 subsidence reached right through to surface. If the  
4 surface actually subsided, then the voidage would  
5 decrease by the commensurate amount. But unless that  
6 subsidence did go through to surface, then the voidage  
7 would remain unchanged.

8 Q. I take it given that comment that you would see it  
9 as being totally unsatisfactory to rely on any kind of a  
10 roof fall as a proper substantial stopping in a roadway.

11 A. A roof fall is not a stopping.

12 Q. All right. Now I just want to clarify this. It may  
13 be obvious but the information on which you based your  
14 calculations during your testimony today, that was taken  
15 from information which was available at the time in terms  
16 of air velocities and volumes. You were using data which  
17 was in existence at various periods?

18 A. I believe that is the case, sir, yes.

19 Q. And I take it that all that was really required  
20 other than the data was a knowledge of the formulas and a  
21 standard scientific calculator. Would anything else be  
22 required to perform the math and the analyses that you  
23 performed?

24 A. I think it goes a little further than that. First  
25 of all, one has to be aware of those formulae, where to

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1 find them, how to use them. One should be experienced in  
2 their utilization. One should be knowledgeable about how  
3 to interpret the results. So adding those factors, it's  
4 a little more than just looking up a formula and plugging  
5 numbers into a calculator.

6 Q. A person with experience in ventilation of a mine,  
7 all that would really be required other than the data  
8 that was available to you would be, other than your own  
9 experience, would be a knowledge of the formula and,  
10 really, a scientific calculator. Did you have to use a  
11 computer or any special programs for this?

12 A. Not for the calculations that I have used in my  
13 report, but let me answer you, sir, what I said before,  
14 it is not simply a matter of looking up a formula and  
15 plugging numbers into it. One has to know how to use it,  
16 one has to know the limitations of it. Many  
17 relationships, mathematical relationships used in  
18 engineering have limitations, not greater than, not less  
19 than. So one should be skilled in interpreting and using  
20 those relationships.

21 Q. All right. Now in terms of, and looking from the  
22 regulatory point of view, it strikes me that as a  
23 regulator, one would want to insure that the person  
24 making decisions about ventilation in the mine had some  
25 qualifications specific to mine ventilation. Is that an

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1 essential requirement?

2 A. That is a prudent requirement.

3 COMMISSIONER It's an obvious requirement.

4 MR. HEBERT And is there anything that you've seen in  
5 the Coal Mine Regulations Act which requires that the  
6 ventilation plans be undertaken by a person  
7 particularly with experience in mine ventilation?

8 A. I'm aware of the fact that ventilation plans have to  
9 be submitted to the regulatory authorities. I cannot  
10 immediately recall reference to the qualifications of the  
11 persons who are responsible for drawing up those plans.

12 Q. Is there a recognized subdiscipline, if you will, of  
13 ventilation experts in terms of coal mine ventilation or  
14 other mining ventilation experts?

15 A. Yes, sir, there are organizations around the world  
16 that are convened for and intended for mine ventilation  
17 engineers.

18 Q. And how would one recognize a mine ventilation  
19 engineer, other than looking at their experience? Would  
20 there be a designation by any official or unofficial  
21 organization?

22 A. That varies from country to country. In South  
23 Africa, for example, it is a regulatory position  
24 recognized in law. In the United States, and I believe  
25 also in Canada, there is no separate certification for

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1 ventilation engineers.

2 Q. It strikes me that as mining becomes more complex in  
3 terms of technology and such that it may be prudent to  
4 move in a direction where you have certificates in  
5 particular fields within the mining engineering.

6 A. Yes.

7 Q. Would that be one of your recommendations if, in  
8 fact, Nova Scotia does not have that kind of a system?

9 A. That is a matter that has been under debate in the  
10 United States for quite some time whether such  
11 certification, education, and training requirements for  
12 ventilation engineers should be required under law. It's  
13 also a matter of debate right at this moment in  
14 Australia. It is likely to be accepted and passed in  
15 Australia. There is resistance against it in the United  
16 States from the mine operators themselves. I think that  
17 this is a matter that I would recommend be debated in  
18 Nova Scotia.

19 Q. I take it that the only argument against that kind  
20 of a regime would be the added costs or availability of  
21 personnel from the mine operator's point of view?

22 A. There are two arguments against it from the  
23 operator's point of view. One, you've identified and  
24 that is the cost of paying the salary of another  
25 qualified engineer, specialized engineer at the mine.

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1 That is one problem. The other one is the difficulty of  
2 separating out matters relating to safety and health from  
3 matters relating to mine production. Where we have an  
4 engineer who is reporting to and responsible to the mine  
5 manager for both production and ventilation, there would  
6 seem to be a conflict of interest here.

7 Q. Okay. With respect to the methane layering, I just  
8 wanted to clarify. I take it from your evidence that the  
9 speed of that methane layer, obviously, is quite  
10 significantly lower than the speed of the air, the air  
11 velocity. Is that, in fact, the case?

12 A. Not always. If we have, let me use an example for  
13 you, if we have an ascending airway with no air movement  
14 in it at all, zero velocity air movement, a methane layer  
15 will be streaming uphill. The methane layer will be  
16 moving faster, obviously, than the stagnant air.

17 COMMISSIONER It depends on the speed of the air.

18 A. Yes. sir.

19 MR. HEBERT In normal condi -- in the conditions that  
20 existed in the Westray Mine with the air velocity that we  
21 know, I take it that relative to that, the methane layer  
22 would be fairly slow.

23 A. Again, there are no simple answers. Remember that  
24 this methane layer is a variation in concentration of  
25 methane from the general body right up to the highest

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1 concentration at the roof level. The velocity of the  
2 methane layer will also vary through that layer.

3 Q. With respect to methane layering in the Southwest 2  
4 No. 1 Road, I might have missed it, but did you express  
5 any opinion as to whether or not there was, in fact,  
6 layering in that area?

7 A. Southwest 2 No. 1?

8 Q. Yes.

9 A. That is this one?

10 Q. Yes, are you able to express that opinion?

11 A. Methane layering could have been occurring in there  
12 from two sources. One, the methane emissions at the rib  
13 side within the headings itself streaming up those  
14 vertical walls and collecting at the highest points of  
15 the roof. We identified that one.

16 Secondly, we also identified the possibility of  
17 layering taking place all the way up this inclined airway  
18 despite the additional turbulence which would occur at  
19 this junction because of the turn and because of the boom  
20 truck. Despite that, it is quite possible that methane  
21 layering could have continued uphill and also, had it  
22 been sufficiently concentrated, the methane layer, also  
23 sideways, and that is assuming that the inclination of  
24 that road would allow such layering to take place. We  
25 know that that was essentially on strike, a level entry,

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1 and, therefore, it is possible that methane layering  
2 could have continued from the junction into that strike  
3 airway.

4 Q. I appreciate that and I understood your evidence was  
5 that in your opinion in all likelihood there was a layer  
6 streaming from the Southwest 1 area up the main slope  
7 into the Southwest 2 area.

8 A. Yes, sir.

9 Q. That was your opinion that that was likely the case?

10 A. Yes.

11 Q. I didn't hear you say that it was also your opinion  
12 that it was likely the case that there was layering on  
13 the Southwest 1 -- or Southwest 2-1 Road, and I might  
14 have missed that.

15 A. I think that there was certainly layering taking  
16 place in that heading because of the make of gas within  
17 that heading.

18 Q. Okay.

19 A. What I'm also indicating now in response to you is  
20 that there is that second possibility of methane layering  
21 coming up the Southwest 2 and turning that corner as well  
22 as preferentially going, carrying on uphill, turning that  
23 corner and entering from the outbye end. We could have  
24 had a methane layer from both ends of the heading.

25 Q. Your opinion is that there was a methane layer, but

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1 at this stage you can't say what was the source, is  
2 that --

3 A. There was certainly a methane layer in there because  
4 of the make of the gas in the heading. My question is  
5 whether the second source --

6 Q. Okay, fair enough.

7 A. Was effective.

8 COMMISSIONER Are you just about winding up, Mr. Hebert?

9 MR. HEBERT Probably another five minutes or so.

10 COMMISSIONER Make it five, yeah, make it five.

11 MR. HEBERT With respect to the coal dust, you  
12 indicated that even a thin layer of dust over dust which  
13 had been previously dusted, stone dusted, could pose a  
14 problem.

15 A. Yes.

16 Q. And I take it that would arise if that dust was  
17 picked up and moved into the air?

18 A. Yes.

19 Q. Later in your testimony you indicated that the force  
20 of the pressure, the explosion, would cause the dust to  
21 mix. And I take it that that would not only cause the  
22 top layer to mix but a substantial portion, if not all of  
23 the dust on the floor. Would that --

24 A. Preferentially, the top layer, because that is the  
25 most recently settled layer and, therefore, be less

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1 consolidated than layers underneath. So the relevance of  
2 this is that if you have a thin layer of coal dust which  
3 has been deposited on the top of underlying layers of  
4 rock dust, that will still be capable of propagating an  
5 explosion.

6 Q. Yes, okay, in the context of this explosion, given  
7 the force as we know it, would you expect that this would  
8 have been a case where it was just the top layer which  
9 was being stirred into the air or would there be a  
10 substantial amount of dust from underneath the top layer,  
11 if you will?

12 A. It takes relatively little coal dust to propagate  
13 the dust explosion, little in terms of settled layers of  
14 dust, that is. So the top layer would have been  
15 sufficient. How deep into the deposited dust it was in  
16 fact disturbed, I do not know.

17 Q. I guess what strikes me is that if you have, for  
18 example, a very high concentration of stone dust in the  
19 coal dust or a mixture, if you will, in the underlying  
20 layers, if you will, and there was a thin layer on top,  
21 and if there was a stirring of both the top layer and a  
22 portion of the underlying layer, the total concentration  
23 of stone dust in the mixture could still be high enough  
24 to dampen an explosion.

25 Q. Let me repeat what I said before, sir, and that is

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1 that experience has shown us and experiments have shown  
2 us that a very thin layer, one that is only just visible,  
3 the blackness of the coal dust, will propagate an  
4 explosion, despite there being stone dust at deeper  
5 levels.

6 Q. In your experience, how long would it take, knowing  
7 the layout of the mine, how long should it take to  
8 properly stone dust for a mine of this size? Is this  
9 something that can be done in a matter of hours, a matter  
10 of days?

11 A. It is something that should be done on a regular and  
12 continuing basis. The best possible mechanism for doing  
13 this is by using devices known as trickle dusters which  
14 continuously, continuously emit a stream of rock dust  
15 into the ventilating air stream. That dust will be  
16 carried with the ventilating air stream and deposited  
17 with the coal dust. That is the best possible way of  
18 doing it.

19 Q. Given what we know about the amount of stone dust  
20 which was actually present, and I'm thinking now towards  
21 the end of April, early May. You're faced with a  
22 situation where there is insufficient stone dusting. You  
23 then say, you know, dust. How long would you expect that  
24 kind of an operation, knowing what we know about the  
25 percentages which were present, how long would that have

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1 taken, should it have taken?

2 A. If I was starting with that situation that you  
3 describe and you were going to stone dust the whole mine,  
4 then it would be a matter of several hours, I would  
5 estimate. Whether one did it by hand, the old fashioned  
6 manual method, or whether one went through with trickle  
7 dusters, I think we're talking about a period of some  
8 hours.

9 Q. So you could have dusted the whole mine within a  
10 period of several hours?

11 A. I would have estimated so. Certainly within a  
12 shift. That is assuming -- let me add the rider, what I  
13 am assuming here. That is assuming that the manpower is  
14 available to do it.

15 Q. And the material?

16 A. And the material, yes.

17 Q. And can you estimate the manpower that would be  
18 necessary, for example, to do it by hand?

19 A. Well, the more people you have doing it, the shorter  
20 time it's going to take.

21 Q. And I take it your remarks about several hours and  
22 you're saying if the manpower is available, you're being  
23 realistic about that in terms of the work force available  
24 at Westray?

25 A. That's exactly what I had in mind and was the cause

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1 of my added rider.

2 Q. Okay, fair enough. And in terms of the stone dust  
3 barriers that you'd referred to, putting the stone dust  
4 on shelves, again, how long would you expect it to take  
5 to erect such a structure? In the typical entry into the  
6 Southwest section, for example?

7 A. This is not a complicated structure at all. I would  
8 imagine a simple stone dust barrier could be erected by  
9 two people in one, at the most, two shifts.

10 Q. Now with respect to the incandescent heating, if you  
11 will, of sandstone or pyrite that you referred to as a  
12 possible source of ignition, would that be visible?

13 A. Yes.

14 Q. Is there any indication that that was recorded or  
15 seen at Westray prior to May 9?

16 A. I do not recall that being reported as an  
17 incandescent streak. We have a number of reports of  
18 sparking taking place at the continuous miner. And as I  
19 indicated earlier, this is not unusual.

20 Q. Would the fact that there were no previous sightings  
21 of this incandescent streak, would that be significant in  
22 terms of whether or not that might have been the source?

23 A. I think we have to bear one thing in mind here and  
24 that is that when the miners in their interviews reported  
25 sparking, I am not at all sure that they would be able to

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1 differentiate between sparking and consolidated sparking,  
2 or as I referred to it, an incandescent streak.

3 Q. So we just don't have the data available to assess  
4 that?

5 A. That is correct.

6 COMMISSIONER One more question, Mr. Hebert.

7 MR. HEBERT I believe Mr. Merrick touched on the  
8 response of mine management in the face of an explosion  
9 such as this. And is there any further investigation  
10 which might have taken place at Westray that didn't take  
11 place but that you would have recommended? Was there  
12 anything in the investigation that you would have liked  
13 to have seen differently?

14 COMMISSIONER This is post-explosion?

15 MR. HEBERT Post-explosion, yes.

16 A. I'm not quite clear on the question, sir. Could you  
17 repeat it?

18 Q. All right, certainly. I'll try to rephrase it a  
19 bit. I take it -- maybe I should break it down. Are  
20 there standard investigation -- disaster investigations,  
21 if you will, procedures in place within the mining  
22 industry?

23 A. I would not call them standard. Fortunately,  
24 disasters like this in the coal mining industry are  
25 becoming rare, thankfully. And because of that, such

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1 investigations are also, therefore, fairly rare. And the  
2 actual procedures adopted from country to country would  
3 seem to depend upon the legal structure and the tradition  
4 within that country. I don't think there is a standard  
5 as such.

6 Q. Now in terms of the legal structure, are there  
7 certain legal requirements with respect to securing sites  
8 and this kind of thing which you're aware of?

9 A. In Nova Scotia?

10 Q. In other areas. In the United States, in Australia,  
11 Great Britain.

12 A. I think that when -- let me back off. When a  
13 disaster, mine disaster, takes place, there is a  
14 procedure -- there is a fairly standard procedure adopted  
15 in the immediate -- during the progress of the disaster  
16 itself, a control center is set up. Certain authorities  
17 are notified. This will include -- this should include  
18 medical authorities, fire authorities, civil authorities  
19 I've been talking about here, and police authorities.  
20 The police will typically take care of securement of  
21 entrances and exits from the mine, and take care of  
22 traffic control. It is not unknown for the police to  
23 then continue their investigations to the extent that  
24 they will commandeer, if that is the right word,  
25 evidence, as indeed happened here at Westray. That is

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1 not uncommon.

2 Q. Okay, fine, I guess that's my question.

3 COMMISSIONER Ms. Gillis?

4 MS. GILLIS No questions.

5 COMMISSIONER Mr. Wells, no questions?

6 MR. WELLS No questions.

7 COMMISSIONER Fine, then we're just left with the  
8 Province. We'll recess at two o'clock, at which time  
9 we'll have the demo which they're saying half, three  
10 quarters of an hour. Mr. Endres, what time are you  
11 thinking of, bearing in mind that Dr. McPherson is  
12 through today?

13 MR. ENDRES I'll let my colleagues speak to that.

14 MR. WILSON That will leave us what, approximately,  
15 about two hours?

16 COMMISSIONER Yeah, about that, yeah.

17 MR. WILSON I guess I'll have to do the best I can.

18 COMMISSIONER Okay, I'm sure you will. Thank you very  
19 much. Recess until two, and I suppose the best thing to  
20 do is to come back here and then the mine -- the museum  
21 people will take us over to the loading gate where the  
22 demonstration will be set up, okay? In case any of you  
23 are concerned, it's going to be indoors.

24 INQUIRY RECESSED (TIME 12:39 p.m.)

25 INQUIRY RESUMED (TIME: 2:33 p.m.)

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1 COMMISSIONER Just before we start, briefly I would like  
2 to put on the record my thanks for the demonstration  
3 which we just witnessed and it was put on by Mr. Gary  
4 Bonnell and Mr. Dave Young who are both with the CANMET  
5 Coal Laboratory in Sydney. And they acceded to a request  
6 from the Inquiry to put on the demonstration here today.  
7 And I think, on balance, it was a fairly informative and  
8 fairly graphic display which should put a little bit more  
9 substance to the discussions about methane coal dust and  
10 coal dust, methane and rock dust, as you have seen in the  
11 -- for the few minutes this afternoon. So I won't take  
12 up any more time. But, again, I thank CANMET for their  
13 cooperation in this. Mr. Wilson?

14 MR. WILSON Thank you.

15 EXAMINATION BY MR. WILSON

16 Q. Dr. McPherson, you talked about many things over the  
17 last couple of days and now we get to go back over it  
18 again. The Kilborn Study that you reviewed and the  
19 numbers relating to ventilation, now as I understand it,  
20 you calculated air flow of somewhere in the neighbourhood  
21 of 6.9 cubic meters a second to dilute the methane at the  
22 headings?

23 A. Yes.

24 Q. And when velocity was taken into consideration you  
25 did an air flow calculation of 8.4 cubic meters a second?

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1 A. Yes, sir.

2 Q. To produce enough velocity to prevent layering?

3 A. Yes.

4 Q. And you also concluded, I believe, that the main  
5 ventilation at the mine was sufficient on May 9th, the  
6 main system was sufficient ventilation for May 9th?

7 A. For the main ventilation route, yes.

8 Q. Yes. Now the requirement set out for Kilborn, I  
9 understand it, they called in their section of  
10 ventilation for 20 cubic meters to dilute the methane?

11 A. Yes.

12 Q. And that would be higher than both the measurements  
13 that you call for, the 8.4 and the 6.9?

14 A. No, sir. The 8.4 cubic meters per second is with  
15 reference to a single heading; the 20 cubic meters per  
16 second being referred to by Kilborn are for a section.

17 Q. And what did you understand the section to refer to?

18 A. The section being a number of working places, a  
19 number of these headings, just as we refer to the  
20 Southwest 2 section.

21 Q. Is there anywhere in the Kilborn report that defines  
22 the sections that you're aware of?

23 A. As I indicated, the treatment of ventilation in this  
24 report is indeed simplistic. I studied only the  
25 ventilation section.

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1 Q. Would it be fair to say that the section would  
2 include the -- the heading would be -- would include the  
3 continuous miner and the roof bolter?

4 A. I would assume that, yes.

5 Q. Yes. And that the methane dilution requirements  
6 would be for that section that was working, the  
7 continuous miner and the roof bolter?

8 A. Yes.

9 Q. And the 20 cubic meters per second would be what  
10 they would prescribe for that heading?

11 A. For that section of the mine. Not for a heading.  
12 Let me repeat, the section of the mine will consist of  
13 normally a number of working places, more than one  
14 heading.

15 Q. But you don't know how many were talked about in the  
16 Kilborn Study?

17 A. The treatment of the ventilation in the Kilborn  
18 Study again is very simplistic. It was rudimentary.  
19 Very little was specified.

20 Q. We were looking at -- on page 9 they list the  
21 equipment for Section 3.72 -- or 3 -- yeah, 3.72.

22 A. Can you give me a reference, Mr. Wilson?

23 Q. I'm sorry, Kilborn No. 1, Exhibit 1. It's page 9 of  
24 the report, Section 3.72.

25 A. Exhibit 1. And the page number again, I'm sorry?

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1 VOICE About the middle of the book.

2 MR. WILSON Page 9 of the text. It's the heading,  
3 "Mine Equipment and Rates of Production."

4 A. Yes.

5 Q. They list the equipment for -- I take it that would  
6 be a production unit?

7 A. It appears to be so, yes.

8 Q. And they anticipated four sets of equipment for  
9 production? On the top of page 10.

10 A. I see it, yes.

11 Q. Yeah. Would it not be, in a sense, reasonable to  
12 conclude that when we're talking about a production unit  
13 and the rate of methane flow to that, that it would be  
14 talking about ventilating the area worked by one  
15 continuous miner and a roof bolter?

16 A. The method of working that was employed here was to  
17 employ the continuous miner in order to advance a  
18 heading --

19 Q. Yes.

20 A. -- a certain number of feet, to withdraw it, send in  
21 the roof bolter to bolt the roof. During the time that  
22 the roof bolter is so bolting that roof, the continuous  
23 miner would go to one of another or others adjoining  
24 headings and continue its work there. It is a cyclic  
25 operation. That implies that there will be at least two

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1 headings, at least two headings, in the section.

2 Q. It would imply two headings?

3 A. Yes, sir. And maybe more.

4 Q. Well, what situations would you see where there  
5 would be more?

6 A. Well, if we look at the Southwest 2 section, we have  
7 one, two, three, four, five headings within that  
8 Southwest 2 section.

9 Q. Yes. And we have one production unit at the -- on  
10 the date of the explosion --

11 A. Yes.

12 Q. -- in that area. In the Southwest 2-1 Road, at the  
13 heading? There are two headings?

14 A. Yes.

15 Q. Now wouldn't it be reasonable to assume from reading  
16 the report that when the production is being ventilated  
17 by 20 cubic meters a second that one would be talking  
18 about ventilating two headings?

19 A. The fact that mining is not going on, that is, rock  
20 breaking is not going on in the heading, does not mean  
21 that there is no methane production in those currently  
22 non-mined headings. Methane production, as we've  
23 indicated in this two days, in the headings comes from at  
24 least two sets of sources. May I go on?

25 A. Uh huh.

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1 Q. One is the methane made at the peak point at the  
2 point of fragmentation of the material.

3 Q. Uh huh.

4 A. And, secondly, we have those sources of methane that  
5 are being emitted from the solid coal on the rib sides,  
6 the solid coal that is in the part adjoining the  
7 continuous miner. You recall, sir, that the continuous  
8 miner cuts one half of the face and then the other half?

9 Q. Yes, I understand that, Mr. McPherson, but the  
10 section on ventilation specifies that each mining  
11 production unit will be provided with an air quantity of  
12 20 cubic meters per second, and you agreed with me that  
13 it would appear that a mine production unit would  
14 reasonably be anticipated as a continuous miner and a  
15 bolter. So ventilating at least 20 cubic meters per  
16 second to that mining production unit, whether that's  
17 split between two headings or one, there's -- it  
18 anticipates 20 cubic meters per second being delivered to  
19 that unit.

20 It also anticipates, in addition to that, a five  
21 cubic meter per second supply of air to the face of each  
22 entry. And that would be at page 7. So we have  
23 production units and we have entries specified in the  
24 Kilborn report, one having 20 cubic meters per second for  
25 the production unit and one having five cubic meters per

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1 section at the face of each entry. From that, can we not  
2 assume that the Kilborn report, and it says at least five  
3 cubic meters per second at the entry, the Kilborn report  
4 would be providing air requirements capable of delivering  
5 the 8.4 cubic meters per second that you say is required  
6 to produce velocity to prevent layering?

7 A. First of all, we seem to be using two separate words  
8 here, "unit" and "section" and they are being used within  
9 the Kilborn report. The top of page 7, "The ventilation  
10 of five mining units of which four will be in production  
11 will require an air quantity of 100 cubic meters per  
12 second." From that I gather that the recommendation here  
13 is that there will be four areas of the mine within which  
14 production is taking place, albeit in one heading at a  
15 time in each of those differing areas and that each of  
16 these five sections will require 20 cubic meters per  
17 second.

18 Q. Well, with respect, Dr. McPherson, it doesn't say  
19 each section will be required, it says each production  
20 "unit" will be provided with. Now "production unit"  
21 consists of a bolter and a continuous miner and each unit  
22 is provided with 20 cubic meters per section -- second of  
23 air.

24 A. Let me, in that case, ask you that in those headings  
25 that are not currently being mined or bolted, what

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1 provision is made in this part of the report for those  
2 noncurrently working headings?

3 Q. It says, as far as my reading of the report is  
4 concerned, it says that they will be provided with at  
5 least five cubic meters per second of air. And that's on  
6 page 7.

7 A. That is for production headings, is it not?

8 Q. Pardon me? It just says, "the inbye blind  
9 ventilation will be provided to provide at least five  
10 cubic meters per second of air to the face of each  
11 entry."

12 A. If we're to have 5 x 20 cubic meters per second for  
13 those headings that are being mined, making up the  
14 hundred, 100 that is mentioned, that --

15 Q. Well, the reports says --

16 A. -- would seem to leave nothing else over to  
17 ventilate those headings that are not being mined.

18 Q. The report specifies only four will be working at  
19 any given time.

20 A. I'm sorry, would you repeat that, sir?

21 Q. The report specifies that four will be working at  
22 any given time.

23 A. Four of those sections, yes.

24 Q. Ventilation of five mining units of which four will  
25 be in production. So that would be 4 x 20 which would be

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1 80,000 cubic meters a second.

2 A. At the top of the page it does refer to the fact  
3 that five units are included in the calculation of 5 x  
4 20.

5 Q. That's right. Four in production. Four units in  
6 use at any given time.

7 A. I'm sorry, I'm waiting for a question on this.

8 Q. Well, is it not reasonable to assume that 20 cubic  
9 meters per second is specified to be provided to the  
10 production units which would be a rock bolter and a  
11 continuous miner. And that quantity of air would be  
12 sufficient to provide the 8.4 cubic meters per second  
13 that you have suggested is required to produce enough  
14 velocity to prevent layering in the heads?

15 A. I think we're going around in circles on this one,  
16 Mr. Wilson. Let me say again that my calculation of 8.4  
17 cubic meters per second was for one single heading, not  
18 two headings or more.

19 Q. Well, we have 20 --

20 A. And these units here that are being referred to, I  
21 believe you've agreed, consist of at least two headings.

22 Q. Yes. And 20 divided by 10, I suggest, or 20 divided  
23 by 2 would give capacity for 10 at least to each heading.

24 A. If we had, indeed, only two headings. But as I've  
25 pointed out, we have one, two, three, four, five headings

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1 in the Southwest 2 district.

2 Q. Yes.

3 A. These headings require ventilation whether they're  
4 being worked or not.

5 Q. Yes, and the report says at least five will be  
6 provided to the entry. I'm talking about what was  
7 specified in the Kilborn plan and can one not read the  
8 Kilborn plan as providing sufficient ventilation,  
9 according to your calculations, to a production heading  
10 to prevent methane layering?

11 A. If we take the five headings in the Southwest 2  
12 area --

13 Q. Well, with respect, Dr. McPherson, let's take the  
14 wording of the Kilborn report.

15 A. Yes.

16 Q. And from the Kilborn report, could one not conclude,  
17 based on your figures, that enough air quantity is  
18 contemplated to be provided to the headings to dilute and  
19 prevent layering?

20 A. Well, the paragraph two-thirds of the way down page  
21 7 to which you have referred stating that at least five  
22 cubic meters per second of air to the face of each entry,  
23 let's take that paragraph. They're recommending five  
24 cubic meters per second of air to the face of each entry.

25 This was twice the 2.5 cubic meters per second that was

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1 recommended in the Manager's Safe Working Procedures.

2 Q. Dr. McPherson, we're not talking about the Safe  
3 Working Procedures; we're talking about the Kilborn  
4 report.

5 A. I want to make a point, sir.

6 Q. Well, you -- I'm -- I would ask you to answer the  
7 questions.

8 A. Very well.

9 COMMISSIONER Mr. Wilson, he's going to make a point.

10 MR. WILSON Okay.

11 A. The point I was trying to make, sir, was that the  
12 2.5 cubic meters per second represent an air velocity of,  
13 I believe, 24 feet per minute. Twice that amount as  
14 recommended here, five cubic meters per second, would  
15 have given the velocity, therefore, of 48 feet per  
16 minute. This is still less than that required to prevent  
17 layering. In other words, specifically to this  
18 paragraph, the five cubic meters per second recommended  
19 in here, had it been followed, would have been an  
20 improvement, certainly, on the Manager's Safe Working  
21 Procedures, but it would still not have prevented  
22 layering in the headings.

23 Q. The paragraph reads at least five cubic meters per  
24 second.

25 A. That is what I quoted to you and that would not

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1 prevent layering in the headings.

2 Q. And the section states that when -- to a production  
3 unit, it's going to provide 20 cubic meters per second.  
4 You don't agree that there are two distinctions in the  
5 Kilborn report, two areas being talked about here? When  
6 an area is being -- into production, 20 cubic meters per  
7 second will be provided and for any blind entry at least  
8 five cubic meters per section will be required.

9 A. Yes, the distinction is being made there between a  
10 single heading, they call it a "blind end." A  
11 distinction is being made; that I agree, and a section or  
12 a unit which will comprise of two or more, at least two  
13 headings. Would you refer to, again, the Southwest 2  
14 with the two, four, five headings. Had the five cubic  
15 meters per second per single heading been applied there,  
16 that would imply without leakage a volume flow of 25, not  
17 20, but 25 cubic meters per second to that section.

18 Q. That is not a production unit though. I mean, there  
19 is one production -- there are -- how many production  
20 units are there? There are two -- one, two production  
21 units.

22 A. A production unit, by your own definition, is at  
23 least two headings, a bolter and a continuous miner. And  
24 for the purposes of continuity of mining, it will be more  
25 than that, as we see in the Southwest -- as we see in the

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1 North. It is only in the Southeast district, this one  
2 that is only just beginning, that we have only two  
3 headings.

4 Q. Now when Mr. Merrick asked whether or not there  
5 were, prior to the drivage of the tunnels, whether or not  
6 there were any -- there was any other data available  
7 relating to ventilation, your answer to that was, no. If  
8 you look at Exhibit 37-A.

9 COMMISSIONER Page?

10 MR. WILSON Page 4. First of all, do you know when  
11 the drivages started for the Westray Mine?

12 A. I'm sorry, did you say page 4?

13 Q. Yes.

14 A. Okay, I have page 4.

15 Q. This is a list of exhibits compiled entitled  
16 "Supporting Documents" for your report, Doctor.

17 A. Yes, I have page 4 in that.

18 Q. Okay. Did you -- do you know when the drivages  
19 started for the Westray Mine?

20 A. I don't recall the exact date, sir, no.

21 Q. Now could you describe what is contained on page 4  
22 and the subsequent pages?

23 A. Page 4 is -- appears to be a fax from Dames & Moore,  
24 addressed to Gerald Phillips. The first page, the cover  
25 page, refers to four sheets itemizing design details for

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1 ventilation, access tunnels, mine developments, and panel  
2 development to production as discussed yesterday. And  
3 the following pages contain -- refer to mine ventilation  
4 design, access tunnel design, mine development design and  
5 panel development and production design.

6 Q. And they include ventilation design figures and  
7 criteria?

8 A. The numerical values?

9 Q. Yes.

10 A. Yeah, the numerical values by figures, presumably.  
11 Not diagrams.

12 Q. Not diagrams, no.

13 A. Yes, I agree.

14 Q. Who is -- do you know Dames & Moore?

15 A. It is a consulting company in mining --

16 Q. Pardon me?

17 A. It is a mining consulting company.

18 Q. And these are ventilation statistics that were  
19 prepared before the mine was driven?

20 A. As I said, I'm not sure of the date the mine  
21 commenced its development.

22 Q. Well, sure. I think in the exhibit with the  
23 development tunnel there it shows the driving starting  
24 in --

25 A. Okay.

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1 Q. -- July of '89.

2 A. Okay.

3 Q. Okay? So this would have been figures available  
4 prior to that?

5 A. Okay.

6 Q. Now we sort of throughout your evidence, Dr.  
7 McPherson, we were jumping back and forth dates and times  
8 from one month to the other in explaining some of these  
9 concepts. Perhaps if you could help me understand, my  
10 understanding of the mine development is that it is a  
11 relatively dynamic process. It changes from day to day  
12 and from week to week. Would you agree with that?

13 A. The physical process of developing a mine?

14 Q. Yes.

15 A. By its very nature, it is developing, yes.

16 Q. And the tunnels advance on a daily basis?

17 A. Yes, sir.

18 Q. And the ventilation changes, the auxiliary  
19 ventilation, in any event, changes constantly in the  
20 room-and-pillars?

21 A. It should not. It should remain at a value  
22 sufficiently high to provide dilution of the pollutants  
23 and adequate mixing of those pollutants.

24 Q. Well, what I was thinking more of, Dr. McPherson,  
25 was not the quantity of air but the actual physical

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1 plant.

2 A. The ducting will have to be extended.

3 Q. The ducting and the fans.

4 A. If the system has been properly designed, then the  
5 fan or fans in that auxiliary ducting line should be  
6 sufficient for the projected duty of the maximum length  
7 of the ducting.

8 Q. Yes, but the cuttings advance as well. So when you  
9 advance the cutting -- When you advance the cutting, you  
10 have to move the fans and the ducting forward?

11 A. No, sir, you have to extend the ducting. The fans  
12 should remain in their location if they have been  
13 properly located in the first place.

14 Q. Oh, I see. So -- Well, perhaps you could  
15 illustrate. I assumed that when you moved -- when you  
16 completed one pillar, you had to move the fans and the  
17 duct to the next pillar that you were developing.

18 A. Yes, that is the stage one reaches when you have  
19 reached the extent to drive the next crosscut. May I  
20 illustrate at the board?

21 Q. Yes, go ahead.

22 A. No. 8. Here we have the kind of system that we're  
23 looking at at Westray where we're advancing forward with  
24 developing drivages and from time to time we're driving  
25 crosscuts. The installation -- Let me put this into a

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1 fuller form, and these, of course, should be open. Back  
2 track on that. They are crosscuts with open ends but  
3 stoppings to prevent direct short circuiting. Okay, one  
4 has reached the position of the next crosscut, these  
5 being at pre-determined distances apart. Then you have  
6 to advance forward until you've got to the next crosscut.  
7 It is the extension of the ducting. Let's assume an  
8 exhausting system such as they were using at Westray. So  
9 the auxiliary fan would be in this position, drawing air  
10 down from the face of the heading. This is often  
11 referred to in mining circles as "the last open  
12 crosscut." Physically, that's where it is. It's the  
13 last open crosscut. So the through-flow of air.

14 I've referred to through-flow of air. The through-  
15 flow of air, the main through-flow would be like this,  
16 and this is ventilated primarily, if not totally, by the  
17 main ventilation fan of the mine; in this case, at  
18 surface.

19 So the ducting in this heading that's moving forward  
20 will be extended as the heading moves forward. The fan  
21 will stay in its same location. When the distance has  
22 been covered for the next crosscut, I'm going off the top  
23 of the page here, that that crosscut will be driven and  
24 at that time, at that time, and not before, the fan will  
25 be moved up to here and away we go again.

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1 Q. Right, and I take it when you're moving those fans,  
2 you're also -- you have to adjust the length of the duct  
3 as well as you're going forward?

4 A. Indeed, the whole thing will be dismantled and will  
5 start off with the short length of duct which will then  
6 go on being increased.

7 Q. Now in figuring out your ventilation needs, is that  
8 as well a constant monitoring process where you have to  
9 evaluate those on a daily basis, whether changes have to  
10 be made, for instance, in the volume going into the area  
11 or whether the ducting has to be longer or shorter. Who  
12 does that?

13 A. The extension of the ducting is made on a basis of  
14 the rapidity with which the mining heading, the face, is  
15 being advanced. The important matter here is that that  
16 ducting should be maintained to within a specified  
17 distance from the face. If you leave it too far back,  
18 then it's obviously not going to do its job of adequate  
19 ventilation near the face area. So the extension of the  
20 ducting is determined by that length of the front end  
21 that does not contain the ducting.

22 Q. I think you may have specified a figure of, is that  
23 correct, 8.5 meters at one time?

24 A. That is not my figure, sir. That was specified in  
25 the Manager's Safe Working Procedures, I believe.

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1 Q. Oh, okay. Is there a magic figure for that or a  
2 figure that one uses?

3 A. Dictated by these factors. First of all, if one is  
4 using a forcing system, which was not being used here,  
5 but if one were to use a forcing system, then the jet  
6 effects of the air coming out of that duct would, as I  
7 illustrated yesterday or the day before, tend to move  
8 forward because of its inertia, because of its kinetic  
9 energy and scour the face of the heading.

10 On the other hand, with an exhausting system, such  
11 as being used here, the air tends to get pulled directly  
12 into the ends of that exhausting duct and, therefore,  
13 does not have the kinetic energy to project forward and  
14 scour the face of the heading. This is why forcing  
15 systems are preferred for gassy headings.

16 Now with respect to your specific question, it is  
17 clearly even more important in an exhausting system to  
18 keep that duct up close, as close as practicable to the  
19 face of the heading. That is one factor. Do you wish me  
20 to go on?

21 Q. Go ahead.

22 A. Another factor is the very practical one of the  
23 ventilation ducting allowing the mining operation to  
24 proceed. It would, for example, be impractical to take  
25 that ventilation ducting so close to the face that it is

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1 over or at the side of the continuous miner. It would  
2 become damaged if one attempted to keep it so close. So  
3 this is a very practical consideration. The 8.5 meters  
4 that I believe was specified in the Manager's Safe  
5 Working Procedures, I also believe took that practical  
6 issue into account.

7 Q. Now there was a little bit of talk on the  
8 continuous miner, and I wanted to get your view on the  
9 continuous -- the effect that the continuous miner has on  
10 ventilating the head of the -- maybe "ventilating" is not  
11 quite the proper word but the effect that the continuous  
12 miner would have in mixing the methane air mixture at the  
13 head of a working face. It's equipped with picks that  
14 rotate at high speed. Water sprays. And in the case of  
15 Westray, I believe, they had scrubbers capable of  
16 something to the order of 7500 cfms of power.

17 A. Yes.

18 Q. What effect does that have in terms of clearing any  
19 so-called dead air zones or impacting on the mixing of  
20 methane with air so they won't layer?

21 A. We did deal with this in response to Mr. Merrick's  
22 questioning. All of those three items that you mentioned  
23 would contribute and do contribute towards the mixing of  
24 the methane. The movement of the drum. Let me correct  
25 one small item you mentioned. You've described this as a

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1 high-speed drum. The drums turn relatively slowly. If  
2 you turn them at high speed, then you produce too much  
3 dust. But, certainly, the movement of the drum does help  
4 to mix the methane into the air.

5 And certainly the sprays, the dust suppression  
6 sprays, because of the ability of sprays, water sprays to  
7 induce air movement, those again will assist in that  
8 mixing process.

9 Thirdly, again you're correct, the dust extraction  
10 system, which is primarily intended to do just that,  
11 extract dust-laden air and filter some of that dust out  
12 of the air, that also, because of the air movement it  
13 would generate, tend to improve and enhance the mixing  
14 and the dilution process. All of that is true.

15 However, if the ventilation provided by the  
16 auxiliary system does not provide a continuous and  
17 adequate flow of fresh air to the face of the heading,  
18 then that mixing, those mixing processes that we have  
19 just talked about will do no more than mix the methane  
20 into the air producing higher and higher concentrations.  
21 An example of what I have referred to earlier as  
22 uncontrolled recirculation. So whilst those mechanisms  
23 do help to dilute the methane, they do not in any sense  
24 mitigate against the need for through-flow ventilation  
25 provided by the duct system.

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1 Q. Are they looked upon as an extension of the ducting  
2 system or a part of the auxiliary ventilation? In terms  
3 of the mining dynamics, how are they classified?

4 A. The three mechanisms that you've mentioned should  
5 not be included as part of the auxiliary ventilation, no.  
6 I would withdraw from that. But they do have that mixing  
7 component that you've mentioned. And, again, let me  
8 reiterate that if the through-flow ventilation provided  
9 through the duct system is adequate and sufficient, then  
10 these mechanisms we've talked about would assist in the  
11 dilution and removal of the methane from the face area.

12 Q. So if your balance is right, I guess, if your  
13 balance of taking exhausting air out and the continuous  
14 miner, then it's an effective way of removing and mixing  
15 methane?

16 A. It is of great assistance, I agree with you,  
17 provided that through-flow ventilation is adequate.

18 Q. How constant a monitoring do you need for that  
19 through-flow ventilation in order to ensure that that  
20 balance is achieved? Is that something that you monitor  
21 daily, weekly?

22 A. It is not monitored on a continuous basis, normally.  
23 In some instances I have seen that done, but it is not  
24 usual. The checking of duct air flows is something that  
25 should be done on a regular basis as it seems to have

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1       been done on a weekly basis towards the latter part of  
2       the life of the mine.

3               I would add to that, however, that the ventilation,  
4       auxiliary ventilation system with its fan and duct  
5       arrangements as employed at Westray would be, should be,  
6       a very visible part of the equipment. And, indeed, we  
7       have seen references to damaged tubing, collapsed tubing.  
8       It's obviously, it's visually obvious if there's a  
9       problem with tubing, number one.

10              Number two, if the air flow through the ducts and,  
11       therefore, into and out of the headings is inadequate,  
12       then this will also be obvious to those personnel who are  
13       employed within those headings, as indeed it was obvious  
14       to those personnel.

15       Q.     Presumably, if there's duct collapse, I presume that  
16       action would have to be taken to repair the ducting as  
17       was done in the instances, I think, you referred to  
18       before.

19       A.     Yes, sir.

20       Q.     And I take it that if the duct was not drawing the  
21       required air flow, you'd either have to get stronger  
22       ducting or take some other remedial measure to correct  
23       that as well.

24       A.     The solution to that particular problem at Westray  
25       would have been to put in larger ducting.

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1 Q. Or could you not have put in stronger, smaller  
2 ducting? I thought you talked about that as well as a  
3 possibility.

4 A. Yes, indeed, that is an alternative to have the same  
5 size ducting or, as you suggested, even smaller ducting.  
6 That would have meant even larger powered fans. Let's  
7 take it through. That would have meant larger powered  
8 fans to overcome the additional resistance of the smaller  
9 ducting.

10 Number two, those larger powered fans would have  
11 generally necessarily more pressure to get the required  
12 amount of air through those smaller ducts.

13 And, three, that larger pressure, suction pressure  
14 in this case in the exhausting system, that larger  
15 pressure would have made it even more important that the  
16 ducting be capable of withstanding that larger pressure.  
17 None of this was done at Westray, of course.

18 Q. I'd like to move into the area of methane layering  
19 with you, Dr. McPherson. Perhaps if we could move in a  
20 way that I've attempted to understand what you were  
21 saying in your report.

22 We've talked a lot about the probability of a layer  
23 of gas existing in the Southwest 2 section of the mine.

24 A. Yes.

25 Q. And a lot of it talked, discusses, the issue of the

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1 propensity of the mine to layer and, in fact, whether or  
2 not there was a layer and that sort of thing. As I  
3 understand it, in order for a layer to occur, you have to  
4 have a source of methane and insufficient air volume and  
5 velocity to dilute it, basically.

6 A. Yes.

7 Q. And the parameters of the propensity to layer are,  
8 from your formulas, air velocity, width of the airway,  
9 and the rate of the gas emission.

10 A. And the fourth is the inclination of the airway.

11 Q. Okay, yes, that's right. And the air velocity is  
12 the function of the volume of the air in the cross-  
13 sectional area of the mine?

14 A. Yes, sir.

15 Q. Now from that, can we agree that as air velocity  
16 increases, the propensity to layer decreases; all other  
17 things remain equal?

18 A. Yes.

19 Q. That velocity increases as cross-sectional area  
20 decreases when volume is constant?

21 A. Yes.

22 Q. And that as the roadway narrows, the propensity  
23 decreases?

24 A. Provided the volume floor remains the same, yes.

25 Q. And that as the rate of emission decreases, the

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1 propensity as well decreases, all other things remaining  
2 equal.

3 A. Yes, sir.

4 Q. Now when you did your analysis of the layering  
5 effect or the layering issue in the Westray Mine, what I  
6 can gather from it is that you assumed basically a  
7 straight, empty room with a cross-sectional area of 21  
8 square meters?

9 A. Yes, sir.

10 Q. A velocity of 1.34 meters per second. And, in that,  
11 you assumed the air velocity to be 59,800 cubic feet per  
12 minute.

13 A. That is correct.

14 Q. A roadway width of six meters?

15 A. Yes.

16 Q. And a rate of emission of .118 cubic meters per  
17 second.

18 A. That was my initial estimate.

19 Q. Right.

20 A. Yes.

21 Q. And an incline of 13 percent?

22 A. 13 degrees.

23 Q. 13 degrees, sorry. And we've discussed as these  
24 factors change how the propensity to layer would be  
25 affected. Now perhaps if we could just -- I'd like to

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1 just take a minute to go through what existed at Westray  
2 as far as I can tell from the evidence, and if you could  
3 refer to Exhibit 45. That's the exhibit with all the  
4 maps. Do you have that, Dr. McPherson?

5 A. I have the document, yes.

6 Q. Okay.

7 A. Do you have a page number for me?

8 Q. Tab 11.

9 A. Yes.

10 Q. In particular, let's look at the ventilation map of  
11 the Southwest.

12 A. Yes.

13 Q. Now the first thing I notice is that, obvious from  
14 the maps, that the path of the ventilation coming from  
15 the Southwest section is not a straight line.

16 A. Yes, that is correct.

17 Q. And if we follow the path, and let me take it from  
18 the C-1 Road. From the C-1 Road, we have 75,800 cfms of  
19 air coming up to the Southwest 1-3 crosscut?

20 A. Yes.

21 Q. Over the crosscut, then taking an angle down the B  
22 Road.

23 A. Yes.

24 Q. To the Southwest section, rounding up into the  
25 Southwest 2-B Road and then into the Southwest 2-1 Road

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- 1 or continuing on the B Road.
- 2 A. Yes.
- 3 Q. Now coming up the C-1 Road and around is an angle
- 4 of, what, some 90 degrees?
- 5 A. You're referring to the angle?
- 6 Q. C Road in Southwest 1 3 cross?
- 7 A. Yes, it's obviously greater than 90 degrees, yes.
- 8 Q. And then another --
- 9 A. Slower angle.
- 10 Q. Slower angle.
- 11 A. Yes.
- 12 Q. And then an angle going back out the Southwest 2-B
- 13 Road of about 140 degrees?
- 14 A. Yes.
- 15 Q. And then another angle going up the Southwest 2-1
- 16 Road of about 140 degrees?
- 17 A. That one appears to be less than 90 degrees of a
- 18 turn at that point.
- 19 Q. Okay, and then --
- 20 A. 60 degrees or so.
- 21 Q. Or going back to Southwest 2 crosscut, then on out.
- 22 A. Yes.
- 23 Q. Now as I understand it, part of the method for
- 24 mixing methane and air velocity is the turbulence created
- 25 in the airway itself and that assists the mixing?

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1 A. We have discussed that, yes.

2 Q. What effect does the shifting of air, the 75,000  
3 cfms hitting the dead end and taking a right angle turn  
4 and then another turn and then a 140 degree turn, what  
5 does that do in terms of turbulence and ability to mix  
6 methane and create shock values or shock loss values that  
7 would have an impact on dilution and delayering? Does  
8 that have an effect?

9 A. Let me take your last two factors first. Shock  
10 losses, there are shock losses at each bend, each  
11 junction, each turn, correct.

12 Your penultimate factor was turbulence, I believe?  
13 Yes, I agree that at those same places, additional  
14 turbulence will be generated.

15 Your first point, I believe, was what effect would  
16 that have on methane layering and to what degree would  
17 such shock losses and such turbulence have on the layer?

18 Q. Promote mixing of the layer.

19 A. Yes. Let me give you two responses to you on this,  
20 Mr. Wilson. We did discuss this briefly earlier with  
21 respect to turbulence at the junction where the boom  
22 truck was situated, and the suggestion was made to me by  
23 Mr. Merrick that turbulence, and, therefore, mixing at  
24 that point would assist, indeed, in bringing methane  
25 concentrations down further into the airway. You may

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1 recall my response at that time was that that would --  
2 that does have a mixing effect. That mixing effect is  
3 accentuated when the density of the methane air mixture  
4 increases towards that of air itself. In other words,  
5 the broader the methane layer has become and, therefore,  
6 the closer it has become to the underlying air, then the  
7 easier that mixing process will occur. If you have no  
8 density difference at all, then it would mix with or  
9 without turbulence.

10 So as the density of the layer approaches that of  
11 the air as it moves uphill in this case, broadens, then  
12 the ease with which mixing can take place also increases.  
13 If you take it back closer to the point of emission or  
14 points of emissions, then the methane is in a thinner  
15 layer; it is more concentrated as a percentage. The  
16 density difference between the layer and the underlying  
17 air is perhaps at its maximum. In those conditions,  
18 mixing will be much more difficult.

19 So the point of this argument is that in those areas  
20 that you referred me to where the air takes sudden  
21 changes in direction close to the points of methane  
22 emission from the old workings, at those points and  
23 particularly on the return side of the old workings, that  
24 is, on the B Road, the methane layer is in a concentrated  
25 form and will not so readily mix.

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1 Another -- May I finish my response?

2 Q. Go ahead.

3 A. Another point to look at is that a jet of air or, in  
4 this case, a cross flow of air coming across Crosscut 3,  
5 a jet of air will, and again I used this word yesterday,  
6 tend to slide underneath a concentrated layer of methane  
7 and in illustration of this I wonder if you could turn to  
8 Exhibit 37-B, page 224.

9 Q. Yes, I believe we looked at that yesterday.

10 A. This is the same paper by Mr. Raine but a different  
11 part of that paper. This is a useful paper and has been  
12 used many times to look at these questions because this  
13 is one of the few occasions when quantification of  
14 methane layers was done to some detail. Do you have the  
15 figure? Figure 3 in that paper in front of you.

16 Q. Yes, I do.

17 A. If you take a look at that, you see that in this  
18 case a methane layer is occurring. The methane layer is  
19 moving in the direction of air. You'll see towards the  
20 -- on the right -- in the middle of that diagram we have  
21 a venturi. This is a means of putting a high velocity  
22 jet of air coming out of the end of the venturi. To the  
23 right of that, to the right of that you see that we have  
24 a methane concentration of 38 percent in the layer and on  
25 the left of that, we have a concentration of 55 percent

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1 methane. High concentrations. The methane layer is  
2 moving from left to right. Now one would intuitively  
3 imagine or think that such a high velocity jet of air  
4 would well and truly break up the methane layer. You see  
5 that that is not occurring. It is simply displacing the  
6 methane to the side and partially down on the side, the  
7 ribs of the airway. And on the downstream side of that  
8 high velocity jet that we would hope would break up the  
9 layer, that layer is reassembling itself. In other  
10 words, a jet of air, such as coming out of a crosscut  
11 accentuated highly in this diagram we're looking at, does  
12 not necessarily cause the dilution of the mixing that we  
13 would hope it would. They can sometimes displace it to  
14 one side and have the layer or the majority of the  
15 methane in that layer reform on the other side.

16 Q. That diagram shows that when it's running with the  
17 layer, but in the situation that we're looking at here,  
18 the 75,000 cfms are running broadside of the layer.  
19 Would that not have a difference? Would that not create  
20 a difference when you're running broadside into the layer  
21 as opposed to with it?

22 A. You can make references to other papers, Mr. Wilson,  
23 but there is at least one other paper showing other  
24 devices used as attempts to break up methane layers. And  
25 many such devices have been developed and attempted.

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1 Q. Sure.

2 A. Including the one we're looking at, the venturi  
3 effects, including suction devices, including delta wing  
4 formations to divert the air in all kinds of angles and  
5 directions with respect to the macro main direction of  
6 the air flow. It is quite difficult to break up the  
7 concentrated methane layer.

8 Q. Getting back to my initial point on this, these,  
9 which was simply the shock value loss of the effect of  
10 the flow and the -- would that have an effect in diluting  
11 the methane at the roof through turbulence or some other  
12 shock value from the methane turning the corners?

13 A. And, again, I --

14 Q. Is there a diluting effect?

15 A. That is the same question. Let me give you the same  
16 answer, that there would be turbulence. There would be a  
17 degree of mixing at the fringe. But because of the  
18 density of difference, the complete dilution, the  
19 complete elimination of that layer would, I very much  
20 doubt, occur. I believe that the layer would continue in  
21 its concentrated form.

22 Q. Okay.

23 A. Perhaps having lost some of the methane through the  
24 mechanisms you describe but by no means all of the  
25 methane.

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1 Q. Okay, it is a factor though. And it is a factor  
2 that's not included in the layering formula that you had  
3 developed? It's outside the parameters of that layering  
4 formula?

5 A. Yes, I agree.

6 Q. Okay.

7 COMMISSIONER Mr. Wilson, would this be an appropriate  
8 time to take a 10 minute break? I'll not deduct it from  
9 your time.

10 MR. WILSON Certainly, Mr. Commissioner.

11 INQUIRY RECESSED (TIME: 3:35 p.m.)

12 INQUIRY RESUMED (TIME: 3:46 p.m.)

13 COMMISSIONER Mr. Wilson?

14 MR. WILSON Thank you. Back to the plan, the volume  
15 of air going into the Southwest 2-B Road, would appear  
16 from the ventilation plan, and perhaps you could help me  
17 here, to be in the order or magnitude of 75,800 cfms  
18 coming to C-Road, across and around.

19 A. There was 75,800 cfms measured in the C-1 Road, yes.

20 Q. And would that same volume carry through to the  
21 Southwest 2-B Road?

22 A. No, sir.

23 Q. And why is that?

24 A. Because we have a leakage point. As you take a look  
25 at the -- go around the two bends --

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1 Q. Yes.

2 A. -- follow the intake air --

3 Q. Right.

4 A. And if instead of going up to Southwest 2, B-Road,  
5 you come back down the belt road, that is B-Road, you'll  
6 see a line across the road with the annotation "chocks"

7 Q. Yes.

8 A. "plywood covered opening for conveyor."

9 Q. Right.

10 A. This is, in fact, a form of stopping. It is  
11 sometimes called a check point on a belt line.

12 Q. Right.

13 A. In this case it is one of our plywood covered  
14 stoppings with an opening cut in it for a conveyor.  
15 Taking a conveyor through a stopping in that way or any  
16 other way, for that matter, is not good design practice.  
17 The reason for that is that we are going to have leakage  
18 at that point because we're going from the intake side,  
19 the blue arrows, to the return side, the red arrows, and  
20 the high velocity that will be generated through that  
21 rectangular hole or box cut in the plywood stopping for  
22 the conveyor to go through, that is a source of  
23 additional dust generation. So it is not good practice.  
24 However, coming back to your specific question, it is  
25 also a source, and a significant source, of leakage. So

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1 some of that 75,800 will leak through the box check, the  
2 belt flap, whatever one wants to call it, and leaving a  
3 reduced amount of air to progress up Southwest 2-B.

4 Q. Do we actually have a reading of that or do we know  
5 the exact quantity that went up to Southwest 2-B Road?

6 A. If you continue up Southwest 2-B Road, beyond No. 1  
7 Crosscut, and then look directly underneath at the  
8 corresponding length of Southwest 2-A Road, a measurement  
9 was made there of 59,800. Do you have that?

10 Q. Yes. Do we know where that measurement was taken?  
11 Was that inbye or outbye that crosscut?

12 A. That was inbye that crosscut, approximately the  
13 location where the number "59.8" is.

14 Q. Okay. So that, I take it then that that would  
15 indicate -- I take it you would suggest there's some  
16 leakage in the crosscut? Or would you --

17 A. Let me go back to finish the answer I was giving. I  
18 referenced you from the Southwest 2-B Road, inbye 1  
19 Crosscut and I referenced you to come underneath and see  
20 the 59.8 K cfm.

21 Q. Yes.

22 A. If you now go back to the corresponding point we  
23 just left on Southwest 2-B Road, the air flow in that  
24 section, that is inbye Crosscut 1, would also be 59.8  
25 kilo cubic feet per minute. The volume flow that enters

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1 inbye beyond that point has to return. There are no  
2 other exits, has to return along the return. So the air  
3 volume flow would be the same excepting for the effects  
4 of expansion of the air. And I think we could neglect  
5 these as this was a fairly cool mine.

6 Q. Right. But -- and following your trail then I take  
7 it that between the B-Road in the Southwest 1 Section and  
8 the Southwest 2, No. 1 Crosscut, there was a volume  
9 greater than 59,800 cfm?

10 A. I agree.

11 Q. And that volume, that wasn't taken account of in  
12 your formula on methane layering?

13 A. No, sir. I considered the major length of the  
14 Southwest 2-B Road. And if you refer simply to the  
15 scaling of this map, you'll see that that length between  
16 Crosscuts 1 and 2 is the larger of the those two lengths,  
17 that is, compared with the one that you just mentioned,  
18 the outbye length.

19 Q. Okay. Now the -- and I guess you just mentioned it,  
20 at the corner of the intersection between the B-Road and  
21 the Southwest 2-B -- the Southwest 1-B Road and the  
22 Southwest 2-B Road, that's where the conveyor belt went  
23 around that corner?

24 A. Well, the belt does not go around the corner, but  
25 there's a transfer point --

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1 Q. Okay. And -- good point. What does -- can you  
2 visualize for me what the transfer point is, what are we  
3 looking at there?

4 A. I did not have the opportunity to go into the mine,  
5 sir, before or after the explosion, so I cannot describe  
6 it to you.

7 Q. Okay. We have some -- if you go back to Tab 7, we  
8 have what I believe, the very first map, some cross-  
9 sectionals of the tunnels and intersections.

10 A. Yes.

11 Q. And first of all, would you agree that the existence  
12 of items of equipment or obstructions in the mine room  
13 itself would reduce the cross-sectional area?

14 A. Would reduce the cross-sectional area available for  
15 air flow, yes.

16 Q. Yes. And we know here that to the extent of pretty  
17 well the entire Southwest 2 B-Road there was a conveyor  
18 belt.

19 A. From the position of the Stamler feeder downwards  
20 there was a --

21 Q. And indeed --

22 A. -- conveyor --

23 Q. And indeed from the intersection of the Southwest 2  
24 1-B -- Southwest 1-B Road or the Southwest 2-B Road, it  
25 extends all the way up almost to the intersection of

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1 Southwest 2-B and Southwest 1?

2 A. You can see that's on the map, the position of  
3 feeder breaker.

4 Q. Right.

5 A. Yes, that was the extent to which the belt would go.

6 Q. And the cross-sectional areas of the -- and two  
7 observations from that, Dr. McPherson, the cross-  
8 sectional area is shown for the conveyor at Station V --  
9 STA V-16? It's on the bottom right-hand corner, the  
10 second diagram in. And that shows the conveyor in the  
11 Southwest 2-B Road hanging from the ceiling in roughly  
12 the middle of the roadway.

13 A. I'm sorry, sir. Could you give me the reference to  
14 that particular diagram again? I missed it.

15 MR. WILSON STA V-16, Diagram 7. The bottom diagram -  
16 - the bottom cross-sectionals.

17 COMMISSIONER Tab 7.

18 MR. WILSON Tab 7, Exhibit 45.

19 COMMISSIONER Yeah. I've got that, yeah.

20 MR. WILSON And it's -- the diagrams are entitled  
21 "Southwest Section, Cross Sections of Various Sections of  
22 Tunnels and Intersections."

23 COMMISSIONER Oh, on page one. Oh, I thought -- oh,  
24 okay. Yeah, okay. Fine, thanks. Thank you.

25 A. Yes, I have it.

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1 MR. WILSON That shows the conveyor roughly in the  
2 middle --

3 A. Yes.

4 Q. -- about -- looks like about -- extending almost  
5 down halfway into the tunnel or into the -- do we call  
6 them tunnels or rooms? Is it --

7 A. As you wish.

8 Q. Okay. Do we have it now?

9 A. Yes, sir.

10 Q. Okay. That cross-sectional area, that would have an  
11 effect on reducing cross-sectional area?

12 A. It would have the effect of reducing cross-sectional  
13 area available for air flow.

14 Q. Yes. And thereby increasing velocity in the tunnel?

15 A. Yes, sir.

16 Q. The other interesting aspect of it is with respect  
17 to the conveyor belt is that the conveyor belt is moving  
18 out while the air is moving in. Would that have created  
19 a turbulent effect on the top of the conveyor belt?

20 A. It certainly would have a viscous drag effect on the  
21 air flow in the direction of the belt motion, I agree.

22 Q. And would -- I don't know -- I picture swirling and  
23 mixing, are there, with methane?

24 A. There would be a viscous drag on the air caused by  
25 the motion of the belt. To what extent that generated

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1 propagating eddies turbulence, upwards, sideways, you  
2 know, and other direction, this whole field is a very  
3 complex matter of air dynamics. The particular  
4 turbulence pattern caused by bends, turns, moving  
5 objects, bluff objects, this has been a major field of  
6 study throughout air dynamics, not only in mine  
7 ventilation.

8 It is only fairly recently that this has become  
9 amenable to analysis using super computers at the present  
10 time. There's a field of numerical fluid dynamics. It  
11 is so complicated.

12 Q. Yeah. Dr. McPherson --

13 A. So to the extent -- if I may finish my answer, so to  
14 the extent that the majority of these analyses are still  
15 carried out empirically, that is, by model studies, by  
16 actual measurements, so because of that and I -- forgive  
17 me for the long explanation, because of that, I cannot  
18 say to what extent, if at all, turbulence produced by the  
19 conveyor would be effective in effecting methane layers.

20 Q. Don't get me wrong, Dr. McPherson, I'm just trying  
21 to understand what impact these various factors would  
22 have on the methane layer that your suggestion was  
23 created, and I guess the short answer to it is that the  
24 conveyor would reduce the cross-sectional area, thereby  
25 creating a higher velocity in the tunnel --

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1 A. That is true, yes.

2 Q. -- and that the conveyor moving in the opposite  
3 direction would potentially create eddies that in turn  
4 could promote mixing of methane with air in the tunnel.  
5 And I assume, thereby preventing -- alleviating the  
6 layering effect, if one existed -- you can't say how much  
7 but it could do that?

8 A. That is a possibility. And the interesting point of  
9 it is that from the diagram anyway, it appears that this  
10 is occurring up at or near the roof of the tunnel?

11 MR. MERRICK Which part of the heading are you  
12 referring him to?

13 MR. WILSON Pardon me?

14 MR. MERRICK Which part of the heading are you  
15 directing him to?

16 MR. WILSON To the top of the -- I presume the  
17 conveyor is running on top of what's outlined as the  
18 conveyor there. But my understanding of the conveyor is  
19 that it runs along the top and then goes under and comes  
20 back so -- on the idlers. And I would assume that the  
21 cross-section would be the top of the idlers.

22 A. The question that's in my mind, and maybe you can  
23 help me on this one, is to what extent the actual  
24 situation as pertained on May 9th is represented on the  
25 diagrams that we're looking at. It is clear that the

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1 nice straight edges, nice clean-cut roofs and floor  
2 certainly was not the case in practice.

3 We also know that the conveyor descended to the  
4 floor or close to the floor as it approached the Stamler  
5 feeder.

6 My question and maybe you can help me on it is where  
7 in actual fact was the conveyor along the length of the  
8 Southwest 2-B Road?

9 Q. All I can answer for that, Dr. McPherson, is that  
10 from this map anyway and I'm not -- I don't -- I didn't  
11 produce this map, it appears to be in the middle as  
12 illustrated by the diagrams. And, presumably, at some  
13 point along its length it flows down into the Stamler  
14 feeder, which I take it as appearing in Diagram vii,  
15 which is shown cross-sectionally, three in from the left  
16 on the top row.

17 A. Exactly, on the floor.

18 Q. Yes.

19 A. No longer at the roof.

20 Q. And presumably you would have the conveyor at some  
21 point in time ascending down to the Stamler feeder, which  
22 would suggest to me that most of the cross-sectional area  
23 of the mine at some point in time is taken up with  
24 equipment and potentially producing a high-pressure zone  
25 at or near the Stamler feeder that would, as well, cause

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1 turbulence to -- and thereby air mixing, methane mixing,  
2 militating against layering in that way. Now is that a  
3 possibility as well?

4 A. I already agreed that the presence of such equipment  
5 would decrease the area to a smaller value than available  
6 for air flow, and I have also agreed that this would  
7 increase the velocity of the air in those regions.

8 Q. Okay. And that is something that's not as well  
9 reflected in the formula on methane layering. That is a  
10 parameter that wasn't addressed in the layering number  
11 that would increase the layering possibilities -- or  
12 increase the mixing possibilities.

13 A. If you would refresh your memory by looking at that  
14 formula again which is given in two places in my report.  
15 I'm looking at the top of page 36. The layering number,  
16 as you've already pointed out, sir, depends upon the  
17 width of the entry. The "W" is the width, not the total  
18 cross-sectional area. The velocity, the "U," does depend  
19 on the cross-sectional area for any given air flow, as I  
20 have agree with you.

21 Q. That's right. And as we discussed earlier, an  
22 increase in velocity decreases the propensity for  
23 layering. This is a set of circumstances that would  
24 militate towards increasing velocity. Agreed?

25 A. If the airway cross-sectional area was less than I

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1 have assumed in this calculation, then that velocity  
2 would increase and layering number would also increase, I  
3 agree.

4 Q. Okay. Now I think -- I believe you made the point  
5 on roadway width and there are variations caused by  
6 roadway width -- or variations in the roadway width. I  
7 think there is talk of arching and assisted means of  
8 supporting roof. Does that -- does the existence of the  
9 arching ribs or that type of thing promote or create  
10 turbulence at the sides or at the roof? Is that a factor  
11 that one would look at in terms of methane mixing?

12 A. Yes, it does. The presence of any roughnesses,  
13 roof, floor, or sides, will increase the generation of  
14 turbulence.

15 Q. I take it, and I don't mean this as a criticism, Dr.  
16 McPherson, but just as a question, that we didn't do any  
17 -- that you didn't do any computer modelling in terms of  
18 estimated methane layering or any of the associated  
19 analyses relating to the ventilation numbers?

20 A. No, sir --

21 Q. Okay.

22 A. -- I did not.

23 COMMISSIONER Just picking up on that previous point  
24 that Mr. Wilson was making there about the effect of  
25 archways and other obstructions on the roof as being

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1 conducive to mixing or turbulence and subsequent mixing  
2 of the methane, is there any correlation, Doctor, between  
3 that and the factor of resistance --

4 A. Yes.

5 COMMISSIONER -- coming in?

6 A. Yes, there is, indeed.

7 COMMISSIONER Okay.

8 A. The resistance of the airway is a function among,  
9 other things, of the roughness of the lining, yes, it is.

10 COMMISSIONER Okay.

11 A. May I make one further comment, sir? You referred  
12 to the existence of arches, or other roughnesses,  
13 increasing turbulence, and I have agreed that that would  
14 be the case. You went a little further and said that  
15 would therefore, per se, improve the mixing of a methane  
16 layer. I have not agreed to that.

17 MR. WILSON Okay. So you don't agree that there would  
18 be a promotion of the mixing and mixing of a layer --

19 A. Not necessarily.

20 Q. Possibly, but not necessarily?

21 A. Possibly, but not necessarily, yes.

22 Q. Now the other variable and the other -- in  
23 determining the methane layering is the source of the  
24 gas?

25 A. Yes.

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1 Q. And the source of the gas that you were speculating  
2 on was from the Southwest 1 unworked area?

3 A. That was one of the sources we talked about, yes.

4 Q. Okay. And that was in fact a source that you used  
5 in your formula for the methane layering?

6 A. The methane layering coming up the ascending  
7 Southwest 2-B, yes.

8 Q. And you used that -- you derive that figure from the  
9 survey of April the 2nd when they had on their  
10 ventilation survey shown a 20,000-some-odd, I think it  
11 was, cfm going into the Southwest 1 section, and you took  
12 2 1/2 percent of that as your volume -- potential volume  
13 of methane coming out and I believe you halved that? Is  
14 that --

15 A. Yes.

16 Q. -- the long and short of it?

17 A. That was an estimate --

18 Q. Yeah.

19 A. -- not a calculation.

20 Q. Okay. And that was -- yes. And that estimate --  
21 now it's been established, and I think it's been  
22 mentioned a number of times that there were no stoppings  
23 in that area on the -- on April the 2nd on the Southwest  
24 1 section --

25 A. On April the 2nd, yes.

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1 Q. Yeah.

2 A. That's why there was 20,000-plus going around it,  
3 yes.

4 Q. And, in fact, there was really no Southwest 2  
5 section on April the 2nd either, if one looks at the  
6 ventilation maps or what might have been the beginnings  
7 of a Southwest 2 section but nothing particularly defined  
8 at that time in the southwest as Southwest 2.

9 A. I would have to refresh my memory on actual dates.

10 Q. Okay, it's on that large map at the bottom. There's  
11 some limited development.

12 A. Okay, the red, March '92 development. April '92  
13 development is blue. So, presumably, the beginning of  
14 April, April 2nd, we would be, as you say, starting --

15 Q. It's the very beginning of the Southwest.

16 A. The Southwest 2, yes.

17 Q. So you're not suggesting that there was methane  
18 layering into the Southwest 2 section on April the 2nd,  
19 or are you?

20 A. There could well have been, sir.

21 Q. At the beginnings? Is that the layer -- is that the  
22 initiation of the layering that you're talking about?

23 A. Well, you recall on that same date that a  
24 measurement of nine percent of methane was made at near  
25 the roof level at this location.

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1 Q. That's out back No. 4 crosscut.

2 A. Thank you. That measurement is a measurement of a  
3 methane layer. It's a definition of a methane layer.  
4 You've got high concentration at roof level. So  
5 certainly a methane layer was in existence at that time  
6 despite there being 20,000 cfm going around the district.  
7 If that methane layer had continued to the point at which  
8 air was being drawn very sluggishly into these headings,  
9 very sluggishly because I'm assuming that this crosscut  
10 has not yet been formed. Therefore, we have exhaust  
11 ventilation only taking place. Then it is possible that  
12 methane layering was occurring in those headings because  
13 of the Southwest 1 workings in addition to the methane  
14 make, such as it might have been at that time, in the  
15 headings themselves.

16 Q. Okay. We know from your report on page 23, 24.

17 A. I have those pages, yes.

18 Q. On April the 2nd, there's a notation that gas was  
19 being cleared from the Southwest 1 section.

20 A. I see it.

21 Q. Do we know whether that was as a response to the  
22 ventilation reading that was recorded around that time?

23 A. I have no knowledge, sir, on what this was in  
24 response to. It was the same date as the high methane  
25 readings were taken.

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1 Q. Okay. Would it make sense that these methane  
2 readings were noticed at that time and then they embarked  
3 upon an operation of clearing the area?

4 A. But they clearly were noticed; they were measured.  
5 So --

6 Q. Pardon?

7 A. They clearly were noticed. They were measured. So  
8 a prudent response to that would have been, indeed, to  
9 take measures to clear the gas.

10 Q. Okay, and in doing that, one would potentially  
11 remove the layering problem that existed at that time  
12 anyway.

13 A. One would hope that to be the case. Whether that,  
14 in fact, happened, I do not know.

15 Q. Okay. In any event, the other observation from that  
16 reading was, and you spoke of this earlier, it was the  
17 reference to, I think it was near back.

18 A. Yes.

19 Q. And you said that was a reference. Is that a common  
20 term? It must be a common term. It means near the roof?

21 A. Yes, these mining terms vary tremendously from, not  
22 only from country to country in the English-speaking  
23 world but also from locality to locality, from state to  
24 state. And "roof" and "back" are used synonymously,  
25 particularly in coal mining. The term "back" meaning

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1 that part above your head is used, I think, more in metal  
2 mining. Maybe the reference to "back" here is a  
3 reflection of the fact that some metal mining personnel  
4 were involved at Westray.

5 Q. And that phrase occurred a couple of times in the  
6 surveys, I noticed going through them. Do you agree or  
7 did you notice that when you were going through them?

8 A. I did not notice it. I'm used to seeing these terms  
9 on them, so it would not register as unusual.

10 Q. Would that indicate that the company was taking  
11 methane readings at or near the roof? In other words,  
12 there were some evidence anyway that they were checking  
13 for layering?

14 A. It is an indication that on the particular day on  
15 April the 2nd and on any other day in which that  
16 reference to the roof or the back is made, then on those  
17 occasions it would indicate that methanometer readings  
18 were taken near the roof, as distinct from the daily  
19 routine observations that were made during mining.

20 Q. And as well an indication that, or one could draw  
21 the observation that if it's not mentioned, they may have  
22 been taking readings near the roof and not recorded any  
23 unusual readings.

24 A. One of the questions I asked is whether the use of  
25 methanometer extension probes was practiced at the mine.

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1 I understand that those telescopic probes were not used  
2 at the mine. In that case, it would be somewhat  
3 difficult to take routine readings at roof level in these  
4 heights of workings without such probes other than  
5 standing on equipment.

6 Q. The stoppings that went into the Southwest 1  
7 section, I guess, a rhetorical question. You weren't in  
8 the mine, so you never actually saw the stopping.

9 A. No, I did not.

10 Q. They were described as plywood stoppings with  
11 plastic?

12 A. Yes.

13 Q. Now you talk about stoppings on page nine of your  
14 report and at the top of the report, "The leakage losses  
15 at individual stoppings varied considerably and this was  
16 a consequence of the use of stoppings constructed from  
17 wood frames and plastic sheeting within the working  
18 sections." Would this be what you were referring to,  
19 stoppings constructed of wood with plastic?

20 A. It would, yes.

21 Q. And the observation you made is that these can be  
22 very resistant to leakage when new or maintained in a  
23 good condition.

24 A. Yes.

25 Q. Now in terms of these particular stoppings, we have

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1 reference to them in the 37-A and we start -- There is a  
2 reference that says "When they..." Or apparently says  
3 "When they were finally completed," and that's at page 72  
4 of 37-A. It's a summary of a ventilation survey of April  
5 15th, 1992.

6 A. I have it.

7 Q. It says "The stopping in C-1 inbye No. 3 crosscut,"  
8 which I take it to be the C Road that we were referring  
9 to, inbye No. 3 crosscut would be the stopping into the  
10 Southwest area on that road. " And B inbye No. 3 crosscut  
11 were completed on April 13th"?

12 A. I see it, yes.

13 Q. "And the fans and stoppings were observed to be in  
14 good condition." Now if we follow that through, so that  
15 is what I take it to be the stoppings that were  
16 constructed in those two roads, and it appears that they  
17 were done by April the 13th. Is there anything, have  
18 you seen anything in the material that you've looked at  
19 that would suggest that any of the inspectors that were  
20 referred to earlier would have seen or observed these  
21 stoppings prior to their visit on April 29th, 1992?

22 A. Would have seen those stoppings before their visit?

23 Q. Yes, April 29th, 1992?

24 A. I don't know. I can't answer that question, sir. I  
25 don't know whether they visited the mine in that period.

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1 If they did not visit the mine during that period, then  
2 obviously they could not have seen them before April  
3 29th.

4 Q. Okay, that's fair enough. Now if I could just move  
5 you on in terms of the discussion of those stoppings. On  
6 April the 23rd at page 86. Sorry, page 87.

7 A. Yes.

8 Q. They talk about "C-1 inbye crosscut, fair condition,  
9 plywood buckled, no loss." And then they have "belt road  
10 inbye 3 crosscut, fair condition, plywood buckled, no  
11 leakage." I take that to mean that, and I take that to  
12 be the crosscuts -- or stoppings that were constructed on  
13 April the -- completed on April 13th. It would seem to  
14 indicate that there is no leakage or loss of air going  
15 through the stoppings so far as the ventilation surveys  
16 disclose on that date.

17 A. Yes, sir.

18 Q. And the next ventilation survey of April 29th, '92,  
19 page 90, as well indicates "fair condition, no loss, fair  
20 condition, no leakage." So I would take it it would  
21 indicate that they are not losing or leaking air at that  
22 particular time in accordance with the ventilation survey  
23 results.

24 A. Let me make a point here, Mr. Wilson. The comments  
25 of "no leakage" should be read from a ventilation

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1 engineer's point of view as indicating that there was no  
2 measurable air flow taking place in those stubs of  
3 airways leading up to the faces of those stoppings. I  
4 make that point because there is no such thing in  
5 practical mining as a leak-proof stopping. Even if one  
6 were to build a submarine-type door in the entry, there  
7 would still be leakage through the strata around the side  
8 of it. So we should read this as no measurable leakage.

9 Q. Yes, and I take your point, and that was discussed  
10 with respect to the explosion-proof stoppings that you  
11 described earlier.

12 A. Yes.

13 Q. But one can assume from that, I take it, that there  
14 is no observable air flow going through those stoppings.  
15 That those stoppings are not free-flowing air.

16 A. I agree.

17 Q. And that the amount and the extent of leakage coming  
18 from those stoppings at those times would be essentially  
19 a matter of speculation.

20 A. The amount of air flowing through, leaking through  
21 those stoppings, if indeed non-measurable, as the surveys  
22 indicate, would be a matter of speculation, I agree. We  
23 are talking about air flow here, I remind you, and not  
24 methane.

25 Q. Now there are no reported readings of methane or

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1 methane concentrations that are noted in the ventilation  
2 reports. So as far as the ventilation reports are  
3 concerned, I take it, and the information that we have in  
4 relation to those reports, the amount and the quantity of  
5 methane, if any at all coming from the Southwest section  
6 is a matter of speculation.

7 A. We have the evidence that I reported of the total  
8 amount of methane that was being made in the whole of the  
9 Southwest. You recall this one when I based methane flow  
10 measurements on the methane concentrations and air flows  
11 at this point; that is, returning from the complete  
12 Southwest. We went through that. So we have a  
13 measurable indication, a measurable quantity of methane  
14 coming out of the total area. Some of that would be  
15 coming from the headings in the Southwest 2. The  
16 remainder would be coming from the old workings in  
17 Southwest 1 which inevitably were leaking methane, number  
18 one.

19 Number two, we have the evidence of miners  
20 indicating that methane was, indeed, coming from those  
21 stoppings.

22 Q. Well, I haven't heard any evidence to that yet.

23 MR. MERRICK If I can just interrupt you for a second.  
24 The last two stoppings you asked him about, I think, were  
25 at page 87 and 90, at the tops of the page? Have I got

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1 that right?

2 COMMISSIONER 87 and 90?

3 MR. MERRICK Are you putting those to the witness that  
4 they were in the Southwest district?

5 MR. WILSON Southwest block.

6 MR. MERRICK Oh, I'm sorry, I was looking at the ones  
7 right above. All right, thank you.

8 MR. WILSON Under stoppings. Your estimate of -- Of  
9 course, your estimate of methane coming from the  
10 Southwest section generally was based on the, at least I  
11 assumed, on the -- What was it? 79,000 cfms outbye on  
12 the B Road from the Southwest 2 section -- or Southwest 1  
13 section, the main road? I think it's in your table.

14 A. Are we looking at page 35 in my report?

15 Q. I'm trying to get there. Yes. You've got a figure.  
16 You've estimated your quantities. I took that methane  
17 percent to be the reading of the methane level in that  
18 air flow in the general air body which would have already  
19 been mixed.

20 A. Yes, main return corresponding with the air flow  
21 measurement in cfm at the side of it, yes.

22 Q. So that air flow would have been mixed.

23 A. Oh, indeed. This is the general body concentration,  
24 yes.

25 Q. You used, just a quick question on layering before

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1 we leave, the layering table that you referred to in the  
2 back of your report, I believe it's on page --

3 A. The very last page. It's unnumbered, but it's the  
4 last page of the last appendix.

5 Q. Okay. Is that a published table?

6 A. Yes, sir.

7 Q. Do we have a reference? It doesn't seem to be  
8 referenced to a publication. I just don't know if there  
9 is one that it's referenced to or is it contained in  
10 the --

11 A. Now you're making me blush slightly with modesty,  
12 sir. It's a publication of my own textbook.

13 Q. So you have -- it's from a text publication then.  
14 That's where we can find it.

15 A. Yes, the original data from which this table is  
16 taken is the classical paper by Baacke and Leach that we  
17 have referenced already on several occasions.

18 Q. Yes, now I was looking for it and couldn't find it.  
19 That's why I asked.

20 A. Yes.

21 COMMISSIONER Are you suggesting he plagiarized from  
22 them?

23 A. It is a classical paper, Mr. Commissioner.

24 MR. WILSON Copyright issue here.

25 A. With full and proper reference, I might add.

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1 Q. The 60 foot per minute U.S. standard on velocity.

2 A. Yes.

3 Q. You attribute that to an attempt by the U.S.  
4 regulators to mandate a level velocity to curtail methane  
5 layering? Is that something of which you have personal  
6 knowledge, that that's why that was done or is it just  
7 there? I mean --

8 A. This dates back to 1969 when the U.S. Act was first  
9 formulated after the Farmington disaster in the United  
10 States. And my comment that the 60 feet per minute was  
11 based on a rule of thumb to help minimize layering comes  
12 from conversations that I have had with officials of the  
13 Mine Safety and Health Administration, and others who  
14 were party to the formulation of that Act.

15 Q. Do you know of any other jurisdiction that mandates  
16 velocity?

17 A. I believe it's -- I'm going to be on safe ground  
18 here, sir, and say no, I cannot immediately recall.  
19 There may well exist such mandates, but I do not  
20 immediately recall and would care to quote them.

21 Q. Okay. Now you talked about stone dusting and you  
22 gave an example or not an example, but you outlined the  
23 procedure for testing for stone dusting.

24 A. Yes.

25 Q. And the one thing that you didn't mention that has

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1 struck me of interest is the requirement for sieving the  
2 samples. And could you explain why that's there and what  
3 stage that comes into when you're doing your sampling?

4 A. The sieving requirements are, I know, specified in  
5 the Nova Scotia regulations. Again, I believe different  
6 testing authorities, differing laboratories, have their  
7 own particular procedures. I'm sorry, what was your  
8 specific question? With respect to sieving?

9 Q. Why is there a requirement? What does it do to aid  
10 the test?

11 A. Oh, yes, it's simply to ensure that the sample that  
12 is being analyzed is of a sufficiently small particle  
13 size that it would be raised into the air by the shock  
14 wave progressing in front of an explosion.

15 Q. The test samples that you observed -- was it on that  
16 basis that you concluded the results of those test  
17 samples? Was it on that basis that you concluded that  
18 there was little or no stone dusting in the mine?

19 A. Not on the basis of sieving, no.

20 Q. No, no, on the basis of the data results of the test  
21 samples that you've recorded in your --

22 A. Those as are reported in my report, yes.

23 Q. Do you have any information relating to how those  
24 test samples were gathered? What procedures were used in  
25 gathering those test samples?

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1 A. I believe, from my memory -- no, I'm going to  
2 backtrack. I'm thinking of samples that were taken after  
3 the explosion.

4 Q. Yes, and there are samples taken after.

5 A. Yes. The answer is, no, I have no direct knowledge  
6 of how those samples were taken.

7 Q. Is it important in terms of the reliability of this  
8 type of sampling to collect and gather samples in a  
9 particular way, in a particular manner?

10 A. There are two recommendations that I can give to  
11 you. One is that the sample be taken from the surface or  
12 near surface of the deposit. The figure one quarter of  
13 an inch is sometimes quoted, number one.

14 And, number two, in order to improve the statistical  
15 significance of a particular sample, it is sometimes  
16 practised that the sample is taken not in one single  
17 spot; it may be several locations of that rib or across  
18 that floor.

19 Q. And you --

20 A. Sometimes called "strip sampling" as distinct from  
21 "spot sampling."

22 Q. Right. And it would be important in terms of  
23 reliability in those samples, how they were taken, how  
24 they were gathered, for your purposes, if you're looking  
25 at it, that would have an influence on your conclusion

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1 whether they're representatives or whatever.

2 A. Clearly, the more samples that are taken, the more  
3 representative they are.

4 Q. The one quarter of an inch, and I've heard this  
5 before, requirement for taking a sample, has interested  
6 me. It seems that that would be -- that would include as  
7 much, if I can called it "freshly laid" coal dust as you  
8 could possibly get in a sample. Would that have an  
9 effect on it?

10 A. We've heard --

11 Q. And perhaps you could confirm or deny this, that  
12 stone dusting is a continuous and ongoing process.

13 A. It should be.

14 Q. Yes. And it is so because workings in the mine  
15 create coal dust layers on a continuous basis?

16 A. Produce coal dust on a continuing basis, yes.

17 Q. And it struck me that when you have -- when you're  
18 sampling procedure requires you to meticulously take the  
19 top quarter inch off the floor or whatever, that that  
20 would take -- you would be maximizing your coal content  
21 in those samples and minimizing your previously stone  
22 dust or previously mixed underneath layers?

23 A. Two points emerge here, one is the purpose of taking  
24 a fairly thin sample, a quarter-inch thickness, is to  
25 ensure that the sample is representative of that surface

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1 and not deep into the layers. Because it is that  
2 surface, as we have said several times now that is  
3 relevant with respect to the reductions of airborne  
4 combustible dust, number one.

5 Number two, the concentration of that dust,  
6 combustible or incombustible, on the surface is an  
7 indication of the rationale behind the use of trickle  
8 dusters to ensure that limestone dust, rock dust, is  
9 deposited with, simultaneously with the coal dust. So  
10 this is the preferred treatment for stone dusting. If  
11 trickle dusters are not so used, and it is done by hand  
12 as in previous years, it was all done by hand, it becomes  
13 even more important for that hand spreading to be done at  
14 very regular intervals of time because, as you have  
15 mentioned, within a few hours, a layer of coal dust can  
16 be formed which is dangerous.

17 Q. But if you're not employing trickle dusting, you  
18 could still be employing stone dusting methodology and  
19 you would be picking up that layer on the top because of  
20 that. Your preferred method is trickle dusting, I take  
21 it, from stone dusting?

22 A. Yes, sir.

23 Q. And I -- and as you described trickle dusting, it  
24 raised another question in my mind in line with your  
25 comment on airborne particles and the health of workers

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1 in the mine. Is that a tricky procedure in terms of -- I  
2 don't know if it was Mr. Smales or someone else was  
3 talking about you would have a lot of miners downwind  
4 rather upset with you if you were trickle dusting in the  
5 air flow. How do you do -- how do you accomplish  
6 trickle dusting when the mine is working?

7 A. The trickle duster is set up at an appropriate up-  
8 stream position from dust-producing activities such as  
9 the workings themselves, such as conveyors, such as  
10 transfer points, conveyor transfer points. And the  
11 limestone dust is submitted as a continuous puffing cloud  
12 into the air, is carried with the airstream and is  
13 deposited in exactly the same way that the coal dust is  
14 deposited, primarily by gravitational settlement. The  
15 matter of this being objectionable to workers, if a mine  
16 worker is standing immediately downstream of a trickle  
17 duster, if he's standing in front of it then, obviously,  
18 he is going to be somewhat annoyed by the puffs of white  
19 limestone dust that are coming at him. However, that  
20 limestone dust is fairly rapidly dissipated across the  
21 cross-sectional -- across the total air flow, just in the  
22 same way that the coal dust is and becomes part of the  
23 dust content of the air.

24 Additionally, limestone dust, as far as we are aware  
25 with present medical knowledge, is harmless to the human

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1 physiology. So whilst it may be an annoyance, if the man  
2 is standing very close downstream, it is not a health  
3 hazard.

4 Q. Okay. The test that the -- the testing that was  
5 done that you referred to and in particular testing on  
6 April the 29th, refer to 37-A at page 191. And I don't  
7 know who wrote this and I don't know if you know. But it  
8 says, "The samples which have -- which would have  
9 contained..." I take it contain carbonates, (stone dust),  
10 should have been analyzed by 69 7D method. The procedure  
11 that was followed, 69 7C, would have burnt off the stone  
12 dust carbonate as well as the combustible matter  
13 resulting in the high percentage combustible matter."  
14 What does that do to the test results or the reliability  
15 of the test results for that April the 29th reading?

16 COMMISSIONER What page are you on, Mr. Wilson?

17 MR. WILSON 191.

18 COMMISSIONER Oh, I'm -- okay.

19 MR. WILSON Sorry. 37-A.

20 COMMISSIONER I misread. I was in 199. Yeah. Okay.

21 A. I must have missed the last part of your question.  
22 I apologize.

23 MR. WILSON Is the writer here suggesting that those  
24 test results were unreliable in terms of the measuring  
25 the combustible content of that -- of those tests?

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1 A. I think what the writer, and I do not know who wrote  
2 this, was referring to, was the difference, is the  
3 difference between the so-called "high temperature" and  
4 "low temperature" tests. You recall yesterday when we  
5 discussed this, we drove off the moisture, weighed it  
6 before and after and then we took it to a higher  
7 temperature, sufficiently high to burn the coal, the coal  
8 dust, and that gave the combustible content.

9 If one raises the temperature of that sample to a  
10 sufficiently high temperature, then the limestone itself  
11 in the stone dust, may begin to dissociate. I think we  
12 mentioned this also yesterday. And that will result in a  
13 loss of carbon dioxide from the limestone dust. And if  
14 that high temperature -- if that temperature is high  
15 enough to do this, then it will appear as an apparent  
16 additional loss of combustibles.

17 This is why on the table in middle of page 19 of my  
18 report, you'll notice that the high temperature results  
19 from each of the laboratories in most cases are higher  
20 than the corresponding low temperature results.

21 Q. So am I taking your short answer to be that you are  
22 concerned or not concerned about the way those tests were  
23 conducted?

24 A. With the results in front of us and with the degree  
25 to which the combustible content is above the maximum

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1 allowable limit in the law, I think this is a minor  
2 consideration.

3 Q. You mentioned stone dust barriers and you've  
4 referred to the Coal Mines Regulations Act on a number of  
5 occasions. Are stone dust barriers required by  
6 legislation?

7 A. In Nova Scotia?

8 Q. Yes.

9 A. I do not believe so.

10 Q. There was some mention and you mentioned in your  
11 report cables and potential problems with cables.

12 A. Yes, sir.

13 Q. And I believe that you mentioned you didn't come  
14 across any evidence of the cable contributing to the  
15 explosion?

16 A. That is correct.

17 Q. Did you come across anything that would indicate  
18 whether or not the cables were checked for damage?

19 A. After the explosion?

20 Q. Yes.

21 A. I am not -- they should have been. All equipment in  
22 that area should have been subject to post-parte  
23 examination, electrically and mechanically. I am not  
24 aware that that was done for all pieces of equipment,  
25 including cables.

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1 Q. I understand when you're checking a cable for damage  
2 you have to sort of run your hand all along the cable to  
3 check for -- in place to check to see if there were any  
4 breakages or whatever. Is that the procedure that you  
5 understand would be used?

6 A. I am not expert in electrical systems, including  
7 cables, but let me attempt to give an answer and that is  
8 that if a cable is sufficiently damaged to cause arcing  
9 which is capable of igniting methane, then it should be  
10 visually obvious, should be visually obvious, by sight or  
11 by touch afterwards.

12 Q. And by particularly by touch if you're in --  
13 presumably, much of this equipment would be covered by  
14 dust or whatever at the time and --

15 A. One would assume so.

16 Q. So you're not aware of whether or not anyone  
17 physically examined any of the cable work that -- in the  
18 Southwest 2 section?

19 A. That is correct.

20 Q. The location of the stoppings in the Southwest 1  
21 section is one point I picked up on. You've referred to  
22 substantial stoppings and directed us to 71(11) as the  
23 requirement for substantial stoppings?

24 A. Yes. The location of those stoppings is not between  
25 a main intake and return airway? Is that correct?

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1 A. That is correct.

2 Q. In light of that, 71(11) talks about, "In mines  
3 giving off explosive gas, all stoppings between main  
4 intakes and return airways shall be of ample strength and  
5 built of..." et cetera, et cetera.

6 A. Yes.

7 Q. That would not apply to the particular stoppings in  
8 this case?

9 A. These stoppings are not between intakes and returns,  
10 but they are stoppings in entries to old workings where  
11 it is a matter -- let me back off there, sir. The  
12 construction of stoppings between intakes and returns,  
13 the primary purpose of those stoppings is indeed to  
14 ensure that leakage, direct short-circuited leakage, is  
15 minimized and, therefore, improves the air flow up at the  
16 working faces where it is required. That is the purpose  
17 of those.

18 The purpose of stoppings in entrances to old  
19 workings is for the reasons that we have described  
20 earlier, and that is to ensure that if there is any  
21 emissions of methane, if there are any collapses, fires,  
22 or other emergencies within that old district, that those  
23 emergencies are contained.

24 Q. Yes, I understand what you -- what you were getting  
25 at there and there is a section dealing with temporary

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1 stoppings and fires. But my only -- my point on this is  
2 that you've recommended legislative change. And as far  
3 as the Act now reads, 71(11) wouldn't apply to these  
4 types of stoppings.

5 A. So your indication of that --

6 Q. Do you agree? No, I mean, do you agree that, as it  
7 now reads, it doesn't apply to those stoppings. That's  
8 the particular section. But separate and apart from  
9 whether you feel it should, but --

10 A. I understand. Can you give me a page number on  
11 that, Mr. Wilson, in the Act?

12 Q. Well, it's 61 on the one I have.

13 A. Okay.

14 Q. Page -- I've got another, 957 here. I'm not sure  
15 where this Act comes from. But it's Section 71(11).

16 A. I see your point and I accept it.

17 Q. Okay.

18 A. You're correct.

19 Q. Now you criticized the mine inspectors for what you  
20 call a lack of rigour and the government inspectorate in  
21 inspecting the mine in your report. And that they should  
22 have taken action earlier in the form of verbal warnings,  
23 citations and, if necessary, stop work orders?

24 A. Yes, sir.

25 Q. Could you -- I have placed in the exhibit at 63, tab

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1 -- First of all, April 29th, 1992, there was a written  
2 order relating to such requirements as stone dusting,  
3 stone sampling and those types of matters. And that's in  
4 your documents. You're aware that the Department of  
5 Labour did put an order or did issue an order to Westray  
6 relating to stone dusting and other housekeeping-related  
7 matters.

8 A. I believe it was four orders, Mr. Wilson, yes.

9 Q. There are four orders. Now Exhibit 73, tab 6, has a  
10 number of orders before you. I'd just like to review  
11 those with you.

12 A. Inspection reports.

13 Q. Inspection reports, I'm sorry. Beginning on January  
14 1st or January 22nd, 1992.

15 A. Yes.

16 Q. On the bottom of that, there is a notation. This is  
17 a report by the inspector who travelled the mine with  
18 Roger Parry and Mr. Parry, I believe, was the underground  
19 manager. And at the end of that he records "Stone dust  
20 needs to be spread on a more regular basis. Mr. Parry  
21 agrees to see to this." Do you see that?

22 A. Yes, sir.

23 Q. So the end of January, the Department of Labour is  
24 raising this with the underground manager, correct?

25 A. Correct.

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1 Q. And we move on to the next report, which is February  
2 the 13th, 1992.

3 A. Yes.

4 Q. Mr. McLean has done an underground with Mr. Jones  
5 and on page two of that report he notes that he discussed  
6 with general manager, Gerald Phillips, and supervisor,  
7 Glyn Jones, spillage of coal on belt line needs to be  
8 cleaned up. Rock dust.

9 A. Can you bear with me, Mr. Wilson.

10 Q. Okay, at the very top. And I understand it's hard  
11 to read. It's the second page of the February 13th, '92  
12 report.

13 A. Second page, right at the top?

14 Q. Yeah, the very first item. Under "Items discussed  
15 with general manager." Under "Occupational Health and  
16 Safety Officer's Inspections Report."

17 COMMISSIONER "... underground accompanied by Glyn  
18 Jones." Is that the part you're --

19 MR. WILSON On the next page, the next page there.

20 The date on the top is put in as '91 and I believe that's  
21 incorrect. It's '92.

22 A. That's what I'm looking at but I can't see what he's  
23 quoting.

24 COMMISSIONER The second page is, it's got some kind of  
25 a dark number, i 51 or i 57?

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1 MR. WILSON No.

2 A. Mr. Wilson, we appear to be missing a page.

3 Q. 08760 is the number on the top.

4 COMMISSIONER Yeah, okay, I have that one, yeah.

5 MR. WILSON And he's bringing to the general manager's  
6 attention "coal dust on the belt lines needing to be  
7 cleaned up. Rock dust needed in different areas of the  
8 mine. Housecleaning needed. Both agree to have these  
9 items corrected." Do you see that?

10 A. I see that, yes.

11 Q. And then again on March the 17th, we're on the  
12 second page of that inspection report, 4639, "Matters of  
13 housekeeping and other matters of concern are also raised  
14 with management and they agreed to look after the items  
15 and they also stated that a plan for stone dusting is  
16 being put in place." And on the end of April, they issue  
17 an order. Now does that not suggest to you that the  
18 inspector was taking steps to enforce and address the  
19 issue of the problem of stone dusting in the mine on a  
20 progressive and increasing basis up to the point where  
21 they are issuing an order that matters be attended to  
22 immediately?

23 A. I believe, Mr. Wilson, that such indications of the  
24 disquiets that the inspectors had with respect to  
25 conditions in the mine existed even before the first of

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1 the dates that you give me. The point you're making --  
2 I'm reinforcing your point that the inspectors were,  
3 indeed, conscious of the dust problems in the mine.

4 Q. And they were working --

5 MR. MERRICK Let him finish.

6 DR. MCPHERSON Thank you, Mr. Merrick. I have finished,  
7 in fact.

8 MR. WILSON I thought he had. And they were working  
9 towards resolving the issue with mine management?

10 A. You've indicated a date of February the 13th when  
11 the management promised to clean up the stone dust.  
12 You've indicated also in March, I believe it was, that a  
13 dusting plan was to be put into place. Yes, 17th of  
14 March. In fact, if you do go back earlier and your  
15 starting point here, you'll find that promises to put  
16 stone dust plans into operation were given on at least  
17 one, if not more previous occasions.

18 When those plans as such seem to have been put into  
19 place, they consisted of requesting or inviting miners to  
20 stay after their shift and spread stone dusting. That is  
21 hardly what I would call a stone dusting plan.

22 Q. Well, there are a number of, and the evidence as I  
23 understand the evidence of the miners, are there are a  
24 number of ways in which stone dusting was accomplished in  
25 the mine. One was to stay after the 12-hour shift.

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1 Stone dusting, I believe, was undertaken by the belt crew  
2 on a continual basis.

3 A. I have not seen this latter one.

4 Q. Well, I have seen people speaking to that and people  
5 speaking to the issue of applying stone dust when they  
6 were on the training crew. So there are a number of  
7 ways. I suggest, and as you've indicated earlier, in a  
8 couple of hours or in a number of hours, you can  
9 virtually stone dust the entire mine.

10 A. Yes.

11 COMMISSIONER What they were doing, according to this,  
12 was stonewalling the inspector, wasn't it?

13 MR. WILSON The inspector took action in the form of  
14 an order --

15 COMMISSIONER Three months later.

16 MR. WILSON On April 29th.

17 COMMISSIONER Yeah, January, February, March, April.

18 DR. MCPHERSON If one takes -- I'm sorry, Commissioner,  
19 may I?

20 COMMISSIONER Sure, I'm editorializing.

21 DR. MCPHERSON If one goes back, as I have done, to  
22 months into '91, you'll see that we have had these  
23 requests by inspectors to clean up the mine, improve  
24 stone dusting, put a stone dusting plan into operation.  
25 Those warnings, those admonitions, continued for a period

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1 of some six months. The question that arises in my mind  
2 is given that time period when there was so clearly a  
3 problem that the inspectors had recognized as a problem,  
4 why was the mine allowed to continue operating with  
5 nothing more than continued admonitions? Why was more  
6 stringent action not taken before April 29th?

7 MR. WILSON Well, we don't know what the state of the  
8 mine was from the inspector's viewpoint when they were in  
9 there.

10 A. You have yourself pointed out the problems they had  
11 time after time.

12 Q. And stone dusting is an on-going problem in a mine.

13 A. No, sir, stone dusting should not be an on-going  
14 problem. The act of stone dusting should be an on-going  
15 procedure. It should not be allowed to develop into a  
16 problem.

17 Q. Would you expect or have you been involved in  
18 inspection practices in coal mining?

19 A. I have never been a mine inspector, sir, no.

20 Q. Have you ever had occasion to read mine inspection  
21 reports coming out of coal mines?

22 A. Yes, sir.

23 Q. Do they mention the need for stone dusting in  
24 particular areas?

25 A. If one looks through inspector's reports for mines

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1 on as many, many occasions as I have, you'll see just  
2 about everything you can think of mentioned at some time  
3 or another. What one looks for and what is so obvious in  
4 this case is one particular problem being mentioned over  
5 and over and over again.

6 Q. And I put it to you that the inspector, in any  
7 event, was attempting to direct management to apply more  
8 stone dusting up to and including an order on April 29th.

9 A. Yes, indeed, they were, but nothing was being done  
10 about it, and no further stringent action was taken until  
11 April the 29th.

12 COMMISSIONER Mr. Wilson, are you winding down?

13 MR. WILSON I know what your limitation is and perhaps  
14 I'll attempt to wind up in the next few minutes.

15 COMMISSIONER That would be appreciated. Thank you.

16 DR. MCPHERSON Before we leave this particular batch of  
17 papers we're looking at, may I raise an issue, Mr.  
18 Commissioner? As I was glancing through these papers  
19 under your direction, something caught my eye and I would  
20 like to ask you to address it, if you can, and that is on  
21 the February 13th.

22 COMMISSIONER 8760, the top number?

23 DR. MCPHERSON I'm looking at, turn over, Mr.  
24 Commissioner, 8765.

25 COMMISSIONER I've got it, yeah.

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1 DR. MCPHERSON Actually this is an example of something  
2 that I mentioned yesterday of things standing out like  
3 red flags and this simply caught my eye. If you would  
4 look -- Do you have the page, sir? 8765?

5 MR. WILSON Yes, I do.

6 A. If you would look towards the bottom of the  
7 handwritten part, "Air readings were taken through the  
8 mine."

9 Q. Yes.

10 A. "CO, 0.04; CH<sub>4</sub>, 0.8." The 0.8 for CH<sub>4</sub> presumably was  
11 a percentage.

12 Q. Percentage of what?

13 A. A percentage by volume of the concentration of  
14 methane in the air.

15 Q. I have no idea.

16 A. There are no units given.

17 Q. No.

18 A. My question does not relate to the methane but the  
19 carbon monoxide of 0.04. What is that referring to? Is  
20 that a concentration in percentage?

21 Q. I can't answer your question.

22 A. It's a number that doesn't make sense. If it is a  
23 concentration by percentage as one would assume from the  
24 methane number it is, then this would be a highly  
25 dangerous concentration.

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1 Q. I can't help you there. You mentioned as well in  
2 the -- and it's something that -- was, as you put it,  
3 matters in the mine were so obvious that they, I think  
4 you were saying, they couldn't have gone unnoticed. That  
5 was an observation you were making from this.

6 A. You're referring to my question about the carbon  
7 monoxide?

8 Q. No. No, I'm referring to the general, when you were  
9 talking about the lack of rigour of government officials  
10 and you concluded yesterday in your evidence, I believe,  
11 that you can't see how these things could have gone  
12 unnoticed.

13 A. I understand, yes.

14 Q. Now the anecdotal evidence appears to be that when  
15 mine inspectors were coming to the mine that stone  
16 dusting was being applied and things were being done with  
17 respect to conditions at the mine. Were you aware of  
18 that?

19 A. Was I aware that stone dusting was done?

20 Q. Prior to the visits of the inspector?

21 A. Prior to the inspections being considered?

22 Q. Yes.

23 A. I am not aware that that was undertaken.

24 Q. Could that explain in part why it wouldn't have been  
25 such an obvious situation in that regard?

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1 A. I was about to add that that is a set of  
2 circumstances that one sees in mines that when an  
3 inspection is about to take place and the management  
4 knows that an inspector is on the way the following day  
5 or the following shift or the following hour, that he or  
6 she will take whatever steps one can to keep that  
7 inspector happy and that would certainly include stone  
8 dusting.

9 Nevertheless, even if that had occurred at Westray  
10 prior to the inspectors' visits, it was still  
11 sufficiently obvious and sufficiently bad for those  
12 inspectors to make those comments that you have referred  
13 me to.

14 Q. Yes, but not so obvious that it would suggest to  
15 someone that they ought to close the mine?

16 A. I think, Mr. Wilson, that if a problem like this  
17 continues month after month and inspection after  
18 inspection, it would have been prudent for the  
19 enforcement personnel to have taken more stringent  
20 actions earlier than they did.

21 Q. Were you aware that there were other independent  
22 inspectors in the mine during the life of this mine doing  
23 inspections and issuing reports and making observations?

24 A. Other than the government inspectors?

25 Q. Yes.

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1 A. I believe that a safety committee was formulated  
2 with workmen's representatives who did such inspections,  
3 but I am not cognizant of the details of their work.

4 Q. And as well there was a mining consulting firm hired  
5 by the bank to inspect in order to protect their hundred  
6 million dollar investment as well. And they did a  
7 monthly inspection.

8 A. I'm not aware of that one.

9 Q. And filed a monthly report.

10 A. I'm not aware of that, sir.

11 Q. Would you not think that they would have seen  
12 something if it were so obvious?

13 A. I'm not aware of and I have not seen those reports.  
14 I'm not aware of how often such inspections were made.  
15 I'm not aware of the qualifications of those inspectors  
16 to make any judgment on mine safety. I have no knowledge  
17 of it, in other words.

18 Q. And if it was a mining engineer who was doing a  
19 monthly inspection of the mine, writing a monthly report,  
20 would you find it unusual if he did not mention these  
21 types of conditions existing in the mine?

22 A. I would certainly find it unusual that the  
23 government inspectors would so repeatedly be conscious of  
24 a problem. If, in that set of circumstances, someone  
25 else came along and saw no such problem, then, yes, that

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1 would be an anomaly.

2 Q. And were you aware that there were a number of  
3 mining experts in the mine in the -- I believe, the  
4 latter part '91 anyway and '92 addressing rock mechanic  
5 issues, who inspected -- who would have been there to  
6 observe what you would have considered to be obvious  
7 conditions?

8 A. Yes, I know that they did have severe roof control  
9 problems and had people looking at it, yes.

10 Q. And these would have been experienced mine people, I  
11 take it, who would have been in observing conditions at  
12 the mine?

13 A. I would hope so, and particularly experienced in  
14 questions of rock mechanics and ground control, not  
15 necessarily with respect to ventilation.

16 Q. You've spoken about the role of the inspectorate in  
17 terms of the factors that led to the explosion on May 9.  
18 What's your view of the role of management in that?

19 A. Well, of course, management has a prime  
20 responsibility for operating their mine in a manner which  
21 is safe for the personnel for which they're responsible.

22 Q. And in fact under the legislation, they are the ones  
23 who are, by legislation, responsible for the occupational  
24 health and safety of the employees?

25 A. Yes, sir.

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1 Q. And the general manager has statutory requirements  
2 as does the underground manager, the overman, and the  
3 mine examiners?

4 A. Yes, sir.

5 Q. And all these individuals have responsibilities with  
6 respect to the operation and ongoing safety of the mine?

7 A. Yes, indeed.

8 Q. What is your view of the role of those who  
9 consulted, reported, to give expert advice with respect  
10 to the design of this mine?

11 A. As far I'm aware, employed consultants have -- are  
12 not mentioned within the regulations pertaining to coal  
13 mines. I may be wrong on this, but I'm not aware that  
14 outside consultants are mentioned. I can't recall seeing  
15 them. So any responsibilities carried by those  
16 consultants would be governed by some other law.

17 Q. Well, do you have a view on that?

18 A. Does some other law cover the matter?

19 Q. No, do you have a view of their role --

20 A. Well, they certainly had --

21 Q. -- as a factor contributing to the disaster?

22 A. Outside consultants certainly should take every step  
23 that they can to ensure that the recommendations that  
24 they're making not only solve the particular problem or  
25 address the particular study that they have been asked to

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1 address, but do so in a manner which will not conflict  
2 with the safety and health of the personnel.

3 Q. But I take it you haven't made an assessment with  
4 respect to the activities of the consultants with respect  
5 to this particular mine in association with the result?

6 A. No, sir, I have not.

7 Q. Thank you, Dr. McPherson.

8 COMMISSIONER Mr. Merrick, do you want to get through  
9 your -- whatever re-direct you have?

10 MR. MERRICK I will have re-direct of about, I would  
11 think, fifteen to twenty minutes. My preference would be  
12 to do it the first thing in the morning. That would  
13 still give Dr. McPherson ample time to make his  
14 connections.

15 COMMISSIONER Within the speed limit?

16 MR. MERRICK Within the speed limit. I can do it this  
17 evening if you'd like.

18 COMMISSIONER No, tomorrow morning would be fine.

19 MR. MERRICK I promise I'll get you to the airport on  
20 time.

21 A. Thank you, Mr. Merrick, I appreciate that.

22 COMMISSIONER Get you to the church on time. Okay,  
23 we'll adjourn until 9:30.

24 INQUIRY ADJOURNED (TIME 5:18 p.m.)

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REPORTER'S CERTIFICATE

I, Margaret E. Graham, Court Reporter, certify that the foregoing is a true and accurate transcript of the evidence taken by way of recording and reduced to typewritten copy.

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Margaret E. Graham

DATED this 22nd day of November, 1995, at Stellarton,  
Nova Scotia.