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I certify that I have read the transcript for the March 28, 2007, meeting of the Panel, and that, to the best of my knowledge, this transcript is accurate and complete.

Linda Zeiler, Designated Federal Officer

Dr. Jan M. Mutmansky, Chair

TRANSCRIPT OF PROCEEDINGS

IN THE MATTER OF:)
)
TECHNICAL STUDY PANEL ON THE)
UTILIZATION OF BELT AIR AND THE)
COMPOSITION AND FIRE RETARDANT)
PROPERTIES OF BELT MATERIALS)
IN UNDERGROUND COAL MINING)

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UNITED STATES DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION

IN THE MATTER OF:)
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TECHNICAL STUDY PANEL ON THE)
UTILIZATION OF BELT AIR AND THE)
COMPOSITION AND FIRE RETARDANT)
PROPERTIES OF BELT MATERIALS)
IN UNDERGROUND COAL MINING)

Glenwood Room
Holiday Inn
Pittsburgh Airport
8256 University Blvd
Coraopolis, Pennsylvania

Wednesday,
March 28, 2007

The parties met, pursuant to the notice, at 9:00 a.m.

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P R O C E E D I N G S

(9:05 a.m.)

MS. ZEILER: I would like to welcome everybody to the second meeting of the Technical Study Panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining.

If you haven't already, we would ask that you please sign in, and we have a very full agenda today, and so we would like to get started. We are pleased to have several speakers here today from NIOSH, in order to provide a summary for the panel of all of the research that has been done to date by NIOSH on belt air issues.

And Dr. Jeff Kohler had intended to be here, but was called away, and so we are fortunate to have Bob Timko. He is the manager of the Dust and Diesel Monitoring Team, and he will provide the NIOSH overview on the research. Bob.

MR. TIMKO: Thank you, Linda. Good morning everyone. Good morning to the committee. I am speaking this morning on behalf of Dr. Kohler. He was called away to Washington.

Interestingly enough, apparently they are doing -- the Congress is doing belt air talks this morning also, and so he was called away to assist John Howard in that area.

I was asked to present this presentation this morning. He and I generated this talk, and it is basically a short overview on the research that NIOSH has accomplished within our history, and this research deals specifically with belt entries and conveyor belt and belt issues.

Today's presentation will involve several questions that we will attempt to answer. Number one, why use belt air. What are the risks of using belt air. How do we intend to manage or how have these risks been managed over the years.

How does the research that we have been doing or have accomplished inform the decision to work with belts. And what are some of the focus areas for further deliberation on belt research.

Let's go into a little bit of background on ventilation, and really you have got two options with belt air. You can keep the belts on return, and there are certain advantages to that, dust and gas, and especially when air is moving away from the face on return, dust and gases are directly coursed to the return.

And typically is there is some kind of a fire in the belt, the smoke from that fire, at least in the early stages, is forced away from the face. There are disadvantages to this, of course.

You are unable to move sufficient air to the face. If you are unable to move sufficient air to the face, the belts become mandatory to get that needed air, additional air, to the face.

And secondly, there is a lack of protection that is afforded with the -- and this is wrong, and I apologize for this, but it is Title 30, Part 75 CFR 350.

Now the other option, of course, is belt air on intake. You also have options here. The advantages to using belt air on intake, of course, is that you will get improved ventilation under difficult conditions, specifically roof control problems, and we will go into that in a little while more specifically.

And other advantages are early detection of fire. You know, some people still say that while sensors are very important, probably the human nose is probably one of the best sensors for really early detection of something maybe possibly being wrong in the belt entry.

Other advantages are that the water, the water lines in the belt entry, are not flowing in the same direction as the air flow, enabling -- if there is an emergency, enabling people to get upstream of the emergency and still be in fresh air to control it.

And finally again, Part III or Section 350 safeguards are involved as an advantage to using belt air on intake. Disadvantages here are that there are also the potential for increased gas and dust in the working space that would be specifically generated by the belt entry.

Also another potential disadvantage would be that there is the potential for the face to be flooded with smoke if there is some kind of a fire related emergency in the belt.

Why use belt air? Well, often times it is mandatory to use belt air, and some of the reasons for that are the need for additional air quantities, especially if you have got an elevated methane concentration at or near the face, or even if you are mining through seams that have the potential for high methane, the potential to better control the methane in the outer entries.

The inability to deliver additional air through existing air courses. Here what we are talking about is if are running a long wall or some operation that requires a large quantity of air to the face, and the pressure differences between the intake and the return entry are high enough that a great portion of the ventilation air entering that section end up in the return.

In other words, it is short-circuiting, cross-stoppings, and things like that, that reduces the quantity of air to the face. And then once you begin moving into that scenario, you run into a limitation. It is easy to run into a limitation on power, trying to get a sufficient quantity of air to the face.

And finally the inability to deliver additional air by driving additional entries. You know, some people say, well, rather than use a belt, drive another intake. Well, in many mines, this is impossible to do simply because of potential ground control limitations.

Let's take a moment to discuss some of the potential problems that are related to ground control, and why some mines, especially those in the west, tend to really readily use belt air to limit or to ventilate their faces.

First, it is based on the pressure arch theory and it deals with stress levels of the remaining strata after mining, and that the stress levels are a direct function of panel width and the number of entries.

In other words, as the number of panels goes up and the number of entries goes up, the stress levels go up. Now under extreme conditions, it is required to minimize that potential stress level, and these extreme conditions can include -- and usually typically do include deep cover, any strata that you have that is bump-prone, or any kind of weak roof or floor where the pillars, the remaining pillars, are punching themselves into the floor.

Now let's take a moment to discuss other ground control entry restrictions and concentrate on intersections. In intersections, understand that -- and this is based on an MSHA report that was generated in the mid-'80s, roof failures in intersections are eight times more likely than in straight entries.

And again these are directly proportioned to the number of entries -- roof failures are directly proportional then through the number of entries that you do have. In other words, two entry developments contain 33 percent fewer intersections than three, and of course, two entries contain 50 percent fewer entries than four entry panels.

There are concerns arising from using intake air to the belt, or belt air through the intake. One of the biggest concerns is conveyor belts systems have the potential for problems, and these could be drives, belt take-ups, any powered or moving item in the belt entry has the potential to cause friction, and potential electrical problems.

And if you look at the fire triangle, this is your heat source. Your fuel source is the second concern and that is coal spillage and accumulation problems. So how you have sufficient oxygen in the entry, and you have sufficient fuel, and you have your sufficient heat source. Consequently, you have the potential there for problems.

Conveyor belt flammability. That is an issue that has been addressed. We are going to learn a little later today as to how flammability has changed over the years, but based on our research -- and our research, I must admit, our research basically on flammability basically slowed to a stop in the mid-'90s.

So our basic research relative to flammability is coming up on a decade old. We also looked at dust entrainment and finally another concern would be methane that is picked up and moved to the face.

There have been risk surveys looking at belt air use. The Bureau of Mines did a survey between 1970 and 1990 on fires. MSHA did a survey that took the years between 1980 and 2005, and in here you can see that the percentage of total fires caused by problems in the belt entry fell from about 28 percent in that 70 to 90 range, down to about -- let's say 20 percent in the 1980 to 2005 era.

There was one fatality out of all of those fires, and that occurred after 1990. I believe it was a heart attack while the gentleman was fighting the fire, and of course, these are formal reports. We did not cut off reports simply to try to eliminate any fires.

I understand that the Aracoma fire in 2006 was the cause of two fatalities, but according to the State report, the belt entry, or the belt itself, was not directly responsible for that.

What are the risks associated with using belt entry? Well, there is the potential for increased respirable dust concentrations at the face, and there is also the potential for increased methane at the face.

Now if there is a fire, and there tends to be a fire in the belt, there is also the potential for increased smoke at the face, and of course this would tend to hinder escape. Also, if a fire begins to grow to a point that it begins flooding entries that are adjacent to the belt entry, there is also the increased potential for smoke in those entries, and again in a lot of cases this would be the intake escape way.

And this would tend to limit the potential for escape also. Finally, there is the increased smoke load is based on -- the increased smoke load relative to belt fires is directly based on belt flammability, which is another risk.

Today, how do we address these risks? Well, first, we keep an average respirable dust concentration in that entry at or below one milligram per cubic meter. That basically eliminates the dust problem relative to using belt air intake, and this is part of Section 350.

We provide early detection and warning of fires, and this is done by the atmospheric monitoring systems that are mandatory again as part of 350. These sensors have to be placed in the primary escapeway or the intake, the belt, and at the point feed location.

Reducing the likelihood of smoke flooding the intake entry. Again, 350 addresses this. No more than 50 percent of the total air flowing to the face can come from the belt entry, and so you are limited to a 50-50 maximum of proportion.

At the point feeder, the point feed itself that is feeding air to the belt entry, it has to have the ability to be remotely closed. There is a 300 foot minimum velocity through the regulator, and this was done -- this was basically -- the rationale behind this was that if there is a pressure differential across the entry due to fire that this 300 foot per minute head that is being generated through that belt, the point feed regulator will tend to control that, and that was done through MSHA research.

That stream air in the belt and the intake also has to be monitored for smoke as again as a part of Section 350. And 350 also states that we require a minimum number of three entries.

Now the fellows out West that are using two entry longwall, of course they have to petition MSHA to use the two entry system, and they are on a case by case basis. They are approved or not approved based on a number of parameters.

Finally, as part of Section 380, we now require of directional life lines, which tend to reduce the risk, especially in low visibility areas. Let's be honest. Fire does have an effect on ventilation. If you are using an entry to ventilate, especially ventilating through the face, as air is moving through that entry, it permits the byproducts of any kind of a fire to flow more rapidly through the mine. That just stands to reason.

The fire itself, as it grows, tends to reduce the air removal within the entry. It other words, it creates its own pressure head due to the heating itself. There are potential secondary problems of this reduced air flow from a fire, or from the heat of a fire.

Downstream, you can have a methane accumulation, and you can have inadequate oxygen by the air being consumed by the fire itself. You can have flow into adjoining entries as the fire continues to grow, and basically the pressure there overwhelms the ventilation pressure and it begins spilling into parallel entries.

And probably one of the most important difficulties or secondary problems is the difficulty with escape. The potential there as the visibility goes down, the potential for problems with escape become greater, and Dr. Kissel will be talking about that tomorrow.

There are also a couple of other problems associated with the effects of fires and ventilation. Understand that if you have a problem in the belt and a fire erupts, everyone thinks that if the air is moving away from the face that that will carry the smoke away from the face and enhance the potential for a safe egress.

Well, that may or may not be true. If you don't have the safeguards that are associated with Section 350, specifically the AMS system, there is the potential for something to happen in the belt to grow to a fairly large size without being detected, and begin roll back or the smoke actually moving back toward the face.

There you have a real problem, and that is a problem, or is a potential problem with belts on return air. In other words, fires in these kinds of entries without an AMS in use can be larger and potentially more deadly.

I would like to take a moment to talk about the atmospheric monitoring system. The AMS is a mature technology. There are over 650 of these things being used underground presently. Understand that these are not devices that you install and forget.

Every 31 days, you have to test and calibrate the sensors. That is in the regulations. They have to have automatic visual and audible alerts at the surface. They have to have visual and audible alarm systems both at the surface and at various locations underground where men would be working.

And finally you have to have automatic visual and audible signals. Even when two consecutive sensors alert, these devices have to warn someone that there is the potential for a problem.

Now what research have we accomplished over the years? We have looked at a number of different areas relative to this. We have never put the whole package together, but a number of different areas have been doing research in belt entry work. Ground control, of course, with our strata control problems and solutions, they have been an ancillary group that has helped us in that area.

Belt flammability. We have done a lot of work. Dr. Lazzara will be talking more about that in a moment. We have done a lot of work in toxicity. Dave Litton, a researcher at NIOSH, will be talking about that later this morning.

Ventilation. We have looked at the problems of fire throttling through ventilation. We have looked at a number of different areas relative to ventilation, and belt entries.

And finally dust control. Years ago, we had a dust control program that looked at the problems associated or the contribution of dust in a belt entry on intake air to the face concentration when using belt air.

The presentation topics, I alluded to them a little earlier, and I would just like to go over them once again on some of the presentation topics that we are going to be talking about today, and some of the potential topics that we could be looking at or talking about to you folks if the interest is there in the future.

Belt flammability. Dr. Lazzara will be talking about that shortly, and belt toxicity, as I said, Dave Litton. Tomorrow, we will have a ventilation expert, Robert Krog, come in to tell you about the three entry ventilation, and some of the inherent problems associated with use of belt air, and when they were told not to use belt air, the resulting problems and solutions that a mine has come up with relative to that.

And finally in this set of meetings today, or today and tomorrow, Dr. Kissel will be talking about escape and various aspects associated with escape from fires.

Other potential subjects that we have thought of right now, but of course our areas are not limited to this, but we are more than happy to talk with the committee about in the future; ground control, dust, looking at sensors, and types of sensors, and the capabilities of various sensors.

And finally we would like to talk about -- I would like to spend a few moments talking about potential focus issues. Now, this slide is continually moving or continually changing.

And Dr. Kohler and I talked about these, and these are some of the more simple ones that we came up with that will have -- that we feel will have more immediate concern, but they are by no means fixed in any case.

First of all, flammability of belts. You know, it has been a while since we have done research, and as I said before, since we have done research in this area.

What are the changes in the makeup of the belts over the years, and have they become more fireproof, and if more fireproof belts in the past have had the potential or had problems with flexibility, and had problems training, and things like that, and has chemistry or engineering changed these over the years.

The tradeoffs in belt materials. Are some better than others. Are there compositions that make up various different components of the belts that they are able to be put together to make a safer belt.

And finally the adequacy of other measures that are associated with belts. In other words, all the rollers, any of the other equipment that is ancillary to the belts themselves.

The air velocity cap, we think that is a potential focus issue. Currently, we have a research project at the Pittsburgh research laboratory that is looking at higher velocity air streams, and relative to the atmospheric monitoring system.

And initial research has found that while the sensors are picking up indications of a fire, and they pick it up to a level that the suppression systems go off, in higher velocity entries, and I think the researcher doing this work was talking about air is around a thousand feet per minute, but at higher velocities, even after the extinguishing agent is discharged, it is not getting to the fire.

It gets picked up by the air stream, and is carried by the air stream past the fire location, rather than basically smoldering the fire itself. So there is a potential problem that we think we are on our way to solving, but it still would be interesting to look a little more thoroughly at that.

Finally, the adequacy of pressure balance and sensor placement guidance. If there is no limit on velocity, maybe things will have to be more -- would have to be a little more thoroughly engineered to determine sensor placement, and extinguishing methods.

Maybe there are better positions or locations for the extinguishing in these higher velocity entries. Finally, merits of a case-by-case determination. That is something that we just entered more recently to determine or relative to statutory 350 determination of the approval for belt entry, versus MSHA looking at a mine by mine determination of approval.

That completes my talk. If there are any questions, I would be happy to entertain them. If not, I would like to introduce our next speaker. Jim.

DR. WEEKS: I have got a couple of questions.

MR. TIMKO: Sure.

DR. WEEKS: Let's suppose an operator does have difficulty getting adequate air to the face. Is using a belt entry the only solution to that problem, or where does it stand in the hierarchy of belt solutions to get adequate air to the face?

MR. TIMKO: I think that depends upon, first of all, the number of entries to the section. If you are limiting yourself to three entries, if it is a development panel, and you are limiting yourself to three entries, you have an option.

If it is a long wall panel, it is a three entry long wall panel, you again have an option. Some mines here in the east are using -- have converted the return entry to another intake. However, they have developed bleeder entries around the back of the panel that they are able to ventilate with.

So, in essence, you have two intakes, and you can use the belt in return. Again, it is a case by case basis, and it is very difficult to say -- you know, to just answer a question like that. There are a lot of variables that come into play.

Multiple entries, let's say, for example. If you have four more entries, it becomes a lot easier to move higher quantities of air down parallel entries and the belt becomes less important.

I think there is a direct relationship between the number of entries and the importance of using belt air.

DR. WEEKS: But the number of entries on that face, that depends on the mine plan.

MR. TIMKO: That depends on the mine plan, that's right. However, it is a lot less important in the east than in the west, but in the west, going back to ground control problems, you are limited. You are severely limited in many instances because of the amount of cover that you have over a mine.

You are limited to the number of entries that you can have in a mine, simply because of ground control problems.

DR. WEEKS: Someone is going to have to explain that to me, because I don't understand it that well.

MR. TIMKO: Okay. Well, hopefully, you know, if that is something that you want more information, we have ground control experts, and they would be more than willing -- more than happy -- to explain that.

DR. WEEKS: Well, we are going to visit a two and three mine and I guess some of those questions will be answered then. Another question is that you mentioned early fire detection.

MR. TIMKO: Yes.

DR. WEEKS: And that is not really anything inherent to entry and the using of a belt entry to ventilate the face, and that is really a function of the atmospheric monitoring providing really protection.

MR. TIMKO: Yes, that's correct.

MS. ZEILER: Excuse me. Jim, could you just pull the microphone over a little.

DR. WEEKS: Oh, I'm sorry.

MS. ZEILER: Thank you.

DR. WEEKS: And you suggested that the nose might be better. Could you elaborate on that?

MR. TIMKO: There is no scientific merit to that. It is just that if you talk with people that have a lot of history in mining, more often than not, they will tell you that I smelled that long before the alarm ever went off, or something to that effect.

DR. WEEKS: Well, the data that we got from MSHA indicated that when there were belt fires that the AMS -- well, that it seems to be a good system.

MR. TIMKO: Oh, it is. There is no doubt. It is.

DR. WEEKS: Is there any reason not to put

AMS on any belt to ventilate the face?

MR. TIMKO: I can't think of any. It is just another safeguard.

DR. WEEKS: Right.

MR. TIMKO: I guess it is a mine ownership philosophy. I know that at Consol, that they are just adamant about AMS systems, and I believe it is just a mine philosophy.

DR. WEEKS: On all belt entries?

MR. TIMKO: On all belt entries.

DR. WEEKS: Thank you.

MR. TIMKO: Any other questions?

DR. MUTMANSKY: Bob, I was just concerned about that fire suppression system problem in higher velocities. Is this basically a fire suppression system at the drive system only, or is it other places as well?

MR. TIMKO: I will be honest with you. I don't know. I was just giving an overview as to the problems they were having. I am not sure exactly of the location of the suppression relative to any pieces of machinery.

I think it is more directly -- off the record, I think it is more directly related to look comparing the emission of extinguishant versus velocity through an entry, rather than at a specific location.

I don't know if you are asking about distance from a specific piece of equipment that may be on fire. I don't know about that.

DR. MUTMANSKY: Well, we can get to that question later, as some of the other speakers may be able to address it.

MR. TIMKO: Okay. Tom.

MR. MUCHO: Let me follow up on that. I know that is ongoing research right now, but the past research, as far as what I am familiar with, when you get into higher velocities, the type of nozzle that is used becomes very critical as to getting the extinguishment on a belt that is usually in the drive area, delicate systems and the like.

I guess we are not going to hear about the current research; is that right? We are not going to get any more discussion other than what you just talked about?

MR. TIMKO: Of that research?

MR. MUCHO: Yes.

MR. TIMKO: Yes, you won't hear any more about that at this meeting. Now if it is of interest to you, we can, of course, generate a program at the next meeting for you, and we would be happy to do that.

MR. MUCHO: I guess one question that I would like to have answered is has the nozzle types been looked at in terms of their efficiency at the higher velocities?

MR. TIMKO: I don't know. Jerry.

DR. TIEN: Bob, I know in the past that the bureau has done some studies on the dust barrier or water barrier. What is the status of that and I know that some other countries are using that still. What is your thinking on that?

MR. TIMKO: I don't know of any research that is current relative to the water or dust barriers that we are doing now. I will have to look into that and get back to you on that. Thanks, Jerry. Jim.

DR. WEEKS: I have another question.

MR. TIMKO: Sure.

DR. WEEKS: You mentioned there is the one milligram limit on --

MR. TIMKO: Respirable dust?

DR. WEEKS: Respirable dust, yes. Where does that number come from? Looking at the data, the belt entries are routinely operated well below that.

MR. TIMKO: Sure.

DR. WEEKS: A half-a-milligram or below.

MR. TIMKO: Right.

DR. WEEKS: And to maximize the efficiency of belt air as far as coal dust, you would want to get that number as low as possible. So, one milligram seems to be generous, but I was wondering where that number came from. What is the rationale for that number?

MR. TIMKO: I will have to look at that for you and get you the answer later. I am not sure myself. I would speculate on it, but I would rather get you the exact rationale behind it then, and I would be just guessing. Thank you, gentleman. I would like to turn the floor over now if I may to the next speaker, Dr. Charles Lazzara.

He is a retired physical scientist with the Bureau of Mines, and then later NIOSH, and he will be talking with you about belt flammability and the tests and research that has been accomplished in that area.

DR. LAZZARA: Thank you. First, I would like to thank NIOSH and Dr. Kohler for the opportunity once again to present this work on conveyor belt flammability tests. This is a cooperative effort with the Mine Safety and Health Administration that occurred in the late '80s and early '90s.

There are a number of people who need to be acknowledge for this. I generally put this down in general terms. The Pittsburgh Research Laboratory personnel that contributed to the flammability of the mines materials project that was on at that time.

And MSHA personnel from the Approval and Certification Center, who cooperated extensively in doing the tests and helping out; and several conveyor belt manufacturers who supplied the belting materials for the test program.

As an outline of the presentation, I would like to say a few words about conveyor belt fires in general, and go into the current federal test for flame resistant conveyor belting, which is in 30 CFR Part 1865; and talk about the large scale gallery fire test that was developed for belting, and the following laboratory scale fire test in a ventilated tunnel, also known as BELT, Belt Evaluation Laboratory Test, the outcomes of this work, and a couple of other related studies.

If you look at conveyor belt entry fires between 1980 and 2006, and this is in underground coal mines, of course, and MSHA data, there were 65 fires. In terms of importance, the main ignition source is frictional heating, following by flame cutting and welding operations, or hot work, and electrical malfunctions.

This is a view of a mine that had a conveyor belt fire, and we were able to get back into it and take some photos. This is the conveyor belt entry, and you see the damage that was caused. The belt was consumed, the belt structure, and a lot of roof falls.

When we were doing this work, there were a lot of conveyor belt fires that caught our attention happening around the same time. In 1986, was Florence Number One, Robinson Portal, where there was one fatality due to a heart attack due to fighting the fire.

That fire occurred in a rock tunnel, mainly sandstone, with a minimum amount of coal. There were 1,200 feet of belting consumed. That was followed by the Beckley Mine fire in West Virginia, and that was fought for several days, and successfully put out.

And the Marianna Number 58 fire in Pennsylvania, and that started in the drive area, and it was discovered, and about 20 minutes after discovery, the flames spread down the belting and involved the coal seam. More than score of miners had to evacuate the mine under smoke-filled conditions. The mine was sealed and remains sealed.

The Bullet Mine fire in Virginia in 1994, and I will touch a little bit more about that in a minute. These fires continued through the '90s, and into the new century. In 2002, Blacksville Number Two, VP Number Eight in Virginia, and this is one of the conveyor belt fires that brought up this question about suppression systems at high air flows, especially if they used a dry chemical powder, and it seemed to be ineffective in putting out the fire.

Mine 84, a mine fire in Pennsylvania. About 600 feet of entry was damaged in that area, and they had 10 mine rescue teams fighting that fire for several days and they were hampered very much by rock falls.

Buchanan in Virginia. Powhatan Number Six in Ohio. It was an interesting fire in a sense that it started in the tail piece, and they had a fire going on there, and the belts got started again, and the fire moved on the belt and stopped at an overcast, and so you had two fires going.

Fortunately, they had a well trained fire brigade at that mine, and they were able to put out one fire, and they noticed that the smoke was not abating, and so they knew that they had something else to deal with and found the second fire and put it out, and limited the damage.

Of course, Aracoma, in West Virginia, where you had two fatalities, and Oak Grove in Alabama. Now, generally about 50 percent of these fires occur along the belt line, and 50 percent in drive areas or tail pieces, et cetera.

Along the belt line, the typical scenario is that you will have some coal spillage and coal dust around, and you have your idlers with your bearings in them, and you get some frictional heating due to bad bearings in your idlers, or perhaps you are missing some idlers, which was found in several cases, and you get frictional heating.

And that friction gets the coal involved, and you have a small coal fire. As long as the belt is moving, and it is not in contact long enough with the coal fire to ignite the belt. But if you stop the belt or off-load the belt, and now the coal fire can interact with the belt, and it is possible to get the belt ignited.

It also had a misaligned belt, and the belt would rub against the wood poles or steel poles, also causing friction, and the possibility of a coal fire, and then the belt ignited.

And in the drive area, of course, you could have slippage, and the slippage causes frictional heating that could ignite the surrounding coal, and then the belt, or the belt.

In some cases in the literature, you will find some cases where you had badly worn belts, and a lot of interior parts or strips of belting that wound around the idlers causing friction, and lead to a fire.

The Bullet Mine fire was a little unusual, in the sense that the conveyor belt was directly ignited by contact with a trolley line, an energized trolley line, at 300 volts d.c. So here we had direct ignition of the belt, and you didn't go through this phase of smoldering coal, and then flaming coal, and then ignition of the belt, or frictional heating.

In that case about 31 miners had to walk out of the mine in smoke filled entries, about two miles, and several miners were treated for smoke inhalation.

So these fires have been occurring and still are occurring, and we have a lot in the regulations to try to reduce their severity and prevent them. Of course, in CFR Title 30, Parts 1 to 199, you need to have suppression systems in drive areas. You would have automatic sprinklers, and water deluge systems, and some mines have dry chemical powder, and even fire fighting foam systems.

You need slippage and sequence switches along your belt line. You need fire detectors along the belt line. Point type heat sensors---if you are not using belt air at the face; and if you are using belt air at the face, you need to have CO sensors, or smoke sensors.

I don't know of any mines right now that have smoke sensors installed. It needs fire hydrants located every 300 feet parallel to your belt entries, and your fire fighting equipment kept at regular intervals.

And perhaps your last line of defense, you need flame resistant conveyor belting. So what does that currently mean? Well, it means that the belt manufacturer would send samples down to MSHA's Approval and Certification Center, and they do a test that is specified in 30 CFR Part 18.65.

It also has been known as Schedule 28 or the 2G Test, and this is the same test that is used for hose material, the inner liner of fire hose and hydraulic hose, outer sections of hydraulic hose, are tested in terms of flammability under test procedures.

So the test is done in this cubical chamber, and they use four samples a half-inch wide by six inches long belt sample. The sample is mounted in the chamber horizontally, with the transverse axis tilted at 45 degrees, and you have a bunsen burner flame. There is a wire gauze located here.

The bunsen burner flame interacts with the belt sample at this location, and the bunsen burner flame is on for one minute. This is sort of a schematic of that diagram, with the inner cone of the flame, which is the hot portion, touching the belt sample.

The bunsen burner flame is removed, and the air flow through the chamber started at 300 feet per minute over the sample, and the observer times either flaming and afterglow. And the belt passes at the average flame duration of the four samples is one minute or less or the average afterglow is three minutes or less.

If it passes the test part, then you label the belt as fire resistant, and USMSHA Number 28, which stands for the type of test, Schedule 28, and you have a couple of numbers following it, which refer to the belt manufacturer, and then a couple of other numbers for the specific belt formulation that was tested.

So this is a test that has been used since

1969. To get an idea of how these belt perform under more realistic large scale conditions, we conducted tests at this large scale gallery located at our Lake Lynn laboratory.

The gallery consists of a 90 foot long metal arch section, and it is coupled to a 20 foot section, to a 6 foot diameter axis vane fan, which blows air through the gallery, and we can vary the ventilation flow by adjusting the pitch on the blades.

It is 12-1/2 feet wide by 8 foot high, and the cross-section of the area is 81 square feet. Inside the gallery, we have located a conveyor belt structure, and for a typical test, we put a 30 foot length of conveyor belting on the structure.

The ignition source was just downstream of this tail piece, a tail pulley, which is left in place. And it was a tray, a diesel fuel fire tray. We set the air flow prior to the test. We also had various thermocouples located on the belt and in the gallery to monitor air temperatures.

This is a view looking down the gallery. The walls were coated with a ceramic insulation to protect them from the heat, and the ignition area was shielded from the direct ventilation flow.

A view of the ignition area. A piece of

belting was turned down into the ignition area, which was a 2-by-3 foot tray, and in which we placed liquid fuel.

The ventilation was set prior to the test by measuring the air flow above the belt at about three different locations, and also at the exit of the gallery where we didn't have the belt structure, and set to the desired number.

You will also notice these windows on the side where you could view what was happening inside, a side view. And you can see that thermocouples were located along the length of the belt so we could measure the flame spread rate, or when flames reached a certain location on the belt.

We established a set of standard conditions for this large scale gallery test. Generally, the samples that we looked at were 42 inches wide by the belt thickness, and that varied from about three-eighths of an inch to about an inch of thickness.

The sample from the roof distance was four feet, and the air flow was set at 300 feet per minute, which is roughly 24,000 CFM. The igniter was two gallons of a liquid fuel in a two foot by three foot tray.

We used a gallon-and-a-half of kerosene, and a half-gallon of gasoline, and that resulted in about a 700 kilowatt fire that lasted about four to five minutes.

The question arose why did you select 300 feet a minute. Well, we found out under these specific test conditions that 300 feet per minute air flow in the gallery provided the most severe conditions for flame propagation.

These are the results that we got from testing one of the belts, Belt R-11. R represents a rubber belt, and this is our code name for the type of belt sample. And here we are monitoring flame spread at feet per minute down the belt, and air velocity, and these are all separate tests.

So this particular belt was consumed or burnt at all those air velocities, but the maximum flame spread rate of about 18 feet per minute occurred at a flow rate of 300 feet per minute, and so that's why we used 300 feet per minute for the gallery test standard.

We looked at 21 different types of conveyor belt formulations, and 30 synthetic covers, and those were basically styrene butadiene rubber and some styrene butadiene rubber of chlorine blends, and eight PVC belts.

Two of the belts were slightly worn obtained from mines, and the rest of them were new from belt manufacturers, and 19 of the 21 belts passed the current small scale federal flame test for conveyor belting. So 19 of those belts would be permitted in underground coal mines.

This is an example of a styrene butadiene rubber belt, three-ply construction. That is the R-11 belt that I have been referring to, and this is a PVC belt, solid weave type construction, polyvinyl chloride.

Those, of course are generic terms, and of course there is a lot more other ingredients in those belts. So this is one of the types of flammability performance that we observed under those test conditions.

At this point in the test the ignition tray fire is still on, and there is a 30 foot piece of belting there on the conveyor belt structure. At this point the ignition source and the tray fire has burned out, and the belt has been ignited in the ignition area.

Now you wanted to see what might occur. Would this fire go out or would it proceed, what speed would it proceed down the belting, et cetera. Well, in this particular case the belt fire progressed down the 30 foot sample, and in this particular case there was like four or five feet of belting burning at a time, and it would fall off the rollers, and burn out on the floor.

And in about 20 minutes the whole belt sample was gone. And that piece of belting generally weighed about 300 pounds, and if you got the ashes up afterwards, you would have about 150 pounds. So about 50 percent of the belt material was missing, and of course that sort of went out the back end, in terms of products combustion; thick black smoke, CO, CO2, et cetera.

This is the type of data that we got our traces from the thermocouples located along the belt in a test like the one you just saw. Here we are monitoring temperature, degrees centigrade, and here is the time from the start of the test, and zero is when we ignite the tray.

These are thermocouples located at three, seven, eleven, fifteen, nineteen, twenty-three, and twenty-seven feet, along the center line of the belt. Each one of these traces start out at room temperature, and they peak around 700 or 800 degrees centigrade.

So it gives us an idea of how the flames moved over that belt surface, and by drawing a straight line or best line through these increasing temperatures, and taking the slope of that, you can determine the flames spread rate.

In this case, we are talking about a couple of feet a minute that the flame was moving over the belt. Now I do have videotape that I would like to play of what I just described.

(Pause.)

DR. LAZZARA: Well, that is the gallery with the fan on the end, and the conveyor belt structure, and it has four inch diameter rollers or idlers. The ignition area would be a two foot by three foot tray, about half-filled with water, and then put the fuel on top of it.

Moving a belt in position, and once again notice these windows on the side. It is a 30 foot piece of belting. It's placed in the ignition area. And then adding the fuel, and throwing a match in. This we found to be a very effective way of starting it.

So we have the tray fire going on now for about seven minutes, and now we jump to 18 minutes, and you can see that the tray fire is out and the belt is ignited. And there is a propagating conveyor belt fire, one of those which I just described with a couple of feet a minute flame spread, and the belt is totally consumed.

Now this is another test of a neoprene belt, or chloroprene formulation, and what we observed was that the flame or the damage was limited to the ignition area, and we did not have any flame propagation beyond that. And this is what we would like to see in terms of performance of a better fire resistant belt.

Now after observing or you are looking through the side window, and you are observing the flames moving over the belt surface through that side window, and the ignition source is off to the left, and this is about a four foot distance.

And this is the belt and there is a roller right here, and there you are observing the flames moving over a piece of currently approved fire resistant conveyor belting.

No coal dust air, no breeze, just belting. No wood. You can see the idler come into view. It spreads along the top surface, and then burns through, and involves the carcass, and the whole thing burns out.

Now I am going to stop this now, but this continues. All right. Now, this is another type of flammability performance that we observed. In this particular test, shortly after we ignited the tray fire, there was a much bigger fire within the gallery, and you can see how it is starting to back up against the -- the smoke is starting to back up against the air flow.

And the belt was totally consumed, and sort of burned as one piece, and got ashes at the end. And, of course, because we had a larger fire, we had a lot more coming out the back end at any given time.

And if you look at the traces for that particular test, temperature traces again, once again we are applying temperature versus time, and zero time is when we ignite the ignition source, and once again we have thermocouples located down the belt at these various distances. Twenty-seven foot is near the end of the belt sample.

And you can see what happened, is that shortly after we ignited the tray, we had flames right down at the end of the belt, and if you take or calculate the flame spread rate for that particular test, it comes out over 20 feet per minute. So the flames moved over that surface at 20 feet per minute, and the whole piece sort of burned up at one time.

Another type of performance that we saw was badly charring. In other words, this is an example of one of those belts where we had complete charring over the 30 foot section of belting. This is 30 foot long.

This is the ignition area and we burned some of the belt away, and you can see the deep charring all the way back to the end of the belt. And during that phase, it was a pretty intense fire.

The undersurface of the belt was basically undamaged. This is some of the data that we acquired for some of the rubber belts, and each one of these symbols represents a different belt formulation under those test conditions.

Belt R-7, flames were at a rate of 15 feet per minute. The maximum temperature. That was measured by a thermocouple located near the exit of the gallery near the roof, because in that distance, we don't have a complete mixing of the gases, and so the hot gases rise.

So this would be the maximum temperature near the exit of the gallery, and remember that the gallery is 90 foot long during the test, 448 degrees C., which is the temperature, and you start getting other combustibles involved.

And the maximum fire size in megawatts, and that was measured by a thermocouple located near the end of the gallery, 12 thermocouples across a cross-section, and we looked at the average increase in temperature of the air coming in and going out.

R-9, that is a slower flame spread of four feet per minute, and at a maximum temperature of 287 degrees C. And a smaller fire size you would expect with the slower flame spread.

R-10 was a non-propagating fire. That is, the ignition was limited or the damage was limited to the ignition area.

And R-11, another fast burner, 18 feet per minute. Complete destruction, 391 degrees C, and 5.4 megawatts maximum fire size. Some of the results for the PVC belts:

For P-1, that was a rapid flame spread and complete belt destruction.

P-2 was deeply charred on the surface like I showed you that photo, and P-3 was a non-propagating fire, which once again the damage was limited to the ignition area.

So to summarize the type of flammability performance and behavior that we observed, we had rapid flame spread, which we define as greater than 12 feet per minute, with complete destruction of the belts, with seven of the belts tested.

Rapid flame spread with the top surface deeply charred, and the bottom surface undamaged for four belts. The slow flame spread less than 12 feet per minute, with complete belt destruction for four belts, and a non-propagating fire with limited damage in the ignition area for six belts.

Now we had a criteria for pass and fail for this test, and if a belt passed, the fire damage did not extend to the end of the 30 foot long sample, and applying that criteria, of the rubber belts, 11 failed the test and two passed; and of the PVC belts, four failed and four passed.

As I mentioned earlier, 19 of these belts would be permitted in underground coal mines at the present time based on the current small scale flame test.

Our next objective was to develop a laboratory scale test having acquired this data from the large scale gallery test, and we call this the laboratory scale ventilated tunnel test. It is now known as BELT, Belt Evaluation Laboratory Test.

And we took those same belt samples that we tested under the large scale gallery conditions, and knowing how they behave, and started burning several of them in this ventilated tunnel.

It is basically five-and-a-half feet long, and 20 inch square, and the air flow -- I have a fan out here, and the air flow is this direction, and the ignition source that we used was commercial methane or natural gas burner.

The belt sample is positioned on a steel rack, fashioned on to a steel rack, and is placed inside the tunnel, and the distance to the roof is eight inches.

And we varied some of the variables, like distance to the roof, and length of ignition source, and the air flow, et cetera. So we got similar damage to several of the belt samples that we got in the large scale test.

And we established a set of standard test conditions for the laboratory scale test. We looked at three pieces of belting, nine inches wide, by the belt thickness, by five feet long.

The sample of the roof distance was eight inches, and air flow was 200 feet a minute, and the igniter was this commercial 12 jet gas burner, which was applied to the front of the belt for five minutes, and with a gas flow of 1.2 standard cubic feet per minute.

This is what he first unit looked like in conducting a test with it. The belt has been fastened to this rack, and placed in the tunnel, and the air flow measured at 200 feet per minute, and the ignition source brought up to the belt sample.

And the flames for the ignition source, this is 12 jets on this burner, and there is a lower row and an upper row. The flames play on both the top surface and the bottom surface. And you remove the torch after five minutes, and you let the belt burn out.

If there is some belting left undamaged in a trial, and you do that two more times, so that you have three trials on a belt sample, and if there is some belting left undamaged, then the sample or the formulation passes the best.

So it is a rather simple test that doesn't require a lot of thermocouples, computers, and that kind of thing. In terms of comparing the large scale gallery tests to the BELT tests, the pass or fail results agreed for all 13 of the rubber belts tested.

The pass/fail results agreed for six of the eight PVC belts tested. So overall the pass/fail results were agreed for 19 of the 21 belts tested.

The conclusions of this work was that the majority of the currently accepted fire resistant belts that we looked at failed the large scale gallery test, 13 out of the 19 belts.

The laboratory scale fire test results for the belt tests were in good agreement with the large scale gallery test results, and belts that passed the laboratory scale test or the BELT test have improved fire resistance.

Now what were some of the outcomes of this work. Well, we built another BELT apparatus and evaluated it, and so we made sure that the results agreed with the first prototype, and then we supplied that to the Mine Safety and Health Administration's Approval and Certification Center.

A public meeting was held on January 19, 1989, to describe BELT and initiate a voluntary evaluation test program. This program -- and Mr. Verakis will go into much more detail on this tomorrow morning -- allowed belt manufacturers to submit their belt samples to MSHA, and they will be tested under this new test procedure so they could get an understanding of what belt formulations would pass.

The BELT apparatus was also fabricated by several belt manufacturers and by CANMET. CANMET did a favorable evaluation of the BELT apparatus for use for identifying fire resistant belting. The petitions for modifications, MSHA petitions for modifications in 1989 and for several following years, to use belt entry air to ventilate working spaces, required this improved fire resistant belting as soon as the materials were identified by MSHA and became commercially available.

What that really meant was that you had to have a final rule that would replace the current test by this new belt test, and there was the notice of proposed ruling making requirements for approval of flame resistant conveyor belts that was published on December 24, 1992, in the Federal Register.

As you heard last time, and I think Mr. Verakis will also expand on what happened between '92 and 2002, this rule was withdrawn on July 15, 2002.

The MSHA belt entry ventilation review committee in its reports and findings, and recommendations in 1989 made the following statement. The primary hazard associated with the belt entry today is the existence of conveyor belting which can be ignited and propagate flame along its length.

Belt fires, when they reach the propagation stage, produce more fire acids and spread faster in surrounding coal surfaces. The committee believes that the elimination of this major fire source through the introduction of improved belting materials is the single greatest achievement that can be made in reducing the hazards associated with belt entries.

And on page 32, the use of conveyor belts meeting the new and more stringent flammability test developed by the Bureau of Mines would significantly reduce the hazards to miners of conveyor belt fires.

And in the final report of the Department of Labor's BELT air advisory committee in 1992, recommendation number 10 on page 74, it is the consensus of the BELT air advisory committee that MSHA proceed rapidly to develop regulations for improved fire resistant belting, including new testing and approval of schedules.

Notwithstanding the scope of the committee charter, the committee recommends that once available the improved fire resistant belting material should be used in all underground coal mines.

There were a couple of other related studies that sort of impact a little bit on the flammability behavior of belting, although their main objective was other purposes. RI-9380 was fire protection for conveyor belt entries, and that was in 1991; and RI-

9570, hazards of conveyor belt fires, in 1995.

In RI-9380, the objective was to see how various sensors would react to an incipient belt fire or coal fire, and we went back into our large scale gallery and changed the test conditions obviously, and in this situation, we had about a 20 foot piece of belting located on the top rollers, and stretched around a tail pulley, and underneath we had some coal pile on a grid, and in that coal pile, we had some electrical heaters.

So we wanted to more slowly bring up the condition where you had a smoldering fire, and then a flaming fire, and see what would happen to the belt, and this was done at various air flows. And we had a bunch of sensors back there, smoke sensors, CO sensors, heat sensors, along the way to look at the detection aspect of it also.

Now I am going to focus on the ignition area. So this is what the ignition area looked like, and here is the coal pile, and these are electrical strip heaters located just below the surface, and there is the belt, and it was also instrumented with thermocouples.

And that is what the view looked like looking down, with a piece of belting stretched over the tail pulley. And there was about a six inch gap between the belt and the coal.

And we brought the heaters up to full power maybe in about a half-an-hour or so, and the first thing observed was the smoke coming out of the coal pile, and then you would have a small flame develop on the coal, and then it would spread, and this is this top surface of the coal burning, and it would start interacting with the belt.

There would be a sustained flame on the belt itself. You can see at this point in time that you have got nice white smoke yet, and you can see the back end of the gallery.

And as the belt got involved -- and of course you can't see the gallery anymore with the black smoke, and the flames would come over the top surface of the belt, and that would be the signal that it was close to propagation, and then it would start to spread down the belt, and in this particular case the belt was consumed.

This happened to be belt R-11 again, an SBR formulation, and we looked at this as various air flows; 150, 300, 800 feet a minute. And this was the time for belt ignition. This was the time from when we saw the first flicker of flames on the belt to when the belt got ignited, and there are sustained flames on the underside of the belt.

And this is the size of the coal fire at about that time, and the point that I want to make is that it is a relatively small coal fire, less than a hundred kilowatts, and is able to ignite that belt, and relatively shortly afterwards the belt started propagating out of the ignition area.

So this is looking at the time of the belt flame spread to the time of belt ignition, and so between 15 and 20 minutes after the belt got ignited, it started propagating out of the ignition area.

This is RI-9570, and in this particular scenario, we had a double stranded conveyor belt located on the rollers, and it went around the tail piece, and we had a bigger coal pile underneath the belt, underneath the bottom strand of the belt.

We also have located wood posts along the conveyor belt, and wood lagging to represent a coal roof. We couldn't cut coal, and so we put wood up there to see how it might spread to the wood. Sometimes you have wood lagging in mines.

And this is what the test setup looked like, and here is the piece of belting stretched around the tail piece, and there was a bottom strand, and this is the coal pile, and electrical heaters again to ignite the coal, and give a simulation of frictional type heating.

This is where you first see the coal starting to smoke, and the fire breakout in the coal pile, and starting to converge on the belt. Now we are getting close to flames converging on top of the belt and flame propagation, and flames start moving down the belt line or down the belt sample.

This is a pretty big fire because we had additional fuel in there and double strand of belt, and the wood. The wood lagging catches on fire, and the wood roof, and the aftermath.

The building is completely destroyed, and the wood roof gone, and the deep charring of the posts downstream of the ignition area. Now this is some of the data from those particular tests, and once again belt R-11 had three different air flows, and this is an average of several tests.

And in this situation we brought up the heaters very slowly, over a couple of hour period, and so we have the average time to belt ignition from the start of the flames on the coal and until the belt got involved. And the average size of the coal fire when we had belt ignition.

Once again, a fairly small fire, and the average time to belt flame spread from the start of the coal fire. The point that I would like to make is that under these large scale experimental conditions a small coal fire, less than a hundred kilowatts, was able to ignite that particular belt, and that belt did pass the current small scale flame test for belting.

And the belt fire then spread over the belt sample and to nearby combustible materials. That's all that I have, and I would be happy to answer any questions.

MR. MUCHO: Chuck, you brought up 9380, and of course that is a little bit of a controversial report at least in some people's minds, and in 1992 the advisory committee had some testimony of course about 9380.

Don Mitchell raised a number of issues about 9380, and the advisory committee had another expert look at 9380 and he gave a written response, which the advisory committee published with their requirements.

And since you are retired, and maybe not you, but I was wondering if someone at NIOSH could give this panel a written response to some of the issues raised, the issues raised by Don Mitchell.

DR. LAZZARA: Ross Handler, I believe, was the other reviewer. Is Mr. Litton here?

MR. MUCHO: You know, a short, concise response to --

DR. LAZZARA: Yes, I'm sure that could be done. Dave Litton was the main author on that, and I am sure that he would be glad to put that together, and I could help him. The point of 9380 was again focused on detection, which we are not covering here today.

But it was an attempt to provide information of how better to detect conveyor belt fires under high air velocities. As you can see, a small coal fire, which doesn't produce necessarily a lot of CO initially, especially in a high air flow because of pollution, could ignite a small belt, and you want to catch the fire ideally before you get to that stage.

You want to catch the fire either in a smoldering stage, and you have just got smoke coming out, or in the flaming of the coal fire before you get the belt involved, because once you get the belt involved, things go downstream pretty quickly, or can go downstream very quickly.

DR. BRUNE: Chuck, you mentioned that 50 percent of all the belt fires that you have looked at have not been in drive wide areas, but along the belt due to faulty rollers of the belt running on these strands. What would be your recommendation regarding detection, prevention, and extinguishment of those fires?

In the drive areas, obviously we have adequate extinguishing systems, and we particularly also have at least in some of the areas we have people attending to detect a fire.

DR. LAZZARA: Well, I can say that the regulations don't call for any types of suppression systems along belt lines. There are some mines that have installed sprinkler systems along their critical belts, like slope belts, et cetera, and spacing maybe sprinkler systems every 20 feet apart past the water lines.

Some mines have looked at what is called walls of water. They are essentially types of systems that you would pre-install in the belt line, maybe several hundred feet from your drive regulator or along the belt line, and that would allow you to have a wall of water or automatic sprinklers turn on.

The valve would be in an adjacent entry and be manually operated. We did some work, and we talked previously about the effect of ventilation on suppression of belt fires. We did do some work in the gallery with automatic sprinkler systems under a high air flow.

And you do have to have -- it is better if you have directional nozzles in that case pointing into the air flow, and we did some work with walls of water also, and there is a published bureau report on that, that shows you at least in the early stages that they are beneficial in putting out a belt fire.

A lot of times they will try to put out a fire by -- or they have tried to put out a fire by sending people into the belt entry and cutting the belt, and that becomes pretty hazardous. And we had people's face masks melt in that situation, and by putting in these walls of water, if you don't actually quench the fire, you at least reduce downstream temperatures and try to stop the fire from propagating rapidly.

One of the belts that I actually showed here, R-7, was one of the belts obtained from a mine that had a fire, Robinson Number 1 -- Florence Number 1, Robinson Portal Mine. And when we showed the people, and the people that were fighting the fire, how fast that belt fire was propagating, they realized that they were never interdicting a fire at its front, and that the actual flame propagation front was way ahead of them.

MR. MUCHO: I have another question. Of course, flame propagation is an important issue with conveyor belts, and we don't want the conveyor belt acting as a way to take a fire down to entries that you just mentioned.

But another issue with the fire resistance or retardancy that most people tend to think of is the ability of the material to ignite itself, or ignite another substance, such as coal, in conveyor belting.

And generally the test used to do that is some sort of friction drum test, which purports to measure the ability of the belt to self-ignite, and/or ignite other materials such as coal.

Has the bureau of NIOSH done any work looking at the frictional drum test, and if so, what are the results?

DR. LAZZARA: No, we haven't done any work directly on the frictional drum test, and we are concentrating this effort obviously on the flammability characteristics. The frictional drum test, of course, is used by Canada and some other countries.

My personal opinion is that it is a rather small scale test, and I am not sure that there is any direct relationship to any large scale tests, or more realistic tests using drum friction. After all, in an actual mine, you have the belt on a drum of a pretty good size, and you have lagging, and so you have the interaction of the lagging of the belt with the belt, and in the drum friction test, you have the belt right on a steel drum.

I know that at one time MSHA had such an apparatus at the Approval and Certification center, but I don't believe that they actually did any tests with it either.

DR. WEEKS: I have one question. I was reading over the MSHA report on mine fires in '94, and somewhere in the report it said that they took a sample of the belt and put it to a test, and it passed the test, and it brings up a very simple-minded question, which is if you pass the test, what do you expect from the belt? I mean, clearly in that instance, there was a belt fire in that mine where the belt didn't pass the test. So what is the test?

DR. LAZZARA: You mean the current test? Generally when there is a belt fire in a mine, if they can get back in, they will take samples of belt, and they will send it to the Approval and Certification Center to make sure that the belt meets the regulations; that is, that it is flame resistant, and they will test it under the 2G test, and then write a report and include that in the investigative report. All that means is that it passed the test and just that.

DR. WEEKS: What can we expect if a belt passes the test? What does it mean?

DR. LAZZARA: Well, as I showed here, it doesn't have a great lot of meaning, at least under the test conditions that we showed, because of the 19 belts that we looked at and that passed the test, 13 failed a more realistic test, this large scale test.

In fact, if you look at the data a little more closely, we did look at a non-fire resistant belt, one that would fail the test under these large scale conditions, and indeed it failed the large scale test, and it behaved not too unsimilar, or a flame resistant belt did not behave too unsimilar to the non-fire resistant belt.

DR. WEEKS: So what does it mean if the belt passed the test? If the belt caught fire and so on, what is the point of the test?

DR. LAZZARA: That's exactly what my thoughts were twenty years ago. The new test is still relevant to the problem that we have today.

DR. CALIZAYA: On question. What about the maintenance problems --

MS. ZEILER: Felipe, could you move the microphone over?

DR. CALIZAYA: You mentioned about different issues with fires, sources of fires, and did you look at the maintenance problems that might be causes of fires?

DR. LAZZARA: The what?

DR. CALIZAYA: Have you looked at the maintenance problem?

DR. LAZZARA: Oh, well maintenance plays a role in a lot of these fires. If you look at some of the investigative reports on belt fires, you will find occasions where you will find bottom rollers or idlers missing for a section. You will find coal spillage that shouldn't be there.

So maintenance and housekeeping are critical in the systematic approach to preventing belt entry fires. Good housekeeping, good maintenance of the belt line, and keeping your idlers and your rollers, and your bearings greased, and replacing them when they need to be replaced, et cetera.

MS. ZEILER: Thank you. I would like to suggest that we take a 10 or 15 minute break before the final speaker of the morning.

(Whereupon, a short recess was taken.)

MS. ZEILER: This is Charles Litton, who is going to speak to the panel on belt toxicity issues.

DR. LITTON: Okay. I was asked by Bob and Jeff Kohler to present a little bit of the work that we did many years ago on the toxicity of burning conveyor belts.

And so my name is Dave Litton if somebody doesn't know me or remember me. Sometimes I feel like I have been there forever, and I think I have. Okay. Well, Chuck Lazzara talked about burning belts, and flame spread, and non-flame spread, and this test, that test, et cetera, et cetera, et cetera.

What I would like to do is talk a little bit about what is down here, the stuff that is in the smoke, this big black cloud here of stuff that comes out of the tunnel and basically what people would be exposed to underground.

I would like to start with just a few little definitions. It is pretty basic, but just to start the ball rolling here. Any substance we would define that comes into contact with the human body and produces some sort of adverse health effect is usually said to be toxic.

And for conveyor belt combustion products, the substances that we are really talking about in terms of toxicity are the gases and the smoke, and primarily the past contact or the mode of contact with the human body, either through breathing, the respiratory tract, or with the skin, and there are some that we -- one other that we would look at is basically a skin problem.

Each combustion product or gas can produce some toxic effect, and that is even so for what we would think would be inert products like carbon dioxide and water vapor simply because if we produce enough of them, we displace the oxygen and then we deprive the atmosphere of breathable air. So that is even somewhat of a toxic effect.

Gases that are most toxic produced adverse health effects at very low concentrations. When we talk about toxicity, there are some terms that people are pretty familiar with. A couple of them, permissible exposure limits and time weighted averages, these are basically the concentrations that people can work in for an eight hour period and not suffer adverse health consequences.

Short term exposure limits. Concentrations that people can work in roughly for 15 minute exposure and for some gases, you can have up to four 15 minute exposures in an eight hour working period, in addition to a permissible exposure limit kind of thing.

And another one, sort of at the upper end, where you begin to look at real adverse health effects, is what we call the immediately dangerous to life and health value, and that is a concentration that typically produces some immediate adverse health effect.

It may not be death. There are I guess terminology beyond this, like a LC-50 value, or a LD-50 value, and these are concentrations that are lethal at 50 percent concentration or 50 percent dose level, and hopefully we won't get there with a lot of this stuff.

When we did this work originally, which is like the early-to-mid-'90s, and that's what most of the handouts relative to toxicity in that time period, and we looked primarily at four different gases, and those gases were not chosen particularly at random.

They were chosen from a lot of work that had been done previously back in the late '70s and early '80s. We had a fairly large contract with a place out on the West Coast called Ultra Systems, where they tested many, many different types of combustibles.

They looked at conveyor belts, and they looked at also wood, and they looked at coal, and they looked at a whole bunch of different things.

And out of that data, when we wanted to go back and look at the combustion products and their toxicity from conveyor belts, we chose basically four gases, because these seemed to be the four that were most prominent in the Ultra Systems' work.

It is not to say that there are not other things out there, and there could be something out there that is lethal at a part per trillion concentration, we don't know, and when we study these, what we were studying was that we were basically looking at what the concentrations are that would result from the fires underground, or in a simulation, and so we really don't have a hundred percent certainty that these concentrations are going to be bad, or good, or whatever.

The only real way to do that would be to test it with human subjects or animal subjects, which we haven't done, at least not in our lab. But to move on, the four cases that we looked at were carbon monoxide naturally, and just to give you some numbers, the STEL value is 200 ppm, and the IDLH value for CO is 1,200 ppm.

We looked at hydrogen chloride, which is a major product from belts that contain chlorine, and large number of them do. For that particular gas, the STEL is five, and the IDLH is 50 ppm.

Nitrogen dioxide. We actually looked at NOX and converted everything to NO2, where the STEL value is five, and the IDLH is 20; and finally, we looked at hydrogen cyanide, with a STEL of 4.7 and an IDLH of 50, and these are both based upon contact with the skin as the route of exposure.

The experiments that we did basically were of two types. We thermally decomposed a sample in a high temperature furnace, and we also burned a sample in the ventilated tunnel, sort of like the tunnel that Chuck Lazzara showed you previously, like an 18 inch square tunnel.

For both configurations, we measured the mass loss of the sample, and we measured the mass of all the gases that were produced, the four that we talked about, and from those two measurements, we defined what we called the yield, and the yield of that gas is simply the mass that the gas produced, divided by the mass of the material that is consumed.

And then we can use these numbers to calculate a concentration, and basically the concentration is just the yield times some mass loss weight for a given sample, and divided by the dilution rate, which is the air flow rate in the tunnel, and this is typically what would happen in an underground mine, where your concentration that you produce is diluted down by the air flow.

Two experimental configurations basically tried to mimic to a certain extent the two stages of combustion, the non-flaming smoldering combustion, where the mass loss rates are typically fairly low, and where you can get gases and smoke produced, and also the flaming combustion, which is the tunnel test.

These are the two experimental configurations. This is basically the tunnel, and for these experiments, basically what we did is we had a load cell here and we brought the samples out, or the gas sample out through these impingers with different solutions according to ASTM standards for capturing and measuring the gases.

And we did the same thing in the tunnel. This is basically the little tunnel that Chuck showed you, and we ignite the belt, and we burn it, and we measure how much mass we lose, and we also measure the concentration of the gases over here.

By and large both sets of data -- and I

think there is one report that is in your packet somewhere -- they produced very similar results. The only result that was not within plus or minus 10 percent was the data that we got for carbon monoxide, and carbon monoxide tended to be just a little bit higher, maybe about 20 to 30 percent for the tunnel test, as opposed to the furnace test, but that was to be expected, at least from my view.

Okay. And in the program, we did these texts for 16 different conveyor belt samples. We did three tests for each sample just for reproducibility, and we looked at the basic belt materials, PVC, polyvinyl chloride, chloroprene rubber belts, and styrene butadiene rubber belts.

And of the 16 samples that we did, we had 10 that passed the rigorous flame spread test, and six that failed the test. And the flame spread experiment was this experiment, which Chuck probably showed you before, where we would ignite it here with a methane gas flame and figure out whether or not it propagated or not.

Clearly, the gas concentrations can vary dramatically, depending upon the belt, the ventilation air flow, et cetera, et cetera, et cetera. So one of the things that we did in this program was that we tried to develop a methodology so we could normalize these results and compare more materials that we did next.

And basically what we did is we took the ratio of the concentration and we measured for each gas, and divided it by its IDLH value. And that results in a toxicity index for that gas in that combustible sample.

So, for instance, if we did a test and there were 10 ppm of a particular gas, and the IDLH was 50, and the toxicity index for that would be .2. Okay. So in lieu of any other thing that we did, we didn't know exactly the synergistic effect between the four different gases, or whatever, and so in order to arrive at a total toxicity index, we just summed the individual ones for the four different gases that we measured, and we arrived at a toxicity index for that sample.

So for Belt A, we looked at all four gases, and divided by their IDLH values, and we added them up and that was the toxicity index for that sample. Okay. The results for the 10 samples that passed the rigorous flame spread test was .61, and that is the concentration value divided by their IDLH, the sum of that.

For the six belts that failed the rigorous flame spread test, the number was .62. So in terms of this toxicity index, depending on whether or not you have a belt that passes that test or doesn't pass that test, it didn't seem to have any effect on the potential toxic hazard.

All right. Based on the type of belt, there was some differences, and you could argue that one was a little bit worse than the other ones, but the numbers, here they are. For the styrene butadiene rubber belts, the toxicity index turned out to be .49. For the chloroprene rubber belts, it was .53, and for the PVC belts, it was .77.

And when we look at the belt content, in terms of its chlorine content and its toxicity, we got this kind of curve, and that is because the test that we did, even the styrene butadiene rubber belts had roughly about 7-1/2 percent chlorine in their chemical composition to start with.

And so there is a correlation that you could draw here. So let's talk about what the data means and some caveats to what it may mean. First of all, or not a lot, but there is some work out there that has shown that HCL sort of deposits as it moves away from its source, and that is because it plates out to the roof and ribs.

I think one of the reports in your packet addresses that, and because of this effect, the average TI, we could also calculate, assuming that there was no HCL present. And the reason that we might do this is because if you are standing right at the source of the HCL, clearly you are going to have pretty heavy concentrations.

But if you are a thousand or two thousand feet downstream, the HCL that is there could be nil. In other words, most of it could have been plated out. So the remaining gases would be the nitrogen dioxide, the HCNs, which is also fairly reactive, or the carbon monoxide.

So what we did is we summed the toxicity index, and assuming that there was no HCL, and without HCL, the toxicity index, the average for all the belts turns out to be roughly .07, and so depending upon where you are relative to the formation part of the HCL, we would expect that the total toxicity index would vary somewhere in this range, .06, out of a factor or .10, .09 or 10. (these numbers need to be checked with Dave Litton, NIOSH)

So let's look at a conveyor belt fire, and in a conveyor belt fire the toxic hazard is defined in terms of the gas concentrations that result. In other words, we can define the toxicity index as being something that kind of compares to belts, but in an actual fire, what we are really interested in is the hazard that is generated.

And the two are related basically by this little expression. The hazard that one gets downstream is simply the toxicity index, times the mass loss rate of the sample burning, smoldering, whatever, divided by the dilution factor of the air flow.

Okay. But we can also define something called the potential or the probability that a conveyor belt will create a significant hazard and it depends upon the probability for flame spread to occur.

And when we write it that way, then the potential for a toxic hazard, which we define as this little guy here, is related then to the potential for flame spread to occur, times the toxic hazard that would result if it does occur.

So the best method to assess the probability for flame spread is to do the work, for instance, that Chuck did, where you do large scale experiments to see whether or not you get flame spread, or you assess the rate of flame spread, which is proportional to the mass loss rate should it occur, and conduct smaller scale tests or whatever.

And the potential to create a toxic hazard depends upon both parameters, the mass loss rate and the potential for that mass loss rate to occur. So there are basically three situations that you come up with that sort of divides the toxic world into not too bad, and kind of bad, and dangerous.

The one is where you get no flame spread, and so that the probability for flame spread is very close to zero, and the potential for toxic hazard to occur is also very low.

Above that, you can get slow flame spread. Now I know in some of the rests that we did down at Lake lynn that we did see some belts that spread the flame very slowly, and I am talking about a half-a-foot to a foot per minute sometimes. It was very low.

And what happens in that situation is that you never have very much belt surface burning at any given time, and because of that, you end up with a flame spread rate that is occurring, and so the probability for flame spread is usually one, but the potential for toxic hazard is not too big, because the mass loss rate is so low, even in those types of fires.

And then finally the situation that occurs where you can get a rapid flame spread, the probability that you get flame spread is again one because it occurs, and the mass loss waste is high because now you have got something spreading flame, and so the potential for toxic hazard is also very high. So basically these are the three regions that you end up with.

Clearly, the potential for conveyor belt fires to produce a significant toxic hazard does exist, but the magnitude of that potential depends upon the probability for flame spread should it occur, and the rate of flame spread.

And in general conveyor belts with pretty good fire resistance properties can be expected to present less of a potential toxic hazard than those with poor fire resistance properties. It is not to say that it can't happen, but the probability that it will happen is much reduced. And that's all that I have to say. Are there any questions or comments, additions, deletions?

DR. MUTMANSKY: I guess my major question now is that with a person wearing an SCSR, what kind of protection does that person get against these toxic products?

MR. LITTON: Well, with the exception of HCN, if you are self-contained -- you are talking about something that sweeps out CO only, and not a self-contained breathing apparatus. Is that what you were talking about?

DR. MUTMANSKY: I am talking about an SCSR.

MR. LITTON: As long as they have the oxygen, we are talking about something then, with the exception of exposure to skin, my guess would be that they would be okay. Why wouldn't they or did I not understand the question?

DR. MUTMANSKY: As it turns out, what I was concerned about was leakage and other aspects of the wearing of the SCSR, and is that going to -- how will these products affect that person, in terms of the ability to keep those toxic products sealed out of his breathing apparatus.

MR. LITTON: You are asking a question that I really don't have an answer to. I mean, as long as he maintains a seal, it would be just like going in under an apparatus with the rescue team. I mean, he would have the same possible hazard, only my guess would be that it would not be as severe.

And if you take a rescue team and put them in to search for bodies or something like that in an atmosphere that is definitely toxic, and where we could be talking about pretty hefty levels of CO, approaching a lethal limit of a percent or so, as compared to what could be formed in these fires.

And when we talk about these fires, and how large, there was another slide -- and I guess Bob didn't stick it in there, or I didn't add it or keep it in here, we are talking about how big the fire actually has to be to be able to produce just a situation that is immediately dangerous to life and health.

And we are talking typically about several megawatts of fire. Those are pretty big fires, and it takes a lot of belt burning to get to that point. So on the average, you can have a propagating fire that is maybe several hundred kilowatts, maybe a couple of megawatts, and it is going to produce junk downstream, but the toxicity of that junk is probably not going to be too bad.

They probably would survive it without a major problem. The biggest problem there is the smoke that is produced, because it is basically total obscuration. You can't see your hand in front of your face, and you reach that point way before you ever reach a toxic hazard.

So if you are worried about hazards downstream, you are talking about a visibility hazard that occurs much, much earlier than a toxicity hazard. I don't care what kind of belt you are talking about. Yes, Jurgen.

DR. BRUNE: I would like to go back to your definition of that toxicity index. I am not sure if I understand correctly. You said that for belts that pass the flammability test, versus those that fail that test, the toxicity index is relatively the same.

Yet, my understanding from Chuck Lazzara's presentation was that those belts that failed the test produced much more smoke products because the fire lasts a lot longer than those that pass the flammability test and the flame goes out relatively quickly.

MR. LITTON: Well, it is not the same thing. In other words --

DR. BRUNE: That's what I am trying to understand.

MR. LITTON: Okay. Let's go back to the case where it burns for a second or two, or twenty, or whatever, and it goes out. We measure the amount of gas that is generated during that nine minute time interval, let's say, and we divide it by the mass that is lost during that one minute time interval.

Clearly the mass that is lost is very, very low, and the gas that is produced can also be very, very low. The toxic index was a ratio of those two numbers. We can produce a lot of gas, and we can burn a lot of belt, and we ratio two big numbers, we end up with the same ratio, and that is the difference. So we end up with the same value.

DR. BRUNE: So that's why you have to go to whether there is toxic hazard potential exercise to differentiate between the two; is that correct?

MR. LITTON: Right, because the toxicity index is just a measure of how close you are potentially to that IDLH value, because it is normalized by that value. To get to the real toxic hazard, you multiple that by how fast it is burning or not burning, or smoldering, or whatever.

DR. WEEKS: I have a couple of questions.

MS. ZEILER: Microphone, please.

DR. WEEKS: I'm sorry. The major cause of death in mine fires is carbon monoxide poisoning, and that puts it at the top of the list, is toxic hazard, and the concerns about that.

And when I looked at the list here, two of these carbon monoxide and nitrogen cyanide are both systemic poisons. The other two are really respiratory irritants. How did that take that difference into account in calculating your toxic index?

MR. LITTON: You don't.

DR. WEEKS: You don't?

MR. LITTON: We don't know. How do you know? I mean, I don't know what the synergism is between the two, or how they react differently to the body. All I do is take the numbers that are quoted in terms of how dangerous they are, in terms of their concentrations, regardless of how they react to the body.

DR. WEEKS: Well, we do know how they react.

MR. LITTON: Yes, but in terms of trying to factor that in here, I think you are asking a little bit more than this work is designed to do. You want to go ask a toxicologist.

DR. WEEKS: I mean, the formula is quite similar to the formula mixtures of those two gases.

MR. LITTON: Right, and that's why we did it. We didn't know whether -- I mean, I could have weighted them, CO, and --

DR. WEEKS: I don't know the answer to the question.

MR. LITTON: And I don't either.

DR. WEEKS: Yes. But when the formula for mixtures is used, it is used with ingredients that have similar effects, and the CO and the cyanide together.

MR. LITTON: It wouldn't make any difference. I don't think it would make any difference in the data.

DR. WEEKS: The other question --

MR. LITTON: Actually, to go back, if you wanted to do that, we have all the gas data, and if you wanted to rework it, and put it in that framework, you can do that.

DR. WEEKS: No. But it is just a concern, particularly because carbon monoxide is the leading cause of death.

MR. LITTON: I agree, and it is, and even these toxicity indexes and indices that we are talking about, and the way that this whole thing works is that they are very heavily weighted to HCL, and I don't know if that is quite fair to be truthful with you, okay?

Because HCL tends to plate out fairly quickly, and so the exposure -- you know, far removed from the fire, or not too far away from the fire, is primarily going to be the carbon monoxide that you are talking about.

DR. WEEKS: Well, the other question and just as a matter of experimental method, did you measure the concentration of these gases directly, or did you determine it theoretically? I mean, did you have instruments that took samples and measured CO by a direct means?

MR. LITTON: We did do that.

DR. WEEKS: You did do that? Okay.

MR. LITTON: We only did it for CO and NO2, because we had on-line gas analyzers for that, but we were not able to do it for HCL, and basically we ran the sample through a solution with the standard ASTM method for measuring.

DR. WEEKS: And you ran the belts or burned at 800 degrees centigrade?

MR. LITTON: We ran the furnace up basically from room temperature to a thousand degrees, was our set point, and what we found is that typically just about every belt started to decompose the way that it was set up around 600, and everything was completed by around a thousand. So I just used 800 as an average temperature in that region.

DR. WEEKS: I just wondered what the mixture of gases and how that varied the temperature.

MR. LITTON: CO always came off pretty much earlier, I think, for most of them.

DR. WEEKS: All right.

MR. LITTON: By the way, we also did -- and there is also data around here when you compare the belt work, there is also similar data for what I call indigenous fuels, coal and wood, which you would also like to take into the mix. You know, does a conveyor belt produce an atmosphere because it is burning that is any more toxic than coal would if it burns, or wood when it burns.

Is that more of a hazard or the same hazard, or less of a hazard, or what. And if you are talking about carbon monoxide, typically coal is just as bad a player as a belt.

DR. WEEKS: One final question, and that is -- well, I forgot the question.

DR. TIEN: David, I noticed that of the four products that the last one, hydrogen cyanide, is irritation to the skin?

MR. LITTON: Yes.

DR. TIEN: I noticed that the unit is quite small, 4.7 ppm?

MR. LITTON: Right.

DR. TIEN: Can you elaborate a little bit on that, as far as the level of irritation, or can you describe that a little bit?

MR. LITTON: Well, it is a point where you would get a rash. I mean, something that you would need to have treatment for at that concentration. So that is why I am calling it an adverse health effect. I don't know exactly what it would be.

DR. TIEN: So chances are that it is going to go away after a little while by itself or what?

MR. LITTON: Well, it could. I don't know.

DR. TIEN: So, 4.7, that's kind of low.

MR. LITTON: That is pretty low. These are numbers that are taken out of the ACGIH Handbook, and also NIOSH has a handbook. These are the same numbers in both places.

DR. TIEN: Thank you.

DR. WEEKS: Well, NIOSH has recommended lower limits for at least two of these, carbon monoxide and CO2 --

MR. LITTON: I didn't quote the PDLs. I quoted the STELs.

DR. WEEKS: Well, no, for the STELs, NIOSH has recommended lower limits for CO and NO2.

MR. LITTON: Well, what are they? The latest data that I saw said that they were the values that I had on the screen, but if they are lower, that is neither here nor there.

DR. WEEKS: I am just referring to the NIOSH criteria document.

MR. LITTON: I know that the PDLs are lower, and NIOSH PDL, in terms of MSHA, or OSHA, is 50, and MSHA recommends 25 parts per million of carbon monoxide, but that is a permissible exposure rate, but I am not sure how that impacts the STEL values. Anyone else?

(No audible response.)

MR. LITTON: I guess that is the end.

MS. ZEILER: Thank you very much. I guess we will take an early break for lunch if the questioning is complete on this topic. We will resume at one o'clock.

(Whereupon at 11:30 a.m., a luncheon recess was taken.)

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A F T E R N O O N S E S S I O N

(1:05 p.m.)

MS. ZEILER: Okay. We are ready to resume. One thing that I wanted to say first was to everyone here that if you have a commentary on anything for today that you wish to make on the record, you are welcome to do that in the last hour of our meeting today, but you need to go back to the sign-in table and let us know that you intend to speak.

And at that time, you can provide your commentary to the panel, and they can ask you questions about what you are saying if you would like that opportunity.

This afternoon, we are going to have a series of belt manufacturers speak to the panel, and Harry Verakis of the staff has helped me a lot in getting this panel organized for today's meeting, and so I would ask if you would please make the introductions.

MR. VERAKIS: We are going to have three belt companies talk about the belt flammability and what they know concerning testing, and composition, and construction this afternoon.

The first presentation will be by Dave Maguire. He is the Director of Global Technology of

Engineered Products for Goodyear. Dave.

MR. MAGUIRE: Good afternoon. Okay. Just to start off a little bit, a few introduction slides. Goodyear. We have been one of the leading global suppliers of conveyor belts for over 90 years, both in the United States and around the rest of the world.

We continue to invest in R&D for all aspects of belt safety, and we are going to show you some things that we have developed recently. We welcome this opportunity to participate in improving belt safety for the future.

And Harry helped me a little about some topics that you wanted to see, and just a little bit of how our belts are made, and a little bit about what has changed in the last 13 or 15 years in terms of belt construction and design in the United States.

A little bit about what we have done in terms of improving quality, and that means improving belt safety, and then a little discussion of what we mean by belt safety, and then what things that we think we can bring to offer that can improve belt safety for the future, and then a summary.

Just a little bit about how belts are made, and in the United States the vast majority of rubber belts are this type of construction, a multi-ply fabric belt, which typically can be between one to five plies of fabric, and we coat each side with rubber, and then a top cover, typically 3/16s to 3/8s of a top cover, and 1/16th to one-quarter inch bottom cover.

Just a note at the bottom. The United States. There are different constructions that are used around the rest of the world for a variety of reasons. We tend to use much thicker belts here in the United States than around the rest of the world.

They are all what we call cut edge belts. They don't have rubber on the edges, and there is a lot of unique fabric instructions used for the applications in the United States.

Just a little bit about how rubber belts are made. They are made in a batch process, and there might be some slight variations between some of the manufacturers, but in principle, they are pretty much the same.

We mix rubber, and we weave and dip fabric. We then coat the fabric with rubber, and then we take each individual ply of fabric and it is coated with rubber on each side, and we ply them up. Some people call this a carcass, and then we apply the top and bottom covers with rubber.

And we vulcanize it with heat and pressure, and then we inspect and pass the belt, and we ship it to the customer. And belts are typically made in one to three thousand feet lots.

Just to go over a little bit about what has changed. Over the last 10 or 15 years, and I think everybody knows this, we have broken conveyor belts into three categories; panel belts, mainline belts, and then slope belts, which are typically steel cord reinforced.

And so in panel conveyor belts, this is our data, and this is basically what we have sold, and so we have gone back to 1992 and then look what we have sold in terms of 2006. And typically panel conveyor belts in the United States were on the average 600 PIW, and that is pounds per inch of width of strength.

They typically now are 1,000 PIW, and the maximum has moved up significantly from 750 up to has high as 1,500. And the average thickness of belts has pretty much increased by about 50 percent, and that is primarily due to the thickness of the carcasses.

Seam-to-seam trend and mainline conveyor belts, typically their rating has increased from 600 to a thousand, and the maximum has gone from 800 up to as much as 1,800. And again the thickness is up about

40 percent.

The slope conveyors and steel cord reinforced are not quite as dramatic, but again you still see the same trend, about a 27 percent increase in thickness, and an increase in tension.

The gentleman from NIOSH that talked earlier this morning about what has changed in conveyor belts. There have been changes. Obviously there have been changes in construction, and there has been a lot of changes to improve belting for performance and safety.

And there has been a lot of changes in these areas, and we break it down into four: durability, adhesion, flammability resistance, and then more permanent flame retardants, and those are the four topics that I will talk about.

Durability. When you look at durability in conveyor belts, it is important for safety, and it is important for flammability, because again NIOSH talked about this this morning. If your covers are burned off, and if your fabric start to wear on the side, and if you start to separate your belt, all of that can cause fire hazards, and it also can cause other safety issues, such as belt breakage.

So abrasion, rip and tear strength, and fatigue, is all important for conveyor belts. And we have done a lot of work here. In 1992, the covers of underground coal mining belts typically had what we call a dent or abrasion of about 300, and in this case the lower the number, the better.

And there are some papers that we have done that have been published to show the lower the dent or abrasion, providing that you have the right compound, and I have to clarify that, that you can get increased durability.

And in 1995, we made a significant change with coverage compounds, were at a 200 level, and that is for the vast majority of conveyor belts underground that Goodyear sells have this abrasion rating, and we also have this as an option, a 100 rating.

And typically in mainlines, where this is very important, it is not uncommon now to get durability up to 10 years, versus typically 3 to 5 years many years ago.

And, of course, the more rubber on the belt, the thicker the belt, and it is a bit like a piece of paper or a log, the less chance that it has of igniting.

Durability is another point in terms of rip and tear strength, and here it is measured in pounds. Typically panel conveyor belts in 1992, and this is a thousand PIW belt, and the tear strength of the carcass is right at about 1,300. Here we have made significant improvements, typically at 2,500 or 2,600, and at the rip strength again at about a 30 percent improvement.

And the significance of that is, of course, that in panel belts, typically the belts only use to last one to two months, and now they last up to six months. A lot of these constructions have been designed to reduce stringing on the edges of belts, and again strings can be potential fire hazards as well.

Seam and mainline belts are not quite as dramatic, but again you see improvements of 20 percent approximately on the rip and tear strength. We have invested a lot of time and effort in the last 10 years on dynamic testing, and here is just an example of some of the dynamic testers we have in Marysville, Ohio.

What this has basically done is improved the durability of both the carcass and the splices, and again there are safety issues if they don't perform as expected.

Adhesion is a very important area. It is an area that we have done a lot of work on in the last 10 years. Typically, most standards are of the order of 25 pounds per inch when you do a field adhesion test. This shows basically our standards in 1992, were basically 35 minimum, and we have increased those now to 50 pounds minimum, and typically on average our adhesions are 65 in the carcass.

The cover, like the AMC thing, we have increased the minimum there to 35 and it is typically at the 45 pound range. It is very, very important for fire safety when a belt starts separating, and again it is a much easier potential to ignite, and we all know that a lot of abuse goes on in mines.

They run into the side of a structure, or items can drop on a belt, and so adhesion is very important, in terms of fire safety. You saw the 2-G test earlier on this morning, and the current standard, MSHA standard, where you burn a sample of the belt for 60 seconds, and then you are allowed 60 seconds for the flame to go out, and 180 seconds for afterglow.

You can see that these are our actual results. We test every row of belts and so we have thousands of plates of data, and typically our flameout is less than three seconds after the flame goes out, and I will show you some video clips of this, and then the afterglow is a matter of a couple of seconds.

So we have improved the flammability resistance and it greatly exceeds what the current standard is. One of the other changes that has gone on in the last 14 or 15 years is that we have upgraded the flame retardant that is in the rubber materials.

This is the plastisizer, and it is a chlorinative material, but again what we have done is we have picked a more permanent flame retardant, and so that you have elevated temperatures up to 325 centigrade as an example, and you get a much lower loss in flame retardant at elevated temperatures.

So this is just a quick summary of what we see has changed in the last 14 or 15 years, which is one of the questions that we were asked. Certainly belts are thicker and stronger for the applications, and they are certainly more durable. We far exceed the current MSHA standard, and with more permanent flame retardants.

So getting into the attributes of safety. I think a lot of this has been talked about this morning, and when you look at safety in terms of flammability of the belt, you need to look at four items. You need to look at ignition, and you need to look at propagation, and you need to look at smoke density and smoke toxicity, and I thought that the speakers were very interesting this morning.

Most of the standards that are around for conveyor belts only consider ignition and propagation. To our knowledge, there is no standards that are current or proposed that measure the control of smoke density or smoke toxicity.

And we would submit to you that that is one of the items that should be looked at when we are considering improving belt safety. And I think that some of this has been touched on before, but there is a standard test that you can do for ignition of materials, and we have done these ignition tests on belts, and these are the ignition temperatures that are generally in the literature of these common materials that are in coal mines.

If you take coal dust, you see generally anywhere between 320 and 350 centigrade, is where people say that coal dust will ignite. Idler grease typically is around about 300 to 400, and this is pretty understanding with the changes that we have done on belts. These are tests that we have done here recently.

Older belts typically had ignition

temperatures of 400 centigrade, and the current belts are running about 500 centigrade. I refer to this as the BELT, and this is the BELT construction, and by the way these are all Goodyear belts, but these are more flame retardant construction that meets the BELT standards that were shown earlier on by NIOSH.

And that typically the ignition temperature that we get on that is about 525. So it is about 25 degrees centigrade better than current rubber belts. Of course, there are a variety of tests that are around for measuring the ignition or propagation. For the laboratory scale, there is the current MSHA 2-G test, which is a horizontal test.

There is an ISO test that is used in various parts of the world that is a 45 degree test on a bunsen burner, and then of course we have a BELT test. Generally, you need a higher level of flame retardants when you want to meet these requirements.

Smoke. We all know that smoke is a danger to miners. We feel strongly that it needs to be considered for improved belt safety, and also you need to consider that smoke can occur from a belt without ignition and frictional heat, and we were talking about the drum friction test, and I will show a little bit of that as well.

One of the things that we have been looking at in the last couple of years, and other industries have studied and addressed this issue, particularly with regard to smoke. You know, petro chemical, residential, aerospace, and military, and wire and cable, and wire and cable has been one of the industries that we have taken a look at to see what they have done with regard to it.

And this is data that was in this research report that the wire and cable industry seems to use a lot. But typically in buildings, they are talking about smoke, and is attributable to over 80 percent of the deaths. Burns are 13, and then other/miscellaneous is about seven percent.

I need to stop here. A little tiny bit of chemistry here before we move on. What you are going to find out is that other industries have looked at this issue of smoke and looked about halogens, okay? And they are looking at the type of flame retardants that are typically added to hydrocarbon materials.

And when I talk about hydrocarbon materials, I am talking about rubber or plastic, and there are two things that you can add. You can either add halogenative materials, and these are typically materials that contain bromine or chlorine.

They are very effective for ignition -- for propagation resistance, I'm sorry, and tend to be lower costs than alternate materials. There are halogen free materials that I am going to talk about here in a minute. You do need higher levels to be effective for propagation resistance, and there tend to be higher costs.

Now that depends on the type of level of flammability resistance that we are looking for, okay? So the cost is going to depend on the type of task that you want to meet.

But the wire and cable industry, and in fact a lot of these other industries, have found a lot of benefits for halogen free materials. Basically, when you go to halogen free flame retardants, you get much lower smoke density, improved visibility, and more time to escape.

Much lower corrosivity, because again hydrochloric acid isn't being formed. And then low toxicity again because of carbon monoxide and hydrochloric acid in particular.

These are some of the common task methods that are used in the other industries and we have tended to use these task methods that seem to be the most common ones that are referenced in the ASTM, JCS

E662, for measuring smoke density, and then a test for measuring smoke toxicity, and this is the Boeing Standard 7239.

So here is some actual belt pads, and for the most part, what these are, are samples that are approximately 3-by-3 inches, and all complete rubber belts, and they are not just pieces of rubber.

And I think that this is some interesting data here. This is similar to what NIOSH was showing where you are doing tasks that are both smoldering before it ignites, and then after it, it catches fire.

This is the ASTM 662, and this is measuring smoke density and optical density. And again these are current belts. These are current belts, and Goodyear belts, and these are all Goodyear belts again that are meeting the current standards as I said, and they far exceed the standard.

But you get around a number of 73 on the average for smoke density. Now over on the right-hand side, this is the BELT. This is the typical belt to meet the BELT, and you actually see the smoke density increasing a little bit with the increased inflammatory retardants, which are halogenated materials, primarily chlorinated materials.

We have developed non-halogen rubber

materials, okay? I have two materials that I am showing here, Halogen 3A, and Halogen 3B. And again, when you take out the halogen, you get a drastic reduction in smoke density, in the order of four or five times.

Now this is when it is smoldering. Then when it is flaming, again you see after four minutes of flaming, you see actually -- I think that this surprised us as well, that the current rubber belts that have optical density of about 200, and they are actually more flame resistant, but it is more flame resistant based on using chlorinated materials, which is the BELT, and actually the smoke density increases significantly.

And again you still see drastically lower numbers when you use halogen free flame retardants in rubber formulations. So, we get on to smoke toxicity. Now, NIOSH this morning was talking about four gases, but they were concentrating on carbon monoxide and hydrogen chloride.

They did also talk about HCN and nitrous oxide, which I think were the other two, and we do have that data as well. I will tell you that on all the data the nitrous oxide and HCN is very low levels, on the order of less than two parts per million.

So I am just showing what I think are the more relevant data. Now this is to the Boeing standard, an accepted test method that is used here. Here the concentration is in parts per million, and this is again a smoldering task. This is before it ignites.

And this is where you heat the sample up until it starts smoldering, and then you measure this after four minutes. And again I think it is very significant. You see the current rubber belts have a carbon monoxide level of 50 PPM. With halogen free, you are on the order of 10 parts, and with the BELT, it is very similar in terms of that carbon monoxide level.

Then hydrochloric acid, of course, is going to be significantly higher on the more flame retardant belts if you use higher chlorinated levels, double the level of hydrochloric acid. Obviously with halogen free, it is practically negligible.

So, drastic improvements when you use halogen free materials. The same when it starts to flame. Again, you basically have 2-1/2 times less carbon monoxide when you go to halogen free type rubber materials, and you do start to see the effect of a more flame retardant material, and the carbon monoxide is lower than this here, than the current belt.

But look at the hydrochloric acid. The hydrochloric acid triples with a more flame retardant, chlorinated flame retardant, BELT construction. Whereas, with halogen free type materials, again, it is practically negligible.

I do have some video clips, and these are off the current MSHA tests, and these are the 60 second tests, and I think on the left-hand one is a current belt. These are current belts.

And you will see the flameout, and this is a 60 second test, and the flame will go out within a couple of seconds, and the afterglow will go out after a couple of seconds, which I will show.

This is a Halogen 3-A, okay? So it is the same test. You are looking at exactly the same picture. What you should look at it is look at the smoke that is emitted when the flame goes out here, and then look at the smoke goes out here. It happens pretty fast, okay?

I used the MSHA test because that is the test that I knew was going to be talked about, and is a reference test. This one will go out first. The flame will go out a second or two ahead of time, and so just notice the smoke here, and then notice the smoke here.

And you can see with a halogen free that it does burn differently. It is not as red hot. A little bit cooler temperature. So it should be going out any second. It is a 60 second test. Here you go. Look at the difference in the smoke.

Then what I have here is a sample of the more flame retardant belt that, the BELT belt, this is a more chlorinated, more halogenated, flame retardant belt, to meet the BELT requirements, and this is Halogen 3-A.

So again you will see the type of flame. This is not as red hot as the previous one. You won't see that, and you see that this tends to run a little bit slower flame, and this one will go out first again, and notice the smoke here, and notice the smoke here.

(Pause.)

MR. MAGUIRE: Sometimes 60 seconds seems like a long time. There you go. Very little smoke, and look at the smoke here. That smoke is even denser than before. It is just a visual picture of the data that we showed previously.

And also smoke can happen from a drum

friction. The drum friction test has been around for a long time, and it is used in other parts of the world. You typically run a belt sample for one to two hours. What the intent of the test is to keep the belt below 325 centigrade.

Now there is two ways that you can pass. Either the belt runs continuously at 325 centigrade, and that is typically a rubber belt, or that the PVC belt melts and breaks.

So I just have a little video to play. This shows that the -- well, the left-hand one is one that will eventually break, and the one on the right will glaze over and stay at this low temperatures. Both of these will stay below 325 centigrade.

I don't think that we have got this running for 60 seconds. So you can have it passing this way by breaking, and you do get a lot of materials coming off here, or you can have it to where it glazes over and runs for one, two, or three hours, and stays below 325 centigrade. Typically if you do it this way, it will typically run about 200 centigrade.

DR. TIEN: What is the belt on the left?

MR. MAGUIRE: The one on the left is a PVC belt, and the one on the right is a rubber belt. Okay. So there aren't a lot of ways that you can measure smoke analysis and I think there are existing test methods out there, and one of the more common ones is a cone calorimeter.

And it is a very useful test, and you generally take a 3-by-3 sample, and in this case, this is a conveyor belt. You have a cone calorimeter here that heats the sample up, and then you can measure the heat release here, the rate of combustion, and there is a load cell here and so you can measure the weight loss, and then the gases come up here, and you can measure the smoke density, and you can do gas analysis, carbon monoxide, carbon dioxide, hydrochloric acid.

This just shows the test. It is heated up, and these are radiant heaters here that heat it up, and gets the sample flaming, and then you get on-line analysis, heat release rate, rate of combustion, the weight loss.

And carbon monoxide and carbon dioxide should come up, and HCL, which there might not be a HCL on there, but it will measure it on-line as well. So a little bit more sophisticated, but a lot of other industries are doing that.

Then, of course, it measures the key properties and controls the conditions. It does measure both flammability and smoke, and it is a small sample size, and it is used by other industries.

There is another thing that we think is interesting and that we wanted to bring up in front of everybody, is that we have talked about flame resistant, smoke density and toxicity, but we think things can be done with temperature detection, and it might be an option to look at.

There is new technology out there that measures temperature by infrared, okay? So in this case, it measures both the reflected radiation, and the transmitted radiation, and the emitted radiation. Previously, as we understand, work had been done where a thermocouple had been used, but the problem is that it only measured the air temperature.

And, of course, with air ventilation, it would not truly measure the temperature of what was going on. This will measure the temperature of the material, the conveyor, and the coal, and not the air temperature.

And it is basically a high resolution scan. It measures I think a thousand points per second on this here and at an unbelievable rate. It scans continuously across the belt, and then you can have an alarm relayed to the suppression systems or belt controls.

It is used in other conveyor applications. It is used in power plants, and it is used in grain handling, and it is used to detect hot spots in coal piles. So it is starting to get used in other applications.

And here is a demonstration. This is on one of our dynamic testers, and this is the actual sensor itself, and what the technician is going to do is he is going to put a hot material on the belt, and hopefully there is going to be a little temperature thing coming up here. There it goes. So this is the temperature control, and we have got this relayed to the alarm.

So again it is actually measuring the temperature of the material or the belt, and it scans it continuously. So we think that this is a very nice option to look at down the road.

So we think that the panel should really consider all aspects of belt safety. You do have flammability resistance, and which was talked about earlier on today, and durability needs to be considered as we were talking about earlier on, because you can have great flame resistance, but if the belt falls apart, or it loses all its cover wear, then it can give you a flammability problem as well.

Obviously temperature detection would be something that we would think could be considered, and then smoke toxicity and density, and this is just a radar chart. Obviously it varies on the curves, and the bigger area the better.

And if we just have these relative numbers, people could debate about them for the current belts. These are the current rubber halogen belts that Goodyear makes to meet the standards, and in halogen free belts, we think that you get significant improvements in smoke density and toxicity, and durability, it should be pretty similar, and obviously if you include temperature detection, then you have a much bigger area.

Of course, with the data that we are showing, you can make a belt more flame retardant, but if you use halogenated materials to meet these BELT requirements, the smoke density and toxicity could decrease. So that is something that we are thinking that halogen free might be one of the better areas to take a look at to certainly improve safety in mines.

And we also think that the committee could consider how do you get to improve standards, and we obviously make conveyor belt, and we make hose, and we car transmission belts, and we make a variety of rubber products.

And we have been involved in similar type events -- might be the better word, and we think you should include all elements of belt safety. It should be an inclusive open transference process. We think that all stakeholders should be involved in it -- government agencies, unions, mines, belt manufacturers.

We do think the Rubber Manufacturers Association may be an option to pull all stakeholders together. And I gave you a couple of examples that have been done in the past. For example, welding hoses. This goes back to 1987. There were a lot of problems with welding hoses.

The hose would harden and crack, and there were a lot of injuries, and so all of the hose manufacturers came together under the umbrella of the Rubber Manufacturers Association, and Compressed Gas Association, and three separate hose specifications were issued with guidelines to use, and separate specifications for oxygen and acetylene, and a separate specification for aggressive gases, such as maps gas and propane gas.

And then a flame resistant spec which

coincidentally uses the MSHA test, the 2-G test. And the same was for anhydrous ammonia. There were a lot of problems with anhydrous ammonia, particularly with farmers in the United States. A lot of new specifications, procedures, and guidelines were issued.

We manufactured these products, and since then, we have seen very little issues with these products since this has all been done. I just use this as an example of -- you know, the RMA in these cases, we brought together all the various appropriate industries together, and to come up with a common standard that would certainly improve hose and hose assembly performance.

So, in summary, we are here because we support improved safety for miners. We think that we have done a job to improve safety, and we have made belts more durable. We have improved adhesion, and we are using more permanent flame retardants.

We also have done a lot of work on smoke density and toxicity, and we continue to do that, and we think that smoke is a significant danger to miners, and we have looked at other industries, and we see that halogen free is a way that can be done to drastically improve smoke density and toxicity.

And that temperature detection -- I showed the little temperature detection system, and is a very interesting one to consider, because it measures the detection or the temperature off both the materials and the conveyor belts. And the RMA may be an option to help come up with improved standards.

And with that, I thank you for your time, and are there any question?

DR. WEEKS: Yes, one for clarification. The diagram that you put up there. Could you explain the logic of that?

MR. MAGUIRE: Yes. This one here?

DR. WEEKS: Yes.

MR. MAGUIRE: What you do is that when we are looking at -- and in this case it is belt safety, what are the items that you need to consider to further improve safety? Obviously, flammability resistance is one, and durability is another one, and potentially temperature detection, and smoke density and toxicity.

As we all know, everything is tradeoffs. So what is the best tradeoff to do. I mean, you would love for everything here to be 10. This is just a relevant scale. The bigger the red area in this curve the better. So this is the way that we just depict that.

DR. WEEKS: How did you arrive at the numbers?

MR. MAGUIRE: The numbers are -- well, for example, in this one, I am comparing smoke density, which was two, all right? Two or three in this one here. So this is with our current belts, and when you go to halogen free, it went to six or seven because it was a two-to-three fold reduction in smoke density, and the same for smoke toxicity.

So in those cases here, smoke toxicity, because you have got significantly less -- like carbon monoxide and hydrochloric acid with halogen free belts, then this number improves from a two or three to a seven. It is all relevant.

DR. WEEKS: What is the difference between halogen and other belts?

MR. MAGUIRE: Well, I can tell you that it will be more expensive than current belts, okay? You have got current belts that meet the current 2-G, and far exceed the 2-G. To go halogen free materials, they will obviously cost more. Will it cost more than the BELT with chlorinated materials? That we are still working on.

DR. WEEKS: Will it be double? Will the

price double?

MR. MAGUIRE: Not double. Not double. I am a technical guy, and I am never allowed to talk about prices, all right? So this is the only time that I have turned around and looked at my commercial guy. He is probably here for that question.

No, not double by any means. Let me tell you some other data that I think is in the public record. I think that most belt manufacturers in 1993 and 1994 talked about if you had to go from the 2-G standard to meet the BELT standard, the belts would increase in the order of a minimum of 40 to 50 percent.

I think that is what the numbers are that people are remembering. If anybody disagrees with me, let me know. I think it was those sort of numbers 40 to 50 percent. Don't forget that we are talking here about halogen free materials, okay? To meet the current standards, or vastly exceed the current standards -- I mean, you have a standard that is 60 seconds for flameout and 180 seconds for afterglow.

I mean, we blow that test away, but if the standard is X, and somebody could make a product that meets 45 seconds, you know. But halogen free will cost more than the current belts.

Will it cost 40 to 50 percent more? I can't answer that question. It is going to cost more, but I don't want to -- I can't give you a hard number because you are asking me what standard do you want to be. I mean, that is the other question. What standard. I am not allowed to talk about prices, and I am trouble as it is.

DR. BRUNE: I have two questions for you, Dave. One is can the halogen free belt be made to pass the BELT standard?

MR. MAGUIRE: That is a good question. We are still testing that. I am not going to say and give my hundred percent commitment that it would, but we are still testing that. You can make halogen free significantly better flammability resistance, okay?

I am not here to tell you that I would commit to meeting the BELT here today. We are still doing further testing. Again, the BELT has a lot of variation in the testing, in the test results. So I need tremendous amounts of data for me to stand here and say that we meet that a hundred percent of the time, which is the only -- that would be the only way for me to say that.

Certainly significantly improved flammability resistance than the current belts. To go all the way to the BELT, we are still testing that. I might tell you in a month, or two months, or three months.

DR. BRUNE: Another question is that since you have experience with standards in other countries, are there a lot of countries have standards that are significantly more stringent or comparable to the BELT standard?

MR. MAGUIRE: Most other countries either do two things. They either use the ISO 340 test, which is a 45 degree test, or they use gallery tests, and of course the debate is does the BELT match the gallery test, but yes, certainly in terms of flammability resistance, much more stringent than current MSHA test.

MR. MUCHO: Dave, on your data, you are showing in four minutes smoldering and when it is flaming?

MR. MAGUIRE: Yes.

MR. MUCHO: The question on that data, of course, is if in two more minutes it is going to be way up, then it is almost a non-factor because it increases so rapidly that the higher the smoke production density would be, and it would happen so quickly that it would be a factor.

So on your data you show the time, and how does it relate over a longer period of time?

MR. MAGUIRE: Well, the reason why I picked those numbers is because that is the generally accepted -- as far as we could go, but the accepted times to use on that test method by other industries. They use four minutes after smoldering.

Don't forget that four minutes after ignition. This is a three-by-three sample, with tremendous heat and burning, and so you are basically pretty far along in consuming that sample. That is my point.

It is a three-by-three sample if I recall, and after you are burning that for four minutes, it is pretty well consumed. And we have other data, and I don't have it here in front of me, but we have other data.

I don't want to speak out of turn, but I don't think it was significantly different, the total smoke density, as a result of that. Halogen free will significantly reduce the smoke density throughout the cycle of that, and will also certainly reduce carbon monoxide and reduced hydrochloric acid. I mean, there is no debate about that.

MR. MUCHO: Your belt sales to the U.S.

market, what percent currently, and let's say in the past year, meets the BELT test?

MR. MAGUIRE: Well, we have not sold any belts in the United States last year that meet the BELT requirements.

DR. MUTMANSKY: Dave, I have either one or two questions, depending on how you answer the first one.

MR. MAGUIRE: Okay.

DR. MUTMANSKY: It wasn't clear to me when you said that -- well, it wasn't clear why when you said that more rubber on the belts reduces the fire hazard. Could you give us sort of the logic on that? What is the reason for that?

MR. MAGUIRE: Yes, the logic is the thicker the material, the more it is going to take to ignite. You have to heat up the complete sample for it really to start to ignite. It is a bit like a piece of paper, versus a log. You can light a piece with a match, but you are not going to light a log with that match.

DR. MUTMANSKY: Now Goodyear still makes the woven type belt carcass; is that basically correct?

MR. MAGUIRE: That's correct. We make -- I think you are talking about solid woven belts?

DR. MUTMANSKY: Yes.

MR. MAGUIRE: Yes, we make solid woven PVC belts as well.

DR. MUTMANSKY: And are there significant differences between ply belts and the solid woven belts in terms of flammability and other issues that we are concerned about here.

MR. MAGUIRE: No, I don't think so. You know, provided that you have to have good adhesion. Obviously if you are using a solid woven belt, it is one solid material.

With a ply belt, you have to have all the plys working together, but generally you use sufficient flame retardants to protect the fabric, and you get the same mass of fabric that you are protecting basically.

As you saw in woven in some cases might be more fabric because it is less efficient. But the durability of solid woven PVC belts, and rubber belts is a different story.

MR. MUCHO: I have a question on belt fires in other countries. You sell belts to other country's standards?

MR. MAGUIRE: Yes.

MR. MUCHO: For instance, what I am

interested in is the number of belt fires that other countries have, and their standards, for instance, in the U.K. Do you have any knowledge of the experience of fires in countries such as the U.K. and Poland, for example?

MR. MAGUIRE: The only one I think that I would refer to is that I think the interesting discussion is that even though you are concentrating just on flammability, other country's standards may have more stringent flame tests.

And I would refer you to China. In China, all belts manufactured and sold in China have to meet full scale gallery tests. We manufacture large quantities for them.

And I would submit to you that you should go and look at the mine fires in China versus the United States. I think that is probably the most powerful evidence that you could see.

But if you have belts that are manufactured in China that meet -- all the mines have to meet these gallery tests, and I would just say that just improving the flammability resistance doesn't actually mean that you are going to reduce fires.

All these other factors have to be taken into consideration, because you are talking about deaths, and we are talking about smoke density and toxicity.

DR. TIEN: David, the halogen free belts looks quite interesting, and are there any -- in addition to costs are there any other drawbacks that you can think of?

MR. MAGUIRE: At the moment, no. We are very comfortable with what we call halogen free A and B, and with Halogen free A, we are very comfortable with it. I have that on all these factors here -- durability, flammability, certainly are little bit better, and smoke density, toxicity, and temperature.

DR. CALIZAYA: And what about durability?

MR. MAGUIRE: Are you talking about halogen free?

DR. CALIZAYA: Yes.

MR. MAGUIRE: I have durability on here for the other properties. The effect is very little. We are trying to match, and the same with adhesion, and the same abrasion resistance, and obviously the trip and tear strength, they are not affected. So we are trying to match that to meet the same durability as current belts.

Now, just to rephrase it. When we get into what will be the flammability standard, and you go too far, then that's when you might get into some questions, and that's why we are still doing testing on that.

MR. MUCHO: Dave, on that durability question, and the reduced stringing, and you are referring to is the rip and tear, and stringing, and strength of the carcasses. Are you saying by increasing or improving the rip and tear strength to a carcass that that is what has reduced stringing?

MR. MAGUIRE: There is two items. Obviously if you have a rip and a tear on a belt, you are going to get some stringing. You rip the side of the belt, and you are going to get some stringing. That one is cause.

But if you improve the rip and tear strength of the carcass that will reduce that significantly. The other thing that could happen is that when a belt runs into the side of a structure, some fabrics unravel, and that is potentially a safety hazard.

And we have done a lot of work on our fabric constructions and it doesn't really affect the rip and tear strength, but on the fabric constructions, we have done a lot of work to reduce that.

MR. MUCHO: Sort of one along the same line. You mentioned that the U.S. has a cut belt with rubber on the edge, and other countries use rubber on the edges?

MR. MAGUIRE: Yes, some do. Not all of them, but a lot of them do, yes.

MR. MUCHO: What is your estimation of the impact of that has on things like stringing?

MR. MAGUIRE: I think that rubber on the edges doesn't do you very much good because we all know that in the world a conveyor belt bangs into the side of structures pretty darn quickly because of the alignment of the structure and that rubber just peels off the side. It doesn't last very long.

So if people think it is there for protection, I don't think it is a very good protection.

DR. BRUNE: In your diagram, Dave, you seem to give flammability, smoke density, and smoke toxicity the same weight. If I was a mine owner or mine operator, I would probably rate flammability much higher in the order than lack of flammability, and flame retardancy much higher than smoke density and smoke toxicity because if the fire is out, I have a lot less to worry about.

I am not so worried about density and toxicity of the smoke. Could you comment on that, please.

MR. MAGUIRE: Well, yeah. I mean, obviously I have put everything at equal really, and so a group of people together could certainly say this is more important than this really. So, I will certainly not disagree with that logic.

The only thing I would say is that don't forget that mines -- and unfortunately it is not the conveyor belt that catches fire first. As we said, the ignition temperature, and coal dust, and grease will catch fire ahead of time, and a belt is going to catch fire.

Just because it is more flame resistant -- and I am going to tell you that if you don't do something with the flame retardants, you could have more carbon monoxide and more hydrochloric acid. Even when it is smoldering, I am showing a level of three, or four, or five times greater.

So fires are going to happen even when a belt is still flame resistant. When there is enough coal catching fire, eventually any belt is going to catch fire as well. So to your point, I think they could be judged differently.

DR. WEEKS: Well, that raises the question -- well, we can't do much about the conditions or temperature of the coal, but we can with the grease if you are going to take an approach that the fire will start in the grease.

MR. MAGUIRE: That is a very good point. I had not even considered that with a conveyor belt. But you are right. I think that is a very good point. There is other factors to be considered. I mean, I am throwing out that we have invested time and effort on temperature detection.

We think that temperature detection could be another redundant system to add to help safety, and so grease could be another one.

DR. TIEN: How about density wise, their handlability? Are they easier to handle, the halogen free belts compared to others, to install?

MR. MAGUIRE: No, these are rubber belts, and basically a mine operator should not notice any difference between installing them versus the current type of belts.

MS. ZEILER: Okay. If there are no further questions, thanks, Dave.

MR. MAGUIRE: Thank you.

MS. ZEILER: We are going to switch speakers now, but Dave will appear over here on the panel and the technical study panel can question at the end of the session if you have any other questions to ask of Dave. So we will take a couple of minutes to switch speakers.

(Whereupon, a short recess was taken.)

MR. VERAKIS: Next we have Geoff Normanton from Fenner-Dunlop. Geoff is the vice president of technology and he will be our next speaker.

MR. NORMANTON: Good afternoon, gentlemen, and ladies. Thank you for the opportunity to come and talk to you today on this very important topic of belt safety in mining, and belt air entry.

We have our full team here today from Fenner-Dunlop We have David Hurd, our president of the North American Operations, myself, VP of technology, and also by special request, Brian Rothery, who is the head of development in Europe, and he is also the chairman of the CN committee or mine safety in Europe.

So all of the normalization of standards in Europe has been under the direction of Brian, and that committee has been running now for the last 17 years. So what we are trying to do is give you a more global view of belt safety in mining across all the continents. We also have Chuck Felix, who is our VP of mining sales in North America.

To give a quick overview of who Fenner-Dunlop is, it has become a little bit more difficult to understand following several acquisitions over the last 10 years, and so just a few minutes of explaining who we are.

And an overview of world standards and also the products that we offer to the field, and a little bit on smoke, although we believe that fire resistancy is the key in conveyor belts and products.

And then Brian will speak at least half of the time on the European approach to mine safety. And it is an interesting opportunity on how the Europeans have actually taken the BELT test and converted it into the European standard.

So who is Fenner. We have been around since 1861, and I guess that is quite a long time. We started making belts and hose out of leather back in those days, and then converted into horsehair and pitch in the early 1900s, and then into rubber polymers and PVC as the last century progressed.

We now have 21 manufacturing plants and we cover all five continents, and are truly a global corporation making conveyor belting. We still remain a British company trading on the London Stock Exchange.

Conveyor belting is our theme, and 70 percent of our revenue comes from conveyor belting. So we don't make tires. Conveyor belting is our main rubber product.

I am not sure how easy you can see those, but basically wherever coal is mined, we have operations close to the end-user, and wherever coal is mined, the current safety standards are different. So the products that we supply across the globe do differ in many respects.

And conveyor belting sales globally, at least 50 percent is into the coal sector. So coal and conveyor belting is what Fenner-Dunlop is truly about. In North America, we entered this market primarily with conveyor belts by acquisition, although we did export PVC solid woven belt for many years from Europe.

We acquired Nationwide Belting in Toledo in 1996, and Scandura, Incorporated, in 1997, who had previously purchased Uniroyal, and so effectively we go back into the Uniroyal era, too.

And then the Georgia Rubber business, which is part of an overall unipoly conveyor belting business, which bought the Dunlop brand. So Fenner and Dunlop are now used as the prime logos for our organization. There is no longer any Fenner family living involved.

And I believe it is generally accepted that Creswell was the initiation of mine safety. I mean, in 1950, 80 miners, perished, because of the banning of non-fire resistant conveyor belting, and they were all killed by carbon monoxide poisoning.

If the belt was not self-extinguishing, and would propagate, and was the cause of the fire.

Prior to that, there had also been three miners died at the Chesney Whitfield Mine in 1948, and from there belting developments had occurred, but not to the standards that are currently out there today.

And basically those two major fires that initiated most of the weld standards. Since that point, with the use of highly fire retardant products, I believe I am right in saying that there has not been one death from a conveyor belt fire in the United Kingdom.

Frictional heating was the prime cause and kind of created part of the standards, and even today frictional heating, as you saw earlier, is still a key part of fires in mines, and depending on how you record fires, those numbers can seem to be different across the globe.

Any degree of smoke in the United Kingdom or Australia is classed as a fire. I believe in the U.S., you have to see a fire for 10 minutes for it to be classed as a conveyor belt fire. So when you compare records from different countries, they are very careful what a fire means. The definition is somewhat different depending on the location.

These fires really created four tests. One was ignition to burning, or resistance of ignition. And there you have a finger burn test, and that one there is BS 3289, and it is similar in some respects to the 2G standard, 30 CFR 18.65.

Although now the belt is also tested in a simulated worn condition, and so the belts are burnt down to the fabric and is also evaluated, looking for a full life of fire-resistance, and not fire-resistance when new.

During friction. Mainly because the fires are primarily created by friction, Creswell also continues to be today when the friction test was invented, and it is pretty well globally now used, and the standards vary, but the 325 degree celsius temperature was used really because it was the temperature when coal dust would ignite.

So if the product would fail or not fail prior to 325, there was a degree of safety created. And typically there should be no sign of fire and glow when the belt is under a friction scenario.

Propagation. Various world standards were developed due to quite large samples of belting, and in a two meter diameter tunnel, or even larger in some of the European countries, and you can use either a two meter or a four meter sample, or in some instances, up to a 50 meter sample, to look for propagation.

If a fire has been initiated by a second resource, and the belt could never self-extinguish because of that second resource, would it propagate fire along with the belt. It became the third part of the package of fire resistance.

Because of environmental concerns and the location of some of these galleries -- you know, close to offices, and people, and there has been a trend towards the smaller gallery tests to be our key facility, and we have continued to operate that test in our Atlanta facility and also have a similar apparatus in the U.K.

And Brian will explain how that has now become part of the European standard for conveyor belts, and underground across all the EUC countries.

The sample on the right-hand side shows a typical fire retardant belt when tested to those standards, and it leaves a substantial length of damage without propagation of fire down the length of the belt.

Non-fire retardant or little fire-retardant belts typically engulf the whole sample, and very little is left from ash.

And the fourth part of that is the conductive resistance. This information comes from the early PVC belts and rubber belts that could build up very high levels of charge when running, and values that were quoted in the Barkley report in the early '50 of 25,000 volts could be built up in conveyor belting.

And then when it got discharged, sparking could occur, and in methane rich environments that could lead to an explosion. So it became part of the package of four key measures to conveyor belt safety: resistance to ignition; resistance to propagation, resistance to frictional heat, and then having a low surface resistance to some conductive network, allowing the belt not to sustain a charge.

And that is also very important in just the environments and in the grain industry it is required to have anti-static belts. Pretty much all products that are used in underground mines in the U.S., even though the requirements don't require anti-static products, pretty much most of them will be, and certainly ours our.

Across manufacturers and locations standards are quite different. There has been a lot of activity in most countries since 2000 on modification and the refining of those standards, which kind of dictates that we make slightly different products in different locations to meet those standards.

With belt manufacturers our number one issue is to meet local safety standards. The second part of that is obviously to give a belt that gives the finest durability. Combining those two together is how we create our competitive advantage.

So looking at those standards, you can see that most areas across the world have some tests looking for resistance to ignition, to friction, low heating on the drum friction type test, propagation from a large scale gallery or a medium scale BELT type test, and then the electrical resistance requirements.

Here you can practically see here in the U.S. the requirements are some what less. It doesn't necessarily mean that the product doesn't meet those other standards, but that is the only current requirement that we are required to meet.

What does Fenner-Dunlop offer in North America? Well, the standard MSHA products, and anti-static, and also meets resistance to ignition, and we also have two of the products called Fire Boss and Fire Boss Plus.

Fire Boss also meets the ISO 340 resistance to ignition when -- are removed, and Fire Boss Plus meets Australian standards, BELT, and ASTM E-162 radiant panel test. And if you go to our website or catalog, you will find those options available for the operators.

Now what materials do we use globally? Typically the U.S. is SBR driven. SBR belts can also meet the BELT standard with suitable compounding. So it does not particularly restrict the manufacturer to one style of compound.

But across other parts of the world, we are also involved heavily in polychloroprene belts in Australia, combined with PVC solid woven, which has some attributes that clearly meet the standards, but is suitable for some modifications.

And then in addition to that is the PVG belt, which is polyvinyl gume, the European name for that product, where you have a PVC solid woven carcass, with a rubber coating. So it kind of has the benefits of both worlds.

So pretty much all of those are driven by safety standards. The U.S., we supply PVC solid woven, and we also supply ply products, and so we offer a full range of products in North America, too.

Our products in the U.S. on the ply range is under the brand name of Mine Haul, and also Mine Flex, which is a straight leg wall carcass, giving extremely high rip and tear, and pretty much double the values that we saw posted earlier.

And these are a kind of premium line in mine safety, as well as durability, and that belt does have molded rubber edges. So a large part of our mining products is molded.

Steel cord on slope belts is a growing market, and particularly ourselves are engaging in the investment in that area. Belts are getting larger, thicker, heavier, and tensile ratings are increasing, and we concur with our friends at Goodyear's remarks on those moves, and the belts are also getting wider as well.

PVC solid woven go to market under the trade name Goldine, and those products are made in Charlotte, North Carolina, and also the Fenner-Dunlop products that is made in other parts of the world, and that is where the solid woven carcass is impregnated into the entire bundle with PVC.

As far as toxicity, which was talked about earlier, our view is that fire resistance is the key, and prevention of fire initiation, propagation, is what we believe to be the correct direction, and in the major belt fires of the past. And carbon monoxide has been the killer, and not any secondary smoke that came with a non-fire retardant product.

As we know other materials are also produced, and can be irritants, and radiant heat also creates oxygen depletion, and in recent times we did have an issue in one of the U.K. collieries where a belt did undergo what we would be simulated during a friction test, and unfortunately it did not trigger off any of the carbon monoxide or smoke detection devices. So there was a limited evacuation.

And then in conjunction with working with the TES at Bretby, that was simulated in our U.K. plant, and the devices were shown to work under normal operation.

So there is work to be done and work on a fail safe product is probably in our belief the best way forward, and during a friction test the volatile hydrocarbons were less than 70 micrograms per liter, which is well below what the U.K. exposure limits are.

And there are some standards around the world that have kind of toxic fume related requirements, and the Czech Republic, and Poland, and Germany are three of those, and in the past have had tests where they have measured the time required to block self-rescue filters, and so they have been used as part of standards, though typically the trend has been towards limiting the propagation of a belt getting involved in a major fire.

I am going to pass you over now to Brian, who has been engaged for so many years now with trying to bring Europe together with a single voice, and anybody who lives in Europe knows that is not always an easy thing to do, and it shows how the European approach to safety has provided new safety standards across all those locations.

MR. ROTHERY: Good afternoon everyone. A little bit of what I will say to start with perhaps overlaps slightly with what Geoff has just said, but it does set the scene for where we started from in Europe.

As was said, the kick-start really was the Creswell mine disaster with the steel belt rotating drive, and the failure of the water systems that should have been able to put the fire out.

And the philosophy since then within -- first of all, the National Coal Board, and the British Coal Board, and still within the privatized U.K. Coal, et cetera, they have worked on three philosophies.

First of all, that the belt should not be the cause of the fire. There is really only two ways that that can happen. The first is if the belt is not sufficiently conducted and it allows the charge to go as Geoff has just commented on.

And the second way that the belt could be the cause of the fire is in a steel belt rotating scenario. The second principle that we worked on is that the belt should be difficult to ignite, and we did have some discussion this morning about why you do a 2-G test if there is no indication of propagation.

And as I understand the 2-G test, the ISO 340, the bunsen burner test, has proven that the belt has a degree of fire resistance in that it is difficult to ignite, which may be a way forward than something that is easy to ignite.

And then finally that you never know what is going to happen, and should a belt be ignited, for whatever reason, contact with whatever, then it should be self-extinguishing.

As Geoff said, you can sort of try and ensure that the belt will self-extinguish quickly, and the products of combustion, the toxicity, et cetera, perhaps becomes a more minor role.

So in the U.K., we have seen a little bit of this, and throughout the world basically there is a long recognized standard for conveyor belt and surface resistance and there is an European and international standard that describes the test methods.

Going on to drum friction. The BS EN1554 gives the basic test methods, and there are various options on the test, from one fixed load throughout the entirety of the test, and up to say, two or three hours. And in the U.K., if the belt hasn't parted within an hour, then the end load is increased.

Now, there is two main approaches in Europe. In the U.K., we always try and use the belts alone to provide the maximum safety, which doesn't mean to say that there aren't other secondary devices installed with detectors, et cetera.

But the principle has been to try and make a belt as safe as possible and not rely on other sources which could fail or not be maintained correctly, or whatever. So we try to ensure that the belt alone can provide the main means of safety in a drum friction test.

And we have a 325 degree maximum drum temperature, with no flame or glow allowed. In other parts of Europe, they are more reliant on water deluge, sprinklers, float detectors, and they permit a more lax drum friction requirements. So frequently in Europe, you will see a temperature of 400 degrees, 450 degrees, and sometimes glow allowed, but never flame allowed.

This is a shot that you saw earlier on drum friction. The little picture at the top shows that these sort of problems are not just limited to underground coal mining. You know, you get a steel belt, and you get a rotating drive, and you can have a real problem.

And with ordinary flame ignition tests, EN ISO 340 is used in much of the world. The tests are all very similar. There is 2-G, and 340, and the Canadian test, and the thing that differs really is the criteria that you apply to the results.

With the British standard, the Barthel Burner test, you are allowed three seconds for the whole flame and glow to disappear, with the covers intact, and five seconds with the covers removed.

And with the ISO 340, six samples have to have an aggregate time of no more than 45 seconds, and in the Canadian approach, I think it is 40 seconds to flame, and 120 seconds to glow; and with the 2-G, you have got 60 seconds to flame, and a further three minutes for glow, although the ignition time is greater in the 2-G.

And as was just said, some countries include tests with and without covers, and as Geoff mentioned, without covers is to simulate worn belting in order to maintain safety throughout the life of the product.

And that is the U.K.'s Barthel Burner test, and that is the latest EN ISO 340 test, and that has recently been changed somewhat. The previous standard allowed a vertical sample to burn at 45 degrees, which allowed a sample at 45 degrees, and it allowed spirit burner, and it allowed a gas burner with towns gas, or a gas burner with propane gas.

So you actually have six variations of the tests. The chances of all those tests producing the same result was a little bit negligible, and in the ISO meeting in South Africa in '92, one of the delegates said it's fine having these six versions, but you ought to have warned us about a definitive test in the event of a dispute.

And once you have got that idea of a definitive test, then the remaining five tests really don't matter, and so now it is a vertical sample, and a gas burner on propane gas at 45 degrees.

Under propagation, it all started in Europe in 1974 with what was called the Luxembourg test, which took a two meter length of belt. It was put in a two meter square gallery. A burner with about 52 small holes in it was placed under a leading edge, and 1.3 kilograms of propane was consumed in 10 minutes.

This test was okay for lighter textile belts. At that time a heavy belt was probably something like a 600 PIW or something like that. And as belts got thicker and heavier as the gentleman said a little bit sooner, they get more and more difficult to ignite.

Now unless you have ignition, you can't demonstrate whether you have got propagation. So people have to look for higher energy forms of that two meter Luxembourg test.

In the U.K., we went to a four meter high energy test, and we increased the rate of fuel from 1.3 kilos in 10 minutes to 1.5 kilos in 10 minutes, but also increased the time to 50 minutes.

And in most of the tests, of course, you burn away completely over the burner, and you have a fairly intense fire, and then of course you can measure how far it takes before it self-extinguishes.

But the problem in the U.K. is that the four meter gallery test that we had was on Old British Coal land, and that was sold off for housing, or supermarkets, or something, and there is not much chance to build a new one.

They are very, very expensive, because the amount of smoke that you get that you saw from an earlier slide this morning, you need expensive scrubbers, and there you start talking vast sums of money, and so we really had a problem, and the U.K.'s Health and Safety Executive, led by the Mines Inspectorate, were very much aware that we would have a standard in place in the U.K. that we couldn't actually test to improve products again.

So they actually funded a quite extensive research program to fully understand what was happening in the gallery in case we ever wanted to build another one so it would get some comparable results.

But also to look at what was available in the world on a smaller scale to see if any of these could be adapted into an equivalent test to the U.K.

test, and I want to stress that, because the work that was carried on was designed to make the test equivalent to the four meter test, and not anybody else's test.

We now will call up the mid-scale test, and it was project managed by a consultant called Cerberus, and Fenner supplied the galleries and the belt samples, and that has resulted in the new mid-scale test.

The solution in Belgium and France was to use the two meter standard burner, but put one above the belt and one below the belt, which was a tremendous heat input. They found that none of the textile belts would pass that, and so they don't test, or they didn't test textile belts. We only used it for steel cord and our belts.

In Germany, they have a very different test. They have a full underground roadway, and you can put 18 meters of belt on a typical idler structure, and they build a wood fire around -- you have two meters of belt, and after three meters, they put 300 kilograms of carefully prepared pine wood of different sizes, and they set the whole mass alight, and it burns for 3 or 4 hours.

And the fire has to die out within 10

meters, and you have to have three meters left intact. I have tested them all and it costs around $20,000 a sample to carry out.

It is actually the two meter propane test and this is -- I should say, and I forgot to mention, that we actually have two small-scale galleries at Fenner. We have the German mini-storm cabinet, and we have the BELT test.

And all the work was done on the BELT test, and also considered all the information that Ken Mintz has done, and some years ago, about 1991, when he was trying to replace the test used in the Canadian standards with the BELT test.

We have problems in reconciling that test with the four meter test. We got different results, and we gradually changed various things. We changed the fuel to propane, and we changed the burnage geometry so that it was underneath the belt rather than hinging on the end of the belt.

And we actually lowered the height of the trussel to try and get the same configuration as the big gallery. It was tested without a belt to start with, just to assess the embed conditions with no belt, and we tried to replicate the conditions of the large scale gallery. So various changes were made.

So Europe, and what kick-started in Europe. Cen TC 188 was formulated in late 1989, and the aim was to prevent collieries to trade within Europe on a harmonization of conflicting national standards. Five working groups were formed looking at physical test methods and specifications for textile loads, and safety test methods for specifications of steel cord belts, and a whole new series of specifications and test methods.

And so within Europe surface resistance was the same, and drum friction was a little different, depending on secondary devices. The laboratory ignition was slightly different, mainly ISO 340, apart from the U.K.'s Barthel Burner.

But in terms of fire propagation, it was very, very different. So we had a correlation project which was funded by the European Coal and Steel Group. We took eight very different types of belts. There were ply belts, and cord belts, PVC belts, and PVCs with covers, and PVC belts with rubber covers.

There were eight completely different constructions, and each of the four countries -- France, Germany, Belgium, and the U.K. -- did their own two meter standard propane test, and a high energy test. On the two meter test, it is well defined, and wherever we tested, there was good correlation.

But when we did the four meter test and France and Belgium did the Brandstrecke test, and Germany did the large scale drum friction test, there was a complete lack of correlation.

And the conclusion was that we were not actually measuring the same property. No country was willing to adopt an unfamiliar test that could possibly lead to a less safe situation on the ground. We all believed that we had very good standards of safety.

As Geoff had said, there have been no deaths in the U.K. since 1950, and so there was all this stalemate. In the meantime, we had plotted on with standards for general purpose belting, and in the past -- you know, you have had belting that was very fire resistant, and you have had general purpose belting that were a little fire resistant.

But there has been a growing trend over the years for even general purpose belting to meet more safety. This has often been prompted by insurance companies for belts carrying fertilizers, or difficult materials, or even things like baggage belts at airports, where if you have a fire, you can easily spread a fire from one terminal to another.

So even with non-underground mine belting, there has been a general increase in the requirement for some fire resistance, and in Europe, we have a thing called a Machinery Directive, and it requires that risk assessments be performed on all machines, and you have to sort of identify the hazards, and then show how they are being addressed.

And because in general the safety requirements are not as demanding as for underground use, then this question of failure to correlate on the high energy test was not a problem.

And we have produced a new standard, the BS EN 12882, and it introduced the concept of safety categories, and specified a means of categorizing conveyor belts in terms of the level of safety required by the end use application.

So bear in mind that this general purpose belting, and the fire propagation column at the end is just the two meter standard propane burner test. So a category one belt has just got to be anti-static.

Category two has electrical resistance, but it brings in the ISO 340 test. Category three, electrical resistance, ISO 340, and a short drum friction test, fixed load.

Category four introduces a fire propagation requirement, and Category four is almost what you might call an early underground belt. Category five, I'm sorry.

So what underground belting? Besides the Machinery Directive, we also have the ATEX Directive, which is what you have to for where there is a potential explosive atmosphere.

And again it demands a risk assessment approach, and that really has provided a way out of the stalemate situation that we said existed earlier. Basically, there can be more than one way to achieve a safe solution.

So there is the safety standard Class A, and that is where basically the hazard is limited access and means of escape. Class B introduces potential explosive atmosphere, and you can have no secondary safety devices, or if you are reliant on secondary safety devices.

And Class C introduces -- as B -- but introduces flammable dust or material conveyed. So, C-1, if you don't rely primarily on this secondary safety devices, which is basically the British standard; and C-2 is when you have got secondary safety devices, and also the possibility of over-flammable materials, such as wooden props or what have you, and really was to let the Germans carry on with their Brandstrecke test.

So you might not be able to read that, but there you have the A and the B-1, and the B-2, and the C-1 and the C-2. So basically we say for fire propagation, it is the two meter test for A and B categories. If the two meter test gives you complete ignition, that's fine, but if you don't get complete ignition, then you use the mid-scale test or the Barthel Burner test.

But for the Category C one, you have to use either the mid-scale or the Barthel Burner test, which is very similar testing; and C-2, the Germans use that.

So in Europe, we have in terms of safety tests, we have our standard and general purpose belting, and an equivalent one for underground belting; and then we have the products standards, and general purpose, 14890 for textile belts, and 15236.1 for steel cord belts; and then underground belts, which we have eminent, and it is at the ballot stage for 22721, and 15236-3, which is also in the ballot stage, and they should be published by about the July or August time frame.

But the product standards call for safety requirements in the top two standards, and as I said, the requirement based on the risk assessment of a particular application.

And further studies. There was a very, very good paper published by Cerberus and Mining Acceptance Services, which looked at what -- and this is about 1990, or I'm sorry, 2000, and it looked at the tests that were available at the time, and including the BELT test, and they looked at what the Canadians did.

And it also looked at all the results of that same correlation program that produced the different results. I have got that with me as a PDF file which I can leave with you, because that work was actually not published. It was partly done as an exercise for the project by students at Cambridge University.

And then the big report, again published by Cerberus, which was the results of the HSE, which lead to the development of the new scale test. That is available to download from the internet.

It is about a hundred page document, and there is an extremely comprehensive review of what had been previously done before, and all the good points from it, and all the minuses, as well as the pluses, and how the work progressed to try and finally give us a mid-scale test which is easy to do, but more importantly, it is giving us the same results over a wide range of belting as the previous four meter test. Thank you for your attention. Any questions?

DR. WEEKS: Could we get this presentation printed?

MR. ROTHERY: Yes. I'm sorry, we weren't tasked with that, and so we didn't prepare it in advance. But, yes, we can do that.

DR. BRUNE: How would you rate the BELT test in comparison to those European tests? Would you say that fits in fairly well or is it completely unacceptable, or is it better in your opinion?

MR. ROTHERY: The BELT test?

DR. BRUNE: Yes.

MR. ROTHERY: In many ways it is a more severe test than what we have finished with the mid-scale test. But it differs because it is still a 50 minute test, and so it does ignite everything in the 50 minutes.

We found with the original BELT test that it was more severe for some belts, and it would have failed tests that would have previously have passed our requirement, and other belts which would have failed our requirement, it passed, but mainly because the five minute ignition time was not sufficient.

So in some ways it is more severe, and in some ways it is less severe. It is probably broadly equivalent, but more important, it gave us the correlation that we had with the four meter test that we had had for over 20 years, and which we felt provided us with a very good record of safety.

I mean, as Geoff said, you have to sort of define what is a fire, and in the U.K., if there is a whiff of smoke seen, it is a reportable fire, and we get probably 12 to 15 reported fires a year from five tests, but none of those whiffs of smoke have ever developed to where there has been a flame.

And most of the -- and although we get the drum friction scenario, most of the reported fires are from collapsed bearings or seized idlers, where the belt droops, where you have virtually a red glowing idler, the belt stops when somebody sees smoke.

But our priority was to correlate with the four meter U.K. test, and in that sense the BELT wasn't the complete answer for it.

MR. MUCHO: In your opinion does the drum friction test add to conveyor belt safety, as opposed to just a flame propagation test?

MR. ROTHERY: I think it does. I mean, the drum friction test is criticized because I think it is a 200 millimeter diameter steel drum, and there is not many drive drums in underground mining that is 200 millimeters in diameter.

But it does show what happens to the belt if you do put it against a potential heat source, such as a rotating drum. Now you can't standardize the tension that is going to be in the belt. Motor speeds will be different.

All it is, is one set of fixed conditions. But Geoff mentioned that we had one mine where they actually jammed the belt, and the drum kept going. The detector didn't work for whatever reason, and so it wasn't detected.

And that was a PVC belt. A PVC belt parted, and of course that is a fail safe situation. The source of the danger has been removed. Now with the drum friction test, you can have a situation with rubber belts where you formulate a belt so that there is glaze, and then the temperature stays down once you glaze.

But if you increase the tension, you can actually go through glazing, and so it is this question of what is the standard condition, and there isn't a standard condition. But the picture at the top is a classic example of what can happen.

We supply to the steel industry, and we have had belts where they wanted something in between an underground belt and a general purpose belt, something that would resist welding or things like that.

And because their tests wouldn't be to severe fire propagation tests, they started looking at all sorts of other tests that we could use. But they found out that with a thick cover down to the burner, they could actually pass the 10 minute standard propane test. So that's what we went for, a 10 minute test with a thick cover down.

But they had an incident just about two years ago, and just with welding, and they actually did set the belt on fire. It not only destroyed everything in the gallery, but all the oxygen supplied to the furnaces were in the same gallery, and the furnaces were shut down for six weeks, and it costs millions and millions of pounds.

And just as our colleague said earlier on, that in the correlation program that we did with the eight belts, we also did cone calorimeter tests on all eight belts, and again we did not find any correlation between the cone calorimeter work and the actual propagation.

I can understand, you know, toxicity, fumes, et cetera, but there was actually no correlation between the cone calorimeter results on the eight belts, and ranking the belts by the fire propagation test.

DR. CALIZAYA: You mentioned conducting safety tests.

MR. ROTHERY: Yes.

DR. CALIZAYA: And how are the risks identified?

MR. ROTHERY: Well, it is up to the maker of the machine to identify what the risks may be when his machine is in use, and that can be anything, from some sort of mechanical risks, to trapped fingers, guards, et cetera.

But if the risk assessment shows that there is, for example, the chance of a fire, or a spark, or something like this, then he has to show how he has addressed it.

So if his risk assessment showed that there was a chance of static buildup and a spark, and that he had addressed it by the selection of a belt that was conductive to 14973. If he show that the risk of a fire was something else, then -- and let's say he identified a rotating drum, and he might say I will go for a belt that meets a certain category of drum friction test.

And so he can demonstrate to the examiners that he has identified that risk or the hazard, and he has addressed it by the selection of a belt that meets the safety standards, and that could vary from application to application.

The way that Europe is going at the moment is very much on the risk assessment approach.

DR. CALIZAYA: And with respect to those experiments, what did the tests show or what was the outcome?

MR. ROTHERY: You mean in terms of risk assessment?

DR. CALIZAYA: Yes.

MR. ROTHERY: I don't know, because it is the machine manufacturers who would do that. I mean, it is all relatively new. The 14973 was only published last year. I mean, certainly the biggest difficulty we have had is the different approaches in drum friction, and particular the Germans allow for 450 and allow glow, and the U.K. standards don't.

So the problem with harmonization is that you always tend to harmonize on the lowest one don't you, and that can be unacceptable. And then of course the other one was the fire propagation.

MS. ZEILER: Okay. If there are no further questions for Geoff and Brian, then we need to make another switchout, and so I would like to suggest that we take our mid-afternoon 15 minute break.

(Whereupon, a short recess was taken.)

MS. ZEILER: All right. We are going to start again. I would just like to mention again that if anyone would like to speak in the public input hour at the end of the day, you need to see Debbie at the door there and sign up.

MR. VERAKIS: Our next speaker is Bernd Kusel, executive vice president of the Phoenix Conveyor Belt Systems, Hamburg, Germany.

DR. KUSEL: Good afternoon everybody. I would like to give you an overview of the international fire resistant conveyor belt test, and I would like to start with a short overview of what Phoenix is doing, and who we are, and then talk a little bit about conveyor belt families, and then the tests and their properties, and the approval tests, and then experience with self-extinguishing conveyor belts.

Phoenix has been making conveyor belts for more than 100 years. We have always been focused on the mining industry. We have belt factories in the coal mining countries like Germany, China, and India.

Phoenix is a supplier of all outstanding conveyor belts, like the strongest, the longest, the heaviest, et cetera. We supplied the first self-extinguishing PVG conveyor belt worldwide that was approved 28 years ago.

We also made the first self-extinguishing steel cord conveyor belt worldwide 22 years ago for a German underground mine. We also supplied the first self-extinguishing steel cord belt as per the new requirements for Australia 19 years ago, and in China, we supplied the first self-extinguishing cord belt 12 years ago.

This shows three of those applications. We have the first self-extinguishing steel cord conveyor belt in Germany. As you can see, we have personal transportation on the belts underground, and on the right, we have the first self-extinguishing PVG conveyor belt, and another highlight on the left bottom, the strongest underground conveyor belt is an ST-7500, which is conveying coal from 800 meters underground to the surface, and simultaneously it is conveying washed refuse back underground.

Phoenix is not producing in the U.S. so far, but we are a major supplier of MSHA approved textile belts to the production coal fields. We also supply steel cord belts for consoles, drift conveyors, and we have been active in the U.S. coal mines for some 10 years now.

Regarding belt families, we divide that into two main groups, which is steel cord belts used above ground and underground, and the other big group with more variations are the textile belts, textile belts with one, two, or even more plies.

And one ply is this solid woven carcass, and which is available in PVC, complete PVC, including the PVC covers, or with rubber covers. This again shows the different types.

On the top, we have a multi-ply belt, and that is the usual type used in the U.S. coal mining. In the middle, we have a two-ply conveyor belt, which is in my opinion a little bit more modern, and also used in the U.S. And the most modern type, the sort of woven conveyor belt, with rubber covers, which we call PVG.

And a conveyor belt consists of 10 to 20 different ingredients, and so aside from the main component, the elastomer or modern elastomers, there are carbon black sold for accelerators, fire retardants, anti-oxyigents, fullers, et cetera, et cetera.

So many, many different ingredients, but the main component is the elastomer, and so I have shown here the various abbreviations, and what we should concentrate on is CR. So the polychloroprene rubber, also called neoprene, which is a trademark.

And then the NBR, which is sometimes used as a blend of rubber and PVC for covers; and the SBR, which is used in the United States, and PVC. So what are the basic properties of these elastomers?

If we again look at where we have these arrows on CR, or neoprene, or polychloroprene, and if it has a green field, then this is very well suited for or has very well properties regarding breaking strength, elongation at break.

So, abrasion, tear resistance, coal flexibility is average, and again heat resistance, weather resistance, oil resistance, and flame resistance, is excellent.

And if we look at SBR, the physical parameters are similar to CR roughly, but as you can see for flame resistance, this is very poor. I mean, it is just adequate.

And for PVC, you see that we have also here the physical data, and very bad, but for flame resistance, it is as good as neoprene. So if we look at the basic rubber types, then CR and PVC would be the first choice.

And as we have seen on this chart, polychloroprene rubber is highly resistant by nature, and so if at all, only a small amount of fire retardants has to be added.

And similarly with the PVC, and also there we don't have to add or add only a little bit of fire retardants, and so they are self-extinguishing by nature.

But if we look at MSHA covers, which are based on SBR rubber, you need a bigger amount of fire retardants, which deteriorate the physical properties of the compound. And of course even if you had big amounts of fire retardants, then you will never get the safety features of CR or PVC.

So what happened in German by is that in the 1970s, all flame retardant conveyor belts -- and that is what we called DIN-K grade, and that similar to ISO 340, or even similar to the present MSHA requirements, and all these belts had to be removed from underground, and be replaced within a certain time frame of some years by self-extinguishing belting.

So from then on 30 years ago in Germany, and this is similar in Western Europe, only self-extinguishing belting were permitted and as of today. Now I have picked the biggest coal producing countries in the world just to find a comparison.

Of course, number one is China, and their safety requirements are at the highest level worldwide. Then the United States, where it is the lowest level of conveyor belt safety. Then Europe, India, and Australia, also at the highest level, and South Africa and Russia between these two extremes.

So here again these countries, China and the United States, India, Australia, Europe, South Africa, and Russia, and if we look at the first line, drum friction test, in all countries of the world the drum friction test is required, except for the United States.

Propane grate burner tests are required in all listed countries except in the United States and South Africa. The high energy propane burner required in China and Europe, but not in the United States. The large scale gallery is -- well, it is unique to Germany, although it is a European standard, but it is unique to Germany.

The laboratory scale gallery, as I

understand, is this BELT proposal, and so that is a requirement in Europe, and in Russia, and nowhere else. Then we have this Bunsen/Spirit Burner, which is required in all countries, including the United States.

Then the surface resistance is required in all countries, except in the United States, and as far as I know this is correct. Toxicity heat testing is done in Europe and in Russia, and additionally, which is not a real fire resistance test, but more a kind of fingerprint or quality control, the lowest oxygen index is required in Australia, Europe, and in Russia.

So again here we can see that definitely the United States is on the lowest levels regarding conveyor belts. I don't have to explain to you this test. This is the present MSHA test on the right, and you have seen this before.

And this is the similar test that we do as for ISO 340 and DIN-22103, which we call K-grade, and so this is only allowed above ground, and no belt for underground.

And now I am coming to the international tests. We have the propane burner test, with a sample of 1.5 to 2-1/2 meters long, or even the four meter long sample for belt width.

And the belt has to be self-extinguishing within a certain or after a certain length, a certain undamaged length has to remain. This is the large scale fire test where we are using an 18 meter long belt, full width, and I have prepared a small -- I hope it works -- video here.

(Pause.)

DR. KUSEL: Here is an 18 meter long sample, 12 meter wide, and they use 300 kilograms of some kind of timber. It is very similar to what we have seen this morning from NIOSH, except that this is twice as long. The sample is twice as long, and the undamaged length should be eight meters.

(Pause.)

DR. KUSEL: Okay. So this is a requirement for all belts in Germany. The drum friction test, we have seen before, and I don't think you need to see videos of that. We know how that works.

The temperature is being recorded and should be below 325 degrees, and there should be no flames or glow. Do you want to see the video again?

(Pause.)

DR. KUSEL: That is a PVG belt and you can see the PVC in the center and the rubber covers on the bottom. This is two hours later. The temperature is recorded. There is not a worldwide drum friction test.

I mean, there are differences for different belt types. The weight of the tension that you put on the belt and also the temperatures, and it is not a drum friction test worldwide, but it is similar testing.

Then we have the laboratory scale gallery test, which is also required in Germany. It is similar to the BELT test, and here you have a 12 millimeter long sample on a 20 millimeter wide belt, and it is put over a propane burner, and again the flames must self-extinguish and undamaged lengths must remain.

(Pause.)

DR. KUSEL: Yes, self-resistant, and I think the worldwide requirement is 300 megohms maximum, and in Germany, we do what we call hygienic tests. First, of course, is that under normal operating conditions a conveyor belt must not put the health at risk and that is quite clear.

But under the influence of heat or fire on belts, decomposition substances must not cause irritation of the skin or eyes, and the main purpose of this test is to measure the resistance of the miner's self-rescuer, and in Germany, every miner has to wear a miners self-rescuer.

So when you smolder a belt sample, and add water and air, then the air flow must not increase the filter self-rescuer's resistance by more than five millibars, and additionally, unfortunately, we have a small animal at the end of this test, and it is a guinea pig, and so it has to stay healthy for a couple of days. Hopefully we can avoid this test in the future, but at present it is still there.

This shows the sample size. I mean, on the bottom, there is the German large scale test, and then the international propane burner, which if it is four meters long, of course, it is double-sized.

The laboratory scale, the drum friction test, and then the present MSHA test. I won't say that big is beautiful, but it is quite a difference. Of course, the main threat, aside from heat, is carbon monoxide if you have a fire underground, and so CR, and SBR, and PVC roughly emit the same amount of carbon monoxide.

In addition, small amounts of hydrogen chloride are generated, usually more from CR and PVC than from SBR. But the main point of course is that since CR and PVC are self-extinguishing, and SBR is not, and so of course the toxic substances are of course drastically lower in case of CR and PVC.

As I mentioned briefly the LOI test, this is to measure the amount of oxygen that you just keep a flame alive. I mean, we all know that the normal air is about 21 percent of oxygen content, and here usually for a neoprene belt, you would have, let's say, a 35 or 38 oxygen index.

So as I said, that is not a test and not a proven test, but it is an easy test to check when you get belts, and if these belts comply with what you tested originally. So you get an LOI index from the approval belt, and then you compare this with the belt that you supply later.

And this is a little bit too small, but this is an English or Australian test certificate would look like, and so they indicate all the tests, and figures, et cetera.

I don't want to make this the same presentation, but again we believe that the PVG belt is the most modern and best belt for underground use. We combine both the worlds of the CR covers, which are self-extinguishing, and of course PVC, is permitted in carcasses which are self-extinguishing, and so this is from a safety point of view that the public can get today.

And since PVC has very poor physical properties, like high abrasion, and elongation at breaks, and so it would wear very fast. So we combined this with rubber covers, and so we have a combination of the advantages of both types, and obviously we don't have any ply separation or things like that, because this is just one ply that has a woven carcass. I don't want to go through all these items now.

Again, a comparison of the PVC solid woven belt and neoprene multi-ply belt, and PVG solid woven belt, and this shows that the PVG has the highest wear resistant robustness and ability, and we believe that is quite important.

And also the elongation properties are excellent, because by impregnating this sort of woven carcass by PVC, you have very low elongation, and so you can use the belt for longer distances.

This is another chart that shows the physical properties if you compare SBR, and the present grade in the U.S., and CR, which is used internationally, and you have similar tensile strength.

The elongation and break will be a little bit better with CR, and tear resistance a little bit better, and abrasion resistance. So this is mainly because -- I mean, you add fire retardants to SBR to get this belt, and fire resistance, which you don't have to do for neoprene.

So I was asked to say something about prices, and I am a bit shy in that regard, and so if we combine or compare self-extinguishing rubber belts with the existing flame retardant belts, it is again very rough, but it is a rule of thumb.

So, 10 to 30 percent more for that belt, and of course depending on the different recipes and qualities, and whatever, but just as a rough figure so that you have an idea.

And self-extinguishing PVC conveyor belts, if you look only at safety, but not at performance, PVC belts will be cheaper, 10 to 20 percent cheaper than the existing MSHA belts.

So the higher safety and the better operation and performance, compensate for the extra costs for servicing rubber conveyor belts.

And I think that somebody mentioned that in Germany, we had an increase of 40 to 50 percent or something, and I think that this is just not correct. I'm not sure. But, of course, we have much better performance now.

And regarding Phoenix and MSHA, we provide MSHA with samples, and in '96, we supplied or we provided an ST-7500, which I mentioned is the strongest underground belt worldwide, and also the PVG 3150 belt, free of charge, and we would be pleased to help if we can also in the future. Thanks very much.

MR. MUCHO: Have you sold any of the neoprene type belts in the United States?

DR. KUSEL: No.

MR. MUCHO: Why is that?

DR. KUSEL: It is of course a question of price and nobody wanted to pay the price for it.

DR. WEEKS: You mentioned the price differences with these belts. That is the purchase price, right? The question is how do they compare in terms of durability?

DR. KUSEL: Well, I did not say price. It is the cost. It is more costs, not price.

DR. WEEKS: Okay. Costs?

DR. KUSEL: Costs.

DR. WEEKS: How does it compare in terms of durability over a lifetime?

DR. KUSEL: A lifetime?

DR. WEEKS: Yes.

DR. KUSEL: Well, neoprene belts, as I said, we have some better physical parameters, and so neoprene belts would last -- well, I mean, what we have, and what we found, and what the DSK in Germany found is that neoprene compared to PVC lasts on average five times as long.

But neoprene compared to SBR, I don't have real figures, but I am going to assume that it is a third better. I have no real figures on it.

DR. WEEKS: Can we get this printed? Can you supply us with that?

DR. KUSEL: I have it on CD, yes, if that is okay.

DR. WEEKS: A CD would be fine.

DR. KUSEL: Okay.

DR. MUTMANSKY: What percent of your company's business is done in the United States?

DR. KUSEL: I don't remember. I wouldn't like to say now.

DR. MUTMANSKY: And what percent of the U.S, market do you hold at the present time?

DR. KUSEL: I also would not like to say that. But I can say that we are smaller than these guys there. I mean, there is no doubt.

MS. ZEILER: Any further questions?

(No response.)

MS. ZEILER: All right. Thank you very much, and if you could come over here and sit at this table. I want to thank everybody who participated, and if you could move over here for any general questions that the technical study panel may have that they would like to ask of the belt manufacturers.

(Pause.)

DR. WEEKS: While this is not directed at anybody in particular, but it would be useful to have some data prepared on things such as the incident of fires, belt fires obviously, and fatalities and injuries related to belt fires, to see what the data reflects.

And keeping in mind that international comparisons on data like that are difficult to make sense, or difficult to make sense because of the different criteria for reporting different kind of events.

But assuming that we could take that into account, it would be useful to try and get some data like that. Could we possibly get something like that, or maybe I should ask you all whether we could possibly get data like that?

MS. ZEILER: If such data were available, we could have Harry try to get it and provide it.

MR. MUCHO: I think we would be interested in conveyor belt fires due to frictional heating.

MR. NORMANTON: Australian information would be available, as they have recorded that kind of information for the last 20 years or so.

DR. WEEKS: What is a fire? Oh, I'm sorry.

MR. VERAKIS: Sometimes you have to go to the organizations, like the British Coal Board, to get fire incidents. You have to go to the governing bodies to get fire information.

The problem is that it is not readily available across the world, and you have to go to separate places. You would have to go to India, and you would have to go to South Africa, the British, the Germans.

It's not that it can't be done, but it is not something where you have a centralized database to gather this information.

DR. WEEKS: It sounds not cost effective. We would spend a lot of time trying to get information that we don't know how to interpret. Is that what you are saying, or something like that?

MR. VERAKIS: No. Are you looking for the data to see what the comparison is based upon the fire resistance standards that these countries have?

DR. WEEKS: Yes, basically. I mean, there seem to be substantial differences between the U.S. and other countries when it comes to standards, and the question is so what? I mean, is there a real benefit or are there real differences in what we are trying to accomplish, which is fire and injury prevention.

MR. VERAKIS: And I think that from our end of things that we could probably get the information from the British, and from the Australians, and some of the other countries. But for some of the countries, it may be difficult to get the information, or to get accurate information.

You may have difficulty in getting accurate information from China as far as the number of fires. But we certainly could try to gather that information, and we could certainly find out how they report their fires.

And as was mentioned here, if there is a wisp of smoke in British mines, that is reportable. So that would be taken into account in looking at that information. But I don't know whether the belt companies can gather that information much more easier than we can. We can certainly try to get it.

DR. WEEKS: Right. But the belt companies have some indication, I think, on how your belts perform, and if you have a problem with a belt in some mines, and your company goes and investigates, then you know how your belts would perform.

MR. NORMANTON: I think we can answer that question. We never had an incident with respect to a fire with our products to investigate. So that is a very difficult question to answer. We can certainly get the data out of South Africa or Australia, and the United Kingdom quite easily. If you wanted us to do that, we can readily do that.

DR. WEEKS: I think you just answered it.

MR. NORMANTON: But there are incidents of frictional heating and recorded incidents, but whose manufacturing law is not known to us, and we have never been asked to investigate one of our products involved in a fire because there have not been any to investigate in any of the locations.

MR. MUCHO: For the panel, the static electricity test, anything that I have ever read just talks theoretically about the potential for static electricity and the emission of methane or some other gas.

Are any of you aware of any real life

incidents where the static charge on a conveyor belt was felt to be the ignition source for some gas?

MR. NORMANTON: I think there has been some in grain elevators.

MR. MAGUIRE: Yes, that's right.

MR. MUCHO: Yes, but in underground mines, I guess.

MR. NORMANTON: No, not in underground mines, but grain elevators.

MR. MUCHO: Well, coal mines specifically.

MR. NORMANTON: Well, I think the issue about meeting the static electricity test is not an issue with rubber PVC belts with all manufacturers, and it is not an issue as I understand it.

MR. MUCHO: That is what it seems to be. Nobody is really worried about it because everybody has no problem meeting it.

MR. NORMANTON: Yes, and all belts being used are already meeting it. There is the original study, and that is from the 1950s, and that is public record, and that was based on some of the early types of PVC belting given their high tension when running.

The work by Barkley kind of proved that those charges could be up to 25,000 volts, and the concern was that that was sufficient energy because of sparking on discharge.

I don't think any of those belts actually were involved with creating that and you're right. What it was is that it seemed to be a risk. I have a copy of that if you desire it.

DR. BRUNE: If hypothetically the United States would be assuming a standard that would be similar, and let's say to the Australian or European standard, would any of you gentlemen wager a guess as to how much that would increase the belt conveyor costs?

Would you have any idea? Not that I want to nail you down to a penny here, but obviously you all offer belts that meet those standards, and so is that something that you can answer?

DR. KUSEL: Are you talking about belt conveyors or conveyor belts?

DR. BRUNE: Yes. If you equipment a conveyor belt with a material that conforms to -- pick one -- Australian, European standards.

MR. MAGUIRE: I think the question is going to be difficult for all of us to answer, because if you don't have one standard that you go to, that is the first question.

The second thing is that if you are talking about gallery tests, or BELT type tests, you are going to start using significant quantities of polychloroprene, or neoprene, and as everybody knows, there is a huge worldwide shortage of it, and there will continue to be.

So when you are asking this question about prices, and that is like asking what the price of copper is. But as usage goes up, the cost of that is going to escalate, and I think that is something that you need to bear in mind, is that there is a huge shortage of polychloroprene worldwide, and will continue to be.

And so you are asking us to put a price on something that is very difficult to give a price on, on polychloroprene.

DR. BRUNE: It is a good perspective anyway to understand that for this panel.

MR. MAGUIRE: There definitely is going to be a cost increase.

DR. WEEKS: That leads to the question about any of the other materials that you all talked about, and are there material shortages like that which can seriously affect production.

MR. NORMANTON: I think we also stated to meet the BELT standard that it wasn't necessary to use polychloroprene. So there are other alternatives as well other than using that particular polymer.

I don't think that would get in the way of examining whatever the future circumstances would be, but --

DR. WEEKS: But are there any other materials that are in short supply other than polychloroprene?

MR. MAGUIRE: With the rubber industry probably not, but that is the critical one that we are talking about.

DR. KUSEL: But the shortage may be in the United States. I mean, it definitely is not in Asia, and if there is a high demand, then why shouldn't production be increased? I don't see where this should govern what you decide about safety. If the material is not there now sufficiently, then why shouldn't it be there?

DR. WEEKS: Well, we want to be in a position to make a recommendation, and actually do something that can't be done. It is that simple.

MR. NORMANTON: I don't think you are in that position. I think there are alternatives that would be useful. There is certainly a polychloroprene shortage. Of that there is no doubt.

MR. MAGUIRE: And just to let you know what happened is that a major manufacturer in Europe of polychloroprene, their plant blew up, and within a year was completely out of the market, and all plants are running at full capacity, and Dupont is going to relocate their major facility in the United States in Louisiana, and reduce production at close to half.

And they have delayed moving it for two years because of startup problems, and meanwhile, China, with coal production, is using very large quantities of polychloroprene. So it is a serious issue that is not going to get any better. There is no end in sight.

DR. TIEN: Just a general question. I am not a belt guy, but what is the total consumption of belts in the U.S. and the total world market roughly?

MR. MAGUIRE: You mean in dollars?

DR. TIEN: Either units or dollars.

MR. MAGUIRE: Conveyor belts in the U.S. versus the rest of the world? A rough number? Are you just talking about coal mining?

DR. TIEN: Well, let's start with coal mining.

MR. MAGUIRE: Well, I think with coal mining, I think that the numbers that Phoenix showed would be a good relevant number as to the amount of coal production, and so you could do a correlation with conveyor belts. I think that is about a good a number as you can get. Maybe the commercial people can answer that.

DR. TIEN: If not offhand, that's okay. I am just curious. Maybe later.

MR. NORMANTON: I think you are getting into the realm of dramatic sensitivity with those guys.

DR. TIEN: I noticed some of you mentioned that you have entered China in the market, and for quite a while, or has it just taken off, or what is the situation?

MR. NORMANTON: We have manufactured in China since the mid-'90s.

MR. MAGUIRE: And we have supplied belts since that time as well. We don't manufacture in China. We supply them from Australia.

DR. TIEN: Has the recent coal production escalation -- have you seen any impact on the demand of your belts, because since the year 2000, they have almost doubled their coal production in five years or six years?

MR. MAGUIRE: Yes.

DR. CALIZAYA: This is just a general

question and it deals with the position of the conveyor, and conveyors used in galleries, and the use of slopes, and the use of charts. Do you do any reinforcement to the conveyor in each situation?

MR. MAGUIRE: Well, obviously there is tension calculations done, and what the tension of the conveyor belt is, and so obviously a sloped belt is going to require more tension.

So typically in the United States most sloped conveyors are steel cord reinforced with higher tension, and so fabric won't withstand that tension. So I think the answer is yes.

We designed a conveyor belt to match the system, and elevator and vertical belts, or sloped belts, are going to use higher tension. On longer belts, they are going to use higher tension, and that is one of the reasons why tensions have increased so much in the United States in recent years.

DR. WEEKS: One of you said -- and I'm sorry, but I don't remember which, that the belt was typically not the first thing to catch on fire. The question is what is, and what is the first thing that catches on fire?

MR. MAGUIRE: Typically, coal dust or grease will catch fire before the belt does. So I think the point that we are trying to make is that from our standpoint the detection systems are still very important, because fires will occur, because coal dust is going to be more flammable and so is grease on a conveyor belt. So early detection is still very important for safety in mines.

DR. WEEKS: How much of a factor is the grease? Is that something that you might pay attention to?

MR. NORMANTON: I think it is probably more idler failure than it is the grease. Idler failure and friction because of them is one of the secondary causes after just pure friction. If you read some of the reports from other countries, that is a key part.

DR. WEEKS: And so idler and then grease?

MR. NORMANTON: Yes.

DR. WEEKS: And can something be done --

MR. NORMANTON: Yes, and it is maintenance related primarily.

DR. WEEKS: Yes, I understand.

MR. NORMANTON: So, a well maintained mine shouldn't really have those issues.

DR. WEEKS: And is it worth looking at the issue of whether something can be done with the grease to prevent that sort of thing from happening? That is must something that came up today that I have not really thought about in the past.

MR. ROTHERY: I think in the U.K., they use the most fire resistant grease. It is usually friction or failure to detect worn idlers, or damaged idlers.

I am not aware that in the U.K. that we actually have -- well, we don't get any fires. We only get smoke, and so we have not had coal fires. Let's say the coal catches fire first, and I don't think we have had that occur.

DR. WEEKS: But you do have fires with grease. You make the belts, of course, but do you also make the idlers or does something else?

MR. MAGUIRE: No.

MR. ROTHERY: When I talked about the risk assessment of belts, the person who supplies the idlers and the drives, et cetera, does the risk assessment.

DR. MUTMANSKY: We seem to be running out of questions, and I thought, Linda, that I would grab the mike for just a second to thank all our speakers today. I really appreciate the fact that people from NIOSH, and the manufacturers were here today to share their thoughts with us.

Obviously this is a very complicated problem, and we really do appreciate your efforts to educate us on all of the parameters of this very important problem. Thank you very much.

MS. ZEILER: And I would just second what Jan said. On behalf of the panel and for MSHA, we really appreciate you gentlemen coming today, and I would like to thank Goodyear, Fenner-Dunlop, and Phoenix for providing very valuable information.

And at this point on the agenda, we were to have a public input hour, but I don't know if we have anyone signed up.

(Pause.)

MS. ZEILER: We do not. So, Chairman, if you don't have any further business for today, then I guess we stand adjourned. Is that all right with you?

DR. MUTMANSKY: Yes.

MS. ZEILER: Okay. Then we will reconvene tomorrow at 9:00. Thank you.

(Whereupon, at 4:05 p.m. the meeting in the above-entitled matter was adjourned, to reconvene at 9:00 a.m. on Thursday, March 29, 2007.)

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REPORTER'S CERTIFICATE

DOCKET NO.: --

CASE TITLE: TECHNICAL STUDY PANEL

HEARING DATE: March 28, 2007

LOCATION: Coraopolis, Pennsylvania

I hereby certify that the proceedings and evidence are contained fully and accurately on the tapes and notes reported by me at the hearing in the above case before the United States Department of Labor, Mine Safety and Health Administration.

Date: March 28, 2007

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