NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

PUBLIC MEETING FOR ADVANCED GLAZING RESEARCH

Holiday Inn Capitol

550 C Street, S.W.

Washington, D.C.

FEBRUARY 1, 1996

9:00 a.m.

A G E N D A

P R O C E E D I N G S

(Time noted: 9:00 a.m.)

MS. GILL: Good morning. I think I've met most of you, but good morning again.

I'm glad that you're all here this morning and in spite of my worries and concerns, Mother Nature has cooperated with us today. We have good weather. So that's a plus.

My name, again, is Margaret Gill. I will be the moderator for the meeting today.

We have a very compact agenda, as you can tell. But we're very ambitious. We plan to get through it today on schedule as much as possible.

We have the room until five if we need to stay that long. We will proceed according to the schedule.

Right now, I'd like to introduce to you the sponsors of the Glazing team and then I'll introduce the Glazing team itself.

From the Safety Performance Standard Office we have Barry Felrice, our Associate Administrator.

Jim Hackney. Would you stand, please? He is now the new Director for Crashworthiness Standards.

Is Ralph Hitchock here? Well, maybe he'll be in later, but he's the R&D counterpart to Jim Hackney.

Now, I will introduce the team members. And if you will stand when I call your name I'd appreciate it.

Lillvian Jones, Steve Duffy, Clarke Harper, Linda McCray, Dinesh Sharma, Rob Sherrer, Don Willke, and Dr. John Winnicki, and your's truly.

Before our Associate Administrator welcomes you, I'd like for you to know just a few things about this meeting.

Your statements will be recorded and transcript will be available at a later date, maybe in a couple of weeks.

I would encourage you to submit your comments to the docket by March 1.

Without further adieu, I would like to introduce to you Mr. Barry Felrice.

(Applause)

WELCOME AND REMARKS

BARRY FELRICE

ASSOCIATE ADMINISTRATOR

FOR SAFETY PERFORMANCE STANDARDS

MR. FELRICE: Thank you. Thank you, Margaret.

I'd also like to welcome you here and to say good morning. It's probably the last good morning in Washington for a few days if we believe our weather forecasters.

It's nice to see such a nice crowd here, some different faces than I'm used to seeing. I appreciate everyone coming from out of town for this meeting.

I just want to spend a few minutes as to what we really want to accomplish here today and why we're having this meeting.

But before I do that I'd like to give you greetings from Dr. Martinez, the NHTSA Administrator and Phil Recht our Deputy Administrator, both of whom wanted to be here this morning, but unfortunately had prior commitments and couldn't make it.

Also from Bill Boehly, my counterpart in the Research Office who's been out of town the last couple of weeks.

Why are we having this meeting?

Those of you who track NHTSA fairly closely will notice that we're having many more public meetings than we have had in the past.

This is sort of the new NHTSA, a new way of doing business. While this meeting is co-hosted by the Regulatory Office it doesn't mean that we're about to issue regulations. In fact, we're not going to do that until we see the results of this meeting and perhaps do some additional research.

For what we want to do, this is consistent with President Clinton's claims to regulatory agencies, is to change the way we do business. Rather than the regulators sitting in Washington, dreaming up all these crazy things, you know, pails with holes in the bottom and that kind of stuff, the President has ordered regulatory agencies to reach out more to their customers; to talk to the public, to talk to the regulated parties and to do that prior to actually issuing regulations.

That's what we're doing today and we've done in the past.

This type of meeting is early input that you can give us to help shape the direction of our programs.

It's consistent with the quarterly periodic meetings that Research holds on specific subjects. It's consistent with the quarterly meetings that my office has been holding for about 15 years now.

It's consistent with the Agency's strategic plan. This is a plan in process that we're taking very seriously, unlike the projects that were undertaken while I was head of the Planning Office which gave us a document that stayed on a shelf for awhile, but our Strategic Planning process is important to the Administrator.

We've published a draft for comment. I think comments were due -- and perhaps some of you commented -- right around Christmas time. We're now in the process of revising that plan. Again, based on your input, so it's the public helping shape the Agency's activities.

And that's what we'd like to do today.

This is really the second meeting of this sort that we've had on a research activity. We had one last summer, I believe, on door latches, potential door latch upgrade. And now we have this one.

We have other ones upcoming. We will be holding one, I don't know exactly when, but sometime the first half of this year on possible improvements to our head restraint standard and will be putting a report in the docket and trying to gather your input once again.

We learned from the first meeting on door latches in the sense that, at that time, we didn't have a report for the public to look at prior to the meeting and so it was mainly government staff presenting the results of the research and everyone in the audience said, "Wow, I don't know what to say about that."

This time we had a report in the docket for a few months, and what we're really looking for is your input to us, your guidance. Tell us what we did right, what we did wrong, what we should do next; more research, rulemaking, whatever.

Margaret introduced the team. I want to say that the Agency is very proud of this team. This is really our prototype team in the Agency in terms of we had five different offices working together toward a common goal as compared to some of the internal friction that existed in the Agency before where everyone felt they had to criticize the other office's product.

This time we threw everyone involved in together early and said, hey, here's the goal, you all work together to get there, iron out your differences now.

I think that led to an excellent product, hopefully you all have this report.

Are there any extra copies if people need it?

MS. GILL: Yes.

MR. FELRICE: Let me also say that -- I notice your seats are kind of close together if you want to spread out a little, I'm sure that's fine and the people next to you won't feel offended.

As I mentioned, we have five organizations in the Agency working on this team to produce this report. They're all here today.

This is a very serious effort in the Agency. If you believe the potential benefit numbers of improved glazing, it's 1,300 lives a year -- up to 1,300 lives a year, a very, very significant safety improvement. Even if it's half that, it's still a very, very significant safety improvement.

This is part of Secretary Pena's rollover plan. Some people have been skeptical about that plan. The Secretary announced it summer of '94.

There were nearly a dozen activities in there. We have made progress on those.

I'm only mentioning this because rollovers are a very important focus of this Agency.

We have everything from public education efforts, to research, to rulemaking.

We did issue our head injury reduction standard last summer. That has significant benefits associated with rollover.

The door latch meeting that we had is geared to reducing rollover casualties, as is this effort.

We've spent nearly a half a million dollars of your money, the taxpayers money, over the last year on this project.

We've had about 6,000 person hours devoted to this activity.

All that, coupled with the number of Agency staff you see here today, it should be a fairly strong indication that we are very, very serious about this subject.

What we really need now is for you to tell us, what next.

It may be differences of opinion, I encourage differences of opinion, I encourage a frank discussion of what the Agency has done, what you as manufacturers or suppliers are doing. This is a time for us to share.

As I said, we are not in rulemaking. We may not be in rulemaking.

Another thing President Clinton asked regulatory agencies to do is not regulate every aspect of performance on a subject.

He asked us to work with industry, to work with voluntary standards organizations to the extent possible.

So as far as improved glazing, if you all want to do that yourselves, if you think that's appropriate, well, we welcome that.

And that would relieve us of the burden of regulating, because I'll be the first to say the government doesn't always know what's best all the time.

So with that, I just want to say, again, welcome.

Give us your frank input and candid input either orally today or in writing by the March 1 date and look forward to a very interesting session today.

Thank you.

(Applause)

HISTORY AND SAFETY NEED

CLARKE HARPER

CO-LEADER ADVANCED GLAZING RESEARCH TEAM

CLARKE HARPER: On behalf of the Advanced Glazing Research Team, again, I'd like to welcome you to Washington, D.C. for participating in this public meeting.

The goal of the Advanced Glazing Research Team has always been to develop a recommendation to the Agency on whether glazing mitigation should be regulated.

Another goal within ourselves was to encourage within the industry research and to assess the developments within the industry as they evolve.

The NHTSA originally started ejection mitigation glazing during the side impact area in the eighties.

Then in 1991, the Intermodal Surface Transportation Efficiency Act required NHTSA to work on preventing rollovers.

The rollover program included both studies of how to prevent rollovers and how to mitigate injuries once the rollover had occurred.

NHTSA quite quickly found that the major cause of injuries in rollover was ejection through the glazing.

On this pie chart (indicating), you can see that this segment is the rollover fatalities and half of the fatalities are caused by partial or complete ejection out of glazing throughout the entire automobile.

Then in 1994 the Agency created and empowered the Glazing Team, which we've been talking about, and the team has produced research results, which I believe are well beyond the business-as-usual expectations that have been done in the past.

The next question is, is there a safety need for this program?

There are over 60,000 people per year partially or completely ejected out of vehicles. 40,000 of these people are partially or completely ejected out of glazing.

7,500 people per year die in accidents involving partial or complete ejection out of glazing.

This is the entire set of fatalities per year, and this is the subset just for glazing.

This is 25 percent of the light vehicle

occupant motor vehicle fatalities. This may be one of the greatest remaining areas of injury mitigation.

Several distinct subsets exist within this information. There are 25,000 people per year partially or completely ejected out of the right and left front side windows of the vehicle.

This is 78 percent of all the ejections out of the non-windshield glazing.

Another pattern that has shown up is that rollovers normally result in complete ejections and side impacts normally result in partial glazing ejections.

The Agency does recognize that ejectees are unbelted. This chart shows that 97 percent of the people being ejected are unbelted.

Since 1982 safety belt use has increased from 14 to 68 percent. However, the ejection rate in fatal accidents has remained constant.

Our research psychologists are trying to establish if there is a correlation between high risk drivers that are involved in rollover accidents and people that do not wear their safety belts.

The Agency continues to work on reasonable ways to save lives and both increase --

attempting to increase safety belt use and improve crashworthiness.

We have made significant progress. In 1995 we published the status report.

I'd like to mention as a side bar that I want to thank the two people that did show up to the December meeting that was postponed. I want to thank them for their consciousness and zealousness.

Today on February 1, we're here to discuss this research report and some additional findings since the report was published.

These presentations will include the research data to date, our cost analysis and we will go over our benefit analysis or the number of lives we feel could be saved.

Let me emphasize several things during the progress of this meeting.

First the information you are about to see is raw data. Some of this data has been generated as recently as -- What, two days ago? And it has not been completely analyzed, but we are presenting it to you for your edification.

Next, the purpose of this meeting is to interact with you.

We encourage you to participate and ask

questions and by the questions and input to the meeting we will try to redirect or direct the future of our research program.

Thank you, Margaret.

RESEARCH

STEVE DUFFY, MEMBER

ADVANCED GLAZING RESEARCH TEAM

STEVE DUFFY: Good morning. My name is Steve Duffy. My part of NHTSA's Advanced Glazing Research Program will be discussing some of the ejection mitigation research that's being conducted at NHTSA's Vehicle Research and Test Center in East Liberty, Ohio.

VRTC is again NHTSA's in-house R&D facility.

The research objectives that we have in this part of the program is to identify common measures to occupant ejection through side windows to show the feasibility of these countermeasures, and by feasibility I essentially mean the durability issues.

Today's program will not discuss any of the durability issues but there will be a report coming out, I believe, in the summer discussing our findings on durability. Finally to limit increased head and neck injuries by glazing contact and laceration potential by broken glass.

The approach I'll take today is first to identify the countermeasures that we've been working with to date in our research, then to tell you about our efforts in developing certification tests in the areas of retention and some injury potential. Finally to tell you about some of our limited testing in evaluating these countermeasures.

The glazing types we've been working with are, of course, tempered glass, which we've been using as a baseline; glass plastics, which I'll refer to as bi-laminates, tri-laminates and some rigid plastics.

Before you, you see the two candidates the two bi-laminate candidates that we've received.

On your left is the product from Saint Gobain in which a one millimeter layer of polyurethane with both abrasion and energy absorption characteristics is laminated to a piece of 3.2 millimeter tempered glass.

On your right you're probably familiar with the DuPont product where the plastic layer is actually a multi layer of plastic composed of polyvinyl butyryl next to the glass layer, on top of which is placed a thin layer of polyester for abrasion resistance.

On top of that is an abrasion resistant

hard coating for additional scratch and abrasion resistance.

The tri-laminates that we've been working with include the one on the left supplied to us by Monsanto where a .76 millimeter layer of PBB is sandwiched in between two 1.85 millimeter annealed glass plys for a total thickness of about 4.5 millimeters.

The one on the right is an interesting concept supplied to us from Advanced Glass Products where a thicker piece of, what they call Novaflex Plastic, which I believe is a durable nylon, is sandwiched in between two chemically tempered glass plys for a total thickness of 5.3 millimeters.

It's a very rigid composite.

We've been supplied with two different polycarbonates. On your left, GE has given us some samples of Lexan.

These samples that we received were coated with a silicon resin hard coating on both surfaces. The product on your right is Bayers' Makrolon polycarbonate.

The thickness of the two products were essentially the same. The makrolon product had no scratch resistant product put on it.

In developing our certification tests, we first had to establish impact conditions, namely mass and speed.

We used three sources of data to establish those conditions, including accident data files from NHTSA's NASS data base, some crash test data that we analyzed from staged rollover crash test that NHTSA performed.

For the mass calculations, we used both pendulum and sled test data that I'll explain in a little bit, and some limited windshield test data.

From the rollover test film analysis -- incidentally, these were rollovers where there was contact between the test dummy and the slide glazing.

We found a contact speed range of 2.4 to 31.4 kilometers per hour. Again, this was obtained through digitizing some films from these rollover tests.

With an average contact speed of 13.3 kilometers per hour.

In our accident data analysis, we calculated the vehicle's lateral change in velocity of a struck vehicle in the -- a vehicle that was struck in the side.

We found a wide range, anywhere from zero to 56 kilometers per hour, with an average of 18 -- with a most frequent delta V of 30.6 kilometers per hour.

We then attempted to come up with our impacting mass for the certification test. What we wanted for our impacting mass was the type of mass that we felt would be evident in certain types of crash modes, including both rollover and side impact crash modes.

So we attempted to measure the effective mass using pendulum tests where we struck the head and shoulder separately and then moved on to some sled tests.

These were all used with the BioSID test device. The BioSid dummy is configured for side impact in that it has an accelerometer located on the shoulder along with the triaxle accelerometer in the head.

An effective mass is simply calculated using Newton's F equals MA where we can measure the force and the acceleration and divide out to get the effective mass.

This is just a frame from a high speed video of the pendulum striking the BioSid dummy in the head.

The pendulum weighed about fifty pounds and on the surface we stuck a number of different foams to increase the contact time with the head. This is also the type of test we ran striking the shoulder as well.

This shows the measurement output from one of these tests. And on the bottom one we have the calculated effect of mass from a head impact.

This is the resultant head acceleration, the impact force measured from a fifty pound pendulum.

As you can see, the effective mass quickly rises to about 4.2 kilograms. Essentially the weight of the BioSid head which is 4.5.

Then as contact time increases, more and more of the dummy is picked up in the calculation and it rises to above ten kilograms.

The same type of output but from the shoulder.

What we found, the accelerometer located on the shoulder -- well, the shoulder itself was very light in weight and the accelerometer output was very occilatory and we weren't able to get some very good data from there.

We were forced to use our acceleration measured at what is known as the T-1 or first thoracic rib that happens to be in line with the shoulder.

The only problem is that because of its location, there was a measurement response delay, which resulted in a near zero divide situation resulting in an artificially high spike.

But as you can see, as the measurement system settled out, the effective mass settled to be about just under 16 kilograms then gradually rose to about 25 to 26 kilograms and then well up to 90 kilograms.

During this point, it is evident that the head and shoulder are being picked up and that effected that mass measurement.

The pendulum tests produced two significant findings. First of all, it validated our effective mass measurement, but because those impacts were isolated to specific areas, namely the head and shoulder, it did not give us any indication as to what would happen when lower segments of the body are involved in the contact absorption.

So to study this phenomena, we ran some sled tests, again, using the BioSid in both the rollover and side impact configuration.

This shows the set up for the side impact sled test. The dummy was seated upright and essentially we have a simulated glazing and door area with a load cell wall here.

On top of the load cells we placed various foams. With some of the foams we tried to match the force deflection properties of Dupont's bi-laminate material that we had access to based on earlier NHTSA work.

In this configuration, the shoulder strikes the glazing area just prior to the head striking .

To simulate the curvature of a window, we offset the head contact area four inches from the shoulder contact area.

The two charts in front of you are from two different side impact sled tests using poly styrene foam and another foam known as ethafoam.

Again, we had that near zero divide situation but once the measurement settles out, we see that the effective mass early in event is at about 9 kilograms.

It then gradually rises to about 18 kilograms. Very similar results with the different type of foam.

This is the rollover configuration that we used on the sled buck. We essentially tipped the dummy 26 degrees towards the simulated wall. And in this case, the head and shoulder struck simultaneously against the simulated glazing area.

Incidentally, the side impact configuration was run at 15 miles per hour. The rollover simulated impact tests were run at ten miles per hour.

This is the effective mass measurement from the rollover sled tests.

What we did for both the side impact and the rollover is we individually calculated the effect of mass for the head shoulder and added them together and these are the results that you see before you.

Because of the type of impact, there is no artificially high spike, but we do find that the effect of mass quickly rises to about 18 kilograms and remains there for sometime before more and more of the body is picked up in that configuration, rising well above 43 kilograms.

We had similar results for the test run with ethafoam.

The results of the sled tests produced two impact conditions. For the side impact we essentially early in event saw nine kilogram effective mass run at 24 or 15 miles per hour for effective energy of 200 newton meters.

The rollover type impact produced, early in event, an 18 kilogram effective mass for the ten mile per hour test for effective energy of 180 newton meters.

So our preliminary selection for impact conditions was 18 kilograms and we decided to not limit ourselves in the impact speeds in some of the testing that we've done. We've kept them between ten and 15 miles per hour.

We decided that we would run these impact conditions on windshields. The reason being that windshields had proven to be effective in reducing ejection.

So we ran the 18 kilogram mass using a hemispherical head form impactor and we found that windshields are capable of resisting penetration with the 18 kilogram mass of just over 14 miles per hour.

This helped us solidify our conclusions of our preliminary selection of 18 kilograms as our impacting mass.

We find from the sled tests that there are similar energy levels at two different impact modes.

One windshield testing phenomena we discovered was that, for the given energy, the high mass, low speed seemed to be more severe than the low mass, high speed configuration.

Because ejection is largely a rollover problem and the rollover sled tests pointed to an 18 kilogram effective mass, we decided to pursue our research with the 18 kilogram impactor.

Before we built our impactor, we needed to decide what type of criteria we thought this certification test should be able to measure.

Of course, retention is the big one that we're after, but also we need to, according to our objectives, look at head injury and neck injury and any laceration potential. Although minor, they are disfiguring.

Along with the selected criteria that we feel we need to research, we need to decide what type of measurements will be made with each of those criteria and what pass/fail limits to apply to that criteria.

For example, retention, we're looking at possibly a maximum dynamic deflection in the certification test. There's also other ways of doing it, including an energy containment value. For head injury, there's of course the widely used HIC injury criteria.

But there's some other research being conducted internally in NHTSA and in the bio community involving a mean strain type criterion.

Neck injury performance criteria would be probably something like neck rotation and neck loading measurements.

And for laceration, although there is no accepted method for measuring the laceration potential, there's one or two developmental programs going on including this Palmer face mask which uses the triple X laceration index, which you find using the shami cut program.

And this is something that we'll start looking at in the near future.

With the impact conditions defined and some of our criterion established, we built an impactor for our certification tests. We decided on a guided impactor that can measure both acceleration and displacement.

The guided form of impacting, we felt,

would be more repeatable than the retention test.

Our impactor is capable of adjusting a mass and we can change the impact face on it. And it's something very important. It can be used inside the vehicle for component system testing.

This slide just shows the impactor we came up with. Again, it's 18 kilograms. The accelerometers are placed inside the head form here that you see before you.

Just behind the head form we have a load cell. What we use the load cell for is to verify the acceleration traces from the head form.

It's widely known that glass testing is a very harsh environment and it's very easy to destroy accelerometers. That way the load cell data could verify if our traces looked correct.

The head form that we chose is known as the featureless free motion head form. It was developed in NHTSA's upper interior head protection program. Obviously it's not free motion in this instance where we rigidly attached it to our guide system.

We chose this head form, first of all, because it was readily available, but also because it provided a large impacting area to the glazing surface.

It measures just under nine inches in length and just under seven inches in breadth.

It's very similar to the Hybrid III head form in that there's an aluminum shelf and the poly vinyl head skin is placed over the aluminum shelf. The accelerometer sit at the CG of the head form.

We began, then, testing some of the alternative glazing that we received; the five alternative glazings that I mentioned previously. We did this to start establishing some of our test procedures.

All these tests in this first round were with glazings that were rigidly mounted to a frame. This way the materials saw all the -- or did all the energy absorption. There was very little frame distortion. We ran all these tests in the 10 to 15 mile range.

The results of this early test data show that in general all the materials that we worked with did an adequate job in containing the 18 kilogram mass up to about 15 miles per hour.

Before you you see the results of a bi-laminate. This was an impact to the center of the viewing area.

One thing we did notice is that with the bilayer it seemed like the entire glazing surface area was used in the energy absorption.

The tri-laminate configuration, on the other hand, I don't know if you can see that, but there was penetration at 15 miles per hour. That seemed to be the upper bound of the tri-laminate in rigidly mounted testing.

And it appears that the inner glass ply prevents all the stretching -- prevents the plastic away from the center to be involved in the energy absorption is something that we've reasoned is going on here.

Now, to help us further define our testing procedures and the certification test, we thought it was necessary to start looking at the countermeasure evaluation.

By countermeasure, I mean, a fully encapsulated advanced glazing sitting inside a window frame so that we can test the whole side door system.

Much of our work stems from early NHTSA work under the direction of Carl Clarke. You're probably all familiar with his T-edge encapsulation design.

Carl reasoned that if we could transfer the load to the window frame, we would have increased retention capability.

This early T-edge was modified with some steel bars to provide increased strength. He also modified LTD doors to accept the T-edge encapsulation and much of the testing was done with the clamped window frame.

That research found successful retention under the impact conditions of 40 pounds up to 20 miles per hour.

About this time, Excel Corporation was monitoring the work of NHTSA and they decided to go ahead and build a production level mold with the T-edge design that could mass produce these encapsulated glazings.

For our research, we contracted with Excel to supply us with these encapsulated windows.

Before you, you see Excel's original design at the T-edge and notice that under the current dimensions we would have to greatly modify the window frame of the LTD door.

So what we had Excel do is modify the edge design into what we call an L-edge where we could simply place these encapsulated windows inside the

LTD window frame with very little modification.

The only modification that we needed to do was attach this retainer section to the window frame of the LTD door after the modular glazing was installed.

The encapsulation material is a polyurethane produced in a rim fashion. There is no steel reinforcement bars in this particular design.

After speaking with modular glazing suppliers, we thought that it would be advantageous if we could develop a counter measure in which the only encapsulation was along the vertical edges of the window of this particular LTD window, both the "B" pillar side and the "A" pillar side. That way we would not have that black band when it crossed the viewing area.

So our first round of testing consisted of this configuration.

In our early tests, with this configuration, we decided to take a look at what effect the impact angle had on the displacement measurement.

The LTD door was rigidly attached to a frame in this early testing at the locations typical of -- that you would find on the vehicle in an orientation as it would sit on the Ford LTD vehicle.

For this particular glazing, we positioned the impactor 23 degrees upwards so as to maximize the surface area that first contacted the glazing. All these tests were run by positioning the center of gravity of the impactor to the geometric center of the viewing area of the LTD window.

This slide shows what effect the impact angle has on some of these glazing. I'm not sure if you can read, but these are the five different advanced glazing that we were using, the first one DuPont, the second Saint Gobain's bi-laminate, Monsanto's tri-laminate, and the two polycarbonates, lexon and makrolon.

As you can see, impact angle does have a rather large effect on the displacement measures of the advanced glazing system by as much as three inches.

Again, I have to point out that this is limited testing. We've only received a lot of these modular glazings or all the modular glazing recently and we have only a few data points to present to you today. Obviously repeatability is an issue that we need to address in the near future.

The other thing we noticed from our

testing was that the edges -- the non-encapsulated edges are subject to large deflections. These are two tests captured from high speed film.

On the left you see a bi-laminate and on the right a tri-laminate configuration. And this has caused some concern for us because obviously that opening is more than enough to allow an occupant's head to fit through.

These tests were all run at 15 miles per hour.

The retention system, to our surprise, was very good. We had no part of the encapsulation along the "A" or "B" pillar came out of the frame.

You'll notice that on the right the tri-laminate showed much less gap between the window frame and the top of the window.

All the glass plastics, the two bi-laminates and the tri-laminates, faired very well in this testing, meaning that they stayed inside the window frame and the part that was encapsulated, there was no penetration and the impactor came to a stop before it reached the physical stops that we put on our impacting device meaning that the material absorbed all the energy put into that system.

There was no cuts or anything like that in the material.

The polycarbonates produce somewhat different results.

Before you you see the makrolon polycarbonate, and this is very typical of the testing we saw where there was quite a bit of fracturing going on.

Incidentally, Bayer supplied us with makrolon that was thermoformed to match the dimensions, curvature and size, of the LTD window.

We did find adequate adhesion with the polyurethane mold and the plastic.

This is GE's Lexon, a typical result of GE's Lexon.

I must point out, though, that GE supplied us in this first round with flat sheets of their Lexon polycarbonate in which we cut to the dimensions of the window and gave them to Excel for encapsulation.

And there's every reason to believe that with our cutting process we introduced some stress concentration factors that probably resulted in what you see there.

Another observation was that we did find a lot of the delamination between the Lexon polycarbonate and the polyurethane mold. Again, that was coated with a silicone coating.

Another phenomena that we discovered in our testing was this erroneous accelerometer output. It was at the outset of our research.

We thought that it would be very desirable if we could from one impact test device measure all the pertinent factors in our tests and we had hoped to get the head injury criteria from that 40 pound impactor as well.

But as you can see, due to a number of complicating issues, we were getting these spurious signals here.

What you have here is the inertial peak just before the glass breaks and we're finding that after it breaks, we're getting this type of noise in all the different materials, all the glass plastic materials.

And as you can see, you can trick the HIC algorithm that we use into measuring some very large HICs over an area that we believe is not part of the impact event.

Again, considerable time and effort was put into trying to solve this problem.

Our solution to our erroneous output was a combination, including going to some higher frequency accelerometers and to introduce a second certification test, the free motion head form.

The free motion head form was recently developed in NHTSA's upper interior head protection program.

This shows the free motion type of testing that we are -- the free motion test device that we were using to calculate head injury criteria. Basically consists of a modified Hybrid III head form with the back plate removed. A metal flat plate is then attached to that, which sticks to a magnet on the impactor.

The nose has also been removed to take away any effect of the nose contacting the glazing area.

This is a typical output from our free motion testing.

On your left is the accelerometer output from an Endevco 7270 accelerometer with a resonant frequency rating of 95,000 hertz. This is the accelerometer output from the same test using the Endevco 7264 accelerometer with a resonant frequency rating of 25,000 hertz.

As you can see, it takes the combination of the two events, both the free motion type impact, and high frequency accelerometers to resolve that problem of the erroneous output.

Now we've done some very limited free motion testing on our advanced glazing, and I caution you that the HIC values that we're using here should not be compared to the HIC 1000 criterion that is widely used in a lot of the agencies research programs and regulation programs.

HIC 1000 was developed on cadavers in which the head was attached to the neck, the neck attached to a body. Research remains, in our program, to equate the two types of accelerometer outputs; one with the free motion type impact and full scale Hybrid III testing.

Basically what this shows us that for -- it appears, again, under very limited testing, that the free motion testing may be somewhat repeatable. Accept, it seems, when we get to the tri-laminate configuration, we see that these last two tests, run at 18 miles per hour, produced very different HIC results.

And one thing we feel in our research is that considerable effort is going to have to be put forth because of the inherent nature of glass to identify the repeatability of free motion testing.

Because we had a larger supply of the bi-laminate glazing, we were able to do a larger scope of free motion testing. What you see there is the results of HIC values from hitting the polycarbonates in two different areas.

The yellow was hitting again in the geometric center. The blue was -- we moved that Hybrid III head form closer to the "B" pillar, which we thought would be a much more stiffer area, and to our surprise, we found that HIC values were somewhat lower.

Again, what I think this points out is that our research is going to have to identify the effect of impact location on our HIC values. It also points though, again, that, especially for the polycarbonate, the HIC seems to be a very repeatable -- or that free motion testing seems to be a very repeatable test.

Now, because of that concern with the frame -- the non-encapsulated edges showing the large displacement, we went back to Excel and asked them to fully encapsulate the glazing. And what you see before you is the encapsulation running across the two edges that were not encapsulated in prior testing.

This design does not prevent the window from being raised and lowered. It only provides what we thought would be increased rigidity of the glazing material. But, again, high speed film has showed that the fully encapsulated windows are subject to these large displacements when we do not hold the edges tightly into the window frame. These are from the same bi-lam -- two tests from the same bi-laminate material.

We are attempting to measure the door frame distortion, and we're trying a few different ways, including some film analysis using tape measurements. We also have some accelerometers mounted on the door. But because of the door frams's low mass, we're not quite sure if we're getting accurate readings on all our tests.

We're seeing on the "B" pillar side, anywhere from four to six inches of deflection. And on the -- in this corner anywhere from one to two inches of deflection.

This slide shows what effect fully encapsulating the window had, if any, on some of our materials that we tested.

Incidentally, we did not have any Saint Gobain material at this point, to test, so you don't see it out there. And what it shows is very modest improvement in our retention -- or in the retention of these certain advanced glazing.

But it also starts pointing out the fact that the retention test is somewhat repeatable, in and of itself.

So the preliminary test observations that we've made, include in the retention test that the guided impactor seems to show good repeatability; that the impact angle will greatly influence the displacement measurements, and the top edge is subject to large deflections, for both non-encapsulated, and encapsulated configurations.

In the free motion testing, we've observed that there is good repeatability on some materials, namely the rigid plastics, and that the impact location will probably influence our HIC values.

Further research that we plan on doing this year includes looking at any further LTD encapsulation developments that we can do with Excel; perhaps adding a steel reinforcement bar to that top and diagonal edge; explore encapsulation on other vehicles to, what I mentioned I before. To validate our HIC numbers by using -- by going to full-scale dummy testing with our glazing materials, and comparing them to the free motion type output that we're getting to evaluate the neck injury potential to determine if this should be incorporated into a certification test; to look at the laceration potential of certain advanced glazing, to see if that should be incorporated into a certification test; and other certification issues that I've briefly mentioned, including impact angle, impact location, and repeatability.

Before I open it up to questions, I just have a few minutes of a video showing impacts to various advanced glazing.

(Starts video presentation)

MR. DUFFY: Again, you'll notice that the impactor came to a stop well before it reached it's physical stops.

Oh, incidentally this -- for this full encapsulation testing with the polycarbonate, GE supplied us with thermoformed polycarbonates in this case and they did not put any coating on it. And we did find, as you can see that there is no fracturing in this case, nor was there any delamination with the encapsulation material.

(Video presentation ends)

MR. DUFFY: That pretty much sums up the presentation part. We'll open it up to questions.

(Applause)

MR. DUFFY: Yes?

CARL CLARK: It would, of course, be better protection --

MR. DUFFY: Could you identify --

CARL CLARK: I'm Carl Clark, of the Safety Systems Company.

It would be better protection if the industry would go back to window frames, front and back. My disappointment is that you seem to be picking out, again, the bottom half of the injury problem.

It would be interesting to look at what you could really do if you take the full power of the technology instead of just saving half the people, the way we tend to do in our NHTSA standards, try and save maybe three quarters. It's possible that you can go to the twenty mile retention.

MR. DUFFY: That is true, and we have the capability of doing that and we plan to explore, once we nail down the type of system that we want, just how fast and how much retention we can obtain and what are the benefits associated with that.

JOHN TURNBULL: John Turnbull, DuPont Company. First, Steve, I'd like to complement you on what really impressed me as a very thorough and effective program.

MR. DUFFY: Thank you.

JOHN TURNBULL: I have some questions, just because it was the last thing that you mentioned, on the deflection issue.

MR. DUFFY: Yes.

JOHN TURNBULL: The fully encapsulated frame appears to be, when you've got deflection, that the encapsulated frame, came into the window.

Was that with the T-edge, and was the deflection because the encapsulated frame came out of the door?

MR. DUFFY: Well the -- we didn't perform on the T-edge. That was prior -- that was Carl Clark's work. What we did is we went right to the "L" edge design. We did not see any part of that frame, that L-edge design come out of the part of the frame that we modified to hold it in.

The part that you saw come out was -- there was nothing holding that glazing in -- that part of the frame in. We didn't want to impede the ability for the window to be raised and lowered. Perhaps some -- our next move may be to try and hold in that top edge, but we have to weigh the disadvantage of not allowing that window to raise and lower.

JOHN TURNBULL: I guess I'm not real clear, but maybe some more discussion about that. But when you mentioned using steel rods and frames, I think there's probably a lot more to be done with the encapsulating system, still allowing movement up and down before you go to some overkill on material construction.

If I may, one more thing?

MR. DUFFY: Sure.

JOHN TURNBULL: When you talk about location, it seems to me that could be very important when you talked about retention in a system like encapsulating frames and deflection and keeping the window in the opening. And I'm thinking about seating locations, and I'm also thinking about in a crash event. After the first impact of the occupant against the window, do you actually get rebound, and how important is the deflection?

I seem to remember that after a crash, you usually get some rebound of the occupant back into the car, and after that continuous loading as your FMH impactor does.

MR. DUFFY: Yes. We've observed the same thing. We do plan on running full scale crash tests to look at our impact method and to see if, in fact, what we're seeing with the component level test, is similar to full scale crash testing.

MICHAEL KOBROHEL: I noticed on some of the most recent data that you projected of the penetration through the glazing and head form, that the plastic substrates actually allowed less penetration than some of the more conventional safety glazing. And realizing this is preliminary data, if the bond was constant, of the encapsulation, and the glazing did not come out, the examples that you had shown on the screen, showed catastrophic cracks in the glazing, plastic glazing.

MR. DUFFY: Yes.

MICHAEL KOBROHEL: How do you attribute that reduced deflection number if the plastic glazing actually cracked?

MR. DUFFY: Yeah. It appeared that cracking appeared well after the energy absorption. The impactor -- the plastic material had absorbed quite a bit of that energy prior to cracking. We also didn't see as much door frame deflection with the plastic testing, to our surprise.

MARGARET GILL: Pardon me. I would like for you to identify yourself, if you will, please. And may I have your name now, for the record?

MICHAEL KOBROHEL: Certainly. Michael Kobrohel --

MARGARET GILL: Thank you.

MICHAEL KOBROHEL: -- with Excel Industries.

SY ADER: Sy Ader, SDC Coatings. In your analysis of the glazing is it possible to try and identify, or try to narrow down what the optimum HIC value would be, and maximum deflection?

MR. DUFFY: Yes. Those -- I mean those are the goals of our certification test; to define what that maximum deflection should be. In this stage in the research, we're still trying to understand the advanced glazing side door system to assist us in developing our retention and HIC levels. We still need to iron out a lot of issues before we can actually set those pass fail limits.

RAY LEBRECQUE: Ray Lebrecque, Chrysler. You show in your free-motion head form, you're doing the impacts face in, and I would think that most impacts on the side window, would be the side of the head.

Is this going to have an effect on the way that the test results come out? In other words, if you're sitting in the vehicle, the side of your head's going to hit, shoulder, and spreading the load out over an entirely different area, rather than straight into the glass with the face.

MR. DUFFY: I'm going to turn that one over to Don Wilke of NHTSA. He's done quite a bit of research on the free motion testing. In fact, he developed or was a large part in the development of the upper interior head protection program.

DON WILKE: I guess, just to answer that, the head form that you saw in there, the featureless head form, was developed kind of early in the 201 research program, and it was designed to be geometrically and inertially, a combination of the front and side head surfaces. Because in 201, you're hitting the front and side surfaces.

So the answer is that impactor shape is fairly representative of the type of area, and overall dimensions of the side of the head, and curvatures, as well as the front. They're really not dramatically different when you compare the geometric shapes of the head.

So, from that standpoint, I think, geometrically, we are doing a reasonably good job of simulating the side of the head. A more complicated aspect of that will be injury criteria.

We take an acceleration response you get from an impactor, and then you have to evaluate the HIC value in terms of injury. And we have the complicating factors of -- you know, with the 201 head form -- I guess, let me back up for a second.

The free-motion, featureless head form that you saw was developed as a combination of the two sides. The 201 head form is, obviously, a Hybrid III head, without a face. But geometrically, the curvature of the forehead and such is not all that different from average side head shapes.

That was one thing we found while we were developing the headform you saw on the front of the guided impactor. And that was one of the reason, in the 201 program, to go ahead and use that impactor, the Hybrid III version of the impactor, because, geometrically, it was not that different. The bigger -- again, you're just getting an acceleration response, and we feel that's a valid response.

The tricky part of that would be to evaluate the HIC response in terms of side head injury and that, obviously, is not a simple problem right now.

RAY LEBRECQUE: Thank you.

BAPI DASQUPTA: Bapi Dasqupta, from Monsanto. In the tri-lam sample, the Monsanto sample you use is this glass on both sides --

MR. DUFFY: Yes.

BAPI DASQUPTA: Do you see, or would you anticipate a change in deflection if one of the surfaces was heat strengthened or tempered?

MR. DUFFY: I would expect to, based on some of that earlier testing that did in the originally clamped testing. It seemed that with breakage pattern of tempered glass, it allowed much greater deflection. And, again, the entire surface area of that glazing seemed to be involved in the stretching part.

I'd like to explore the effects of what that inner glass ply does. Does it impede whether it's tempered or laminated? Does it impede stretching of the plastic in the area outside of the contact area?

But I think, just in discussing that issue with some other people, I think a tempered piece would allow a greater amount of deflection and energy absorption.

MICHAEL KOBROHEL: Michael Kobrohel, from Excel. When you move from the shoulder accelerometer, down to the thoracic TO 1 accelerometer location because of errant leadings if you will, have you the availability or the opportunity to use EuroSID, as a comparative value of the BioSID, realizing that EuroSID had taken into account with accelerometers, a little more mass, and a better distribution throughout the torso?

MR. DUFFY: No. We did not look at the EuroSID dummy at all. I think that that would have -- could greatly complicate and add time to our research. We felt that the readings at the TO 1 location was adequate enough.

RONNY JANOKOSIK: What is this in regard to the slide you had about the target areas and prediction values being lower near the side of the "B" pillar, than the center of the glazing?

MR. DUFFY: Yeah. That was some very recent data that we just obtained. And, to be honest with you, I haven't quite fully analyzed it. I haven't been able to measure, just yet, is it --

if that's due because of more deflection from the window frame, at that point, but it certainly is a phenomena that we plan on investigating and unfortunately we haven't time to look at that.

J.L. BRAVET: I have a general question about rollovers with these advanced glazing. What is the first event? Does the glass break by deformation during the rollover, or does the glass break by contact with the head?

MR. DUFFY: Yes.

(Laughter)

MR. DUFFY: Rollover is a very, very complicated issue. I've seen plenty of film to support that the glazing remains intact with -- even under some repeated contact by the dummy itself. I've seen tests where, on the first roll, before the dummy makes any contact, due to the massive frame distortion, the glass disintegrates.

You're likely to see both events in any given rollover.

J.L. BRAVET: And do you think that you should enhance your testing by testing the broken glazing, to make sure that you have retention?

MR. DUFFY: Yes. That's a very good point. We plan on doing multiple hits in the future here, just to see if we lose all benefits after the first contact.

J.L. BRAVET: No. I should say, not contact but breakage due to compression of the --

MR. DUFFY: Yes. Again, we are equipped in the lab to put, or to simulate the rollover deformation that you would see, and we can break the glass that way, and then run the impact test, which we fully intend on doing as part of our benefits analysis.

CLARKE HARPER: Clarke Harper, NHTSA. I think that's a good idea. I'll see if we can find some date specifically.

Obviously our NASS files do not clearly say what's going on during the event, but perhaps there's some subsets we can answer that question, or at least take a better guess at it.

MARGARET GILL: Well, if we don't have further questions, Steve, thank you. And thank you.

(Applause)

MARGARET GILL: Well, to my surprise we're on schedule, and it's time for a break. I'm sure you're ready for it.

So let's try to get back by 10:45.

(A brief recess)

MARGARET GILL: May I have your attention, please?

When I introduced the team this morning, I omitted one member's name, John Lee and I apologize for that. I didn't see him at that time.

Steve Summers. I apologize. Steve will be recognized later.

Next on the program we have Dinesh Sharma who will make a presentation on modeling.

MODELING

DINESH SHARMA

ADVANCED GLAZING RESEARCH TEAM

DINESH SHARMA: Good morning. The topic of my presentation is computer modeling of rollover accidents.

The objectives of this study were to simulate the typical rollover accidents to estimate the benefits of alternative glazing in terms of the retention capabilities and injury potential.

And secondly to estimate the occupant into glazing impact velocity in rollover accidents.

In rollover accidents, the motion of the vehicle can be quite complex, and violent resulting in multiple impacts of the occupant with vehicle interior and possible ejection if the occupant is unrestrained.

The computer models can provide a viable means for predicting the occupant motion during these complex rollover accidents, and conduct parametric studies with perfect repeatability.

The rollover crashes we selected for modeling are NASS investigated cases, for which we have some information on vehicle damage and occupant injuries.

These were single vehicle rollovers in which an occupant was either ejected from the vehicle, or made severe contact with the side windows.

The methodology used to set up the occupant simulation. First we estimated the vehicle motion at the onset of the rollover using a vehicle handling software called VDANL.

This software can simulate the vehicle motion only up to the point when the vehicle loses control and starts rolling.

Then data from NASS files, such as vehicle trajectory and velocity were used to simulate the vehicle maneuvering prior to the onset of rollover. From this we obtained the linear and angular velocity at the onset of rollover.

Then we set up one segment model of the vehicle with appropriate contact surfaces defined, for the vehicles interaction with the ground and estimated the entire rollover motion of the vehicle.

The NASS files in this case provided us with the number of rolls and final position of the vehicle.

Then we -- the motion derived from step

two is then used in step three to set up an occupant simulation. For the baseline run, the occupant kinematics, which includes the context of the interior of the vehicle were matched with NASS file.

Finally, we set up parametric runs with different glazing materials. We started with the baseline run and changed the forced deflection characteristic of the glazing contact with the different glazing materials.

This slide shows, pictorially, how we set up the simulations. The first figure shows the trajectory of the vehicle that is available in NASS files. Then we -- on top, we set up the vehicle model, and computed the entire rollover motion of the vehicle. And finally we set up the occupant simulation.

These were the parametric runs that we set up. A run without a glazing was set up to simulate the tempered glass that was shattered due to the ground impact.

Simulations with belted and unbelted occupants, with different glazing, like tempered glass, rigid plastic, tri-laminate windshield, and bi-laminate were set up.

Here are results from a rollover of a

Volkswagen Jetta. Now, in this case the driver of this vehicle fell asleep. The vehicle left the road to the right and struck an embankment and started to roll. It made four quarter turns before stopping.

The unrestrained passenger of this vehicle was ejected from the vehicle and received fatal head injuries due to the ground impact.

I don't know if the numbers are very clear here, but in this simulation, the dummy's head impacted the windshield, right door header, roof, and right front glazing.

As you can see, the maximum HICs are lower than 500, well below the HIC 1000 criteria that is used for the frontal crash situation.

These HIC values corresponded to head impact with the door header. The maximum neck loads are the same in all the simulations for the unrestrained passenger.

These loads are inflicted by the occupant contact with the windshield. As you can see, the alternative glazing didn't produce any significant neck loads on the occupant. The maximum is like 1000 newton for a bi-laminate.

We compared thess values with Mertz criteria. That's the only criteria that's available to us, to compare. And all these glazing prevented the ejection.

In the second table, the same set of simulations were repeated after restraining the occupant with a three point belt. The belt prevented the total ejection.

Again, the HICs are very small. The maximum is 340 for tri-laminate. The maximum neck loads, due to the direct contact with the glazing are also small, but the loads inflicted with the contact with the door headers are higher, more than Mertz criteria.

However, the glazing impacts are not that severe. Again, the glazing prevented the partial ejection.

Here are the results from another rollover simulation. In this case, a Toyota pickup was rolled over after making contact with another vehicle and losing control.

The belted driver in this case made severe contact with the front left glazing. Again, you can see the HICs are not very high. The maximum is 369 for the tri-laminate.

The neck loads are all less than 3,000 newtons, and may be considered insignificant as far as the Mertz criteria is concerned.

(Interruption. Fire alarms sounds)

MARGARET GILL: We are about ready to resume, and what we are going to do, since we were abruptly interrupted -- we had no control over it, but I hope it hasn't been damaging to us, because I see a lot of empty seats.

Dinesh is going to give us a summary, or even start over with his presentation on modeling.

So, without prolonging it, Dinesh.

Oh, one other thing, sorry. We will schedule a break after the benefits section. We realize it's going to be a long time if we continue as the schedule is right now. So we'll have a break about 1:45.

DINESH SHARMA: Before the break I was talking about computer modeling of rollover accidents.

We set up these computer models to investigate the benefits of alternative glazing in terms of their retention capabilities and injury prevention in rollover accidents.

One of the cases I was discussing before we broke -- took a break for lunch, was rollover of a Toyota pickup.

In this case a Toyota pickup was rolled over after making contact with another vehicle and losing control. The driver of this vehicle was restrained, however he made severe contact with the left side glazing.

In the simulation, you can -- I don't know if the numbers are legible, but the maximum HIC is 369 for tri-laminate type windshield glazing.

The neck loads were also low; the maximum neck load was 3,000 newton. They were less than Mertz criteria for injuries due to the neck loads.

Again, all these alternative glazing prevented the partial ejection in this case, because the driver was belted.

We repeated the same simulation with an unrestrained driver, and, in this case, HIC were again small, less than 500 -- less than HIC 1000 established for the frontal impact.

However, you can see the HIC are 700 for tri-laminates, but, in this case, I would like to mention that we used FDF for the windshield type of glazing, which is seven millimeters thick, as compared to five millimeters for side windows, so we expect it to be more stiffer and probably produce higher HICs.

Again, the neck loads were higher, but these were produced by the impact with the door header. The direct contact with the glazing produced only maximum 1,500 newton for tri-laminate.

So the alternative glazing in this case prevented the total ejection and the neck loads were not very high.

To summarize, in conclusion, we can say that in rollover accident simulations with the alternative glazing, the HIC -- most of the HICs were less than 500. Well below the HIC 1000 criteria established for the frontal impacts.

Again, the neck loads, due to the direct contact with the glazing were small. The maximum was 3,000 newtons, which is below the Mertz criteria for injury.

We also believe the dummy's neck is more stiffer than the human neck. So a 3,000 newton number you see here, maybe even smaller for a human neck.

All these glazing prevented ejection, which is what we wanted. The head to glazing impact velocity varied from 14 kilometers per hour to 20 kilometers per hour.

As Steve mentioned earlier, we observed

these same head impact velocities in crash film analysis of rollover tests. And these velocities were also in line with what we are using for the head form impact.

The partial ejections are more prevalent in planar types of accidents, like side impacts. To estimate the benefit of alternative glazing in side impacts, we simulated a control rollover side -- a controlled side impact test of an MDB with a Chevrolet Achieva car.

It was FMVSS 214 type test. The parametric runs for different glazing materials were set up. I don't know if the numbers are legible, but the maximum HIC was for a bi-laminate, which is still less than 500. It's 422.

Again, the neck loads were less than 3,000 newtons. Which probably will not produce a fatal injury, as per Mertz criteria.

And the TTI in all these simulations did not change. It's the same for all of the alternative glazing. And all these glazing prevented the partial ejection.

Now I have a video of simulation runs.

Steve if you can put that in.

(Starts video presentation)

DINESH SHARMA: This is the pre-simulation to get the rollover motion of the vehicle. With the one segment model of the vehicle, you can see the whole rollover motion.

It's a rollover of a Volkswagen Jetta. We computed the entire rollover motion from this simulation.

Then we set up an occupant simulation, took the motion from the previous run, and put an unbelted dummy in there.

You can see the dummy will be ejected if there is no glazing there.

Then we repeated the simulation with alternative glazing for the side window. This is a rigid plastic on the side. Same simulation, same motion.

You see the dummy hits the side window and comes back in; rebounds.

Here we repeated the same simulation after putting a belt on the dummy and rigid plastic for side windows. The belt is not visible, but this is a belted dummy for the same simulation. And he's hitting a rigid plastic type of material here.

This is a side impact. It's a small run

with no glazing actually.

Next, you'll see some head form impact tests, which actually duplicate the tests that Steve has done. The simulation includes a fixed glazing all around, and there a partial encapsulated glazing, and a fully encapsulated glazing hit by a 40 pound impactor at 15 mph.

This is a glass/plastic glazing. You see the head form 40 pound impactor rebound and this is a partial encapsulation; you see an open space. And this is a full encapsulation, with a steel rod reinforced on the top, which prevented the opening on the top.

This is all I have. If you have any questions, I'd be glad to take them.

CARL CLARK: Carl Clark, Safety Systems.

CLARKE HARPER: Carl, where are you? Could you speak into the microphone? We got a request from the reporter.

CARL CLARK: One of the services that you might do to the small companies would be to offer the use of your computer models to other case scenarios. Is that kind of thing conceivable? Could that be worked out in some way?

DINESH SHARMA: I'm not sure. I'm a

contractor for NHTSA. I don't know how it's --

CARL CLARK: Then you're a contractor already. Then, I'm --

STEPHEN SUMMERS: The models that Dinesh has used are generally considered publicly available, but the problem is that since he is using dummy models that are a proprietary part of the MADYMO, you need a MADYMO license to actually use them. But his vehicle simulations are available on request.

CARL CLARK: Another available -- what I'm looking at is the economics. Could someway be worked out that we could come to you and you run the models.

STEPHEN SUMMERS: I can't see us being able to support that.

CARL CLARK: We would pay you certainly.

DINESH SHARMA: Okay. Thank you. You don't have any other questions?

(No response)

DINESH SHARMA: Thanks.

(Applause)

MARGARET GILL: Our next presentation will be by Lillvian Jones, on alternative glazing costs.

We are interested in your questions and

input; however, please hold them until the end of the presetation.

ALTERNATIVE GLAZING COSTS

LILLVIAN JONES

ADVANCED RESEARCH GLAZING TEAM

LILLVIAN JONES: Good afternoon. I'm a member of the Engineering Systems staff in the Office of Safety Performance Standards. And as Margaret has said, my role, as a part of the Alternative Glazing Team was to provide preliminary estimates for the cost, weight, and lead time for alternative glazing to tempered glass in the side windows of automobiles.

To accomplish the task, the Agency contracted with Management Engineering Associates to provide preliminary estimates of the suppliers selling price.

Management Engineering Associates used literature searches, teleconferences with authorities in the glazing industry and the automobile manufacturing industry, plant visits to AP Technoglass, Excel Industries, Guardian Industries and United Glass to estimate their suppliers selling price.

These estimates were then used to derive the wholesale and retail price by applying mark up rates of 1.28 and 1.121 respectively, which were developed by the Agency through analysis of manufacturer income statements.

This study used window and door configurations for a 1995 Ford Taurus. And we costed out tempered glass, tri-laminate, DuPont "Sentry-Glas," laminated on tempered glass, Saint Gobain film laminated on tempered glass and a rigid plastic.

Encapsulations. All alternative glazing analyzed were encapsulated on leading and trailing edges. And their abrasion resistant coating was applied only to the rigid plastic. And a primer and a coating are applied to both sides during emergence and baking on the rigid plastic.

This may be a little out of focus. This graph shows the wholesale price, retail price, and the differences between the retail price of tempered glass and those alternatives for a four door vehicle.

This difference is considered the incremental cost to consumers. In all cases there was an increase to consumers for the use of alternative glazing. With the greatest increases associated with the use of rigid plastic; with an incremental price of $158.76. And the least, with the use of a tri-laminate; incremental price of $96.

The first graph was for a four door vehicle, and these statistics are just per unit.

As you can see, the estimates for incremental cost range from $24, for the tri-laminate, to $39.69 for the rigid plastic.

For DuPont "Sentry-Glas" estimated incremental cost being $25.25 per piece, and Saint Gobain's estimated incremental cost of being $25.67.

Now we're looking at the capital investment estimates. This chart breaks down the capital investment between plant and building, equipment and tooling for the four alternatives. These numbers listed are in millions.

The study assumes encapsulation and abrasion resistant coatings will be provided by companies outside of the initial glazing manufacturers.

Therefore, for this chart, the total capital investment for encapsulation and abrasion resistant coating is added to the chart to give an aggregate industry estimate.

The totals for the tri-laminate on capital investment were estimated to be $3,072,000,000; the DuPont "Sentry-Glas," $2,028,000,000; Saint Gobain,

$2,028,000,000; and rigid plastic, $2,865,000,000.

For this analysis, planning equipment is depreciated on a ten year straight line method; equipment and depreciation on a seven year straight line method, and tooling is amortized over a three year period, straight line method.

Again, we just used the same statistics to show per window, or per part, with a total for tri-laminates being on capital investment, $28.41; "Sentry-Glas," $23.70; Saint Gobain, $23.70; and rigid plastic, $24.58.

Under the weight estimates, rigid plastic seems to offer the most benefits in weight reduction. A window made with rigid plastic weighs less than half a window would that is made with a tempered glass or a tri-laminate.

Weight estimates range from 8.82 pounds for a tri-laminate, to 4.32 pounds for the rigid plastic. The bi-laminates weighing in almost the same with the tempered glass at 8.21 and 8.20 pounds.

Lead time estimates. We estimate the automobile industry can be able to incorporate the use of either alternative glazing within 36 months.

This estimate assumes that the

establishment of flat glass suppliers to securing or producing of a laminate film, or developing resin sources, the planning and construction of facilities, the order and receiving of equipment and designing, and the building of toolings begins simultaneously.

And this concludes my portion of the presentation.

Are there any questions?

Yes?

RICK SALER: Rick Saler, am I correct in saying that the cost analysis, as far as capital investment is concerned, is based on just the front windows having alternative glazing?

LILLVIAN JONES: No. This is -- the cost estimates are based on -- I gave the per part, or per window, but it's our total estimates on a four door vehicle.

RICK SALER: Okay. Thank you.

CLARKE HARPER: Lillvian?

LILLVIAN JONES: Yes.

CLARKE HARPER: May I caveat that during the development of this program, we made several directions. Some people have done their analysis on full vehicle and other people have done it on front window only; such as the benefit analysis coming up will be focused on the front windows.

And we tried to be careful to present these things to you, and if it's not obvious -- but Lillvian's is full vehicle.

LILLVIAN JONES: That was one of the reasons I gave the per unit estimate on the charts.

CLARKE HARPER: And it stands the same way in the report.

LILLVIAN JONES: It stands the same way in the report, using a four door vehicle, but if you broke it down into a one window, this would be the cost of one window. And this would be capital investment.

So, that's the way we approached it.

CARL CLARK: I had the impression that your equipment cost assumed you were starting over with the industry. That you were just throwing away the present plants, and putting up new plants.

LILLVIAN JONES: Not in all cases. I think for the bi-laminate we did consider some cross-over where the glazing could be used in existing plants and equipment.

So we didn't assume in all cases. With the rigid plastic, we did assume most of it would be new equipment for the industry. But for things like the bi-laminate, because they are laminated on tempered glass, we did consider the existent plant and equipment that can be used.

CARL CLARK: But you still came out with near three billion dollars, and that seems very high to me.

LILLVIAN JONES: Well that's --

CARL CLARK: Cranking up this industry.

LILLVIAN JONES: Okay. Well that's for the bi-laminates, and it came out to be $2,028,000,000, yeah.

Yes?

SY ADER: Sy Ader, SDC Coatings. When you go through the further analysis, I'd like to have -- give some input with you on the costing of coatings, and the costing of plastic coatings.

I think the numbers are a little on the skewed side.

LILLVIAN JONES: Okay. We are happy -- this is a public meeting. We're happy to get any information that we can, and we thank you for it.

BAPI DASQUPTA: Do I need to go to a microphone?

LILLVIAN JONES: Sure. I think they want

your name and to be able to hear everything you say for the record.

BAPI DASQUPTA: Can I sing a song while I'm here?

LILLVIAN JONES: If you like.

BAPI DASQUPTA: Bapi Dasqupta, Monsanto. Did you factor in production yields in your cost analysis? Yields for making the products. Yield, losses that sort of thing.

Because some of these products are, again, from the manufacturing perspective, they run a steady -- others may be batch processes and have yield complications.

LILLVIAN JONES: I'm not sure I understand, but what, are you talking about for a start up -- again, the start up cost, or for producing --

BAPI DASQUPTA: Or producing final materials.

LILLVIAN JONES: As far as -- yes, we did. As far as adding in encapsulation and abrasion resistant coating?

BAPI DASQUPTA: And making the --

LILLVIAN JONES: Yes, we did.

Question?

JOHN TURNBULL: John Turnbull, DuPont. I'm scratching my head, and maybe if I ask a general question it will get at a couple more focused questions that I have.

Could you explain, just because I don't understand fully, what you will use a capital and a weight number for in your program? Just tell me what -- before I wonder how accurate they should be and what the estimate is, could you tell me what happens?

LILLVIAN JONES: Well you always look at cost, weight and lead time when we analyze a rule, and the weight estimates go toward fuel efficiency or when that was -- it's still an issue, but more of an issue of fuel economy.

And that was one of the reasons why I used weight. But, again, the capital investment estimates are looking at -- when we say cost, not only the cost to produce, but -- I don't want to say harm -- but how much it's going to cost the industry.

It goes to how quickly they can incorporate the -- in this case alternative glazing -- but how quickly they can incorporate a safety feature into automobiles and still -- I don't want to say -- not harm the company, but produce it, or -- produce the product without causing significant harm. I can say that.

If it's going to damage the industry is what I'm trying to get at. How would the industry suffer, or how is it going to effect the industry if we require this regulation.

CLARKE HARPER: That's part of the rulemaking procedure. I have to, if I do a rule, make an assessment of the cost of a product as if it's received by the consumer.

Which would include the capital investment, correct?

LILLVIAN JONES: Yes.

CLARKE HARPER: And I have to consider the effect it would have on fuel economy. It's one of the Presidential regulations. Even though the weight might be negligible, I'm still obligated to make sure it's not a ton.

So, as part of the process, she just added one more layer, to see what the weight value is. Just to confirm that we're not adding a significant weight.

JOHN TURNBULL: What you said helps explain. For instance you said, if the weight's not a ton. I can understand that, but when we -- let's say we pick a number for capital, if I knew that that did not have some significant implication on what you do with rulemaking, either progressing or not progressing, if I knew that that number was very important in that decision, then I would think that we ought to more carefully examine it.

If it's a matter of eight pounds or a ton, then it doesn't matter to me whether it's eight pounds, six pounds, nine pounds, ten pounds.

That's what I was trying to get at with the question. When you have a number like that, if it is significant, if you tell us it's significant, then maybe I'd know whether it's important to pursue it a little more fully.

CLARKE HARPER: My understanding is, for a rulemaking standpoint, I have never seen something in the matter of one or two pounds that made anybody flinch.

The capital is calculated into the final consumer price.

LILLVIAN JONES: Right. This is the breakdown.

CLARKE HARPER: And we're basing it on what, ten million vehicles?

LILLVIAN JONES: We're basing it on 16 million.

CLARKE HARPER: Sixteen million. So you be the judge that that actually showed up in the $96 per automobile. So if you say, "Okay. It's 17 million versus four -- seventeen billion versus four billion, you can automatically calculate the effect it would have on that $96.

JOHN TURNBULL: Thank you.

SY ADER: Sy Ader, again. In that analysis, in the weight statements, plastics particularly, there's another give back, which is the shipping costs. Now are those number calculated back into the savings to the consumer?

LILLVIAN JONES: No. Not in this analysis.

SY ADER: So that shipping of raw product to the OEM --

LILLVIAN JONES: That's considered in the cost, yeah. When you -- the part of --

SY ADER: Say when the glass manufacturer ships his glass to the OEM, there's a shipping cost involved.

LILLVIAN JONES: Yes.

SY ADER: Now, with a weight reduction,

there's a reduction in price that the OEM pays for their products, is that included in that?

LILLVIAN JONES: We're estimating shipping costs, but not --

SY ADER: Well when you did this analysis, there was price column for rigid plastics?

LILLVIAN JONES: Right.

SY ADER: Now, along with that associated price, the material cost, and the processing, there's a savings in shipping that -- supplying that part to the OEM, above, say, shipping the glass.

LILLVIAN JONES: Okay. I see what you're saying, yes.

SY ADER: What I want to confirm -- you're saying -- is this a micro study, or is this a macro at this point, and you're going to go on and keep shopping --

LILLVIAN JONES: Are we going to expand the cost study or are we going to --

SY ADER: Is the intent of this to just get an overview, or the favor of it, or to develop it to a fine line?

LILLVIAN JONES: This is a preliminary study to get an overview of the flavor or -- well to get an overview estimate, an initial estimate on the cost of these alternative glazing, to support the research.

As the research is -- as the Agency decides which direction to take, as it concerns alternative glazing, we may, of course, have to do more cost analysis, and do a broader cost analysis.

CLARKE HARPER: What they taught us in engineering school, when I learned to use a slide rule -- no reaction -- is that an engineer tends to estimate and round off, and if we're talking about the fourth decimal point, I don't think it would change the White House's decision on something.

If we're talking about changes in the first or second decimal point, then it would become significant in the analysis.

DICK MORRISON: Dick Morrison, Ford. I wonder if you can put up the slide that shows the wholesale cost of the various materials. Is it possible to see that again?

LILLVIAN JONES: It will just take a minute.

Is this the one you're talking about?

DICK MORRISON: Yes -- no. Keep going.

It's that one. Could you explain that to me? I'm not sure I understand the basis for those values on your wholesale and resale -- retail, sorry, for the various products.

LILLVIAN JONES: Okay. What we did is, as I said, the Management Engineering Associates estimated supplier selling price. From that we gave a mark up derived from inter-Agency --

DICK MORRISON: Those values in particular.

LILLVIAN JONES: Right, those values in particular. Those mark up rates are for a company. We do corporate financial analysis, and for all our cost estimates we derive our own mark up rates to wholesale and to retail.

Okay. Applying a 1.28, I think it was for wholesale mark up, to the estimate of tempered glass, we go $7.14. To that we applied the 1.12 and got $8.01.

Those are for the base tempered glass, and those are the base designs. We did the same thing for the estimates for the other four alternatives. The last line, incremental cost line, is just the retail -- the difference between the retail selling -- the retail price for alternatives, say, tri-laminate. A retail price for the tri-laminate of $32.01, minus that of the baseline tempered glass,

$8.01, that gets you a difference of $24. That's the incremental price to the consumer. And we did the same thing for all the other --

DICK MORRISON: I understand that and I don't have a point of confusion about that, but I guess what I am not clear on, in my mind, is the basis that you use for the 1.2 incremental mark up.

Where did that information come from that enabled you to proceed with this particular analysis?

LILLVIAN JONES: The Agency does corporate financial analysis, using the corporate income's manufacture's income statement. When we break down those and get a ratio. Basically 75-25 ratio variable manufacturing cost. We use that to develop our mark-up rates.

Then from developing our mark-up rates from the retail price, we use basically prices for dealer mark-ups, the dealer suggested prices, minus selling prices, and then weight these prices for all the models, makes and models.

You weighted those by makes and models to determine what a mark-up rate would be for the Ford company. We used that when applying to Ford vehicles.

We used the mark-up rates we determined for GM when applying to GM vehicles.

And since in our analysis we used a Ford Taurus, we used the mark-up rates for Ford.

RICHARD MORRISON: So if I understand you correctly, you're telling this audience that you have verified these values through a survey of the market for these particular windows, is that correct?

MS. JONES: A survey of the --?

RICHARD MORRISON: Price.

MS. JONES: Repeat your question.

You are asking: As far as the mark-up rates, how do we develop the mark-up rates?

RICHARD MORRISON: Yes.

MS. JONES: Through a survey of financial income statements of the manufacturers; of Ford.

MR. HARPER: May I ask a question?

MS. JONES: And then the contractor also supplies supplier mark-up rates.

MR. HARPER: Is this a mark-up rate that you use for all Ford products? It's not unique for Ford glass, it's the Ford number?

MS. JONES: Right. It's Ford vehicles.

MR. HARPER: So if I came to you with a

Ford seat belt, you would use the same mark-up?

MS. JONES: Right. Yeah.

RICHARD MORRISON: Thank you.

MS. GILL: Are there other questions?

(No response)

MS. GILL: Thank you, Lillvian.

(Applause)

MS. GILL: We will now hear from Rob Sherrer, Linda McCray and John Winnicki on benefits.

I'm not sure who will be first, so that's up to -- Rob. Okay.

BENEFITS

ROBERT SHERRER, LINDA MCCRAY & JOHN WINNICKI

MEMBERS, ADVANCED GLAZING RESEARCH TEAM

MR. SHERRER: We followed a systematic step by step approach to estimate the benefits of advanced or ejection mitigating glazing in front side windows of light vehicles.

The first major issue we had to come to grips with was the extent to which advanced glazing would remain in place during crashes to prevent ejection.

Step one, therefore, was a hard copy analysis in which the case files of a select number of ejection crashes, were reviewed in depth in an attempt to answer that question; would advanced glazing have remained in place during the crash.

Step number two entailed a case by case review of detailed vehicle damage data from all front side window ejection cases over the 1988 through 1994 period.

Based on this analysis and conclusions reached in step number one, criteria based on the severity of damage in the window area were established for estimating the likelihood that the advanced glazing would have remained in place during the crash.

The analysis undertaken in steps one and two will be discussed by Linda McCray who is a Safety Standards Engineer in the Office of Safety Performance Standards.

In step three, the criteria established in steps one and two were applied to estimate the annual number of ejections out front side windows that occurred in crashes for which it was estimated that this advanced glazing would have remained in place to prevent the ejection.

Next, the number of fatalities and non-fatal serious injuries that would be prevented by preventing ejection was estimated.

The statistical procedure he used and the factors derived to produce this estimate will be described by Dr. John Winnicki, a mathematical statistician in the Agency's National Center for Statistics and Analysis.

The fatalities and serious injuries that it was estimated would be prevented were then redistributed to less severe injury levels.

Finally, the safety benefits were estimated by subtracting the projected or mitigated injury severity distribution for the present one.

Following John's presentation, I'll return to present the results of this benefits estimation procedure and also discuss the cost effectiveness of the advanced glazing.

Now, Linda will discuss her hard copy analysis.

MS. MCCRAY: Good afternoon.

As Rob indicated, a clinical analysis was performed.

My task was to assess structural damage, such as the roof, roof header, window frame, "A" and "B" pillars in the ejection area of vehicles in real world crashes. Ultimately evaluating the difficulties alternative glazings may encounter in retaining occupants whose vehicles have significant roof and/or door frame deformations.

Cases were selected from the National Accident Sampling System database from 1988 through 1992. I sampled 101 NASS cases of fatal occupants completely ejected through front side window glazings. That was 50 passenger cars and 51 light trucks and vans.

Cases with occupants ejected through opened side window glazing and door openings along the ejection path were omitted. That reduced the study size down to 78 cases and it was then 37 passenger cars and 41 light trucks and vans.

A qualitative analysis was performed to evaluate alternative glazing as a solution to ejection mitigation posing the question, would the alternative glazing have remained in place, given the exterior damage shown in the slides of the hard copy cases.

In the NASS hard copy cases, we do not know exactly when the occupant was ejected during the accident sequence.

Some assumptions were made for the qualitative analysis. One, that the physical damage shown in the slides are similar to the physical conditions during the ejection occurrence.

Also, the alternative glazing would have some degree of resilience to retain the occupant, maybe similar to windshield glazing.

Also, the alternative glazing would be designed to stay in place during moderate deformations of the window frame, such as an encapsulation.

Based on these assumptions, the cases were classified as addressable, meaning ejection was preventable, possibly addressable and non-addressable.

The addressable category included cases in which the window structure of the door frame was still in tact and the frame was typically in its original shape and ejection could have been prevented.

The possibly addressable category included cases in which there was considerable bowing at the window base and/or a deformation of the roof, roof header, "A" pillar and/or "B" pillar.

These cases are highly dependent on a resilience of the alternative glazings and will be considered addressable if the alternative glazings were in place that could manage the deformations.

The non-addressable cases were typically vehicles containing extensive structural damage to the window frame. This category included cases in which the window frame typically was destroyed.

The following slides are passenger cars involved in non-rollover crashes.

This is considered an addressable case where ejection could have been prevented. This is a single vehicle crash off the roadway into a tree. The driver was ejected through the left, front glazing. The window structure still has its original shape.

However, survivability is a different issue. And that wasn't considered at this level in the study. We were purely looking at structural damage.

This is, again, considered an addressable case. Note that this is a side impact collision. The driver was ejected through the right, front glazing but the right, rear quarter panel was where the damage occured.

And I'm going to reference some of these side impacts later.

The window frame is slightly bent away from the roof header. But if you look at the front, right window frame itself, it's still in its original shape and basically intact.

The following slides are passenger cars involved in rollover crashes.

This case was considered possibly addressable. It was a two-vehicle, head-on collision resulting in two quarter turn rolls. The driver was ejected through the left, front glazing.

This is an example of the stretching along the "A" pillar.

And this shows the "A" pillar deformation and bowing at the window base. I saw that a lot in some of the cases where it could have been either from occupant loading, and you see like occupant contact points noted by the investigators or also the crush deformation, going back, pushing the "A" pillar back.

This slide just shows moderate bowing at the window base.

This is considered an addressable case. The occupant could have been prevented from ejection.

This was a two-vehicle, side impact. The driver was ejected through the right, front glazing, but the impact was on the left side, center panel.

As you can see, the window frame is still intact.

This case was considered possibly addressable. This was a single vehicle crash off the roadway resulting in four more quarter turns. The driver was ejected through the left, front glazing.

Again, this is an example of the deformation along the "A" pillar.

Also it shows roof damage along the

header.

This just shows that the window frame is slightly bent away from the roof header.

This is considered a non-addressable case. This was a single vehicle crash off the roadway into a tree resulting in eight quarter turn rolls. The driver was ejected through the left, front glazing.

Here you can see extensive bowing at the window base. The frame is pretty much destroyed and torn.

I want to note here that when I spoke with the NASS investigators they indicated that the more severe the crash, the easier it is to determine the ejection path. The occupant tends to leave more physical evidence along the ejection route.

(Next slide inserted)

(Laughter)

MS. MCCRAY: Well, I'm putting that in because it could become a question, how do you know whether they went through the glazing or the opening because the frame was bent away.

This is also considered a non-addressable case. This was a single vehicle, off the road into a culvert resulting in unknown number of quarter turns. The driver was ejected through the left, front glazing.

This just shows the twisting of the window frame and the vehicle.

Again, there's extensive bowing at the window base. Again, they have the investigators marking the occupant contact points.

The following slides are light trucks and vans involved in rollover crashes.

This is considered an addressable case. Ejection could have been prevented. This was a single vehicle crash with a median resulting in ten quarter turns. The driver was ejected through the left, front glazing.

As you can see, the window frame was still intact.

There's no bowing or anything at the window base, but, again, they mark the occupant contact points with the yellow tape.

Here you see extensive roof crush. There's some shifting of the roof. I found that in a lot of the pickup trucks in rollover crashes, the roof shifted back.

This is just showing how the roof was crushed down into the occupant compartment.

Now, this one is considered a possibly

addressable case. This was a single vehicle crash off the roadway resulting in eight quarter turns. The driver was ejected through the left, front glazing.

Again, this shows slight stretching along the window frame, along the "A" pillar, and there's significant deformation along the header, the roof header.

This shows that it's torn at the "B" pillar on the actual roof but the window frame on the door is still intact.

This shot just shows that it's slight bowing at the window base and that it's substantial damage to the roof header.

This is considered a possibly addressable case. This was a single vehicle crash off the roadway resulting in two quarter turns. The front passenger was ejected through the right, front glazing.

Here you see the "B" pillar collapsed. And this shows a sharp fold in a roof header.

This is considered a non-addressable case. It's a single vehicle crash off the roadway resulting in eight quarter turns. The driver was ejected through the left, front glazing.

It shows that the frame is destroyed, twisted and bent.

This is showing that it's bent away from the frame on the header.

The following slides are related to a light truck case involved in a non-rollover crash.

This was considered non-addressable. As a result of a rear impact the driver and front passenger was ejected through the right, front glazing.

The frame is bent away from the window but it's bent away at the "A" and the "B" pillar, which even if there was still some glazing there, it permits an ejection route through the opening of the top of the window frame and the roof header itself.

This just shows how far it's bent away from the roof header.

In summary, 51 of the 78 study cases were considered potentially addressable. That's the addressable cases plus the possibly addressable cases.

Applying the weighted numbers to these cases, it shows that over 75 percent of these cases, ejection could have been prevented.

Ultimately, these findings indicate that it's possible for alternative glazings to remain in place given the structural damage we've seen in real world crashes. Ejection can be prevented through means of alternative glazings.

These hard copy cases were used as a template to extend retention capabilities to the remaining automated cases; partial and complete ejections.

To better assess specific deformations in the ejection area, an analysis was performed evaluating the relevant intrusion codes, such as the roof, the roof side rail, the window frame, the "A" and "B" pillars.

Each study case was tallied according to its respective category, addressable, possibly addressable and non-addressable, and it's maximum intrusion code for each case.

After these cases were tallied, this table shows the projected rate of retention capabilities of the alternative glazings.

I just want to make a note here that in the non-relevant intrusion, that category pertained to addressable as well as possibly and non-addressable cases.

The retention rate had to be broken into crash type.

The rollover crashes had a lower retention capability because it was due to more extensive and non-intrusive type of damage, such as the window frame being mangled and bent away from the actual vehicle.

In the non-rollover cases, typically side impacts, the damage was not necessarily in the ejection area as I indicated in some of the earlier slides, but the occupant may have been ejected through the opposite window.

The structural damage would include damage only to the lower portion of the door frame and not include damage to the actual window frame structure, or there could be no intrusive damage at all where it would possibly be moderate bowing of the window base, so it would include that type of damage.

Now, these retention rates were applied to the weighted value of the additional automated cases.

The next step after that, was a statistical approach, the matched pair analysis, was used to estimate reduction in the risk of fatality and non-fatal serious injury from preventing the ejection, and that will be covered by John

Winnicki.

(Applause)

JOHN WINNICKI: Now, I'm going to present the statistical analysis that underlies the assessment of benefits of advanced glazing that the Agency performed.

It is not very obvious that ejection prevention is beneficial at all. Up until 1960s there was a widespread belief that it is better in a severe crash to be thrown out of the vehicle rather than be trapped inside.

But since then, it's been documented that ejection is associated with the most severe consequences of crashes, and, in fact, occupants in the same crash who were not ejected are better off.

Now, the challenge to actually quantify this and in particular assess how advanced glazing would effect injuries, is that the current fleet of light vehicles doesn't have advanced glazing. There's no data on actual crashes with advanced glazing installed.

What we had available are some crashes with regular glazing data on traffic accidents that have regular glazing.

The basic approach was the following. We took from the data base, which contained basically records of traffic accidents based on police accident reports, all crashes which involved pairs of driver and front seat passenger when one of these occupants is ejected and the other is not.

So we selected those pairs. And then for the ejected occupants, we calculated the fraction of fatal injuries. And for non-ejected occupants, we also calculated the fraction of fatal injuries. We compared the two.

The fraction of fatal injuries indicated potentially the probability of fatality in either group.

Now, the basic assumption made here is that advanced glazing does not contribute to injuries more in an ejection crash more than other elements of vehicle interior that prevented an occupant from being ejected.

In other words, the idea here is that non-ejected occupants in a crash which have sufficient severity resulting in ejection suffer the same type of injuries as occupants would have suffered if they were prevented from being ejected by advanced glazing.

It's just the basic assumption here.

Now, the approach that we take here takes into account crash severity, which is crucial, because we know that ejection crashes are more severe crashes and we have to account for. Here we are looking at pairs of occupants in the same vehicle, so the same crash severity.

There are a few aspects of crashes that we have to consider in this kind of study. The first one is restraints use.

So here we used only data on unrestrained occupants. Both driver and passenger in these selected pairs were unrestrained.

The use of seat belts prevents ejection almost 100 percent. In addition to that, the problems --

MR. CLARK: Whole body ejection.

MR. WINNICKI: Whole body ejection, but even partial ejections are quite rare for occupants using seat belts if you look at the data.

Also, the reporting of belt use is questionable in traffic accident data. I won't go into that.

The seating position is another important factor to consider. The risks associated with driver and passenger seating positions were taken into account in this analysis.

Here is the basic calculation idea. So this would be a little bit of algebra, I hope. This won't -- we have to get through this technical part.

Let's look at N1, number of pairs involving ejected driver and ejected passenger, and N2, number of persons involving non-ejected driver and ejected passenger.

We then count D1 out of those ejected drivers number of ejected drivers who are fatally injured, and D2, the number of non-ejected drivers who are fatally injured in these crashes.

And then we then form this ratio here. The fraction of ejected fatal killed drivers to the fraction of non-ejected and fatally killed drivers. This represents the ratio of probability of being killed in an ejection crash when the driver is ejected to the probability of being killed when being non-ejected occupant.

Now, we can change, we can interchange the routes of drivers and passengers to assess similar risk ratio for passenger and we can also, instead of fatalities, look at serious injuries, excluding fatalities to estimate the risk ratio of serious injury.

So in that case, the formula is basically the same. A1 here injuries, incapacitating injuries, and so we look at the fraction of incapacitating injuries among ejected occupants divided by non-ejected occupants.

Now, Leonard Evans pioneered this type of analysis calling it double pair comparison. The Leonard Evans approach was slightly different. He looked at actually driver-passenger fatality ratio among pairs of ejected driver and ejected passenger and then he looked at R2 here, which is a ratio of non-ejected driver but ejected passenger fatalities, and then he basically formed the ratio of the fatality ratios as indicated.

This estimate is the same quantity, but it's more difficult to inter-approach, but it's looking at that, that's why I present quantity R, the risk ratio, using a simpler approach.

Now, once we have the risk ratio, the ratio probability of death or serious injury in ejection to the same probability without ejection, we can then calculate fraction of fatalities that would be prevented if ejection is eliminated by this formula here.

But there's a simple argument that asks

you that you can do it.

So we'll be able to present, based on this analysis, fractural reductions in fatalities and serious injuries.

Before I proceed with presentation of actual results, I have to say a few words about the data I used. I used here States database, which contains data of all police accident reports filed in 17 states that participated in the program. There are millions of traffic accident records in this data base and we selected those high quality, which had our required data elements.

There are actually 12 states which were used in this analysis because California, Florida, Georgia, Indiana, Louisiana, Maryland, Missouri, Ohio, Pennsylvania, Utah, Virginia and Washington state data over four years, approximately. For some states it's a slightly different time frame, but basically four years data.

The injury scale used here is the KABCO scale, and this divides injuries into fatal incapacitating and non-incapacitating evident and possible and no injuries.

Now, the best, I think, illustration of benefits of ejection prevention is this table here, which basically gives you distribution of injuries among drivers who are ejected and passengers in the same crash who are not ejected, so these are based on drivers, passengers, driver ejected, passenger completely ejected, passenger not ejected.

Here we have fatal injuries. We have 15 percent driver fatalities and only five percent passenger fatalities. About three times lower fraction of fatal injuries.

Also A injuries, incapacitating injuries, about 36 percent among drivers who are ejected and among passengers who have avoided ejection about 21 percent.

These proportions become reversed at the lower scale, less severe injuries where we see that non-ejected occupant to passenger suffered less severe injuries compared with the ejected occupant.

Now, when we reversed the rolls and drivers were non-ejected and passenger becomes ejected, then the numbers are reversed. Non-ejected drivers have only about four percent fatal injuries, and passengers about 12 percent.

Again, similar proportions similar relations lower severity levels where A incapacitating injuries are still higher among ejected occupants, lower among non-ejected occupants.

The next slide shows partial ejections and here we have -- see, you can observe this consistent pattern where an ejected occupant is about three times more likely to be killed and about perhaps close to two times less likely to be severely injured, to suffer incapacitating injury.

And then you look at reverse situation driver not ejected, passenger ejected.

But comparison of these distributions of injuries don't take into account differences in risk among different seating positions and other mathematical adjustments that we have to make, but it is a very good, in my view, illustration what is really happening when ejection doesn't take place.

Here we have combined partial and complete ejections.

Now, we proceed to conduct the risk of fatality that quantitative R, that I introduced, ratio probability of ejection for drivers, one, ejected, two, non-ejected, and then we see here about three and a half times more likely ejection. The number in parenthesis is the standard error estimate.

And the number in the second column here (indicating) is the fractual reduction in fatalities, about 70 percent reduction. For passenger, the numbers are substantially the same.

Also, for partial ejections, we have here complete consistency of results, about three and a half times less likely fatal injury and 70 percent reduction in fatalities if ejection is prevented.

This is a table that combines partial and complete ejection data.

For an incapacitating injuries, for drivers as well as passengers, there's about twice as high a probability of that type of injury if ejection is prevented and associated reduction in fatalities about 50 -- reduction in incapacitated injuries about 50 percent.

These are the numbers for all ejections combined.

Now, this table here provides information about light trucks.

The previous tables gave -- illustrated benefits across all types of light vehicles, including light trucks and passenger vehicles. For light trucks we see higher relative risk of fatality for both driver and passenger approaching four percent and four times higher relative risk of fatality and the associated fractural reduction in fatalities about 75 percent.

Incapacitated injuries relative risk is also higher in light trucks, approaches three times higher for drivers and about two times for passengers and that associated fractural reduction is also higher compared with passenger cars.

Now, this was data for light trucks. When you combine partial and complete ejections. And here's data for passenger cars, which is basically the same type of results, the same type of numbers as when we look at all vehicles because the majority of vehicles are passenger cars, so the light trucks don't stand out when you look at all vehicles.

Now, let's proceed to break down by impact.

In front, impact crashes, there is about over three and a half times higher risk of fatality for driver and incapacitated injury about two times. This is consistent with results for all types of crashes, slightly higher, perhaps. This is all ejections, partial and complete.

I've shown these results separately for partial, and complete, just to show how consistent these results turn out.

Now, rear impact crashes slightly lower benefit but also similar about three times reduction in probability of death and about two times reduction probability of incapacitated injury.

Now, something interesting is observed when you look at left side impact crashes where the passenger has much higher benefit to passenger in ejection prevention. We have here about three times higher probability of fatality for ejected passenger and only about one and a half for driver. These are left side impact crashes.

Now, for right side impact crashes, the numbers are exactly reversed. Here the driver has much higher risk and much higher relative risk when ejection is prevented.

Let us now proceed to the last series of tables in rollover crashes, and this is basically -- the punch line here you can see that in rollover crashes the relative risk of fatality is about eight or nine, so here we have high, very high, benefit of prevention of ejection associated fractual reduction fatalities is almost 90 percent.

The numbers concerning incapacitated injuries are a little over two in terms of relative risk of fatality.

And the results where all ejections confirmed this conclusion that for rollovers, the benefits are clearly the highest.

That concludes my presentation of the statistical analysis and now Rob Sherrer will apply these ratios to specific numbers obtained from the NASS data to present benefits in terms of dollar amounts and numbers of lives saved.

Thank you very much.

(Applause)

ROBERT SHERRER: This first slide shows the present situation. On the right we see that the total estimated number of ejections out front side windows is 25,000 annually.

We also see the injury distribution for these ejectees.

The very minor and moderate injuries account for 14,000, 58 percent of the injuries to the ejected occupants.

However, the fatalities account for about 5,400, and this is 22 percent, of all the ejectees, all the 25,000.

The distributions, as you can see, are similar for the complete and partial ejections.

The next slide shows the factors which Linda presented you and as she said, these factors are multiplied times the expansion factor for each case that we've investigated.

They are then summed, and since we have seven years worth of data and include every ejection case in that collection, we then divide the sum of this by seven to come up with the estimate of the annual number of ejections that could have been prevented, because the advanced glazing would have been in place.

The assumption here is that if the advanced glazing would have been in place, the ejection would have been prevented.

We assume this for this initial estimate. And there's good reason to think that the great majority of these would be prevented.

First of all, as we've heard, the ejections during rollovers are at rather low speeds, and also by eliminating the cases in which the window area is heavily damaged, we've eliminated certainly a good portion of the most severe crashes in which the occupant would have likely been ejected at a high speed.

Now, this slide shows the number of

ejections. Those are our 25,000 ejections on the far right, and the estimate 11,300 ejections that would be prevented by the advanced glazing.

Apart from the vehicle damage criteria for excluding cases, all cases for which the ejection window had been partly or fully opened prior to the crash were excluded, as were cases in which the door containing the ejection window had opened during the crash.

The reason for this latter procedure being that even if advanced glazing had been installed and remained in place during the crash, the occupants still might have been ejected out the open door.

In a 1993 SAE paper, Clarke Harper and a colleague of his, Susan Partyka, estimated that about 20 percent of the ejections out front side windows, the ejection window was either partly or fully opened.

So those cases were excluded in addition to applying the criteria that Linda presented.

That resulted in an estimate of 11,300 ejections which took place through the front, side windows in which the advanced glazing would have been initially in place, the window up, and the door would not have opened during the crash, and the glazing would have remained in place during the crash to prevent ejection.

This slide presents some information on those 11,300 cases in which the glazing would have been in place and ejection would have been prevented.

The colors indicate, as would be expected, that the great number of ejections were to unrestrained occupants.

This slide shows the abbreviated injury scale that the Agency typically uses for rating the injury severity to occupants.

It should be understood that we typically use the MAIS designation, that is the maximum injury, and that occupants in accidents will typically receive numerous injuries.

For example, an individual may receive an AIS-4 injury, two AIS-3 injuries and several AIS-1 injuries and expire because of combined effects of these injuries.

Now, this slide shows the injury severity of the ejected occupants who would be prevented from being ejected.

It is significant that the majority of these occupants received only a minor or moderate injury. In fact, 7,100 of 11,300 received these very low levels of injury. This was 63 percent of all the ejected.

It is also significant that as indicated, a substantial number, 2,075, were fatally injured.

This next slide illustrates how we applied the matched pair factor that John derived in estimating the major benefits. That is, the number of fatalities that would be prevented.

This, as an example, is the injury distribution for partially ejected, unrestrained drivers.

As indicated, 602 of these drivers were killed.

By preventing ejection, we would save 71 percent or 429 of those fatalities.

The next step was to redistribute these 429 fatalities to lesser injury severity levels.

The redistribution was based on the injury distribution for unrestrained drivers who were not ejected and who were paired with unrestrained passengers who were ejected as derived from state accident data.

Note that a large majority of present fatalities that would be prevented would be shifted to no or low injury severity levels.

The safety benefits of retaining occupants inside their vehicles are indeed great.

This same estimating procedure was used for estimating the reduction in serious injuries and then the redistribution of those to less serious injury levels.

This slide shows the present situation, the injury distribution, what the injury distribution would be with advanced glazing and then the difference, which is the benefits.

Since we are talking about benefits, the sign seems opposite of what one might expect, but a total of 1,313 fatalities would be prevented.

Note, the large increase in the number of occupants who would not be injured or who would receive only an AIS 1 or minor injury.

This slide didn't come out too clearly, but it shows the present situation compared to the situation with advanced glazing.

Again, we can see the large reduction in the number of fatalities. And on the left side, a large increase in the number of no injuries or very minor injuries.

This, again, summarizes the net safety

benefits.

Again, there's our reduction of about 1,300 fatalities and the increase in the number of ejectees who would now be either uninjured or receive only minor injuries.

This slide presents the estimated cost per equivalent fatality prevented. This is typically how the Agency assesses the cost effectiveness of a proposed regulation.

On the left we have the four types of advanced glazing. The second column shows the incremental costs of having this glazing on the front side windows.

The next column shows the total annual cost of installing advanced glazing in the front side windows, assuming there would be 16 million light vehicles sold in a year.

We then show the discounted equivalent fatalities prevented.

What this is, is the number of fatalities, 1,313 that would be prevented, plus the economic equivalent in fatalities of the injuries that would be prevented, discounted over time, because while the cost of the advanced glazing would be incurred at the time of vehicle purchase, the benefits accrue over the operating life of a given model year fleet.

The last column shows the estimated costs per equivalent fatality prevented. This runs from about $800,000 to $1.3 million.

This slide shows the estimated cost per equivalent fatality prevented for some recent rulemakings.

For the passenger car side impact protection, the amendment to Standard Number 214, the estimated cost per equivalent fatality was estimated to be $470,000 for the front seat, almost three million dollars for the rear seat and for both seats combined, about $730,000.

For the light trucks side door beam regulation, it was a million and a half to two and a half million dollars. For the upper interior head protection, that is the recently issued amendment to Standard 201, it was about $400,000 to $460,000 for the front section, extremely high. 3.1 to 3.6 million dollars for the rear section, for an average of $687,000 to $784,000.

Finally, for the light back air bag standard, the cost per equivalent fatality prevented was estimated to be $560,000 to $660,000.

We just got some of these slides back this morning and this one didn't come out but I did want to show it to you.

This is the estimated front side window ejection problem, compared to the rear side.

The yellow bar on the left indicates there are 25,000 ejections out the front side windows. The blue bar next to it indicates there are 2,100 ejections out the rear side windows or eight and a half percent of the number out front side windows.

With respect to fatalities, we have 5,400 fatalities from ejection out the front side windows and only 368 fatalities from ejection out the rear side windows.

We follow the same procedure in estimating what the benefits would be if advanced glazing were applied to rear side windows and this contrasts those benefits to the benefits I just presented to you for the advanced glazing in the front side windows.

Obviously the difference that would be expected, given the data I just presented, is enormous.

You see our estimate, about 1,300 fatalities that would be prevented by advanced front side glazing. We have only an estimate of 166 fatalities that would be prevented if advanced glazing were in the rear side windows.

This next slide breaks our estimated benefits of 1,300 fatalities that would be prevented into the categories of crash type.

The rollover benefits would account for about 1,000,; side 218, the front and rear about 95.

The reasons why the rollover benefits would be so great include the fact that the rollovers account for 56 percent of all front, side window ejection-side impacts account for 32 percent -- and the criteria developed that Linda described produced fractions that estimated that 53 percent of the rollover ejection crashes would still have their front side window glazing in place to prevent ejections. However, for side, the fraction was only 29 percent.

Finally, applying the matched pair factors, which John developed, preventing ejection during rollovers would prevent 90 percent of the fatalities; preventing ejection during side impacts would prevent 60 percent. Still substantial but not as high as rollovers.

This, the final slide, divides the benefits by car and light truck.

On the left we have the current situation, which shows that 899 out of the 1,313 fatalities that would be prevented would be prevented in passenger cars. Light trucks account for 414 of the fatalities that would be preventd by advanced glazing in light vehicles.

In the future, based on long term sales of nine and a half million cars and six and a half million light trucks, you can see that the estimated benefits would be fairly closely divided between the cars and light trucks.

That concludes the presentation.

(Applause)

MR. SHERRER: Do you have any questions for Linda, John or myself regarding the benefits analysis?

Yes, sir.

Please identify yourself, sir.

MICHAEL KOBROHEL: Michael Kobrohel with Excel Industries.

As an additional selection criteria, on one of your slides I noticed one of the vehicles you analyzed was a hard top door design, i.e., there is no door structure above the belt line, which are --

MS. MCCRAY: Like a Camaro or something?

Was that the one, the Camaro?

MICHAEL KOBROHEL: Yes. In which case a glass door, any safety glazing would remain because there is no seating in the structure above the door, it's all external. So that would have skewed your figures perhaps higher?

MS. MCCRAY: I'm not sure what the ratio is. We are aware that some vehicles out now do not have the complete door frame, but to have an encapsulation, we would have to have some structure there.

In the beginning, some of the assumptions made, one of the assumptions, is that it would remain in place similar with some idea holding in place with an encapsulation. Which, in my analysis, I was thinking with an encapsulation there.

MICHAEL KOBROHEL: That's what I'm commenting on, regardless of the encapsulation, the door design is phenomenally different than a limo-type door where the glass does not seat within a structure of steel, whether in the roof or the door. It seats exterior and literally is a ceiling, is what retains it.

The second point would be to Mr. Winnicki who I believe you identified that one of your assumptions was that it is not less hazardous, the safety glazing, impact of the safety glazing versus impacting on "A" pillar or a "B" pillar roof is not less hazardous.

Thus the converse of that is, it is no more friendly. And if we were looking at some of the data provided earlier, a deflection of glazing eight inches still retain the output, plus the addition of four to six inches of door frame retention will certainly defer a great deal of inertia over that penetration. So retaining as opposed to hitting just the "B" pillar that would in total deflect.

So I would question if that was a valid statement?

MR. WINNICKI: The advanced glazing is somewhat elastic and when it's -- you know, when an impact occurs it will give in somewhat. You're saying that that would tenuate the benefits? I would imagine if it's somewhat elastic it would.

MICHAEL KOBROHEL: I'm saying that getting a piece of safety glazing and allowing it to travel eight inches in the direction that I'm being ejected and the door frame being deflective, to some extent, as we saw in the morning presentations, is far more advantageous to a head than striking a "B" pillar covered by two inches of plastic and moving four inches.

MR. WINNICKI: Well, I would agree with that. So that would mean that the benefits may be even higher than would follow from this analysis.

MICHAEL KOBROHEL: Forgive me, I don't see that. I see that the benefits would be lesser in the data because you didn't segregate between the occupants being ejected through the glazing or being deceased prior to going through the glazing because impact was "A" pillar and "B" pillar.

MR. WINNICKI: Yes. Of course, I was not able to even differentiate between ejections for the glazing as opposed to ejections through, for example, open door. That is certainly true.

So for some of them, you know, ejections wouldn't be prevented as was assumed. But that certainly is true, but, of course, we have limitations on the data.

So I think that the numbers that are presented may not be a one hundred percent accurate, assessment of what will happen if you have advanced glazing in vehicles, but I think it cannot be a coincidence that you have three times less injuries among non-ejected occupants than ejected occupants at the same crash. And that's the basic message here.

Now, even if it's two times less fatalities, there's still considerable benefits.

MICHAEL KOBROHEL: I totally agree with you. By my point I was merely trying to add perhaps the next time this is gone through those additions can be looked at to better fine tune.

MR. HARPER: I guess I don't quite understand your point. I want to make sure because I'm working this number all the time.

What you're suggesting is that we do a micro study of where the person hits the different components before they go out as opposed to a macro study as we did?

MICHAEL KOBROHEL: No. By no means. I'm just saying that as I understand this, as information continues to develop and more frequency of this type of full review, let's say the issues are developed, I felt I brought two good examples of where additional accuracy can be interpreted into the data, was to continue to fine tune the numbers.

MR. HARPER: I can understand the technical design concerns of the first one, the window type. It's your concern that Dr. Winnicki's conservative assumption that people would not get hurt worse by hitting the glass.

The point being that he's trying to assume the glass itself will not kill people when he's doing that analysis.

I guess I don't know -- you're basically agreeing with him and then saying the benefits should be lower. So I guess I don't understand your point.

MICHAEL KOBROHEL: I'm agreeing and lauding all the study that was presented for us and only bringing up what I saw to be additions to your view or selection of criteria that could more accurately provide data.

In the first case where a headerless door would not be able to retain any type of safety glazing that would skew the data. In the position of claiming that there is no difference to the occupant, there is no preference or no safety enhancement or interaction from hitting anywhere on the door and being ejected. That, perhaps, would be the worse to be worked out because of the lack of data available to work with.

So I was lauding all studies, just trying to give impressions of areas where more accuracy could be inputed in the future.

MS. GILL: Thank you. Yes?

GERALD DONALDSON: I'm Gerry Donaldson from Advocates for Highway and Auto Safety.

I wanted to bring up an issue that lies outside the confines of the benefit cost analysis that you presented us over the last hour.

Dealing with advanced glazing may not be the only countermeasure that's relevant. And I bring this up to see how you all would accommodate the evaluation with benefits that would intrude on the kind of premises that we use to do a benefit plus analysis.

Now, we all know that it would be optimal to have more people restraints, we'd have less problems with ejections. But it's even more desirable to have the occupant not strike the window at all.

When we just got through having NHTSA issue the modification to 201 to give us the Upper Interior Head Impact Protection Rule, there are now upwards of a dozen petitions to reconsideration -- I'm sure Clarke Harper noticed that -- of which two were issued by Volvo and BMW.

In both instances, they're asking for a number of modifications to the rule, including lower compliance impact speeds.

But I think most intriguing is the fact that both of them have suddenly leapt out of the woodwork with many miniaturized inflatable restraints for the upper interior.

Now, the Volvo restraints are interesting, but the BMW restraint, at least one part of their inflatable restraint system's even more intriguing, because it's an inflatable tubular restraint or string or hammock which bridges the distance between the upper impaction between the "A" and the "B" pillars, and across the top area of the window opening or the glazing.

Indeed, BMW in passing claims that well the desirable features of the restraint, as Clarke probably knows, is not only not contacting the side roof rail, but also not contacting the glazing at all.

In fact, I would think that there might even be some benefit to the device in preventing or at least litigating the extent of the ejection through open windows.

I'd like to know to what extent the Agency, even though it obviously hasn't ruled one way or the other on the BMW or the Volvo proposal, would account for this in dealing with her benefits analysis.

We know that manufacturers are very, or at least somewhat, anti-pathetic to the non-refundable phone solution. We know that metal air gap has become fugitive now for almost 20 years. There's probably an outlaw militiaman hiding somewhere in a Montana cabin waiting to be revealed again as a plausible countermeasure.

So how would you all deal with the intrusion of another countermeasure that even prevents head impact against the glazing itself in relation to the advanced glazing consideration that you presented over the last hour?

STEVE SUMMERS: I'm Steve Summers and I'm in charge of the Rollover Research Program for Crashworthiness.

We are well aware of the tubular restraint system and we are doing, right now, because we don't have any physical samples we can test, we are doing modeling, looking at them, as Janette said earlier, for how they behave in rollover accidents.

There is still the question of exactly how to inflate them, when to inflate them, well, who'd be important.

GERALD DONALDSON: How long do they need to be inflated?

STEVE SUMMERS: Exactly. We are doing some basic parameter studies at this point to determine what their effectiveness will be as far as reducing ejection.

We do see that there is at least a good percent of them playing a safety role in rollover accidents. We're trying to assess. It's very preliminary at this point. Perhaps when the hardware becomes available, we'll be able to do more physical tests.

MR. HARPER: Rather than addressing how, I would just say that I believe we would address it if it could be measured and quantified.

Right now as you can see, the device we have is not a full body device. Sled testing might have to include actually pulling at a Hybrid III and running some kind of testing and trying to wild guess exactly what ramifications it would have on ejection.

So we are aware of it, we're considering it, and it's another difficult analytical thing we'll have to get through.

I remember I worked on a steering column upgrade program many years ago that got overtaken by the airbag program, so something like that might overtake this program and this program might have to get immediately redirected.

Thank you for bringing that to our attention and keeping us honest.

MR. SHERRER: I'll just add that I read in Automotive News that Ford Motor Company plans to install these side impact air bags on all its cars and light trucks sometime in the future.

So this, it would seem to me, would certainly affect the benefits estimate for this potential rulemaking, for this analysis.

MS. GILL: Yes?

LAWRENCE PETERSON: Lawrence Peterson, Ford Motor Company.

In all the work that's been done today it appears that the assumptions that the windows are rolled up. In the real world there are windows that are rolled down.

Has that been a common cord? It seems like it was indicated in your benefit analysis.

MR. SHERRER: No. In the benefit analysis we did exclude all crashes in which the window had been partly or fully opened.

MR. HARPER: Yeah. He cited my 1993 paper where we found 75 to 80 percent of the windows were rolled up and he used that deduction.

LAWRENCE PETERSON: But if that be the case, the benefit would only come from the 75 to 80 percent.

MR. HARPER: No. They took the deduction before they calculated the benefit.

LAWRENCE PETERSON: Okay. Thank you.

MS MCCRAY: It also, mine excluded, which was encompassed in the benefit calculation, it excluded door openings. If that door came open, because it's still an ejection route even if the glazing was still in place.

CARL CLARK: Over the years the long term implications of injury, costs have continued to rise. There is this controversy, are you including in your cost analysis the quality of life implications in this long term picture.

Where did your cost numbers sit with regard to that problem?

As we transition to this current period, the numbers used for the total cost of injury in the Agency have gone down 100 billion dollars. As you've shifted back, I gather, to paying more attention to existing medical costs and directly identified cost.

MR. SHERRER: The cost of injury figures which we used were comprehensive costs.

For example, the value for a life, -- I should even state that differently. The amount that society would be willing to pay to prevent a fatality was estimated to be 2.9 million dollars.

The values for AIS 1 through 5, non-fatal serious injuries and fatalities include the direct economic costs, which have been estimated by the Agency, and also an amount to represent the amount of money people would be willing to pay to prevent that level of injury.

But they are not all inclusive. A life is invaluable and so there are tremendous grief and suffering costs related. We can't capture those.

MS. GILL: Other questions?

If not, we're going to take a ten-minute break.

(A brief recess)

MS. GILL: All right. Now that you've

heard from NHTSA personnel, we are about to hear from a non- NHTSA individual and his name is Doug Nutter. He will be speaking to us on Rigid Plastics. I'll let him introduce himself and go from there. For the next twenty minutes, it's yours.

RIGID PLASTICS

DOUG NUTTER

GLOBAL GLAZING BUSINESS LEADER, GE PLASTICS

DOUG NUTTER: Thank you, Margaret.

My name is Doug Nutter. I'm the Global Business Manager for GE Plastics Automotive Glazing, and I have with me two individuals; Mike Sikes is our engineering leader and Demetrius Hatzenberis, many of you know, is our global technology leader and also works with the ISO and SAE committees.

First of all, I wanted to thank NHTSA for holding this meeting. It's very good information. I think the process of getting the information out early has been very helpful in our program.

What I'd like to do is share with you just some thoughts and some of our comments on polycarbonate glazing.

As we go forward, I think there are many interesting alternatives.

At GE we do have -- and we also have BEAR with us today. We want to recognize him as another polycarbonate producer on a global basis.

But I wanted to share with you some of our comments regarding the work that was presented and just share with you, perhaps from a more industrial point of view, what might be some of the anticipated changes from a commercial perspective.

Some of the things that I'd like to talk about are a cost estimate based on what would be sort of our view of industry practice, looking, again at unit variable costs.

We estimate roughly a $17 lower cost. I'll be going into the details of that in a minute.

Additionally, with injection molding, which is a process that we would use to manufacturer a polycarbonate windows, also they could be formed thermally like thermoforming, but in molding processes we are able to incorporate functionality like one encapsulation may provide at least some of the attributes of it as identified in this program.

We also have a lot of data on hard coats, which are required to protect the polycarbonate from incidental scratches, so we have some of that to share with you.

We do have some variability data that we do need a lot more. We're just beginning to get some of this. I will talk at the end about what's required there.

Again, there are also integral design and part features.

One of the things that we really have just begun to explore, what are the opportunities to incorporate metal parts, brackets, blast standoffs, attachment methods to both fixed and moveable glazing.

There's also a weight savings advantage, which is significant to auto makers, ten to 25 pounds. Some of that was illustrated in the earlier numbers. Those are pretty accurate. We would agree.

One of the other things that's kind of interesting is there's been many recycling initiatives and we have a process and are actually commercially recycling polycarbonate.

It's very much a very easily recyclable material. It has very high economic value. It's sort of, if I could draw an analogy, something like an aluminum. It has high residual value in its clear form with a coating we have a technology commercial practice to take coatings off.

So that's a very good, interesting feature. I don't know how that plays out in other benefits, but I know that many auto manufacturers are beginning to look at increasing their cyclyability of the vehicle.

Coated polycarbonate has very little UV transmission. We'll talk a little bit about some other data, but basically one of its advantages is inherently UV light is absorbed in the polycarbonate or in the coating that's applied to it. So that the effects of UV on the interior vehicle, compared to standard glass, are welcome.

Then there is a fair amount of experience. Apparently the Corvette has a cordura top, a full roof top, that is injected molded with polycarbonate. This is a removable roof.

There's also some side windows the Bugatti sports car. And there's a lot of Viceroy on trains and buses.

But I really do want to say that although we have very good coats and there's a lot of very strong indications of feasibility, we do have a lot of work to do. And that in particular includes a lot of one car durability testing and fleet vehicle testing with OEM partnership and cooperation.

We need a lot of work to understand what are the limits on vision as it may degrade potentially over time, what would that look like.

Additionally some continuing work on mechanical testing.

What we'd like to do, then, is briefly run through just some of the things that are known about polycarbonate in multiple applications.

People participating on the SAE and ISO committees know this very well, but basically the bottom line is that polycarbonate meets ANSI Z26.1, the item for requirements, and has been used in various appropriated DOT applications that we mentioned earlier.

There's a lot of experience, as I said before, that is used with hard coat polycarbonate. Since 1985 a hard coated sheet has been manufactured using a dip coating process, basically dipping the sheets into a fluid and curing the coating.

These are then applied to trains, to buses of all types, police enforcement vehicles, off road vehicles. I did mention the Bugatti window has been used using thermoform windows and then coated with a flow process, which is sort of like taking a garden hose over it.

The Corvette, we mentioned, or since 1994 and a number of other applications, although they're not glazing but sort of have a similar relationship.

General Motors and Chrysler have used Lexon in their polycarbonate parts since 1988 that have been dip coated. These are black applicates on the exterior of the car, right where you would open the door, along the "B" pillar.

They then coat it so that they retain the high gloss and luster without scratching.

Head lamps is perhaps the single biggest application, again, looking at the validation of coated polycarbonate for durability, probably 75 or 100 million head lamps have been on the road since about 1982.

In a somewhat similar related application we have a little bit of data to show you on police vehicles in Holland. These are riot control vehicles. We have some data that the front window is a laminate and all the other windows are polycarbonate that has been hard coated.

These vehicles have been in Holland since 1979 and they have required or been out there with a whole range of severe applications.

We talked about some additional benefits, but this window has 45,000 kilometers and it's approximately maybe 35,000 miles since 1986.

But you can see that the window, although it's scratched, is still intact. It's had bricks, rocks, bats, spears, a whole variety of things that would be in a typical riot, I guess.

What we've done is we've gotten a whole series of these back to look at for how the durability has been regarding conic adhesion, a yellows index, any degradation of optical performance.

As you can see, although it's scratched, it is transparent and it is intact. So this is an interesting area to look at.

We don't see any micro cracks of delamination and the part is able to be seen through.

Another manufacturer, Bugatti, those making the econo car, has used Lexon in side windows and some rear quarter windows and also the rear window over the engine compartment.

Here the moving side window, which is the lower side window, right about here, and then this window that's fixed are both made in polycarbonate. That application is thermoform and then the coating is applied to it. Again, there's not a lot of vehicles for testing. What there is, it does show a very nice aesthetic window that does meet these requirements.

I'd like to move on now to some of the perhaps meat of what we wanted to talk about as far as unit cost comparisons, in particular, just showing what NHTSA had presented in the analysis for unit cost, this is before the mark ups before wholesale and retailing. These are basically manufactured unit variable costs.

First of all, in the processing, we're looking at a significant reduction from what our estimate would be of about $6.90.

That's driven by the fact that when you're doing the cost calculations for these, you're typically looking in a towing operation or fully invested. NHTSA has broke out the capitalization and equipment costs as separate items and separate depreciations.

So these are the unit variable costs for molding.

Material costs, the estimate that was used was a price of $2.31 a pound. We used a price as published in a trade industry, an association called Plastic News. They report market prices. Since we can't really discuss customer only in pricing, this reflects what would considered to be an industry market average price for polycarbonate, so what one might expect that prices can be lower than that for volume.

I think one of the bigger significant savings is in encapsulation. This was something that was added to all the windows.

One of the integral advantages of injection molding is that it is a process, relatively speaking, the glass somewhat similar to encapsulation, so the designs and shapes and forms that you can conceive of can be molded into with the plastic and that shape can be filled.

As you can see, that's a very significant savings.

On the abrasion coating, we took a target estimate to get a coating cost of around $1.00 a square foot. That's, we think, a fairly reasonable estimate to shoot for.

So when you stack all those up, there's a drop of about $17.00 in the unit cost per one window and that the per vehicle cost, I guess, would be four times that in your analysis at NHTSA. It would be about $68 lower cost. Again, as a reference point.

Just a quick example of some of the things that can be done. Just a few quick ideas.

This, for instance, would be a one piece molding with an L-edge molded in. Just conceptually the opportunity to work with the auto makers, looking at door design integration, it is critically important and that work has yet to be done, to make this accessible.

But the opportunities to provide some of those features in one piece and eliminate some other additional parts with the OEM's is there. This is an L-edge concept.

Again, one could also conceive a T-edge concept.

Additionally, one could even conceive building things that would latch or unlatch, walking mechanisms at the top with moving windows.

This, again, is all conceivable to be done.

Finally, I wanted to end on a note of things yet to be done that are really important questions yet to be answered, because this is really just the beginning and not fully there yet.

But importantly we really need to get more on car durability. There's a lot of accumulation of testing and environmental cycling yet to be done to validate data.

We don't know the limits to a five year hard coat and what could be longer lasting hard coats, and additionally what would be the trade offs for vision, and durability versus safety. You know, we don't know how to answer that.

What would be the customer acceptance of scratches over a time? Again, this is a willy-nilly thing. They would need to validate what the customer acceptance would be. We don't know what that is yet.

Then on mechanical testing, how would noise and vibration effect it by design? We feel good about that but we need more data on impact and occupant protection.

I think that there's, again, opportunities to integrate these kind of moldings into advance designs that incorporate more of the body that provide new styler woods. Those are all interesting goodies for the OEM. But we have a lot of mechanical work to do to make sure everything's integrated.

So I just want to end by saying we have a lot of technical work, working with the OEMs, the glass industry and all the suppliers.

I just wanted to, I guess, get on record some of those comments.

I'd be glad to answer any questions.

MS. GILL: Thank you, Doug.

DOUG NUTTER: Thank you.

(Applause)

MS. GILL: Are there questions?

GERALD DONALDSON: I have a quick one.

DOUG NUTTER: Sure.

GERALD DONALDSON: What kind of either real world long-term observations or accelerated testing can be done for age development?

I've seen lexon used for many years in the boat industry. I had lexon windows for years in a sloop that sank in 1994. The age production was minimal. That's a pretty adverse environment.

So what have you seen as the kind of consequences of long-term aging as well as accelerated laboratory tests?

MR. NUTTER: We could answer that. Demetrius, would you care to answer.

We have some specific tests, Xenon and Hark, that can be done with barometer tests, and we also, of course, do Florida testing.

As I said, we do have field data for 15

years in hard coats and we do have ongoing programs to improve their life to what we typically would say every five years in a Florida type environment.

As far as accelerated testing, again, I think the Xenon and the weatherometer tests.

What we're working on now are ten year and those kind of durability numbers that would be there.

Any questions from NHTSA?

JIM HACKNEY: I may have one. Jim Hackney, NHTSA.

What kind of time frame -- you mentioned three areas which you're working in to resolve some issues. What kind of time frame did you put on for those areas in reaching production state?

DOUG NUTTER: I would hope that we would be able to get some on vehicle fleet testing over the next one to two years, that sometimes, perhaps in the three-year time frame, some companies may be willing to try very small rear windows, fixed windows, that would be less aggressive to get more fleet testing.

I think we still have, as I say, with technology development to do for scratch resistance and there's some new technologies that we think will bring it up to glass levels available but we don't see that for in the four to five year time frame just beginning at that point.

So by the time you talk with one vehicle, that will be a couple of years after that.

So rough estimates, earliest optimism would be four, and most likely be like a six year level.

Yes?

MR. CLARK: Do you accept the capital costs for expanding that they're using?

MR. NUTTER: No. But at this point they were reasonably close. You mean, encapsulation would not be required?

MR. CLARK: The factory costs. They wanted to build totally new systems and --

MR. NUTTER: Right.

MR. CLARK: -- you have quite a bit going.

MR. NUTTER: Well, yes. This would be required to do capital investment for, say, injection molding and tools --

MR. CLARK: As much as they said, is the question?

MR. NUTTER: No, I don't think so. But, again, that requires a lot more refinement.

I didn't focus as strongly on that because I felt that estimate was high.

MS. GILL: He's got a question in the front.

MR. NUTTER: Oh, sure. Clarke?

MR. HARPER: I just would like to reemphasize -- I mentioned this to the group many times -- that if you do gather data, it would be appropriate to share it with the world, in either SAE papers or forwarding it to our ongoing rulemakings, because you run these tests and then we're sitting here in the dark and we can't see what your durability data is and we can't make any decisions.

We go around the world and try to find railroads and fleets and try to find out what the haze and durability is.

So if you collect data, share it with the world. That's all I can do is encourage you.

MR. NUTTER: Okay. We'll do that.

(Applause)

MS. GILL: Thank you, Doug.

We will go now to our next guest, J.L. Bravet. He's with Glass Plastics International. He's the Glass Plastics International Project

Manager. I'm sorry.

LAMINATES

J.L. BRAVET

GLASS/PLASTICS INTERNATIONAL PROJECT MANAGER

SEKURIT SAINT GOBAIN AND SAINT GOBAIN VITRAGE

MR. BRAVET: Ladies and gentlemen, I will just do a short communication.

I am representing the Sekurit Saint Gobain subsidiary of the Saint Gobain group.

As you may know, Sekurit Saint Gobain is the leader producer of automotive glazing in Europe. Our group is also conducting operations in Asia, Central and South America.

Since many years the name of Sekurit Saint Gobain is associated with safety glazings. Our glass plastic activity with secure flex and bilayer products is one of the examples.

But we are also involved at production level in tri-laminates, not only for windshields but also for side windows.

We are presenting and equipping a full set of tri-laminates in one available German car maker, including side windows, for more safety and security as well as increased acoustical and thermal conform.

In Europe, we also participate with affection groups and tires in the way of reducing ejection with side windows in the case of rollover.

In this line of productions, Sekurit Saint Gobain supports strongly NHTSA in the way of increased safety against ejection through side windows.

Our tradition to report harm today can testify of that. Sekurit adds it statement expressed before to reemphasize the importance of and need for another policy to address the roll of glazing in crash injury prevention and, of course, Sekurit continues to offer cooperation at a technical level.

We have experts in safety testing, designing glazing with encapsulation for side, which is another field where Sekurit is operating by it's own -- in Europe we frequent use technologies for our rim, thermal plastic, injection and extrusion. And of course, we can offer to supply materials.

In this topic on the ejection side windows, Sekurit Saint Gobain considers the tri-laminate as the first step, which can be operated with limited lead time and reasonable costs.

Tri-laminates may further increase safety by preventing laceration and glass intrusion in the car compartments.

Thank you, very much.

MS. GILL: Thank you.

Are there questions or comments?

Clark?

MR. HARPER: Clark Harper. Let me clarify current usage of your side windows.

It's being used in the Audi 88, correct?

MR. BRAVET: Yes.

MR. HARPER: You mentioned a bus?

MR. BRAVET: No. The bus is -- at the moment at the testing level. We have some work with French car maker -- bus maker in order to test the interest of advanced glazing for the prevention of ejection.

An in Europe many of the bus side windows are tempered side windows on the glass. And there were a few occurrences in the past years, and in the very recent cases, like the case of that accident, involving ejections and this is developing some pressure, maybe, to introduce things like advanced glazing.

At the moment the use of laminated or bi-linear glazings or even plastic is considered as the number one contender, before the use of safety data.

MR. HARPER: Without divulging any future plans of an automotive companies, do you think there will be some other companies within the next few years?

MR. BRAVET: For automotive, or for personal?

MR. HARPER: Automotive.

MR. BRAVET: At the moment we think that there is less pressure for that from the automotive point of view. The people seem confident with a safety belt, and airbag from the car makers. And at the moment we think that for safety reason could be difficult to push advanced glazing in Europe.

DICK MORRISON: Dick Morrison, Ford. Mr. Bravet, would you expect that the mechanical durability of your product be considered for use in side window glazings would be any different than you experienced in your windshield pleats over the front?

MR. BRAVET: For?

DICK MORRISON: For durability.

MR. BRAVET: For durability for side glazing compared to windshield?

DICK MORRISON: Yes.

MR. BRAVET: Yes, we think that it should be about the same amount. Yes.

MS. GILL: Well, thank you.

(Applause)

MS. GILL: Our next speaker is Richard Morrison. He will be speaking to us on ejection mitigation and he's representing AAMA.

EJECTION MITIGATION

RICHARD MORRISON

AMERICAN AUTOMOBILE MANUFACTURERS ASSOCIATION

RICHARD MORRISON: Good afternoon.

America's car companies, Chrysler, Ford, and General Motors, commend the Agency for adopting recommendations made at the Administrator's meeting on reorganization to increase the communication between the Agency and the private sector before formal rulemaking proposals are published.

This approach helps to smooth out and expedite the rulemaking process. It also affords the Agency staff opportunity to draw information and ideas from a much broader range of expertise than otherwise may be available.

Open pre-rulemaking discussions, such as today's, allows alternative and even opposing approaches to be examined more comprehensively and more candidly than they could be within the formal rulemaking process.

We appreciate this opportunity today to be here and to learn more about the substantial amount of Agency work in the area of ejection mitigation using advanced side glazing, and to hear the comments of other interested parties.

We've not yet had the opportunity to fully evaluate the technical options identified in the November 1995 status report, Ejection Mitigation Using Advanced Glazing.

However, the information presented today will help us to prepare a comment in the near future.

Notwithstanding that, the American Automobile Manufacturers Association strongly urges the seat belt use. There are two points that are evident that I wish to make at this time.

First, occupant ejection, through side door glazing, is recognized as a rare event.

1988 to 1994 NASS data shows the national estimate to be less than one percent through passenger car windows.

However, given the injury risk associated with ejection, we recognize the importance of minimizing the potential for occupant ejection, which brings up my second point, and that is the need to continue to urge the proper use of seat belts, which has proven to be the most effective ejection countermeasure in all crash modes.

In 1988 through 1994 NASS data shows that properly belted occupants of passenger cars are ten times less likely to be ejected.

AAMA is willing to assist the Agency in this rulemaking process, and in any case it's clear that occupant ejections are a very complex matter and we're willing to assist the Agency in any way that we can to better understand the safety concern.

We look forward to additional pre-rulemaking discussions with NHTSA on this subject.

Thank you very much.

(Applause)

MS. GILL: Are there questions? Any comments?

(No response)

MS. GILL: No questions, no comments. What is this?

MR. MORRISON: Oh, great.

MS. GILL: We cannot leave before our scheduled time.

But if there are no further questions or comments, we will move on to the next individual who is consultant, Carl Clark.

He has a video, I believe, on side vent window ejections.

SIDE VENT WINDOW EJECTION VIDEO

CONSULTANT, CARL CLARK

CARL CLARK: Margaret you gave me ten minutes instead of five, so I can say a little bit more.

MS. GILL: All right.

Dr. CLARK: Indeed, we are killing, still, 22 percent of the occupants that are killed in passenger cars by ejection and something like 75 percent of these go through glazing.

So when you say, the side window is a minor part of all of this, Dick, in terms of the deaths it's very significant.

In the light trucks and vans it's even worse because they roll over more easily. It's 40 percent of the occupant deaths are with ejection.

Now, how many in this room have been driving any part of a trip without their belt attached? Be honest about it.

Only one? Really? Every minute you attach your belt? Well, good for you.

Most of us do not. Most of us have

moments when we're out there without our belts attached. The child is fighting and you turn around and help them, or you're backing up.

GERALD DONALDSON: We already have the children bound and gagged, Carl.

DR. CLARK: Good.

So, indeed, in Germany, for example, they claim over 90 percent belt use, and yet when I've questioned, what percent of your fatalities involve ejection, they first say, well, we didn't measure that because the belts take care of the problem. But then when they do begin to look at it, it is, indeed, in the 18 to 20 percent level.

Terrier and France said the same thing to me. When he examines the deaths that involve ejection of occupants, it's around 20 percent of passenger cars.

In other words, we all have lapses and there are a sub-population or part of the population that do drive too fast, don't restrain themselves, don't restrain their children.

It is astounding when you look at the one to four year olds, one to four year old children that are killed in passenger cars, 22 percent are ejected. Twenty-two percent are ejecting, and yet we're claiming, you know, a child restraint will save 75, 85 percent of them, and 80 percent of them were restrained.

It only takes a fraction of one percent of the people driving to make the number that are killed. A fraction of one percent.

So this is a major problem and we do need to deal with it.

I did some of the early work at NHTSA and so I am going to show a quick video summarizing some of this and it ends up with these big -- I call them event windows, but indeed, I understand today that some people call them flipper windows; on the Dodge Caravan and so on.

So let's just take a quick glance at the laceration problem. You get all cut up with fresh glass and it breaks all up and you get torn; it's the Insurance Institute for Highway Safety.

We have the secure flex windshields, boy it's so nice and smooth you bulge into the glazing so that the neck effects are very much reduced from hitting a solid structure.

If you had a side window, it will break down into pieces, come flying in, and they're often in big chunks that cause significant laceration, although the pretense is that tempered glass does not lacerate.

With a glass plastic window, you hit this, the pieces are staged together. You can still see through them unless there's a bright glare situation.

And so the pieces don't go flying around and you get head support for preventing ejection.

If you are in a situation where you hit the window hard enough often you do roll up over the sill. You see the sides of some of these pieces. They have cracks in them so they pass the standard, but if you look at them as they're out on the road, they're big pieces.

This is the glass plastic glazing. It provides the impact protection so that you do not go through.

This is a dramatic rollover of GM just showing the way the bodies fly around in a rollover. The windows break out pretty promptly when they get these transfer loads. Eighty-five percent of the people who are headed toward windows head into a window that's already broken out.

Here they come. One goes out the windshield, the other one partially ejects through the side window. And both killed, undoubtedly, if they were alive at the beginning.

The rollover, on the other hand, has very little decelerations inside. The vehicle is decelerating at maybe two to three G at most. Actually, .4 G is what we use over the duration of the whole roll. So the loads are often small.

If you stay inside, you should not get killed if there's reasonable padding inside.

You can see an unrestrained person does float around you, you are better off with your belts and I urge you to use your belts. But nonetheless, enough of us don't, but we need to do more than that.

Once there are openings, why, you bounce along and start floating out these openings. And so as the floating continues, why one ejects all the way out the windshield, and the other one, who has his body out, but when the car rolls onto him he compresses the roof. The weight of the car on his chest.

In a slip situation, the dummy will hit the glass and the glass will shatter and go flying out and your head laceration and partial ejection and so on.

As you go to other -- you can see, again, the cracks often make fairly big pieces as you start the straining process.

With the glass plastic glazing, you form out whether or not ejected.

Again, 40 percent of the one to four year old children are ejected from light trucks and vans. That's ridiculous. That's ridiculous. And they're not all sitting in the front seat, so we shouldn't stop at the front seat is my own feeling.

There's the glass plastic and it deforms enough to reduce the loads on the head and on the neck. I do feel we need to strengthen the door frame a little bit, so it won't bulge out quite so much. You don't want it to slide up and go through too.

This was the LTD that had the front and back parallel supports and it would be nice if the auto companies would go back to that because they will get better ejection convection. And then you can make this just a plastic window.

That's a 30 mile an hour side impact; deforms the whole thing.

Now, here are the six year old, 46 pound dummies, dropping onto the Bronco side window at ten miles an hour. Now, at 15 miles an hour he's going to break through, and he just zaps right through that window.

Notice again the size of the pieces. Look at this big thing. Look at that.

Those cracks do not fully separate.

Now, this is the swing out latch that you have in the Caravan and the Villager and so many of the Japanese cars and so on. It's a stress localization point. The window is hinged to open like this by pushing on that latch.

So the child hitting that window will go right through it.

Again, look at the size of some of these pieces.

If you drop the child dummy ten inches, five miles an hour, hitting that stress localization point, the window will break and the child can eject. You can get five miles an hour lateral speed simply turning a sharp corner; five miles an hour of relative speed of a child hitting that window.

So we run the implications that in a severe -- now, watch, here's the latch and watch the stress pattern develop right at the latch.

As you must predict, you must predict

either a metal going through the hole or a glued support at the hole, is a stress localizer. And so we're risking our children at five miles an hour impacts.

Of course, glass plastic glazing with the encapsulation for laminated glazing and some sort would do this.

This is a 20 miles an hour on a rear window. Actually you went through those big, tourism windows under 15 miles an hour. This is 21 miles an hour with glass plastic. There's a lot of epilation on the outside. The inside remains smooth and the dummy hits it and slides down.

Now, you still worry about, what does he finally hit and you'd want to pad that and so on.

In Europe, there's a lot of interest now in the theft implications. Tempered glass, you give it a bang and it goes, and you reach in it and you grab the camera and that's it.

With Sentry-Glas Dupont, or glass plastic glazing in general, it takes quite a wallop to crack the glass and then you still have the plastic. By that time somebody's alerted and you stop the situation.

Can you imagine your wife sitting inside and having this happen?

So perhaps in Europe it's going to sell first for theft protection and for noise reduction, but indeed, 40 percent of the people in light trucks and vans are killed with ejection. Three-quarters of them are through glazing. Twenty-two percent in passenger cars. And this is true even for the zero to four year olds.

So let's get with it. It's time we put this stuff in. You all know it, you ought to do it, not wait for the government to say you must do it.

I preach. Thank you very much.

MS. GILL: Thank you.

(Applause)

MS. GILL: Are there questions or comments?

SY ADER: I've been involved in Ford Motor glazing for three years and I've worked with each of the OEMs on prototype and few production programs. One issue that was always burning at the onset, what's going to happen when we have to be in litigation.

I'm not a lawyer but it's a burning issue as a product that I do when I supply it.

What item that you list in every one of

those is responsibility. If the parents are not going to belt their kids, why does society have to take the burden of that?

As an OEM, if we're going to move a new technology forward and we're using some guidelines from NHTSA, is NHTSA going to support us when it gets to that litigation situation?

DR. CLARK: If the parents would train everybody to be tightrope walkers we wouldn't need bridges, we'd just spring a rope across the road.

Things do happen. And what you have to do is look at the reality of the world. And if indeed people are getting hurt and you can do something so they won't get hurt, then you ought to do it.

Now, we've been talking about training, but all of the studies do show that each generation has to be retrained and there's always a percent that don't do it. And when that percent is 40 percent, you should go after something other than trying to train.

SY ADER: The federal government just came out with the average price of vehicle is over $18,000 it's too high and we have to put all this safety stuff in because the public doesn't want to use these things.

And the lawyers come along and they get their cut at the pie. I'm saying if we're raising the issue of what we're going to do, what is NHTSA going to do and what are consultants going to. What do we do to make the vehicles safe for the people, but the people have to use them.

DR. CLARK: One of the major problems, of course, in the cost of the vehicle is that they're all after the 500 horse power engines. It takes 15 horsepower to maintain a car at 50 miles an hour on a level road. We don't need 500 horsepower.

There are a great many of things that are done for the so-called beauty effects.

You could make a very safe, big car that would have lower acceleration, but nonetheless be cheap.

SY ADER: I may be overstepping my bounds, but there was just a court case, Ford does now have to test to support a seat belt in an Escort, which is not a high count car, just a regular commuter type vehicle. Why? It wasn't legal in '91. It wasn't required in '91.

And if they wanted an air bag, they could have bought another type of vehicle. Why does Ford have to take the burden for that?

DR. CLARK: A lot of things are not required. There's no head impact requirement on a side window. You could leave no glass in the side window, I think, and pass the applicable safety standard, if you use a certain material that has to pass a test.

But, the original safety act says the manufacturers are responsible for any of the civil liability aspects, not just the government standards. Government standards are minimum standards. They're not the maximum standards to comply with. But that's a point of view.

Go ahead.

DICK MORRISON: Carl, Dick Morrison.

I just wanted to make a comment on the rollover tests that you and on your video. You make the statement that the occupants went out the windshield, when, in fact, they went out that windshield opening.

CARL CLARKE: Yes, yes.

DICK MORRISON: And it would be an incorrect statement to infer that infer that another product would have prevented that.

This was a breakdown of the mounting system of that function.

CARL CLARKE: Yeah. But if would have had the glass plastic kind of windshield, it would not have been so easily ejected from that opening.

DICK MORRISON: I don't know on what basis you would deduce that from that video tape.

CARL CLARKE: Well, not from that video tape. That was a fairly old car, probably with a rubber gasket, and whole windshield came out.

But I've done rollover tests in which the window is significantly broken up and yet the pieces are still attached enough to probably stop the bodies.

And that's what the analysis that you all have done has shown. If you have enough pieces left over this window, you prevent the ejection.

Yeah, I stand corrected on that. Thank you, Dave.

Well, I do think there ought to be a national consideration of this liability issue in some way to allow experimentation with new ideas through a pool of some sort so that if someone is accused, there is a spreading of the burden.

I thought about that for years, but I'm not sure just how to do it. I think that ought to be considered in a formal way, and maybe you should pass that up through your boss and see if we can do something of that sort.

But new ideas should be allowed to come into the market ahead of waiting for the common standard to force everybody to do it.

Thank you very much.

MS. GILL: We will take that into consideration.

CARL CLARK: Thank you.

MS. GILL: Thank you.

Our next speaker is consultant Herbert Yudenfriend.

OTHER PERFORMANCE BENEFITS ASSOCIATED WITH EJECTION MITIGATION

HERBERT YUDENFRIEND, CONSULTANT

MR. YUDENFRIEND: Actually, Carl stole a lot of my thunder and I really am not sure that I have too much left to say.

My purpose today is to respond to question 13 which says, are there any performance benefits in addition for preventing ejections known to be associated with ejection mitigating glazings.

We're all, of course, aware of the fact that practically all satellites in today's automotive vehicles are bent tempered glass and when glass -- and when doors and related pillars of these vehicles are deformed during side impact crashes, shattering of tempered glass can occur from flexural stress thereby increasing the probability and severity of lacerative injuries from flying glass fragments, and these fragments often fly in interlocked clusters which have pointed and sharp edges.

Of course you saw a lot of that in the video that was just presented.

The object, of course, is to focus a little bit on what I consider a critical issue and that is laceration injuries, which has been I think regulated to the background and yet they exist in numbers of hundreds of thousands annually in terms of automotive glazing related injuries.

I'm in the process of conducting ongoing research concerning the nature of automotive glazing and its behavior under various conditions, including crashes.

The first report of this research will be presented in a session on technologies for occupant protection at the SAE International Congress in Detroit on the 26th.

I would like to show you an example of fragments which occurred during a passive test of automotive side lights.

What we did was we took automotive side lights and slowly applied pressure until they failed and collected some representative fragments. These fragments are all interlocked, inter linked and obviously are in a position to cause significant lacerative injuries.

When related to side impact collisions, such as this one (indicating), where the doors and

"B" pillar are deflected significantly, the possibility of glass fragments flying at speeds which we measured at the inter -- yeah, the medium size fragments, which we could measure, were flying at a velocity of approximately 23 kilometers per hour.

In this particular case, they produced that kind of result. That photograph was taken by the attending physician.

It took over 220 stitches to close the wounds after the glass fragments were removed and it would ultimately require three additional surgical procedures to correct the disfigurements which resulted from this accident and that process would take several years.

The real issue here, I think, is the existing Standard 205, which I think needs to be revisited in view of the fact that it is so old. Originally I think it's 40 years ago or older and of course it still indicates that the individual glass fragment will not weigh more than .15 ounces or .425 grams if the glass has been shattered.

The fact is that our configurations today, in side like glazing, are so varied and the bending configurations, some of them are so radical that the fracture mechanics that are employed by that geometry is vastly different from those that occurred when the standard was first adopted.

If you'll remember a term that I used lightly today, plate glass. Quarter-inch plate glass tempered was the basis for the original standard and we're still using it in spite of the fact that both configurations and thicknesses widely vary.

Under the circumstances, and because there are hundreds of thousands of lacerative injuries related to automotive glazing, I would respectfully suggest that this needs a serious evaluation.

So in conclusion, I'd like to leave you with three thoughts.

First, serious lacerative injuries can and do occur due to the fracture of current tempered glass window and side impact crashes.

Second, that there have been many references today to alternative safety glazing technologies. They've existed for many years and the incorporation of any of those technologies would significantly mitigate lacerative injuries.

Third, obviously the question of the current FMVSS 205 standard and its appropriateness or adequacy in terms of the present use of tempered side lights and automotive glazing.

Thank you.

(Applause)

MS. GILL: Thank you.

DR. CLARK: Herb -- I've been working with Herb on some of these issues -- you talked about implying increased pressure, but you didn't describe it. You were simply bending the glass with a roller in the middle of it and rollers on the other side supporting it. You statically, very slowly, bent this glass and suddenly it shattered and the glass didn't fall to the floor, it flew, it flew at 22 kilometers an hour.

That's been a controversial point for years. Does tempered glass shatter and fly or not? And if it's strained, it flies.

MR. YUDENFRIEND: Well, Carl, to tell you the truth, I was hoping you'd induce everybody here to come to hear what the full paper said.

Thank you.

MS. GILL: Any other questions?

(No response)

MS. GILL: Well, I'd like to thank you for tolerating me today.

This has been my first time being a moderator. It's been some work. It's been a lot of fun and it didn't turn out as -- all has gone well, I think. I don't know what you think, but I think.

Before Steve Summers comes to us with closing remarks, I hope all of you have registered and I hope that you will provide comments in response to the Federal Register Notice. The docket will close on March the first.

Steve is going to put the address on the screen for you.

I hope that you have gained some information. We have. And we look forward to continuing to work with you. I hope you have a safe return back to wherever.

We held the snow up for you, and thanks again for your participation.

(Applause)

CLOSING COMMENTS

STEPHEN SUMMERS

MR. SUMMERS: I'd like to second Margaret's comments in thanking everyone for enduring the fire drills and the frigid temperatures to be here today. I appreciate the good turn out.

Real quickly, I just want to summarize where we're standing, what our time schedule is and where we're going to go from here.

As was pointed out earlier, this is some preliminary research we've conducted today. We've got a long way to go as far as our research.

Steve Duffy's going to be very busy out in Ohio continuing to work on the component development test and trying to refine the test so we can start answering some questions about the repeatability and seeing how it compares to a sled test.

We have only begun to address a lot of the injury questions.

We've been, right now, using HIC as a measure. We haven't really gotten involved so much with the neck injury, which is a big concern to our bio group. Hopefully once we stabilize the test we can get a little more information from the biomechanics, get them more involved.

But what are the injury concerns as far as there was no side window there before and now there is a side window even though it's a compliant plastic.

You've got low level forces that help over duration and that has some implication for neck injury.

Also, as you know, we've been working with Excel and other people in the audience in the industry who are helping us working on our encapsulated glazing designs. As we refine our designs, we're going to have to do additional testing on them and eventually down and around we might have to readdress the cost issues once we get to a more final design.

Our accident analysis is going to be an ongoing thing. All the way through this we have a lot of questions that we even brought up today about benefits questions and also most of our concerns to date have been about the full ejections and the rollovers.

We have not fully addressed the questions of side impacts and particularly belted people who are now going to hit that glazing where before there wasn't a glazing.

We're a little bit concerned about the dis-benefits that they showed in the benefits analysis where the people were being responsible for the bulk of the drivers where their belts have now got a harder object to hit and we might be causing some more AIS 1 benefits.

We've got to get a lot more resolution about that and exactly what are the trade offs. It's kind of hard for us as an Agency to penalize people who are wearing their belts even if it would save quite a large number of lives.

So we have to get a lot better handle on what exactly is going on there. So we'll be doing additional work on that.

As far as our schedule goes, Clark and I sold the glazing program, and the whole team, we sold it to the Agency and they have given us at least a stay of execution at least through next December when we're going to review the program and progress to date and we're going to revisit our rulemaking options.

One of the options that has been bandied about is, well, maybe before we make a decision or even before we go out with an ANPRM to hold another public meeting. Also, we need feedback on that. How effective or useful was this meeting to you today? Would it help you to have another one in the future? Would you rather see them every, you know, two years, what not?

Please, if you are going to give comments, not just -- include some comments on the whole public meeting process, whether it's helpful to you.

Because we are in a research stage and not a rulemaking stage, this is open research and you can come talk to us for additional research.

If you have a specific question or you want to give some specific information, you can contact any of the team members here or myself or Clark Harper who are the two co team leaders.

Feel free to give us a call. Send us some E-mail. I will have some information out on the Internet, the World Wide Web. It's a little bit easier for me to do that.

We have an electronic copy of our report up there. Real soon we're going to have a copy of the accident analysis, the hard copy analysis, that Linda did where she actually goes into further details.

It's in the docket and it's also going to be out available on the Internet.

Same goes for Dr. Winnicki's report on the matched pairs analysis. He goes into greater depth in a separate companion report. That's currently under Agency review. When it's done it's going to be published as an NTS report. You'll find a copy in the docket. You'll also find an electronic copy available through the Internet.

So we're going to try and reach out and make the information available to you. If you need help locating it, please let us know.

We are also going to try to make copies of all the slides that NHTSA used today available in the docket. So we'll make copies of those.

Since I know the docket is not the most readily accessible for any of you, if you call Clark or I, we'll be glad to see you get a copy. It might take us a couple of weeks to get them out because of some other things going on, but we will get a copy to you, and I'll also put them out on our Web site available.

Finally, I want to leave you with docket address. We really do need some comments and some feedback.

This is the address to send them in to the docket, and thanks for coming once again.

(Whereupon, at 3:20 p.m., the proceedings were concluded)

C E R T I F I C A T E

I Paul W. Mayes, transcriber, hereby certify that the foregoing transcript consisting of 185 pages is a complete, true, and accurate transcript of the testimony indicated, held on February 1, 1996 at Washington, DC, in the matter of the National Highway Traffic Safety Administration Public Meeting for Advanced Glazing Research.

I further certify that the foregoing transcript has been prepared under my direction.

___________ ______________________________

Date

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