UNITED STATES OF AMERICA
ENVIRONMENTAL PROTECTION AGENCY

IN THE MATTER OF: Volume I

Proposed Regulations for)
Revisions to the) EPA Air Docket
Federal Test Procedure for) Docket No. A-92-64
Emissions From Motor Vehicles)

Public Hearing of the Environmental Protection Agency in the above-entitled matter, held at Washtenaw Community College; Ann Arbor, Michigan; on Wednesday, April 19, 1995.

APPEARANCES:

MARGO OGE,
Director, Office of Mobile Sources

ROBERT MAXWELL,
Director, Certification Division

CARL FULPER,
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I N D E X

Ann Arbor, Michigan

Wednesday, April 19, 1995

10:10 o'clock a.m.

MS. OGE: Good morning. Please take your seats. Can you hear me?

I would like to welcome you to the public meeting this morning. As you know we're holding this public meeting to discuss the EPA's notice of a proposed rule to revise the federal test procedures.

My name is Margo Oge. I'm the EPA's director of the office of mobile sources, and I will be acting this morning as the presiding officer for this hearing. Unfortunately my schedule does not permit me to be here for the whole hearing, so I'm going to ask Bob Maxwell to be the presiding officer for the remaining of the hearing.

We're holding this hearing in accordance with Section 307(d)(5) of the Clean Air Act, which requires EPA to provide interested persons with an opportunity to give us oral presentations of data and views in addition to an opportunity to make written submissions.

The official record for this hearing will be open for 30 days as is provided under the Clean Air Act. Because the 30 days period ends on a weekend, this means that the written comments will be accepted through May 22nd of 1995, which is a Monday.

We will hold this hearing in an informal manner, however as the presiding officer I'm authorized to strike statements from the records that I consider to be irrelevant or needlessly repetitious, and to enforce reasonable limits on the duration of the statement of any witness.

Witnesses are reminded that any false statements or false response to questions may be a violation of the law. Witnesses will be allowed to make oral statements which may later expand in writing for the record.

We would ask you to state your name and affiliation prior to making your comments. When the witness has finished her or his presentation the members of the panel will be given an opportunity to ask questions to the witness -- issues that probably will be raised during the testimony.

We're having this hearing recorded and the transcript will be available for public inspection at the EPA air docket A-90-24. The docket is located at the EPA, Room M1500, 401 M Street, Washington D.C. 20460. Anyone wishing to purchase copies of the transcript directly from the court reporter should make individual arrangements with the reporter prior to close of the hearing.

As I said earlier the purpose of this hearing is to discuss EPA's February 7th 1995 notice of proposed rule making, which propose additions and some revisions to the Federal Test Procedure, referred to as FTP.

The proposed revisions are the result of several years of collection and analysis of what I consider extensive data regarding the in-use driving behavior. Much of the research that has been collected today, and the data collection, forms the basis of the EPA proposal. And we believe that that was done on a very collaborative effort with EPA, the auto manufacturers and the California Air Resources Board. As a result of this cooperation we all know much more today than we did four years ago on the behavior of motor vehicles and how such behavior affects emissions.

I hope that we can continue to work and learn together to improve an understanding of the issues as we move forward to finalize this regulation. We belive, and I hope that you agree, that the notice that we published on February 7th is an open and flexible proposal that has outlined a set of options that are here today for the purpose of public discussion.

The notice of the proposed rule making was intended to reflect the fact that there may be several ways of accomplishing the desired goals of the Act, and we will hear from you about those options that were presented in the notes of the proposed rule making. We will rely on a continuing cooperative relationship throughout the common period and beyond, to allow us to come to a well informed and appropriate decisions for finalizing the regulation.

So I do hope that today's and tomorrow's hearing will provide, along with your written statements, the material that EPA is looking for to finalize this regulation.

Once again I'd like to welcome you to this meeting. And I will turn this over now to John German, who's going to talk about the agenda and probably some more administrative issues that I didn't want to talk about, and he's going to do it.

Thank you.

MR. GERMAN: I just have a few housekeeping notes to go over here.

First thing I'd like to just clarify, you know, this is a hearing. We are not intending to provide any kind of background information. I assume that the folks here know what we published and have the background. If there are some people here who are here more for informational purposes and are not familiar with what we've done, we do have a limited number of copies of our Federal Register Notice, the Notice of Proposed Rule Making. And that'll be back at the sign-in desk. We ask you to please just take one copy each, the numbers are limited.

So what we will do today is simply hear testimony from anybody who wants to give it. We have a panel of people from EPA and we'll ask some questions -- and so on.

You've already met Margo, who is the office director for mobile sources.

Bob Maxwell, sitting on the right, your left, is the division director for the certification division.

I'm John German, I'm the project manager for the Federal Test Procedure revisions.

John Hannon is our representative from the Office of General Counsel, who has been working with us on these provisions.

Jim McCargar took the lead on putting together the Notice of Proposed Rule Making.

And Jim Markey has been doing a lot of coordination issues to much of the project, especially in reference to the high speed and acceleration work.

There's a couple of other people who may wind up speaking later or asking questions, maybe even on the counsel and individual issues, and if that happens I'll introduce them as the time comes.

If anybody had not signed in out at the back we would request that you do so.   And I'll ask you to sign in again tomorrow, separately, so we have a record of who was here on each day.

There's an agenda that's also back at that sign in desk. Attached to that is some of the very important information such as where are the restrooms, snack bar, telephones, pop machines, all that kind of stuff. So if you need information it's attached to the agenda.

And one thing we'd like to do is find out if there is anybody who is not signed up, who would like to speak.

And should I get that name here now? Okay. So is there anybody here, who hasn't signed up, who would like to speak, just raise your hand and we'll have somebody get the information.

As far as I know there's five groups who have signed up to give a presentation. The AAMA, the American Automobile Manufacturers Association, and AIM the Associated International Automobile Manufacturers, are doing a number of joint presentations. I belive there's 11 in all, and they will be consuming a fair amount of time today, at least tomorrow morning.

We will lead off with an overview presentation by Greg Dana from AIAM and Gerald Esper from AAMA. Following that there'll be presentations by Jack Kitowski of the California Air Resources Board, followed by Kevin from NESCAUM. And at that stage we'll see where we are and where we are relative to the lunch break. We may pick up with some other presentations then or just wait until after lunch.

The other folks who've signed up, Mercedes has signed up to do an independent presentation, and at 3:15 this afternoon, NRDC will have a representative here to do a presentation.

So, unless I've missed somebody? That's about it.

We're going to proceed with the testimony at this stage. We would like everybody who does speak to please clearly state their name and affiliation. Please used the microphone. And we would also like to have copies of your presentations both to the EPA panel and for the court reporter.

Anything else?

(No response)

MR. GERMAN: The first one is Greg Dana and Gerald Esper.

PRESENTATION: ASSOCIATION OF INTERNATIONAL AUTOMOBILE MANUFACTURERS, (AIAM); AND AMERICAN AUTOMOBILE MANUFACTURERS ASSOCIATION.

BY GREGORY DANA AND GERALD A. ESPER

MR. DANA: Good morning, my name is Gregory Dana, I am the vice-president and technical director of the Association of International Automobile Manufacturers, or

AIAM.

With me today is Gerald Esper, director of the Vehicle Environment Department for the American Automobile Manufacturers Association, or AAMA.

We appreciate this opportunity to comment on EPA's proposed regulations for revisions to the federal test procedures. We'd also like to commend EPA for the significant progress made toward providing a sound technical basis for this rule making.

During the last four years substantial effort and resources have been devoted by EPA, the California Air Resources Board, and vehicle manufacturers to identifying and analyzing in-use driving patterns that are not adequately represented by the current federal test procedures. These include high speeds, high acceleration rates, and air conditioning operation.

There are many complex issues associated with this rule making, each requiring extensive review and analysis. Industry has several test programs in progress to investigate these issues, although the extremely tight rule making schedule will make it difficult to develop sound technical answers for all of the open issues.

We would like to share our concerns and comments with you today.

Before Mr. Esper summarizes manufacturers' technical comments on the major aspects of the proposed rule, I would like to point out how far the automobile industry has come in controlling vehicle tailpipe emissions.

Compared to uncontrolled levels, Tier I passenger car tailpipe hydrocarbon emissions have been reduced by 98 percent, carbon-monoxide by 96 percent, and oxides of nitrogen by 90 percent over the current FTP. This was accomplished through significant vehicle modifications, both to vehicle hardware and software.

As you will hear today, the current FTP represents 85 percent of the in-use distribution of vehicle speeds and acceleration rates. Vehicle upgrades to control FTP emissions, such as exhaust gas recirculation, catalyst technology, electronic fuel injection, and the like, have gone a long way toward controlling emissions over the remaining 15 percent of the in-use distribution of speeds and acceleration rates unaccounted for by the current FTP.

While additional work is required to make the FTP more representative of certain in-use driving conditions, if those changes are needed and cost-effective, we do not believe that significant vehicle and facility changes are either necessary, or appropriate, to achieving this end.

We are concerned, however, that the regulations, as proposed, may indeed require very costly vehicle and facility modifications that move beyond the realm of reasonable cost-effective emissions controls. We are particularly concerned that the proposed standards may indirectly increase the stringency of current Tier I standards by requiring the use of Tier 2 or low emission vehicle technology.

We believe that such an increase in stringency is not allowed under Section 202 of the Clean Air Act. AAMA and AIAM legal staff will address this and several other legal concerns in more detail in our written comments. At this hearing we would like to focus our comments on technical issues and related cost effectiveness and cost benefit analyses.

At this point, Jerry Esper will provide you with some background on this rule making effort, as well as a summary of the detailed technical comments to follow this introduction.

MR. ESPER: Thank you, Greg.

As Greg mentioned, my name is Gerald A. Esper. I'm the Director of the Vehicle Environment Department for the American Automobile Manufacturers Association.

I'd like to reemphasize AAMA's and AIAM's commitment to investigating FTP revisions. To date our member companies have spent several million dollars and expended countless staff hours to ensure that any revisions to the FTP have a sound technical basis. We remain committed to the effort -- to that effort -- and to develop appropriate procedures and standards.

For background, Section 206 of the Clean Air Act states, and I quote, "The Administrator shall review and revise as necessary the regulations to insure that vehicles are tested under circumstances which reflect current actual driving conditions," unquote. I want to emphasize, "reflect current actual driving conditions." Given that mandate, EPA held a meeting in December of 1990, to share their plan for reviewing the FTP, emphasizing the role of vehicle driving behavior.

A major outcome of this meeting was a plan for several vehicle usage studies, a joint AAMA/AIAM ad hoc panel usually referred to as the FTP ad hoc panel, or just the FTP Panel, was formed to assist with the studies.

Over several months during '91 and '92, EPA and the FTP Panel monitored several hundred vehicles in Baltimore, Maryland; Spokane, Washington, in order to assess in-use driving patterns.

At the same time, the California Air Resources Board studied in-use driving patterns in the Los Angeles, California area, and -- Research Triangle Park division studied driving in the Atlanta, Georgia area.

In-use driving patterns and behavior were compared with those represented by the current FTP and several chassis dynamometer drive schedules were developed to investigate driving not currently captured by the FTP. These non-FTP drive schedules were then used to determine whether significant emissions producing events occur in-use, that are not represented by the current FTP.

In 1992, the FTP ad hoc panel developed a test program with significant input from EPA and the California Air Resources Board. Over several months in 1992 and 1993, 28 vehicles from various manufacturers were driven through the non-FTP schedules while critical vehicle parameters were monitored including engine-out emissions, tailpipe emissions levels, catalyst temperature, air/fuel ratio, and throttle position. Similarly air conditioning operation and its effect on vehicle emissions was studied in a later test program.

Based on the results of this testing the FTP ad hoc panel developed a proposal which included procedures and standards setting methodologies for FTP revisions. Although the Panel's proposal was not incorporated in the NPRM, it was referenced as a viable option.

The AAMA/AIAM proposal first presented in October 1994, will be reviewed here today by the FTP panel. Since last October, in anticipation of the NPRM, and to supplement the original data, additional industry test programs were developed and are currently in progress. Some new data and analyses will also be presented today.

I will now briefly summarize AAMA/AIAM comments on the treatment of the following topics in the proposed rule:

The first item is the AAMA/AIAM's preferred methodology. We believe that you should test vehicles over the intended control cycle, determine what emission control targets are feasible, add a compliance margin, which is typically referred to as "head room," and then determine, overall, the cost effectiveness of that limit and then take appropriate action based on that.

Next slide, please.

Under high speed, high acceleration driving, vehicle performance, we belive that the standards proposed in the NPRM are too stringent. The extreme nature of the proposed drive cycle, USO6, effectively overestimates the emissions attributable to high speed, high acceleration driver, which distorts the need for control.

The available data do not support correlation with the current FTP at Tier I levels, and the proposed requirement is inappropriate for lower performance vehicles. The FTP ad hoc panel will go into that in much greater detail later in our testimony.

With regard to air conditioning, the EPA and industry proposed standards need to be revisited based on cost effectiveness, taking into account hardware and facilities implications. The drive cycle proposed in the NPRM contains unnecessary content. The EPA's windows down method proposed in the NPRM is not the most technically sound alternative that was considered or is available to EPA, and the alternative of testing in a full environmental cell is extremely costly and burdensome.

After the FTP panel talks about this in more detail we'll discuss the stringency of the proposed standard and we will propose an alternative simulation method based on duplicating A/C compressor load.

The intermediate soak requirement has associated air quality benefits that are very small and are diminishing. The associated burden in terms of vehicle and facilities cost, however, is extremely high.

The FTP panel will recommend that this proposed requirement be dropped from consideration by EPA.

The benefits associated with off cycle control were overstated in the NPRM. New intermediate soak data based on LEV prototypes suggests a much lower, or much higher cost, a much worse cost effectiveness.

A representative of Air Improvement Resource, Inc., will testify. He is under contract to the AAMA/AIAM panel, and he will analyze the air quality implications of the proposed rule and will recommend revisions to the cost effectiveness and cost benefits calculations in the notice.

The facility burden associated with the proposed requirements is very large. The proposed phase-in is too short and too soon, and separating phase-in of the Supplemental Federal Test Procedure from the implementation of the 48 inch electric dynamometer is not feasible, and provides no added benefit. We'll discuss this again in additional detail and then we will recommend an appropriate and concurrent phase-in schedule and implementation date for both the Supplement Federal Test Procedure and the 48 inch roll electric dynamometers.

And then finally we have a number of concerns on other issues, the fuel economy implications of the notice, the electric dynamometer changeover issues, in addition to facilities burden associated with that; the defeat device language in the notice; high altitude implications, one particular case will be discussed; the weight-to-power implications for vehicles with low power to weight; microtransient driving -- sort of "twaddle" flutter if you will; vehicle power loss associated with control of non-FTP emissions.

And then diesel implications will be discussed this afternoon by Mercedes Benz. That is an independent presentation, but I have been asked by the FTP panel to endorse that on behalf of AAMA and AIAM. We do support what Mercedes is going to tell you about diesels.

Again, these issues will be discussed as we go through the testimony.

So then in conclusion, the AAMA and AIAM member companies, and in the case of diesels include some independent companies, fully endorse the testimony today, and the analyses of the FTP panel will present to you over the next several hours, which we incorporate by reference into this testimony. I do have a copy of all the slides that will be shown later today, so I'll give that to you.

And we firmly believe that the panel's proposals are technically sound, however the necessity and cost effectiveness must still be demonstrated.

And then finally, in consideration of the extensive test programs in progress and the need for further analysis, we would like to ask EPA to extend the comment period for no less than an additional 90 days.

That concludes my testimony and Greg and I will be happy to answer any questions you have on this overview that we've provided you.

MS. OGE: Thank you.

We're going to hold questions, specific questions when the technical panel presents their papers. But I have a general question.

Out of curiosity, are you using, in your presentations this morning and the afternoon, are you going to use the same data that EPA has used for your recommendations, or do you have additional data that EPA has not seen today?

MR. ESPER: Again, I'm Gerry Esper. There will be a little bit of additional data that has not, because of the recent time in which it was generated, has not yet been shared with EPA staff.

MS. OGE: Okay, and one more question. How do you define stringency?

MR. ESPER: How do you define stringency?

Well, I'm not a lawyer so I'm sure I'll get it wrong. Stringency is the level of standard that manufacturers must certify their vehicle control level to.

MS. OGE: And your comment was that the EPA proposal represents extensive stringent standards. How do you define that?

MR. ESPER: I'm not sure I understand the question, but --

MS. OGE: (Interposing) Well, what do you -- what criteria do you use to say that what EPA's going to do today or what we're going to do in the final, represents adequate stringency or it's extensive stringency?

MR. ESPER: Okay --

MS. OGE: (Interposing) and maybe that will come through the papers this afternoon?

MR. ESPER: I would think it will be addressed in more detail, but again --

MS. OGE: (Interposing) I think it will important issue for us, for all of us to understand, is the cost effective issue is a technical issues, I would personally like to better understand your concerns about what you're calling very stringent standards.

MR. ESPER: All right, we'll make sure we address that.

MS. OGE: Thank you.

MR. DANA: Any other general questions?

MR. GERMAN: Just a request that we probably should have made up front. If the speakers could let us know in advance of their presentation whether they intend to provide hard copies of the slides, that will save us a certain amount of scribbling. And if you also have enough to distribute in advance that would also be very helpful. The court reporter has also requested that he be provided a hard copy as well.

MS. OGE: Thank you.

MR. GERMAN: The next presenter on the agenda is Jack Kitowski from the California Air Resources Board.

ARB REGULATORY GOAL - NON-FTP EMISSIONS CONTROL BY JACK KITOWSKI

MR. KITWOSKI: Good morning. My name is Jack Kitowski, I'm with the Air Resources Board.

I'm please to present comments of the Air Resources Board here today, and before I start with the technical comments I would like to reiterate what's already been said a couple of times, that this really has been a cooperative arrangement. We've gone from, a couple of years ago, having emissions data on just one vehicle and a lot of opinions on how the emission results would look, to looking at non-FTP emissions in a variety of different areas, soak and air conditioning and high speeds; and getting a lot of information thanks to EPA and industry.

And I was pleased to see Mr. Esper's commitment, his emphasis on continued commitment by their member groups.

So that's very helpful.

I also think we have a long way to go. I'm going to say several times during my presentation that we need more information. I don't think that's news to anybody. I guess we're -- you know, being engineers, we get a little information, we want more. And that's pretty typical.

To first start out we talk about our goals and what our goals were. This is the goals of the Air Resources Board, is to maintain minimum FTP emission controls on the future LEV fleet. I'm going to emphasize the future LEV fleet throughout my comments today. And I know a lot of EPA's proposal covered both the L.A./LEV fleet, but pertained primarily to the nationwide fleet. And so I want to emphasize this is a California concern. We're going to primarily focus on the LEV fleet.

We've stated to industry and we'll state it here publicly that our goal is to require minimum emissions without a lot of hardware change on the majority of vehicles. We believe what we're proposing or what we will propose down the road, can be conducted with calibration changes, therefore it can be done more cost effectively, it can be done in a quicker time frame. That doesn't mean that it's going to be calibration changes on all vehicles. We fully believe that certain vehicles will need to go above and beyond that. And we're looking at a cooperative test program, an additional cooperative test program to set standards.

I'm going to provide a little overview here. I'm going to focus my comments on simply three areas, and I'll have some additional comments on a few other areas.

I'm going to start with USO6, USO6 stringency; and specifically as it relates to the composite approach. And again, this is as it relates to LEV vehicles. This is not conventional vehicles.

In looking at the stringency of the USO6 it's a little difficult to do it wrapped up in the composite approach. There are implied assumptions of the stringency, but there is certainly additional flexibility that manufacturers have, that they could go greater or less than the levels we're looking at.

For hydrocarbons, USO6 stringency, is at approximately Bag 2 levels. Again, more data is necessary. We think this may be a little bit more stringent than is feasible, with calibration changes for LEVs. We've got minimum data here, preliminary data on three vehicles we've tested at our lab. These three vehicles, there's certainly some qualifiers on them. These are three vehicles we want to be in our cooperative test program, but these three vehicles have 10 thousand miles, in that range. They're '95 vehicles.

On the FTP these vehicles, they're all Tier I or TLEV vehicles. On the FTP they did approximately half LEV levels, which is why we're looking at them in our test program.

And you can see, if you compare FTP Bag 2 emission results to the USO6 results it's very difficult. The Mazda 626, for instance, was basically zero, and trying to get to those levels would be very difficult.

These vehicles were selected, had minimum rich excursions. They weren't -- they didn't run at stoich, but they had minimum rich excursions. And so it follows that there's not going to be -- there's not going to be a lot of changes necessary to bring these vehicles into compliance.

For CO it's assumed to be roughly at the FTP levels, and we think this is a fair assumption, again based on these three vehicles. There's the FTP results and the USO6 results. There's some optimization that's needed, but we're in the ballpark there. Obviously more data is necessary and will be obtained, but that's in the right ballpark.

And then for NOx our preliminary look at the data indicates that we can probably do a little bit better than where the proposal's at. NOx gets a even a little more complicated than the rest, but assuming it's at FTP levels we think we can do a little bit better than that.

Again, all these were for LEV vehicles and not for conventional or Tier I vehicles.

I talked about more data being necessary. The ARB and industry's agreed to conduct a test plan of 20 vehicles, 10 of them at our facility, 10 of them by industry. And they were agreed on after quite a bit of negotiations. The negotiations certainly started internally in our organization just getting the test proposal out. I think both industry and our agency had to give up a lot on the comfort level. And what they really would like out of the test program, to get a test program that they need.

And we think the test program, when it's done, will provide some very important data on exactly where those emissions levels should be.

Most of the vehicles -- all the vehicles we're going to test and several of the vehicles industry will test will do some work in a rich bias area. This is not -- this is not calibrating rich, this is a slight rich bias.

The standard would be set at approximately fourth lowest vehicle and a headroom would be applied following that. And again, to reiterate, the standards are going to be chosen so that majority of vehicles, the LEV vehicles can meet the standards with calibration changes.

Talked a little bit about USO6 control strategy. There's a variety of different control methods, calibration changes. We talked about certainly avoiding enrichment. Eliminating enrichment is going to be the primary thing. Maybe a rich bias under certain high load conditions may be effective. And again, that's what we're going to study in our test program.

And I want to go over some test data industry's seen and EPA, I believe, has a copy of it at this point. This is some test data we did. And it's preliminary test data. It's one vehicle. It's a lot of room for improvement, but it's given an indication that rich bias is a strategy we should look at more thoroughly. It was on a '95 Pontiac Bonneville. It was not an aged catalyst. And, as I said, one vehicle, room for improvement; but the Bonneville met -- you know, certainly below LEV levels LEV levels when we tested it.

And that's just a typical example of oxygen sensor and a schematic of how it works. What we did was apply a multiplying factor to the oxygen sensor signal to get a slight right bias, and we did that a couple of areas with very predictable results.

The hydrocarbon levels went up as the multiplier went down. CO trapped hydrocarbons, except the increases were more significant; and NOx went the other way. And again, the increases were fairly significant.

When you combine the hydrocarbons and NOx together, what you get is, at some point right around .7, .75, there is going to be an optimum setting, optimum rich bias that these vehicles could be calibrated to under high load conditions that would reduce emissions. And that's simply because the NOx increases were much more significant than the hydrocarbon increases.

CO, during this process, as you see, the NOx benefits are much more significant than the hydrocarbon increases.

CO would go up slightly, but our primary concern during this process, as we stated, is hydrocarbons and NOx.

Talk a little bit about air conditioning. There's been a lot of work done on air conditioning. I think it's been great. Prior to this test program very little has been known about air conditioning emissions under real world situations, and we simply added a 10 percent load factor and said, "Well, we'll use that to compensate," and I think everybody -- well, everybody -- people may have known that it wasn't appropriate, but nobody had a handle on what the emission results were like. So we really appreciate the efforts of industry and GM to general additional data, clarify the situation.

This is just a summary of EPA's proposal.

The Air Sources Board, at this time, prefers the 95 degree test that EPA has proposed as their primary option. I don't think we've got enough correlation on that to real world, but it's still the option that we prefer the best, it still looks better than the other things we've seen. We certainly would like more information on that if that's the option that EPA decides to go with.

The secondary option we see is a full environmental chamber.

And then the third -- and I list this third, is the dyno load simulation work. I know industry's been doing a lot of work on that, but we have not seen much data. And I hope to see some of that data here today, but we have not seen much of that data. And hopefully when the data comes in it'll look good, but at this point there's no way to put the load simulation effort any higher than third on the list.

For LEVs -- and I'm limiting this to LEVs, it may be very difficult to meet the HC/CO NOx levels simultaneously, that EPA has proposed.

Air/fuel bias may reduce NOx emissions, but you're going to have -- you may have some slight hydrocarbon increases. Again, we would like to see more testing on that. I think if EPA, once a procedure is decided upon it'll be more easy to focus our testing results and our testing efforts.

Little bit about the phase-in schedule. EPA has proposed a very stringent phase-in -- I shouldn't say stringent, I should say aggressive phase-in schedule.

(Laughter)

MR. KITOWSKI: We like it.

(Laughter)

MR. KITOWSKI: But we do have some concerns. We have LEV standards phasing in at the same time and we do need to look at how that's going to work with the LEV levels. We realize that industry is going to have to -- or has limited resources, and is going to have to work on both of them at the same time. And so to that extent we may have some concerns for LEVs that EPA doesn't have.

So, for ARB that may be a stringent phase-in schedule. But it's still going to depend on how -- to the extent that -- basically it's going to depend on where the standards lie. And if this can be done strictly with calibration changes on the vast majority of vehicles, then that phase-in may not be too rigorous. If it requires additional hardware changes by more vehicles than we had anticipated, you know, then maybe we have to extend it out a little bit. But for the ARB, we're specifically going to be looking at how this impacts with LEV.

On the intermediate soak, that's a touchy issue. If you'd asked us six months ago on intermediate soak, what our position was, we would have said we probably don't need to be concerned with that. And that -- because our feeling was that the LEV levels coming in will control cold start emissions and consequently warm start emissions so significantly that it isn't going to be necessary to look at intermediate soak.

We did, however, one test point just to confirm this point, one test vehicle. And the results were a lot more significant than we would have thought. And so we're looking to test a few more vehicles on that. That's going to be planned -- no, that's going to be done next month. But until that we'll just say we're looking at the issue, we're open to it. It's not a closed book for us. And we'll see how the emission results out.

Obviously we have to balance -- again, the LEV issue, we have to balance the fact that most manufacturers will be putting catalysts closer and will have more thermal degradation concerns for their catalysts on LEV vehicles than they might for federal vehicles. And that may simply be an issue that the ARB has to look at independently.

A couple of issues now on the USO6 test cycle.

On the power to weight issue, one of the things we're doing is, where EPA has proposed, after a lot of discussions with industry, is for the high performance vehicles to simply have a two second, no enrichment clause in there. And I think that was a good compromise. We're still debating on the level point at which we do that -- weight to power point we do that.

But I think that was -- I think we'll get there from here.

One of the things we have a concern with, though, the point that's been debated is right around a weight to power of about 18. And we've tested some vehicles at around a weight to power of 20, that haven't needed two seconds of enrichment. And our thought was if that was -- two seconds of enrichment applies to the high performance it should apply all the way up. So we would want to insure that those vehicles -- all vehicles, at least have two seconds of wide open throttle control.

By the way, medium duty vehicles, we understand some adjustments are going to be necessary. It's been a back burner issue for us. It's one of those -- there's been several back burner issues for us. And we're getting down to crunch time. It's going to be one of those things where we're going to have to address it a lot more rigorously. I hope industry has some ideas, because I don't. But we'll just keep on going through and hopefully we'll get some test data on it.

With the USO6 test cycle, one of the things I wanted to point out was that directionally we all understand that stoichiometric control is going to cause higher temperatures. That's going to perhaps put an additional strain on the catalyst. But I don't think we've -- at least ARB -- hasn't seen enough data that really indicates the severity of the problem. We've seen very very little data, actually, that tries to quantify this.

And all we've heard is directionally this is not the right thing. So if manufacturers have some data where they're making an argument that in fact deterioration is a concern, especially maybe as it applies to intermediate soak, we would be interested in a little more data than we've seen in the past.

And basically, as a second point, all we're doing is re-confirming that, yes, we -- the whole object of this is to eliminate commanded enrichment. And we think the direction EPA's going is going to do that.

Summary and conclusions: I said it before, I'll say it again. We've directed this towards LEVs, ULEVs. We have not made really, many comments on how this is going to apply to the majority of EPA's proposals. And the composite strategy in itself provides quite a bit of flexibility for manufacturers, and that may be a very effective route to go.

We are going to look specifically on how these standards will impact the vehicles in California. We've appreciated the cooperative efforts we've had with industry. It's probably going to get tougher in the next six months. And that's good. That's okay. That means we're getting closer to the end.

We've really come a long way and I think we've got just a little bit more to do. Even if it is tough, I think it's going to be doable. I think we're going to have a test program, or a regulatory item, where we probably had more data generated than any other regulatory item in a long time. And I think that's a good thing. If we all have more information there's less guessing going on out there.

But more data is necessary and we look forward to cooperatively doing that with industry, with EPA.

MS. OGE: Thank you for your testimony. I have two questions for you.

QUESTIONS AND ANSWERS

MS. OGE: You mention in your testimony that there is a cooperative effort between your agency and industry to do some additional testing. You referred to any vehicles. When is the schedule for that data?

And the second question has to do with your current schedule for the proposed rule making from ARB?

MR. KITOWSKI: The EPA/Industry program, we're ready to get going with our testing. We're waiting on -- not to make it sound like industry's lagging, they're not. We're simply waiting for aged hardware, and when we get that we're ready to start our part of the testing.

I would think, over the next two months, that we should have that data generated. So that's about the time frame we're looking at.

In terms of our schedule, we currently made a decision to have our hearing after your final rule, assuming your final rule tracks the currently projected schedule. Tentatively January is when we're proposing out hearing on the item, and therefore our plans would be to reference a lot of the work you've done in terms of the test procedure already in the Federal Register.

We would be having a workshop on test data and the test program after that is complete, probably in the fall.

MS. OGE: Any other questions?

MR. GERMAN: You stated off with a comparison on some more -- I guess the transitional low emission vehicles, comparing the Bag 2 and the full emissions to the USO6. I don't think -- have we seen that data? Have you provided that to us?

MR. KITOWSKI: That data? No. That is recently pulled together. That's data we tested in the last two to three weeks, basically while we're waiting for our test program to start.

So we may not have provided you with that data.

MR. GERMAN: Okay, I'd appreciate it if you could.

MR. KITOWSKI: Let me just mention, John, if I didn't reiterate the point before, that -- that data was basically done to basically provide a reality check on where we thought we were, based on the data that's already been generated.

And it really -- we wouldn't want to use that in the rule making. There aren't aged hardware on that. It was done simply as -- because the dyno was free. And we're waiting to start our test program and we were hoping it could give a reality check. But certainly -- and it does give us good indication. It basically confirmed our assumptions.

But it's preliminary data because of some of its limitations.

MR. GERMAN: What I'm interested in is just that there seemed to be a pretty dramatic difference between a couple of the vehicles and how they behaved on hydrocarbons. I'd just like to take a look at that.

MR. KITOWSKI: Okay, certainly.

Yes, sir?

MR. MC CARGAR: Your date on the Bonneville when it had the rich bias introduced. You said that the catalyst had not been aged. Do you mean that was a green catalyst? Or it had some mileage? Or it just didn't have very high mileage?

MR. KITOWSKI: It had about 10 thousand miles on it.

MR. MC CARGAR: Okay, so it wasn't a green catalyst?

MR. KITOWSKI: It wasn't a green catalyst. Manufacturers have indicated that that still isn't enough mileage for their preferences, that there may be increased oxygen storage capacity at 10 thousand miles than you'd see at 50 thousand miles.

And directionally I can see that they're right, but directionally I can also see that the work that's done there appears sound. So the idea of a rich bias, I think, is valid, although the magnitude of those numbers may change.

MR. MC CARGAR: Okay, and on the data that John just asked about, did you get second by second data on those vehicles?

MR. KITOWSKI: No.

MR. MC CARGAR: Okay.

MR. KITOWSKI: Also, one brief comment. You asked for presentations, I don't have those available today, but I will get those to you.

MR. MAXWELL: I'm going to ask the general question. It's been a concern of the industry all along that we end up with common test procedures. And it's been certainly our objective, and CARB's to come out that way.

Is there anything about our current NPRM that raises a concern with CARB, that we could be set up somehow to go on divergent paths?

MR. KITOWSKI: I'm glad you brought that up, Bob. Let me run through the items:

First of all, the USO6 test cycle, we've agreed to it, industry's agreed to it. I think that was a great effort on all of our parts, to finally get to a point where we -- basically everybody got what they needed out of the cycle, but nobody was really comfortable with the final result. That's okay. It's a good test cycle and we'll all be happy with it five years down the road. That test cycle is not going to be different. The EPA and the ARB will have the same test cycle.

In terms of A/C, we feel you and industry have taken the lead on A/C. We voiced some comments here, that we'd like to see better correlation, but I don't -- I don't see us changing on that at all. I think you guys have taken the lead and you've done a great job on it. And we're going to let you continue to take the lead and provide technical comments where we can and where we think they're justified.

In terms of intermediate soak, that's an issue that we've told you all along, that we may or may not track. But I don't feel that, again, that that's necessarily critical for California vehicles. If we didn't track it and you did, they simply wouldn't run that test.

We've stated before that in terms of the standard we have some special concerns, in terms of the standard, that we're dealing with LEV vehicles. And it gets kind of complicated with the current composite approach in that the composite approach does apply to LEV vehicles and in fact the effective standard is more stringent for LEV vehicles simply because you're referencing either Bag 2 or the entire FTP and the levels have been reduced. Therefore we may deviate on the standard. I don't think that's going to cost manufacturers any significant concerns. I believe they've anticipated that.

MR. MAXWELL: To deviate means something that's probably more stringent than the level we propose for Tier I vehicles, but on the other hand what we, in effect, propose for Tier II vehicles, probably not that stringent, is that?

MR. MAXWELL: It may not be. It's very complicated to us and in fact, for instance if the hydrocarbon levels came out the way they did with these preliminary tests, we probably wouldn't want to go with Bag 2 levels.

So then you'd say numerically we are more stringent than EPA on the conventional vehicles, but yet our test procedures would be less stringent because you're referencing -- less stringent in terms of the fact that as it pertains to the Bag 2.

We also have some special concerns with phase-in in that we have some serious considerations with LEVs and how it's going to impact that. That'll probably be tied in a lot to the standard. And we like your schedule, as I said, but that may be a little aggressive in California. We're not sure yet.

MR. MAXWELL: Has California had a chance yet to address its own plans of what to do about the dynamometer changeover and how it would affect the basic FTP?

MR. KITOWSKI: We've discussed it briefly. I think we are letting you take the lead on that. I don't see any reason to deviate from what you're doing. So the rules that you apply with regard to dynamometer changeover, I believe will apply nation wide. I think that manufacturers would want that and we want that as well.

MR. MAXWELL: Obviously if we held to the current very aggressive schedule for the dynamometer changeover, which is due at all in '98, is one thing. But if we get into, say, coordinating that with other aspects of the revised FTP changeover, is there a point where you get concerned that we could go the other extreme, where the dynos are phase-in too slowly or have you not had a chance to really deal with that?

MR. KITOWSKI: Certainly there would be that concern. I don't believe they can be phased in any less stringently than the non-FTP requirement.

And when I say that -- I don't want to be misleading when I say that your schedule may be a little aggressive. I'm not talking we should -- what I've heard from industry and that we should extend it out six years and -- start two years later and extend it out six years or, you know, whatever it is. I'm talking maybe, you know, maybe a year. And that's a maybe.

So we're on the same page. It's a matter of fine tuning it. So I don't think any changeover of the dynamometers, as long as they at least track the implementation of the FTP, is going to be a concern.

MS. OGE: Anything else?

(No response)

MS. OGE: Thank you for your testimony. I think we agree with you of the importance of working together with your agency and the industry, because I think this is a wonderful opportunity for both California and federal EPA to harmonize on test procedures. And we're looking forward working with you. Thank you.

MR. KITOWSKI: Thank you.

MR. GERMAN: Okay, the next presenter is Kevin Green from NESCAUM, and I'm not sure what that stands for, so maybe Kevin can?

NORTHEAST STATES FOR COORDINATED AIR USE MANAGEMENT (NESCAUM)
BY KEVIN GREEN

MR. GREEN: Good morning. I'm Kevin Green, I'm an engineer with NESCAUM, I'd like to begin by expressing our gratitude for the opportunity to be here to talk about this important proposal with you, and by giving you a little bit of background on who we are.

The Northeast States for Coordinated Air Use Management, or NESCAUM, was formed in 1967 by the New England

Governors Conference, and represents the directors of the state air quality agencies in Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.

Our purpose is to exchange technical information and promote cooperation among the eight member states. To accomplish this, we sponsor occasional training programs, participate in the development of regional and national policy, and we promote a variety of research activities.

I've only been with NESCAUM about 18 months, but it's very clear to me that our members care really deeply about what they're doing, and I think they have what is a really unique ability to share resources and expertise to achieve objectives that might otherwise be imposing.

I think that an excellent example is our joint release yesterday, with our counterparts in the mid-Atlantic region, of a report that we think is going to establish a blueprint for air emissions trading programs that will help to provide important flexibility to regulated parties, and thereby reduce net costs to society of achieving air quality objectives.

I think that this is a great example because it demonstrates that we in the Northeast, like most state and federal officials, are probably more sensitive to costs than we may have been in the past, and are increasingly interested in seeking innovative and flexible solutions.

However, I think it should be clear that in pursuing innovations and flexibilities, we need to ensure that adequate tools are available to accurately measure achievements.

Within the context of motor vehicles the key tools from this standpoint are the Federal Test Procedure, or FTP; and the mobile emissions model. For a number of years we've realized that both suffer from "varyingly" severe shortcomings. Recognizing their importance, several of our senior agency staff met with EPA before passage of the 1990 Clean Air Act Amendments to explore the potential for appropriate revisions. We're therefore extremely gratified to see these early discussions finally bearing fruit.

Before addressing the proposed revisions to the FTP, I'd like to acknowledge the remarkable progress that has been made in reducing emissions from motor vehicles. Concerns about uncontrolled emissions aside for the moment, it should be clear that with a doubling in vehicular travel over the past 20 or so years, we wouldn't be seeing improvements to air quality if the cars and trucks hadn't gotten significantly cleaner along the way.

Unfortunately the importance of such achievements is often overlooked. We clearly need to remind ourselves that the continued push for advancements in technology provides the flexibility that allows us to grow economically and still achieve progress toward environmental objectives, and that we've got pretty convincing evidence to prove it. A perspective of this sort helps us to avoid a sense of impossibility when faced with inventory projections and air quality modeling results that indicate difficult challenges to achieving ozone attainment, as scheduled in the Clean Air Act; and further challenges achieving further ozone reductions that are probably necessary to adequately protect public health.

With that in mind, NESCAUM continues to support an integrated strategy to manage emissions from motor vehicles over the next couple decades. This strategy is based on four core elements:

The introduction of increasingly clean vehicles, the reliance on periodic inspections and on-board diagnostics to ensure that vehicles receive proper maintenance; the reformulation of gasoline for lower emissions, and the implementation of measures to increase reliance on alternatives to single occupancy vehicles.

As you all know, progress on these core elements has been anything but easy in recent months. I think there's a false sense that EPA and states are singling out the auto industry. Anyone who's considered the scope of our activities should realize that really isn't the case.

In the Northeast we recently completed a very difficult process that enabled us to finally forge an agreement with some of our upwind neighbors regarding appropriate levels of stationary source NOx control.

We're also taking a very serious look at other mobile sources. In fact the only reason I'm here today is that Arthur Marin, my boss, is here in town negotiating with lawnmower and chainsaw manufacturers over what will already be a second round of VOC controls. We're also a little bit behind on a promise to try and provide a forum for states, environmentalists, EPA and manufacturers, to discuss a few difficult issues related to recently proposed regulations for outboard marine engines. And I shouldn't overlook our strong support for EPA's plans to further reduce NOx and fine particulate matter from heavy duty highway and nonroad engines, as these engines may eventually overtake light duty vehicles as mobile sources of NOx, and are already a major source of particulate matter, perhaps our most hazardous air pollutant.

However, a lot of those efforts are being pursued based on the assumption that the comprehensive motor vehicle program we've advocated will eventually reduce light duty vehicle and truck emissions to the point where the remaining mobile source emissions will be largely represented by heavy duty and off-road engines. Projections of this sort are generally based on EPA's mobile emission factor model, which, in turn, draws significantly from testing based on the Federal Test Procedure.

It has been widely acknowledged in recent years that the FTP and, perhaps to a lesser extent, the mobile model fail to account for a significant amount of emissions that occur "off cycle". This results in several biases in the development of air quality improvement programs.

First, it biases the program against further reductions in light-duty vehicle emissions.

Second, it biases the program against technology enhancements. In particular, it biases motor vehicle programs against numerous advanced technologies such as electric vehicles, which eliminate all off cycle emissions; and solar powered cabin fans that can drastically reduce initial air conditioning loads on hot days.

Third, although we strongly support the periodic inspection of in-use vehicle emissions, a similar bias may exist toward this strategy and away from on-board diagnostics and further technology advancements.

Fourth, within the context of periodic inspection, it may bias repairs somewhat away from those that are affected in reducing off-cycle emissions.

More fundamentally, such shortcomings in our measurement tools mean that we really aren't achieving as much as we thought. It's therefore of the utmost importance, as was recognized in passage of the recent amendments to the Clean Air Act, that EPA revise the test procedures used to measure emissions from motor vehicles so that they more accurately reflect real world driving.

We would therefore like to applaud the extensive effort that EPA, ARB, and the automobile manufacturers have all undertaken to develop the data that's so critical to such a technical rule making.

We know that EPA is very late relative to the schedule laid out in the Clean Air Act, but we think that in light of the intensive technical effort needed to support this effort, that the wait has been worthwhile.

We hope that EPA will make good progress toward promulgation of final revisions and will be glad to assist to the extent that we are able.

Before getting into detail I'd like to discuss our view of the basic philosophy outlined in 206(h) of the Clean Air Act, which requires enhancements to vehicle test procedures.

In our view, EPA's charge under 206(h) is to fix the test procedure. There's no indication that the numerical values of the standards are supposed to change in the process. Although this means manufacturers will be held responsible for emissions under conditions not covered in the past, we think that was the intent. More importantly, we really think that this is the right way to go even if it's somewhat more painful in the short term.

What got us to this point in the first place was that we had a test procedure that didn't capture certain aspects of in-use operation that now have a sizable impact on vehicle emissions. With the data EPA now has in hand, it can go down one of two very divergent paths.

One would be to revise the test procedures such that they cover as much in-use operation as possible, extending the useful life of the current round of revisions and minimizing bias against technologies that improve emissions that aren't covered by the current FTP.

The second would be to make incremental modifications to the test procedure based on the capability of what are essentially Tier I technologies. Although this approach is likely the path of least near term resistance, it would tend to continue the state of denial that got us to this point in the first place, and would continue to bias the test procedures against advanced technologies that can effectively reduce off-cycle emissions.

Given that the clear mandate to undertake significant improvements to the test procedures was so long in coming, NESCAUM feels that it is appropriate to take a long term perspective and to therefore pursue the greatest possible coverage of in-use operation. In our view, this is the directive embodied in 206(h).

As EPA acknowledges, Congress was silent on the relationship of this directive to the level of numerical standards. This leads NESCAUM to the conclusion that Congress intended the numerical standards for Tier I vehicles, and the pending numerical standards for Tier II vehicles, to apply under the revised test procedures. The logic of this interpretation is enhanced if the deadline for test procedure revisions is taken into account.

Congress directed EPA to modify vehicle test procedures by mid-1991, two and a half years before Tier I standards went into effect. Given that the language regarding Tier I and pending Tier II standards is not contingent upon the outcome of these revisions, it must be concluded that Congress intended for both the Tier I numerical standards and the pending Tier II numerical standards to apply under the revised test procedures. In other words, Congress intended for the standards to be met under real driving conditions and mandated that EPA fix the test procedure to assure that.

In NESCAUM's view, EPA should therefore modify the test procedures in order to fully account for at least those aspects it has already been pursuing, in other words aggressive driving, increased throttle speed variations, intermediate duration soaks and air conditioner use; and should retain the Tier I numerical standards under the modified test procedures.

However, we recognize that a lot of time and effort has gone into developing the currently proposed framework and would like to offer a few suggestions within that context, bearing in mind our clear view that such a context is considerably less protective than that outlined in the Clean Air Act.

First -- and I've got, I think 11 of these:

First, with respect to aggressive driving, we support the use of the US06 cycle that's been developed by EPA and ARB. We think it strikes an effective balance between coverage of important off cycle driving characteristics and overall testing time requirements. We also feel quite strongly that such a test cycle must be based on actual in-use driving, as opposed to simulated acceleration and/or high speed cruising.

Second, we strongly support the inclusion of intermediate duration vehicle soaks and vehicle start driving behavior, which can have a significant impact on emissions. If greater emphasis had been placed on the short median trip length observed in EPA's driving surveys, this effect would likely be even more pronounced. NESCAUM also supports the use of the air conditioner during this portion of the test, as synergistic effects could be important during the initial pulldown after a one or two hour soak.

Third, we're encouraged that EPA has proposed to take into account the use of air conditioners. Obviously this is a relevant factor on the hot summer days that tend to coincide with ozone "exceedances".

Although we're still weighing the alternatives proposed by EPA, our initial inclination would be to rely on actual operation of the air conditioner, with some sort of environmental simulation. This would minimize the dependence of the test procedure on a technical characterization of the A/C system and its operational profile, and would also aid in the detection of engine control algorithms that adjust the emission control strategy based on A/C operation.

We share the Agency's concern regarding the potential cost of full environmental simulation, and encourage the Agency to seek less expensive ways to simulate thermal loading. We think EPA's attempt to use interior heaters to simulate solar loading is a step in the right direction and will try to offer additional suggestions in our written comments.

NESCAUM also encourages EPA to promulgate a test procedure that reflects the reasonable assumption that air conditioner use occurs in all summertime driving conditions. In particular, we think EPA should require use of the A/C during the cold start cycle.

Fourth, we strongly support EPA's proposal to rely on a composite supplement to the FTP. NESCAUM is aware of the joint AAMA/AIAM proposal to have two separate tests, one for high speed load operation and one for air conditioner operation.

As I already mentioned, inclusion of intermediate duration vehicle soaks is important to NESCAUM, as such soaks have a significant impact on emissions.

I have to say that we're basically at loss to comprehend why the automakers would want to have two or three separate new tests to pass without any opportunity to balance relative opportunities on each test. The one reason we have been able to think of is that keeping these off cycle operational aspects separated ensures that emissions increases due to synergistic effects will be ignored. For example, although the relative impact of an intermediate soak period may be greater with the air conditioner on than off, this wouldn't be observed in a testing scheme that maintains a clear division between these operational aspects.

We therefore must argue that a composite cycle is important because it offers manufacturers greater flexibility, and because it should enhance the ability to capture synergistic effects.

Fifth, we remain of the view that EPA's instructions in the Clean Air Act basically require revisions to the test procedures without adjustments to the numerical standards, and therefore recommend that EPA reduce the proposed NOx standards so that they're numerically identical to those given in the Act. At a minimum we urge EPA to reject the automakers proposed weakening of the numerical standards, and the move to combined HC plus NOx standards.

Although we can understand the desire for interpollutant averaging as a source of flexibility, we need -- and I think this is quite important -- to be able to manage HC and NOx emissions independently at the state level in order to design cost-effective ozone control strategies.

Sixth, we urge EPA to revisit the fuel

specifications for the test procedure, an area specifically identified in the Clean Air Act. And we will attempt to provide some specific suggestions in our written comments.

Our basic interest, I believe, is achieving greater consistency between certification and in-use fuels, which would require some sensitivity to the characteristics and market penetration of both conventional and reformulated gasoline.

Seventh, we would like to make sure that EPA is being mindful of the potential impact of the proposed dynamometer improvements on independent testing laboratories. Although we fully support EPA's inclusion of aggressive driving patterns, and although we can't argue with the fact that a large, electrically loaded, single roller will do a better job of representing a real driving surface than a hydraulically loaded set of small rollers, we're concerned that many labs are going to have a hard time coming up with half a million dollars per cell to upgrade.

We're encouraged by EPA's indication that alternative dynamometer designs will be accepted given appropriate correlation. However, we'd like to see a more explicit analysis of the potential of some of the alternatives in the spectrum between eight inch twin rolls with hydraulic loading and a 48 inch roll with electrical loading. At a minimum this should include electrically loaded dynamometers with twin eight inch and 20 inch rollers.

We also believe that EPA should issue performance standards for dynamometers used for such testing, in order that a target for correlation may be clearly defined.

Eighth, although we support EPA's intent to use the sum of the change in specific power as an additional trace tolerance criteria for all FTP drive cycles, we'd like to see more detail in the regulatory language regarding this parameter and potential acceptable ranges.

Ninth, we'd like to make sure that EPA is actively seeking to resolve some of the potential challenges that may arise in attempting to perform the revised test procedures. For example, rear wheel drive vehicles -- in particular lightly loaded vans or pickups -- may experience difficulty achieving the high deceleration rates included in the US06 and SC01 cycles.

Also, in exploring cost effective alternatives to full wind tunnels for cooling during A/C testing, we hope that EPA will consider potential side effects such as fuel heating.

We don't mean for these concerns to detract from our support for changes to the test procedure, we just want to make sure that EPA is attempting to resolve them in ways that take into account the capabilities of independent laboratories.

Tenth, we recommend that EPA seriously consider adjusting its defeat device policy to account for the fact that increasingly sophisticated vehicles can be programed to detect virtually any predefined test procedure and relax emission control strategies without fear of repercussions.

We tentatively support the approach outlined by EPA in the support documentation, which would require proportional vehicle controls, and will attempt to provide additional thoughts on that approach in our written comments.

Finally, we urge EPA to demonstrate a stronger commitment to near-term enhancements to the mobile model to account for the effects observed in the course of this development effort. As this is the tool that's used by states to chart progress and make decisions about program development, it's important that it fully characterize in-use emissions.

In conclusion we're truly impressed with the efforts of EPA, ARB, and manufacturers to develop the data needed to make sound revisions to the test procedure, and hope that our comments will be useful as decisions are made about precisely how to make those revisions.

We will continue to review the entire proposal in more detail and will expand on these comments in writing in the near future. We hope that EPA will look to our members for support on this very important activity.

Thank you, and with that I'd be happy to take any questions you might have, bearing in mind that we're coming into this with considerably less involvement to date.

MS. OGE: Thank you, Kevin.

You mentioned that you will be submitting additional data on some of the aspects that you have expressed concerns. We would be looking forward to get your additional data in the next few weeks.

MR. GREEN: I'm not sure I promised data.

MS. OGE: You promised some additional information throughout your testimony. If you don't have data, that's fine too. Whatever you have we're looking forward to receive it.

MR. GREEN: Well, the New York DEC lab (phonetic) tried to run a USO6 a couple of days ago when I called in for some thoughts, and I heard tires squealing in the background. So perhaps we'll have something.

MS. OGE: Okay, that sounds fine, too.

Any questions?

QUESTIONS AND ANSWERS

MR. GERMAN: I think, if I interpret what you said correctly, is that you were saying that you --on the air conditioning stringency that we are proposing, that you would actually like to see us eliminate the increase, the allowance that we were giving. Is that correct?

MR. GREEN: Again, I think our basic philosophy coming into this is that Congress asked you to fix the test procedure, not change the numbers of the standards.

So I think, in our view, Congress was saying, you know, "Make the test procedure representative of real world driving," which includes air conditioner use. And I think the assumption there was that the Tier I standards were to apply in real world driving conditions.

MS. OGE: Any other questions?

(No response)

MS. OGE: Okay, thank you again.

MR. GERMAN: We're moving well ahead of schedule here. This is supposed to have been noon right now. So it's definitely too early to break for lunch. And I'll leave it up to the AAMA, or whether we should go ahead with the Mercedes presentation on the diesel right now.

Do you have a presence?

A VOICE: We'll have Mercedes now.

MR. GERMAN: Okay, then we'll have Mercedes, and if I can read this scribbling, I belive it's Karl Weber and

William Kurtz.

IMPACT OF PROPOSED CHANGES ON DIESEL (Mercedes)
BY KARL WEBER, PATRICK RAHER, and WILLIAM KURTZ

My name is Karl Weber, I'm manager of North American certification for Mercedes-Benz AG.

Accompanying me today is Patrick Raher of Hogan and Hartson, and William Kurtz of Mercedes-Benz of North America.

We appreciate this opportunity to comment on EPA's proposed revisions to the Federal Test Procedure for exhaust emissions from motor vehicles, as published in the February 7, 1995 Federal Register.

MBAG is especially interested in the impact the proposal would have on diesel vehicles. My testimony will be limited to this issue and I will present important new test data concerning the impact on diesel vehicles, which would result from the current proposal.

By way of background, MBAG is actually one of only two manufacturers of light duty diesel vehicles sold in the United States. The diesel engines produced by MBAG for the U.S. market contain the most advanced emission control technology currently available. Accordingly, our engines include four valves per cylinder, prechamber diesel fuel injection, electronic control diesel fuel injection, map controlled EGR and oxidation catalysts.

As a result of this technology Diesel vehicles have an excellent record in terms of low emissions, virtually no emission deterioration over one hundred thousand miles, and reduced greenhouse gas emissions.

MBAG believes that EPA must take diesel vehicles into account in finalizing its proposed rule. As noted in the proposed rule, the Agency had no data available to gauge the impact of the revised test procedure on diesel engine certification to existing standards. Indeed we are unaware of any diesel vehicles being used to determine actual driving modes.

As I will demonstrate, test data clearly indicates that diesel engines equipped with the most advanced emission control technology cannot meet the standards proposed for the new test procedures. Accordingly EPA must either exempt diesel vehicles from the proposal or adopt a combined HC/NOx standard with a sufficient margin of safety or headroom. Without such action, the proposal would be an inappropriate increase in the stringency of the standards.

To specifically address Ms. Oge's question, stringency is increased if the EPA proposal would require significant vehicle modifications or new technology, as opposed to calibration changes, from what is required to meet the current standards under the FTP.

As you are no doubt aware, a diesel vehicle operates differently than a gasoline powered vehicle. A diesel engine operates throughout the total engine map with excess air. A conventional gasoline engine operates without excess air.

Thus, when analyzing the diesel engine we must recognize that unlike the gasoline engine, there is no operation at stochiometric levels, the ability to operate in a closed loop mode.

For purposes of comparison it is interesting to note that the raw emissions of a diesel engine are actually lower than the raw emissions of a comparable gasoline engine, except for particulate matter. Current uncontrolled NOx emissions from a Mercedes-Benz three liter diesel engine area are approximately 1.5 grams per mile, while the comparable gasoline engine is in the range of about six grams per mile.

The difference in the ability of these two engines to control NOx is that the gasoline engine can utilize a three way catalyst while the diesel engine cannot.

Diesel NOx is controlled through the use of EGR. Over the years MBAG has improved diesel EGR control systems to the point where today EGR is electronically controlled through the engine map according to engine load and speed conditions.

It is important to note that MBAG utilizes its EGR strategy throughout the engine map and not only during the current FTP. For this reason, as the new test procedure increases engine load in areas outside the FTP, the MBAG system will compensate.

If, nevertheless, vehicle emissions exceed the current standards it is a clear indication that the stringency of the standard is being increased and that totally new emissions control technology would be required to meet this new standard.

As noted at the outset of my remarks, MBAG has developed important new data concerning the impact of EPA's proposed test procedure on diesel vehicle emissions. Specifically, MBAG conducted emission tests on two diesel vehicles, following as closely as possible the EPA proposed rule. The two vehicles were a Model Year '96 prototype E300D, and a Model Year '95 C250D Turbocharged; both of which have basically the same emission control technology.

Each vehicle was tested three times. The ambient temperature for the LA4 testing with the A/C on was between 92 to 98 degrees Fahrenheit. Since a 48 inch dynamometer was not available, testing was performed on an electric twin roll coupled dynamometer of 14.3 inches.

Finally, because the test sequence suggested by EPA late last year, and that proposed in the Federal Register, were somewhat different, the SC01 cycle was not performed at all, and the LA4 cycle with A/C on was performed over a full LA4. The results of these tests are summarized in the charts attached to my testimony.

The test data demonstrate clearly that the diesel engine's EGR system cannot operate at maximum effectiveness at increased load and speed that would be required by EPA's proposed test procedures. The major reason for EGR limitation under high load and high rpm conditions is the increased smoke formation, which means increasing particulate matters at high engine loads.

Accordingly the data demonstrate that without any changes the EPA proposal is dramatically increasing the stringency of the standard for diesel vehicles, which cannot be addressed by a simple recalibration of existing technology.

The question that we must consider is how to fix the EPA proposal so that it meets the legal standards for revising the test procedures. MBAG has two suggested options.

The first one is suggested in the proposal itself In the proposed rule EPA stated that it considered exempting alternative and/or diesel fueled vehicles from the supplemental Federal Test Procedure requirements, but decided such vehicles would be able to comply.

As demonstrated by the attached test data this latter assumption is not correct. Diesel fueled vehicles will not be able to comply, therefore EPA should consider exempting these vehicles from the supplemental test procedure.

In view of the limited number of diesel vehicles sold in the U.S., this would represent a reasonable approach and would not require extraordinary increased costs for little if any emissions benefit.

The second option is also contained in the proposal. The attached data indicates that a combined HC/NOx standard, with sufficient headroom, could resolve this issue. The problem, of course, is that the data available at this time is limited.

Additional testing and time would be required to determine the appropriate safety margin. The overall benefits of such a program would be extremely small in comparison to the cost.

Accordingly MBAG requests that the Agency exempt light duty diesel vehicles from any final rule revision.

This concludes my testimony, and if there are any questions I will try to answer them.

MS. OGE: Thank you very much.

You are referring to some new data that you have developed and you shared some of the information here with us. Have you submitted the actual date to EPA?

MR. WEBER: No, they are presented the first time here.

MS. OGE: Okay, we would very much appreciate, if you have technical data support the statement that you have made, to please go ahead and submit it to us.

Any other questions?

QUESTIONS AND ANSWERS:

MR. GERMAN: You talked a little bit about the formulation of particulates limiting the effectiveness of EGR at high loads. Any data that you would have on what the increase in particulates would be, corresponding to an increase in EGR in those conditions, would also be very much appreciated.

MR. WEBER: Mercedes-Benz did a lot of development testing in this area, not right in conjunction with the new proposed test requirements, but I think we have a lot of data and we could provide data to you.

Yes, to answer your question.

MR. GERMAN: We would definitely appreciate that.

Also, I understand that Volkswagen is intending to introduce some direct injection diesels in this country, and how does direct injection compare to pre-chamber?

MR. WEBER: The direct injection diesel engine has certainly big advantages as far as fuel consumption is concerned, performance and other advantages. It also has a big disadvantage, this means NOx emissions increase. We account an increase for about 30 to 35 percent to raw NOx emissions increase with the direct injected diesel action.

MR. GERMAN: Does the same phenomenon occur, where if you increase EGR your particulates increase?

MR. WEBER: Sorry, I didn't catch this?

MR. GERMAN: I mean does the same thing happen, if you increase EGR under high loads, do particulates also increase on a direct injection?

MR. WEBER: Yes, it's basically the same mechanism.

MR. GERMAN: Okay, thank you.

MR. MAXWELL: You had commented on the second alternative, that being of the HC plus NOx standard and the need for additional testing to get a handle on what was really feasible and the headroom needed.

Are you planning any additional testing?

MR. WEBER: We would like to, but we are limited in our manpower and our testing facilities. What we could offer to you is that EPA gets a diesel car and can thus perform all testing which is necessary to set up a proper procedure.

MR. MC CARGAR: I haven't quite had enough time to review the attachments that you provided with your presentation. You've beautiful color slides, by the way. We like that.

But in the slide that you did put on your overhead the -- shows average emissions as a percent of standard? That percent of standard is not percent of standard as we have proposed it, that's percent of standard for 50K, numerical standards across the top of the plot, is that correct?

MR. WEBER: This is correct, yes.

MR. MARKEY: I want to thank Mercedes for helping fill in a void in terms of the diesel test data and I appreciate your providing that data, and I know you'll provided it in as timely a manner as possible.

In your opening remarks you mentioned the possibility of the HC plus NOx standard with appropriate or sufficient margin of safety in terms of headroom.

Can you comment on or quantify what you would consider sufficient margin?

MR. WEBER: As I indicated before, it's a few tests we did so far seems to us not to be a proper base to set such a standard. So we would have to have much more data to be able to set the proper safety margin.

MR. MAXWELL: On the safety margin issue, in your comments you mentioned how there's not a deterioration problem with the diesel. Just at the current certification levels, is your margin you allow for different than what is on gasoline vehicles, for diesels? In general, I think the gasoline industry has commented about a two to one kind of ratio. Is it different for diesels?

MR. WEBER: I would refer to the graph which was shown. If you looked at the hydrocarbon emissions and the CO emissions they were so extremely low that the variability from test to test plays a major role for the deterioration factor you're finally gaining.

As far as NOx is concerned, the NOx emissions are stable through all the diesel's lifetime. So there is no degradation in raw emissions. And the jar system (phonetic) should also work properly over the whole piston. So there is not -- different than for catalyst, which has thermal degradation over the life time. This holds now true for PTR system (phonetic).

MR. GERMAN: Okay, if there's no other questions, then, thank you very much.

At this stage, before we break for lunch, we'll start in on some of the technical presentations. We actually have a whole list here from AAMA/AIAM, and the first one is on the USO6 cycle, and Harold Haskew and company, I believe, will be doing that presentation.

ANALYSIS OF THE SFTP

BY KEVIN CULLEN, HAROLD HASKEW and Koji OKAWA

MR. CULLEN: I'm Kevin Cullen. I'm representing AAMA/AIM today. I work for General Motors.

Also presenting in this segment is going to be Harold Haskew from General Motors and Koji Okawa from Toyota.

We appreciate the opportunity to present information today before the EPA on the FTP revisions issues and we think we have a pretty significant amount of new material to review. Hopefully it'll be instructive for you. And we're continuing to do the testing in support of this and are probably a month or so away from wrapping it up and having a complete data set to submit.

We're going to cover several topics in this presentation. I'll be talking initially about the industry cooperative test program. This is the latest test program, for clarification, not the one that EPA used as data in the NPRM. We'll show the interim test results from this program on the vehicles we've completed testing on to date and then do some comparing and contrasting of those results to the previous test program that had been submitted earlier by industry.

We'll then present some analysis of the results. Harold Haskew will discuss the observations in terms of USO6 versus FTP emissions.

Koji Okawa will review some material trying to explain the effect in the relationship we see between load and NOx emissions.

And then we'll talk briefly at the close about the outlook we see for USO6 standards.

A couple of opening issues that we thought we should touch on before we get into the data, proper. This first one is that we try to establish a position on USO6 vis-a-vis in-use inventory. And in the work that went into developing the USO6 cycle there was a lot of emphasis on keeping the test relatively short and still including the modes of interest, shall we say, and those tended to be the modes that were out towards the extremes in terms of speed and acceleration rate.

As a consequence of that it is not in effect representative of all of the off FTP inventory, it tends to be more tilted toward the high end of the off cycle or off

FTP inventory. And as such, we would caution that those in the community who model and try to understand how inventory correlates to certification levels, should be cautious about using USO6 data to plug in the missing piece of inventory represented by off cycle. We think it represents the upper edge of that but is not appropriate to use as representation of all of off cycle driving.

And as a consequence modelers may want to consider trying to develop cycles that are appropriate to represent a balanced view of inventory. And that could either be an off cycle view or an all inclusive view of total inventory.

The second issue we wanted to lay out a position on, there's been a lot of discussion. Jack Kitowski, in his presentation, indicated that in working on these issues ARB's intention is to promote standards that require calibration changes on most vehicles, hardware changes potentially on some. EPA has said, for the most part, that their intent is to develop standards that can be achieved through calibration changes.

As manufacturers we thought it was appropriate to lay out our perspective on what the distinction is between hardware changes and calibration.

In terms of hardware changes those are clearer in most people's minds, although there are a few of these that may not necessarily be thought of as hardware changes. Obviously the catalyst, the key control component, its volume, its precious metal loading, the type of catalyst and its location in the system are hardware changes. They have long lead time requirement and they require changes to vehicle architecture.

The EGR system (phonetic), the actuation of the EGR system and its capacity to flow exhaust gas are hardware changes. And for instance, to the extent that high speed, high load control may require more EGR volume than current systems can provide. That would require a hardware change that would get into base engine features.

Control algorithms are hardware changes in that they drive the processor needed to perform the algorithms in the time available. We're finding today, as we look at advancing control algorithms to get better air/fuel control, that those often require a step up in ECM capacity (phonetic) in order to run the algorithm in the time available.

So you've got to be careful distinguishing calibrations from algorithms. The PCM itself obviously in its capacity, combustion chamber, the hard metal in the engine; any thermal protection -- either materials. We expect some of the things we're facing may require improved materials in exhaust valves and exhaust systems, et cetera;

potentially pistons, and shielding for thermal protection. All those, to us, are hardware changes.

Contrast calibrations -- and essentially what you'll find the common theme here is settings. You take the available hardware or architecture and adjust its settings to achieve a particular emissions control result. That can be air/fuel, it can be spark timing, EGR -- profile -- that's an adjustable feature in the EGR valve. EGR scheduling, transmission shift points, there are lots of other examples that -- thought was worth getting on the record in our minds the distinction between hardware changes and calibrations.

Now to the update on the test programs. A little bit of setup. Industry has agreed to and has provided the support for both the original test program and the follow on test program because we think it's appropriate to establish emission standards with an empirical basis. In order to do so, after much discussion with EPA on the results of the first test program and what were felt to be shortcomings in that test program, we tried to design a test program and a test fleet that would address those shortcomings and give us an appropriate data set on which to establish standards.

We set up the test fleet that was all Tier I and had at least 50K aged hardware, and when I get into the data later you'll see that a few vehicles actually had 100K aged hardware on them.

We looked for vehicles that had sequential fuel injection systems and intrinsically had tight air/fuel control. We supplied testing with both production and no enrichment calibrations over USO6 as well as production calibrations on the FTP. And we tried to get a fleet that provided a relatively broad representation of current production. It's impossible to represent all the combinations and permutations in any test program that can be done in a reasonable amount of time, so there's always a compromise there.

Once the data's in hand we think it's appropriate to then use that data to develop the appropriate control standards and it's important to provide adequate compliance margin. We've discussed these issues at length with both the EPA and CARB. I think we've arrived at a pretty good agreement on compliance margin on what's appropriate, and we've generally said is a minimum factor of 2 is the appropriate margin.

In terms of the data that's provided, it's similar to the last program and a few areas streamlined. We measured engine out and tailpipe modal HC CO and NOx on a second by second basis. That allows us to calculate catalyst efficiency for each of the three pollutants.

Measured air/fuel ratio at both the engine and the tailpipe, and a series of diagnostic measurements, the key ones being catalyst fed temperatures, and for multiple catalysts we recorded the temperatures in each catalyst, throttle position and manifold backing.

We're going to report today on a work in process. Of the 41 or 42 target vehicles in the program we've completed testing on 15 of the 25 vehicles in the passenger car, light duty truck I classification; and we've completed testing on 6 of the 13 light duty truck II vehicles. We have, I believe, 4 LDT4 vehicles and none of those have been tested as of yet.

And we'll look now at preliminary results from both the passenger cars and the light duty truck I vehicles.

This is a list of the vehicles we're reporting on. This isn't a list of all the vehicles we intend to get in the program, just the ones completed so far. I won't go through this in any detail other than to say that you see there's a broad representation of both manufacturers and vehicle types. That's the rest of the passenger cars and LDT1s.

And the next slide is a similar listing of the LDT2 vehicles tested to date.

Spent a little time setting up this chart format. There's a lot of information there and I want to make sure everybody's aware of the format we're presenting it in.

We go across the X axis or the bottom axis of the plot; there are three groups of data.

The first group is non-methane hydrocarbon measurements.

The second group is the CO emissions divided by 10. I want to emphasize that that's to get it on the same scale as other two pollutants.

The third grouping is the NOx emissions. This data is data on the vehicles, the passenger cars and light duty truck "ones" over the traditional FTP, not to be confused with the supplemental tests.

And on the Y axis we have FTP composite grams per mile for each of the pollutants.

For non-methane hydrocarbons, for the 12 vehicles included here we see that against the non-methane standard of .25 we observe a mean of these vehicles of about .12. And you'll see, as we go through this, that that factor of 2 or greater of headroom with 50K aged hardware, tends to flow through.

The CO data on these vehicles against a CO standard over 10 of .34, or a standard of 3.4, we've got a mean of the vehicles of .14, so translated to CO that's 1.4 grams per mile.

In terms of NOx emissions the NOx standard is .4 and the mean of this set of 12 vehicles is .2.

And we'd certainly say that this data seems to confirm the degree of headroom that we think we are designing into our products today.

One clarification. Along the right hand side are vehicle numbers. We prenumbered the fleet for all the vehicles we anticipated having in there. Obviously as a point in time not all of those are represented, since we don't have data. So where you see gaps between the bars those are reserved spots for data that will come in later.

This would be data on largely the same set of vehicles. In this case, though, you'll notice we've got 15 vehicles with off cycle data. Only had 12 with FTPs. At the start of the program we had not planned to run FTPs. We agreed to do that in response to requests from EPA. So we're still trying to go back and catch some of the early vehicles and get that data.

Now we've combined the non-methane hydrocarbon and NOx emissions, so we're reporting as NMHC plus NOx. And on the right side of the graph, again, is the CO emissions divided by 10 for the set of vehicles. Again, the vehicles, each bar represents an individual vehicle.

We look at these vehicles, and this would be the production USO6 emissions in grams per mile. We see that the 15 vehicles for NMHC plus NOx average .52 grams per mile. And for CO we had an average for CO over 10 of 1.42, or a CO average of 14.2 grams per mile. And you see gusts up to 30 to 40 grams per mile on the highest vehicles in production configuration.

Same set of vehicles, same presentation of data. Now with the no enrichment or stoichiometric calibrations, and what is done here is we asked the development engineer who supplied the vehicle to go in and turn off all of the features in the software that would cause commanded enrichment to occur.

When we look at the NMHC plus NOx, interestingly enough, it's about a push, it's .53 versus the .54 for the production calibrations, and we see the large CO reduction we typically expect when we look at elimination of commanded enrichment with an average CO level down now to 1.8 grams per mile, C over 10 at .18 grams per mile

Now we're going to look at the individual constituents to try to see how the effect of removing commanded enrichment affects the emissions results.

We've got an XY plot. On the Y axis is the stoichiometric results for the vehicle. On the X axis is the production results. They're paired for each individual test, so there are twice as many data points here as vehicles, since we ran two replicate tests on each vehicle.

We looked at a regression line through the non-methane hydrocarbon data, which is what's represented on this slide. We see that on average we're seeing about a 77 percent reduction in the hydrocarbon emissions with enrichment removed, as compared to what we saw in the production calibrations.

The same data for CO, the same presentation. And now we see about a 90 percent reduction in the CO emissions with commanded enrichment removed as compared to the production calibration.

This is the NLX emissions (phonetic). And in the initial program this was the constituent that I think presented us with a challenge in that when we went to the no enrichment calibration we typically saw large increases in NOx.

One difference we've seen so far in this data is that the increases in NOx tend to be much less significant. And here you see about a 27 percent increase on average across this fleet of vehicles in stoichiometric or no enrichment calibration versus the production calibration.

And when we combine the results of NMHC and NOx into a cross plot of those two for a stoichiometric versus production, we see that there's pretty close to one to one agreement there. The regression line predicts about a 5 percent reduction, but with the amount of scatter around the line I guess I'd leave it at -- there appears to be no directional effect. You get about the same NMHC plus NOx with no enrichment as you get with the production calibration.

A couple of detail plots out of the data. I want to emphasize maybe the one overriding concern about this particular area of control that we've been wrestling with really since Day One, and that's the effect of removing the commanded enrichment on catalyst temperature.

This is a plot over the USO6 cycle. You'll see the cycle ghosted in, the speed time traced on the bottom. And we've got two plots shown and blue is the production calibration catalyst temperature. In red is the nonenrichment or stoichiometric calibration catalyst temperature. This is on the Honda Civic, which has a fairly close coupled catalyst. And not surprisingly you see very elevated temperature patterns on the catalyst temperature when we remove the commanded enrichment -- increases that tend to show up at the peak temperatures most exaggerated. And the increases that in magnitude approach 100 degree C, probably 80 to 90 degree C on the two high points on this vehicle.

I want to emphasize that this creates great concern and heartburn for manufacturers. We've talked today about the fact that catalysts do deteriorate. They deteriorate primarily as a function of thermal degradation. And even with the improved catalyst technology that's available to us today, this magnitude of temperature increase, we think, will have impact on deterioration, and will probably require more premium catalysts.

Same kind of presentation on another vehicle, the GEO Metro. Again, blue is the production calibration and red is the no enrichment or stoichiometric calibration. Fairly similar results. A little less increase than on the Honda. And again, this vehicle has a fairly close coupled catalyst. And now we're seeing a perhaps 80 degrees centigrade increase in peak temperatures at the 2 highest load points in the cycle.

In terms of observations on the passenger car and light duty truck I data, the FTP results confirm the margin we think should be there. We see that they're complying at around half or less than half of the standard.

Looking at the USO6 results we see about a 90 percent reduction in CO emissions when enrichment is removed, as compared to the production calibration.

We see that the stoichiometric HC plus NOx is equal to the production HC plus NOx. And this is a new finding. We didn't see that on the previous data. We saw a substantial increase in the HC plus NOx stoich.

Peak catalyst temperatures, as we showed, do increase with the stoich calibration. On many of the vehicles the increase exceeded 50 degrees C, and it was pretty vehicle specific. Some vehicles showed less increase than that.

We certainly think there are catalyst durability implications as well as implications for exhaust valves materials, exhaust system materials. Not only the catalyst toting, but he catalyst mat and "canning". So there are a range of concerns about that thermal hit.

Okay, now we're going to look at the light duty truck II category. That's trucks from 3750 to 6000 pounds GVW. Same presentation for the FTP results here as we had on the past cars and LDT1s. The standards for the truck are somewhat higher than the passenger car standards, but we see a similar pattern here.

Let me call out one difference. The three bars under the little 100K notation are three GM vehicles. And we only had 100K aged hardware available for those. And you will note that they tend to be somewhat closer to the 50K standard than the other vehicles. If we had plotted those against 100K standards we'd see the same kind of headroom we're used to seeing, or the same kind of compliance margin.

Even with those three in there, when we look at the vehicles as an average, we're seeing a hydrocarbon mean of .19 against a standard of .32; a CO mean of .19 -- CO over 10 mean of .19, a CO mean of 1.9 against the standard of 4.4, and a NOx mean of .32 against the standard of .70.

Again, the same presentation for the USO6 data. On the left side of the plot -- NMHC plus NOx, on the right side of the plot CO over 10. We've got now six vehicles represented that we have both data sets in on USO6. And I haven't bothered putting averages in here, because with this incomplete data set with only about a third of the vehicles represented it seemed a little premature.

But I think it's fair to say we're seeing consistent kinds of emissions results to what we saw in the past cars and LDT1s. If you eyeball through that data you're running somewhere in the .4 to .5 range on NMHC plus NOx, and CO over 10 is probably averaging about 1.2 or 12 grams per mile.

Again, the same presentation with now the stoichiometric USO6 with a no enrichment USO6 results. And when we look at the NMHC plus NOx we see a similar pattern to the past cars and LDT1s, and that's that in this data set we're actually showing a reduction in NMHC plus NOx as compared to the production calibrations.

And again, the dramatic reduction in CO over 10, where now we're down to maybe 2.5 or so grams per mile of CO.

These are the regression plots. This is non-methane hydrocarbons for that set of trucks. Same presentation as the past cars. And we see here about a 70 percent reduction, on average, of the stoichiometric calibrations as compared to production.

Again, CO is where we see the most dramatic impact when we remove the commanded enrichment, and we've got here about an 86 percent reduction in CO emissions on USO6.

And again, on NOx, somewhat different from the original data set which was primarily Tier 0 vehicles, we're now seeing just a slight increase -- about a 13 percent increase, when we remove the commanded enrichment, as compared to the production calibrations.

And when we combine the non-methane hydrocarbon and NOx results on the light duty truck 2s, we see that essentially we predict a 20 percent reduction in NMHC plus NOx with the no enrichment calibrations as compared with the production calibrations.

Again, a plot of catalyst temperature for one of the light duty truck 2s. This is a 5.8 liter Ford Bronco, and we see again a similar pattern to what we saw in the two passenger cars we looked at with large increases in catalyst temperature and typically the biggest increases occurring at about the peaks for the cycle. Here we're looking at increases of perhaps 70 degrees C or so on the two peaks.

Observations on the trucks are pretty consistent with what we saw in the past cars and light duty truck Is. The FTP results confirm the expected level of margin.

On the USO6 we saw about an 86 percent reduction on CO, a 20 percent reduction on combined NMHC plus NOx as compared to production. Peak catalyst temperatures again increased. The increases were less severe than we saw in the passenger cars and I think that's because on average catalysts on trucks tend to be mounted a little further from the engine than on passenger cars. But we did see a number of vehicles showing a 50 degree C or larger increase, and certainly the same concerns and implications for catalyst durability, material requirements, et cetera.

Now if we revisit the proposal that AAMA/AIM made to EPA originally, back in October of 1994, for USO6 standards and design targets based on the data set from the original test program, the two charts shown on this slide are the charts we reviewed with EPA at that time. And at that time we were predicting that the appropriate levels would be a compliance standard of 1.3 grams per mile and a design target down around .6 to .7 grams per mile for HC plus NOx; a compliance standard of 5 grams per mile for CO, a design target down around 2 to 3 grams per mile. At that point there were certainly some shortcomings in this data. We reviewed this data almost ad nausea with both the agencies. And some of the shortcomings, we didn't run any USO6 cycles on these vehicles. This test program was based on the three earlier high speed, high load cycles, ARB 02, REP 05 and HL 07 (phonetic). So what we had to do was take the mobile data, go in and snip out the appropriate segments and then paste them together to get a synthesized USO6 result. And that's an obvious shortcoming. It's not real data, it's sort of assembled data.

The vehicles we had in this fleet were predominantly Tier 0 vehicles and clearly this rule will come in in a Tier I and more stringent environment so that they weren't necessarily the right set of vehicles to use.

We did have 50K aged systems and we had crude no enrichment calibrations. And at this time, you know, we were talking about a compliance margin factor in the 2 to 3 range, or a design target that was .33 to .5 times the standard.

If we look back at this test data and look at the same regressions of production versus stoich emissions we see some similar patterns but some distinct differences. This is the non-methane hydrocarbon for that original data set. And here we saw about a 72 percent reduction in non-methane hydrocarbon when we went to the no enrichment calibrations.

For CO we saw about an 83 percent reduction as compared to the production calibrations.

And this is probably the most significant difference, the NOx results on these vehicles showed a much larger increase in NOx when we took away the enrichment, with about a 65 percent increase in average on NOx as compared with the production calibration.

Combining NMHC plus NOx -- and this was one of the challenges we faced, was we went into this regulation originally going after commanded enrichment, and we found when we took that way the NOx went up. And even when we looked at NOx plus HC we saw a net increase. And here we saw about 20 to 21 percent increase in NMHC plus NOx as compared to the production calibrations.

So if we kind of compare and contrast the original and current test program, when we look at the stoich calibrations on USO6 we see larger CH and CO benefits than we'd seen on the original program.

We see a NOx increase that's considerably lower. And when we look at the improvement in HC and the smaller degradation in NOx we see an HC plus NOx result that is less than or equal to the production calibration.

So if we look at HC plus NOx combined, we're not seeing the penalty that we're paying for the enrichment reduction that we saw in the original test program.

And that's true even on an extreme cycle like USO6. I want to emphasize that we had done some analysis on the original test data, that suggests that as you went through the 3 cycles we looked at, "repo 5", "ARB 02" and "HL 07" (phonetic), kind of in order of difficulty, in order of the extremeness of the speeds and accelerations represented; the pattern we saw was the NOx CO tradeoff that you saw got worse as you looked at more extreme cycles.

Now we want to keep in mind that when we go into control standards we're establishing those to get results in inventory. And you want to keep in mind that a cycle like USO6 is likely to distort that tradeoff to over represent the NOx emissions hit that you see as compared to a more representative cycle like "repo 5" (phonetic).

So in terms of inventory impact it's our expectation that if we go forward with no enrichment calibrations on Tier I vehicles with some optimization we'll be able to achieve HC and CO benefits and we expect to see essentially no NOx impact, that NOx will be a push.

I'm going to talk about the outlook for the standards. I want everybody to recognize that this is a work in process. The data set's only about 60 percent complete and certainly the numbers could move around as the rest of the data drops in. But as we've added vehicles to this, that means it stayed pretty stable.

What we see as an interpretation of this data set as appropriate standards is an NMHC plus NOx standard of around 1 gram per mile in a target zone that would be down at about half gram per mile; a CO standard of about 5 grams per mile, target zone of about 2 and a half grams per mile.

I don't want to leave you with the impression that we turn off enrichment and everything's done. If you look at where the data resides -- and this is the Tier I vehicle, no enrichment data -- you see an awful lot more vehicles outside the target zone than inside the target zone. It's our hope that the optimization that will do to calibrations, along with some potential hardware changes, would be able to bring everything into the box.

It isn't a "We're-not-going-to-do-anything" standard, it's standards that will require us to do considerable work to get the appropriate level of margin back.

And that's the end of the presentation.

Questions?

QUESTIONS AND ANSWERS

MR. GERMAN: I appreciate all the work that's done on the data and I think this will make things a lot easier on all of this to sort out.

On the other hand, just taking a look at some of the graphs, there's an awful lot of variability from vehicle to vehicle in their emission levels on USO6.

MR. CULLEN: Sure.

MR. GERMAN: And there's also a lot of variability in the -- for example if you look at the NOx, the stoich versus production. By my count there were six cars and two trucks in which the NOx on USO6 with the no enrichment calibration was lower than it was in the production.

Have you folks had a chance yet to take a look at whether there were some underlying causes why some vehicles were high or low or some vehicles went up rather than --

MR. CULLEN: (Interposing) No, we intend to do that, John. We haven't -- as of yet it was everything we could do to get to this stage of analysis for the hearing. We intend, as we complete the data set, to go in and try to understand what's happening on individual vehicles and try to understand the "whys" behind this.

I don't disagree with your observation. If you look back at the earlier data set, though, I think you see less variation in individual vehicle behavior as compared to the Tier 0s, so that's encouraging.

We tend to think what's happening here is as you went from Tier 0 to Tier I the biggest change was reduction in the NOx standard from 1 to .4. That was the biggest hill to climb for us. And it appears that the technology we put on the vehicles to do .4 on the FTP is accruing some benefits in the off cycle area that appears to be more robust in maintaining control even when you take away commanded enrichment. But we haven't done analysis beyond this. We do intend to do that and submit our comments including that.

MR. GERMAN: Okay.

MR. CULLEN: Yes, Linc?

MR. WEHRLY: A question I had for you, Kevin.

On the catalyst temperature data you had, you had for the Honda and, I believe, the Metro?

MR. CULLEN: Yes.

MR. WEHRLY: The Honda, was that a close coupled catalyst by any chance?

MR. CULLEN: Yes, both of those vehicles, and I'd ask those manufacturers to kick in, are fairly closely coupled "pup" type catalyst (phonetic), I believe.

(Voice out of microphone range)

MR. CULLEN: Oh, it is an under flow, okay. Thank you, Tom.

(Voice out of microphone range)

MR. CULLEN: Okay.

MR. WEHRLY: So both of them, I mean I know the Metro you tested -- prior program had an under flow catalyst. And the Honda -- so the Honda does not have a light off catalyst (phonetic), it's just strictly under flow? Okay.

I guess another question I have, does -- back -- when you talked about hardware changes versus calibration?

MR. CULLEN: Yes.

MR. WEHRLY: And your definition of the calibration were primarily just changes in settings?

MR. CULLEN: And when you talk about settings in today's vehicles you're typically talking about either look up table entries --

MR. WEHRLY: (Interposing) Right --

MR. CULLEN: -- or gain factors that are applied to the software. The distinction I wanted to make was if you're doing things that change the software as opposed to the values that are in the software, that can drag you more over into a hardware change. And it depends on the nature of the change and whether or not that requires more processor to run.

MR. WEHRLY: Okay, so for example if you were to consider reducing some commanded enrichment --

MR. CULLEN: (Interposing) That's a calibration change.

MR. WEHRLY: Okay. And I just -- because that's one of the main things --

MR. CULLEN: (Interposing) to simply turn off the fuel is a calibration change. What you have to do to get back an acceptable level of durability may well involved hardware changes in response to that calibration.

MR. WEHRLY: Okay, one more questions.

MR. CULLEN: Sure.

MR. WEHRLY: I guess this goes back to the catalyst temperatures. Just again looking at those three vehicles it looks to me like potentially those -- the temperature increases were greater than some of the data we saw on the other vehicles. Would you agree with that?

MR. CULLEN: I think they were -- and I'm saying this from memory, you know, we haven't done a close cross analysis. I think, again, as you go to Tier I catalysts move a little closer, fuel control gets a little tighter, and I don't think it's surprising that we're seeing somewhat larger elevations.

I expect if we were to look at a LEV type vehicle we might well see yet more increase as we get sort of closer to that zone of thermal concern.

MR. WEHRLY: Finally could you expand upon what you think might be some -- you know, you talked about catalyst durability implications? Just kind of in a nutshell, what are some of the things you think that you might need to do to address some of these?

MR. CULLEN: I think the problem we face -- you'll hear some more about this later when we talk about the extended soak requirement. There are already a lot of forces in place that have driven us towards catalyst technologies that are more thermally tolerant to get acceptable deterioration and be able to put the catalyst where you need to. And the LEV program is taking us further up that curve.

With what's going to happen with constraints on commanded enrichment we'll go further up that curve. If we potentially had to insulate the catalyst for an extended soak requirement that's another hit.

And I think where the manufacturers are is we are applying the best catalyst technologies our suppliers can give us now to meet the current requirements in the next two or three years. When we do that we still see catalyst deterioration. The best catalysts we can get still deteriorate at the temperatures we run them. And as we run that temperature up the deterioration will get larger. It's very difficult to quantify. The relationships here are not precise, they're approximate. When you talk about how much of a hit that is you need to talk about a range not a precise value. But there is no question that these kind of increases will drive us toward more deterioration.

MR. WEHRLY: Okay, so you're saying even just the 50 degree -- that --?

MR. CULLEN: The 50 degree of C, when you say just, that's -- if you sit down with a catalyst guy that's not a "just", that's a significant increase in temperature.

MR. WEHRLY: But I'm saying that that, in itself, excluding the --

(Simultaneous voices)

MR. CULLEN: -- particularly because it's occurring at the peak temperatures. I think our analysis, the analysis done by air for us would suggest that USO6 is a 7 or 8 percent of BMT kind of cycle.

If you see the average temperature increase there and you assume it's happening 7 or 8 percent of the time in use, that certainly is going to produce tangible deterioration. No question about it.

MR. WEHRLY: Okay, thanks.

MR. KOUPAL: Kevin, this is John Koupal, EPA.

MR. CULLEN: Yes, John?

MR. KOUPAL: Actually a related question to Linc's. On the catalyst temperature increase on USO6, it does appear higher than on the -- 5 cycle, and you mentioned the potential increased thermal environment of Tier I vehicles being the case for that. How much do you think the -- the impact of USO6 just being more of the high end, high speed acceleration events causing kind of a synergistic effect on catalyst temperature in the sense that you have more stoich operation --

(Simultaneous voices)

MR. CULLEN: -- no --

MR. KOUPAL: -- relative to --

MR. CULLEN: -- no question as you take cross product of higher throughput operation of the engine and take away enrichment, you'll see more thermal response in the catalyst.

MR. KOUPAL: Okay, so my question is if you're looking at in use operation in which the stoich event is spread out more than on USO6, would you expect to see lower catalyst temperature increases than you're seeing on a cycle like USO6, where you're seeing a lot of stoich events, basically strong right -- one right after the other?

MR. CULLEN: I think you're suggesting that USO6 may not be a representative cycle?

MR. KOUPAL: No, what I'm suggesting is that --

(Simultaneous voices)

MR. KOUPAL: -- is that --

A VOICE: -- we've acknowledged it's not a representative cycle, we're just trying to get at the impact of that --

MR. CULLEN: -- yes -- the people who understand catalysts, and I'm not one of them in any detail, suggest that thermal degradation is cumulative, that it happens relatively quickly. That, you know, the concatenation of 5 or 6 events in 10 minutes may not be a whole lot different from those same 5 or 6 events separated by days or weeks or whatever. But I'm not the right guy to answer that question.

MR. GERMAN: By the way, I said I'd introduce people from EPA as we went along.

Linc Wehrly, on the left, has done a lot of our technical analysis of the USO6 cycle; and John Koupal was the coordinator on the intermediate soak requirements as well as helping out with some other analysis.

MR. CULLEN: Other questions?

MR. MARKEY: Yes, just a couple of question.

Early on you talked about the criteria for vehicles in the test program and the desired characteristics included tight air/fuel control.

MR. CULLEN: Yes?

MR. MARKEY: Is there, at this point, any attempt to evaluate how good the air/fuel control is on these vehicles?

MR. CULLEN: Yes, that's being done off line by Pete Groblicki (phonetic). As we run data it's being passed across to him. He has some kind of an algorithm that I think you're aware of that he is using to, in essence, score air/fuel control.

We haven't, again, done any detail analysis of that. As we were going through this material Pete made an anecdotal observation that two of the vehicles that were best on USO6, stoich HC plus NOx represented both the better end and the "worser" end of fuel control. So for whatever that's worth. But no, we haven't looked at that in detail.

What we did was looked at the vehicles as they came into the programs on the FTP and essentially eyeballed the air/fuel trace and said, "Yeah, that looks pretty good." And we'll be happy to share all that data as we go through the rest of the program.

MR. MARKEY: Your one graph showing the NMHC plus

NOx?

MR. CULLEN: The cross plot?

MR. MARKEY: Yes, showed quite a range of vehicles again --

MR. CULLEN: (Interposing) Oh yes --

MR. MARKEY: -- in terms of on either side. Can you -- although in response to John's question you admitted that you hadn't had a chance to do a lot of evaluation vehicle by vehicle, but can you comment on reasonable explanations for the differences between those at the top, far above the line and far below the line?

MR. CULLEN: No -- I could speculate, Jim. I can't really offer anything beyond that. I would expect, as you got into detail, it could be things like details in the catalyst. How big is it? What's the -- metal loadings? It could be details in the fuel control, you know.

We're looking at fuel control on the FTP on USO6 -- I think you wouldn't see as ideal a fuel control as you do on the FTP because vehicles haven't been honed in that range. And you may be seeing differences in how well their current calibrations pass on up into the USO6 operating range. But that's speculation. We haven't analyzed it in any detail.

MR. MARKEY: One other question may call for speculation?

MR. CULLEN: Sure.

MR. MARKEY: In Jack Kitowski's presentation he discussed some of the work that the Air Resources Board's done on rich bias.

MR. CULLEN: Yes.

MR. MARKEY: With these vehicles, can you speculate what type of difference a rich bias would have on the NMAT (phonetic) plus NOx?

MR. CULLEN: My speculation would only be informed by work we've done before. GM presented data and submitted to both agencies some time ago that suggested to us that any level of rich bias was intolerable down in the FTP range. We haven't done any work looking at isolating that to USO6, nor have we done any testing on USO6 with rich bias. Although, as Jack said, that is coming in the cooperative program we're working through with CARB -- sort of pointed at their LEV vehicles. So I'd say that that's information we have to learn.

My "going in" sense, based on the inputs I get from my development engineers is the systems are calibrated at the optimum catalyst efficiency for HC, CO and NOx; and if you move any significant distance off that point you'll see a fall-off in performance.

When we saw the CARB data our first reaction was that maybe an artifact of the low aged catalyst, that new catalysts have much more capability to deal with transitions off stoichiometry than aged catalysts do. They have more oxygen storage and more noble metal area available. But again, speculation. We'll hopefully learn more about that as we run the CARB program.

Jim?

MR. MARKEY: When would you expect that you'd be able to furnish the actual data for this?

MR. CULLEN: For this --

MR. HASKEW: Interposing) Can I take that?

MR. CULLEN: Sure.

MR. HASKEW: John? Harold Haskew from General Motors.

As you know, a program of this type generates a lot of data. There is a whale of a lot of information and I think we're prepared to reconvene the ad hoc data analysis panel, start meeting on a regular basis and let's dig through it and answer some of these questions like you're saying -- as we originally did in the first part of the program. It seems an appropriate thing to do now and we'll all get a chance to answer some of these with more informed information.

MR. CULLEN: And I might make a comment, sort of question to you.

We're running this program with primarily development vehicles that we have to beg, borrow and steal, and that's why I didn't show the list of all the vehicles we're going to have, because I can't promise those at this point.

I think what we need to think about from our end is a time cutoff for you that is sort of the latest the data will be useful, because for us it's going to be a tradeoff. If we want to get all the vehicles on our hit list it may be a good number of months before those are in. We'll have to make kind of a running decision as to when, "Okay, that's close enough and let's analyze now instead of continuing the test."

(Simultaneous voices)

MR. CULLEN: -- it's something we'll have to talk about --

MR. HASKEW: -- there have been some other major rules written with a lot less data than you presented this morning --

MR. CULLEN: -- of magnitude, less.

Jim, you had a question?

MR. MC CARGAR: Yes, I 've got three questions. One, simple one, in our package we didn't get a copy of the last slide. Can you provide that?

MR. CULLEN: Oh, sure, I'm sorry.

MR. MC CARGAR: Second, you commented some on the catalyst types that were reflected in the vehicles with the temperature plots that you showed --

MR. CULLEN: (Interposing) And I was mostly wrong on --

(Simultaneous voices)

MR. MC CARGAR: -- I had originally written down, do you notice any kind of correlation between the vehicles that had the over 50 degree temperature increase and catalyst configuration or any other variable, or is that premature to ask?

MR. CULLEN: The analysis that's been done so far was done Monday evening about 6:00 o'clock, going through a book full of data and I'd hesitate to say anything about that yet.

MR. MC CARGAR: Okay, I was also interested in asking about the data availability, and I think we'd certainly be amenable to reconvening that panel, including EPA participants back in it again. But it would also be very useful for us to get our hands on, at minimum, the bag data, but also some of the modal data as quickly as we could do it, for the very reason that you identified, we don't have a lot of time to be doing this. So --.

MR. CULLEN: I'd suggest we get the data analysis panel together at the earliest opportunity and once we understand what the highest priorities are we should be able to get into that pretty quickly.

MR. MC CARGAR: Okay, third question was, recognizing that the industry has made its own standard setting proposal, have you made any effort to go back and analyze these data from the point of view of EPA's standard setting proposal?

MR. CULLEN: I think only in the very gross sense, and --

(Laughter)

MR. CULLEN: -- actually the next presentation speaks to that issue. So maybe, rather than getting into it we can jump to the next presentation.

MR. MC CARGAR: All right. I guess that's it.

MR. CULLEN: Okay.

MR. GERMAN: I would like to propose that we break for lunch.

MR. HASKEW: After this.

MR. GERMAN: After this? Okay.

BY HAROLD HASKEW:

MR. HASKEW: I'm Harold Haskew

from General Motors, and my little part of the action here will be to go back and look at the initial assumptions that were made on -- as part of the composite standard, and how the new data would fulfill that, or not fulfill that prophecy.

As I recall -- and I think this is a fair paraphrasing, the composite approach for setting standards relied upon three pillars: That the hydrocarbons on the new USO6 cycle would be like the Bag 2 on the FTP; that the CO on the new cycle would be pretty much like the composite CO -- not Bag 2, but composite CO; and the NOx on the new cycle would be pretty much like the FTP, perhaps with a slight kicker.

Is that a fair paraphrase?

MR. GERMAN: Yes, that was proposed and we've acknowledged that the CO probably needs a kicker too.

MR. HASKEW: I'm going to offer, I think 5 slides. The data that Kevin has already described -- and I think each one of you have that. And I would like you to stay with me on the slides and not be looking ahead. Okay? It's hard to stand here and talk while you're jumping head. All right?

In fact, one of the pillars upon which the composite cycle is based is true. It would appear from the early returns on this data that USO6 hydrocarbons, Bag 2 --

and this is total hydrocarbons -- believe the same thing is true for non-methane -- agree pretty well with USO6.

I think there are some fundamental reasons why the engine out emissions on a higher load cycle can even be lower as a function of load, the things that the proportion of the crevice volume, the portion of the quench zone goes down. So there are some reasons why hydrocarbons can be less under a high load cycle. And so far the data would appear to support that very well.

Similarly for CO --

MR. MC CARGAR: (Interposing) Harold? Just let me ask. Is this -- the use of 6 data, is that production or no command enrichment?

MR. HASKEW: No, I'm sorry, this is stoich data.

MR. MC CARGAR: Okay, thank you.

MR. HASKEW: Okay, now let me look at -- Tom Liberty (phonetic). Thank you, Tom.

This is a stoich USO6.

That -- the stoich data for USO6 for CO is slightly higher, John -- as you just said, compared to the composite FTP CO for the vehicles of which we have the regular FTP testing as well. Although that is close it appears to converge at the higher end.

It is the NOx, though, that for -- well, I guess the next in line in my pile here is CO_2. Interestingly enough the carbon dioxide between the high load USO6 cycle appears to agree pretty well with the FTP, which is a little counter intuitive of why at higher loads you'd get about the same fuel economy -- again equating CO_2 to fuel economy. But the fact that you are going a lot faster seems to average out.

It is -- the NOx is the pillar of the composite approach that we object to the strongest, and I think is the fatal flaw in it. And why the industry has taken such a hard position and wanted a more fundamental approach to individual cycles, or individual tests with individual standards.

This is the composite -- or -- the composite FTP NOx in production, compared to the USO6 stoichiometry where every observation was higher on USO6 and in fact the number we've been using, that the USO6 is about twice what is on the FTP seems to ring true.

Now again, we've got additional data coming, but with this many data points we don't see it as being fundamentally different.

And a point that's going to be anchored by Koji Okawa here a little later, is going to really try and explain why NOx builds up with load. This is a plot of the data I've just shown you where a load variable across the lower axis is exhaust volume. Now that's the exhaust volume on the USO6 in total cubic, but the NOx in grams per mile increases on the larger engines and the heavier vehicles, increases with load.

And Koji is going to go into that in more detail, to show why a higher load, a higher speed cycle is going to have higher NOx and support our objections to the composite cycle.

I believe that's that part of the presentation.

MR. GERMAN: Okay, in our proposal we did acknowledge that engine out NOx emissions were higher than they were on the composite FTP, but the argument that was made is that catalyst conversion efficiency could also be higher because you don't have this cold start to contend with.

Have you done any of this looking at tailpipe emissions yet?

MR. HASKEW: John, we don't have that plot with me today. I think I could show you the same plot for tailpipe and come up with the same conclusion. Okay? I don't have it.

MR. GERMAN: Okay.

MR. HASKEW: But the point is as the conversion efficiency for NOx is going to go down at the higher lower loads and will come down slightly at higher temperatures. So we don't think we're going to see an increase in conversion efficiency, per se, for USO6 compared to the FTP with Tier 1 vehicles with good air/fuel ratio control.

MR. MC CARGAR: At the risk of giving you a straight line here, Harold, I missed why the NOx data presents a fatal flaw for the composite approach? I can see how you're making a point about how we set our NOx standard and how big a kicker might be involved and so forth, but how does that relate back to how we composite it with the other elements of the supplemental Federal Test Procedure as proposed?

MR. HASKEW: You're sure you want me to answer that?

(Laughter)

MR. MC CARGAR: Yes.

MR. HASKEW: Well, it kind of comes down to our perception, or my perception, that the composite approach started from the fact that you didn't know how to handle the headroom and the deterioration from 50 to 100 thousand miles, and that if somehow you could come up with weighting factors that made the USO6 and the A/C and all that data look like the statutory standards, then you could abandon having to deal with headroom and with 50 to 100K emissions. So it was all taken care of.

We have had that discussion and I think that's exactly what I heard. My perception was right. Okay?

So then, in trying to work backwards and make these cycles, the pieces of the cycle puzzle go together so that they equal .25, 3.4 and .4, then you've got to sit there and play with weighting factors to make them come up to be the answer.

That's the fundamental flaw, is you're working from some set numbers. And then, without a reasonable test of how it applies to inventory or how it applies to hardware or stringency, how do you adjust these things to make them come out? See?

We have offered you a good engineering, documented with data explanation for how to handle the headroom. We've agreed to a forcing kind of thing where we would limit it under the new high speed, high load cycles, to only a factor of 2. And I think, for a hot cycle, the data would support that it ought to be higher.

We fundamentally believe you've got to go back to stand alone standards where the data makes some sense. And then later, if you wanted to composite it, fine, we'll talk about that. But not as trying to, through the assumptions that were made, put these pieces together to equal .25, 3.4

and .4.

And if an leg of that chain falls apart, then I believe, logically -- and I'm an engineer, okay? The logic argument falls apart. That's why I think it was fatally flawed.

MR. MC CARGAR: Okay, in the NPRM we proposed a kicker which effectively took the NOx standard higher than it was in the FTP, and that was for air conditioning. Fundamentally why couldn't the same thing be done for a NOx -- for USO6?

MR. HASKEW: If the weighting factors are all going to equal 1, which I believe the original proposal did, you weighted the bags and it equaled 1, then you're going to have to distort one of them -- you're going to have to distort the USO6 to make it all come back to this fundamental argument of .25, 3.4 and .4. And that's where we're disagreeing --

(Simultaneous voices)

MR. MC CARGAR: -- No, Harold, I'm saying -- is we didn't do that in the NPRM to begin with. So why couldn't the procedure we followed for air conditioning also be applied to a USO6 NOx?

MR. BERUBE: Mike Berube, from Chrysler.

Add to what Harold is saying -- maybe somewhat addresses yours. Industry, from the very beginning, in our reaction to the composite approach, I think, as Harold has laid out, has said that we want stand alone standards set on appropriate data with appropriate compliance margin set first. And we're not opposed to then looking at composite.

And a key part of looking at stand alone standards also is looking at the cost effectiveness of each of those individual pieces, and then looking compositing essentially a simple flexibility tool to be added thereafter.

But I think what Harold's trying to say is that to the degree you try to composite them, to force them to match these numbers, even though -- theoretically, I guess, what you're suggesting is true. You can always add kickers. You can always add kickers. You can add kickers to all the different constituents. The kickers could be, you know, any size you want. They might have to be done a little bit different than how you did them in the NPRM.

But what you end up coming with, I think, as Harold's saying, is you've distorted what you were originally trying to get. And what if you -- what's been accomplished there -- what you end up doing is getting closer to setting appropriate stand along standards and then composite them after.

We don't see this need to have them numerically tied to the .5, 3.4 and .4.

MR. MARKEY: Are you going to be making additional comments about the composite in later presentations? Because I think my -- confusion over the point you're trying to make here might be better in that context. I would interpret the information you just gave us is comment on EPA's conclusions on achievable level of control in the NOx arena for USO6. And we haven't said anything yet about A/C or intermediate soak and how that achievable level of control might get reflected in an ultimate composite standard.

MR. HASKEW: Jim, I've looked at the panel and I don't believe we have any more to say about the composite standards. I think we told you from "day one" we were fundamentally opposed to it. We had a very, very negative reaction.

We think the data does not support the original assumptions, okay? And we are coming forward with a positive suggestion, with stand alone standards, with data that would support.

We're going to propose standards that be set that are technology forcing, that we'll agree to. Okay? And rather than waste more time debating ownership or something like that, I think we've tried to pull this more on the positive aspects of what we can come forward here and did.

MR. MARKEY: I guess I'll reflect the answer that you gave back in the context of comment on the composite. But it still seems to me to be reflecting more on the narrow issue of the achievable level of control and NOx for USO6.

MR. HASKEW: Well, if you go back and look at the achievable level of control that Kevin was putting up, we're saying that it would look like, given stoichiometry, given air/fuel ratio control, that the whole package we're presenting can get something like an 80 to 90 percent control of CO, which I'll remind you is why we started all this. We could get an 80 to 90 percent of CO over that cycle, with a push for combined hydrocarbons plus NOx. I think that's a significant plus, and suggest you ought to just take the money and run.

MR. BERUBE: Jim -- Mike Berube from Chrysler again.

I think -- your comment's -- we are making a very significant comment about the achievable level of control here and what we think it is and that the level of control that's achievable and appropriate is not reflected within the composite approach within the NPRM. I mean the two of them are integrally tied to us -- when we say the composite approach -- integrally tied to it because of the nature of the composite approach built in to the composite approach as reflected in the NPRM, is the achievable level of control and design target.

Don't misunderstand us. I think as Harold said clearly, as AAMA/AIM have said in our previous statements. We're not opposed to the concept of compositing standards to add flexibility, but before achieving that we need to look at what the appropriate level of control is over each cycle.

MR. MARKEY: Just to clarify. When we started this the focus was to make sure we had a representative of characterization of in-use operation. We thought the enrichment would be the big piece in terms of emission. But the reason why we started was to make sure it's representative. To the extent that there are other emission increases in other areas, as we learned quite a bit -- and largely because of the industry involvement -- our focus on CO has evolved.

MR. HASKEW: Well, we've all talked about the off cycle, we've all published technical papers about off cycle driving and, you know -- and you've talked about two orders and three orders of magnitude of increase of emissions under off cycle driving, and that's the last big piece of emissions that EPA ought to go get. Okay?

And every one of those statements was made regarding CO. You know, two orders of magnitude, three orders of magnitude was regarding CO. And we came forward with proposals to -- hey, we will help control CO, we will help control off cycle. Okay?

And we're offering now a 90 percent reduction under a very extreme cycle, okay? Which addressed that problem.

MR. MAXWELL: Is this an appropriate place to break for lunch? Okay.

(Discussion off the record)

MR. MAXWELL: Okay, we're going to start up again at 2:00.

(Luncheon recess)

2:00 o'clock p.m.

AFTER RECESS

MR. MAXWELL: Okay, I think we might as well go ahead and get started.

I believe you still have another portion of the USO6 presentation to go through? Okay.

BY KOJI OKAWA:

MR. OKAWA: Good afternoon, my name is Koji Okawa. I'm senior principal engineer of Toyota technical center.

What I'm about to introduce is analysis on USO6 NOx results. I will explain why it cannot be equivalent with FTP NOx level like EPA is estimating on the NBLM (phonetic). And this analysis will support the result of industry test program which was introduced by Harold this morning.

And actually there was some conversation about the catalyst conversion efficiency and we go into that as well as engine out NOx.

We have -- a total of 9 -- vehicles for FTP and US NOx levels using 50,000 miles aged catalyst; 6 of them are LDV, LDT1, and other three LDT2.

As you can see we can hardly say USO6 NOx level is equivalent to the FTP, and we believe there are two reasons for that. One is increase of engine out NOx and another is negative impact on conversion efficiency. And there are not the kind of problems that you can overcome by good air volume control.

I would like to explain details of those two problems. This figure shows comparison of engine driving range during USO6 and FTP for two engines. Going towards right upper side of this graph means you have higher speed and load.

You can see how USO6 needs to use higher part of this graph compared to FTP.

You can say the same thing by comparing intake air volume for FTP and USO6. For USO6 the amount of air needed is about 2 to 3 times than that of FTP.

Now I would like to look into the load impact on engine out NOx. Here we have intake air volume, on X axis, as representative of engine load compared with second by second NOx data.

In same graph we have bar graph showing the frequency of each air volume range, so we can compare the distribution difference from cycle to cycle.

We have graph for USO6, FTP and highway. As you can see, engine out NOx does increase rapidly as you go towards higher load. We believe major reasons for this are the increase in combustion temperature give rapid increase of NOx generation and the reduction of EGR rate (phonetic) due to lack of manifold vacuum.

Now the trend of increasing NOx is about the same for each cycle, but because of the distribution difference, average NOx of USO6 will be largest, then highway and FTP.

Now when determining the stringency of standard we cannot simply discuss by average NOx amount because the standard is grams per mile and the average speed of each cycle is different.

So in order to see the impact on grams per mile we made a similar graph as before, but this time each dot of NOx values are divided by the miles of each second. So we have grams per mile per second on Y axis.

Now the trend of increasing NOx is not so significant as before, but there is still increasing NOx as you go to your higher load. So we can say USO6 is most stringent of the three cycles from grams per mile perspective.

Here the results of engine out NOx data from the 9 vehicles that I mentioned earlier. We have results of FTP, USO6 and some highway data.

And this time we took the average intake air volume on X axis as representative of average load. You can see clearly that there is separation between air volume and engine out NOx and how the engine out NOx increase on USO6 is inevitable. And for the third case USO6 NOx is little less than double the FTP NOx.

Now I would like to move the subject to the impact on conversion efficiency. One of the factors that influences conversion efficiency is space velocity. Space velocity is the amount of air per catalyst capacity, and increasing the space velocity reduces conversion efficiency, especially with aged catalyst.

This graph shows the comparison of space velocity during FTP and USO6. Because of high speed and high acceleration, USO6 requires two to three times more of space velocity than FTP. So it is difficult to maintain conversion efficiency equivalent to FTP.

This graph shows the A/F impact on conversion efficiency for both green and deteriorated catalyst. You can see the great impact with deteriorated catalyst. And what I would like to point out here is you have very narrow range of A/F to maintain HC and CO NOx within relatively high efficiency, especially with deteriorated catalyst. So tradeoff between NOx and CO is not so easy to do because if you try to get higher efficiency for NOx it could easily push CO and HC out of the control window, causing significant increase on the emissions.

In conclusion I would like to show you the results of the 9 vehicles again, but this time with tailpipe NOx on axis. Tailpipe NOx of USO6 cannot equivalent with FTP because, "A", increase of engine out NOx due to significant higher load is inevitable; and "B", it is difficult to secure the same conversion efficiency as FTP.

I also want to point out that when highway mode was introduced EPA recognized a NOx increase on that mode, so they admitted a 33 percent increase for highway standard. I cannot think of any reason why only USO6 can be the same as FTP. So for the third case, again, tailpipe NOx is about the double of FTP.

Thank you.

QUESTIONS AND ANSWERS

MR. GERMAN: One of the graphs you put up was comparing the catalyst conversion efficiency for the different pollutants for green and deteriorated catalysts for different air/fuel ratios. Where did that information come from? What's that based on?

MR. OKAWA: Which one are you talking about?

MR. GERMAN: These, here.

A VOICE: He's got it up there, it's Toyota data.

MR. OKAWA: Yes, this is Toyota data.

MR. GERMAN: Where did it come from? You know, what kind of vehicle is it based upon?

MR. OKAWA: Oh, I see. Well, I'm not sure about what vehicle of this catalyst is used. But this deteriorated catalyst is made by -- method of ageing catalyst. And so you have the equivalent deterioration of 50,000 miles in use deterioration. So I'm not sure about the vehicles.

MR. GERMAN: Okay, but the deteriorated is a 50,000 miles?

MR. OKAWA: Yes.

MR. GERMAN: Aged catalyst?

MR. OKAWA: Aged catalyst.

A VOICE: Simulated ageing.

MR. GERMAN: Use the microphone, please.

(Comment from floor, out of microphone range)

MR. MAXWELL: We need a few minutes to kind of analyze what we've seen here to be able to ask questions. Bear with us.

MR. GERMAN: The generic one I have is that you did a lot of comparisons, intake air volume and liter per seconds, and so the catalyst, I can see the sense in that because the volume of air can impact the volumetric efficiency. But I guess, going through it I was just wondering, a couple of graphs, whether it was really appropriate to compare the liters per second to an emission value which is really in the grams per mile -- because the loads on the USO6 are clearly higher per second. But the speeds are also a lot higher as well. And we're doing our standard in terms of grams per mile.

A VOICE: He showed it.

MR. HASKEW: He showed that data, John. Showed it in grams per mile second.

MR. OKAWA: We used this little for the sake of air volume just to represent load. So it can be anything else. We can use manifold vacuum as load. We can still the increase of the engine out NOx.

MR. GERMAN: I mean I'm not arguing that when you increase the load you increase the NOx. But if the load is increasing at a lower rate than the speed then your grams per mile go down.

A VOICE: I know what graph he's referring to.

MR. HASKEW: Koji went through a master's thesis, if you will, in about 5 minutes.

MR. GERMAN: And I understand and that's why I'm sitting here puzzling over some of the stuff.

(Laughter)

MR. GERMAN: It was a good presentation and I'm still trying to absorb it all.

I guess what it comes down to, when he gets to this graph is that when you look at the entire cycle those points are -- they're not totally linear, but they're a reasonable approximation of being linear. And so what happens now is that you kind of need to weight each point by how often it actually occurs.

MR. OKAWA: That's why we show the distribution of the -- the load.

MR. GERMAN: That's the bar. Sure. That's right, but you certainly have some higher load points on USO6, they certainly generate higher emissions even, you know, on the gram per mile sort of scale. But if you weigh them out you also have a lot of points on USO6 that are very low emission levels. And so how it weighs out for the whole cycle is the step that wasn't taken here, which I would like to see.

That's all. I may have missed it. The vehicles that are on here, were these all Toyota vehicles, from the first graph?

MR. OKAWA: Yes.

MR. GERMAN: Okay, thank you.

MR. OKAWA: This is all Toyota's data. But we are planning to have industry test program data analyzed in the same manner.

MR. GERMAN: Okay.

MR. HASKEW: John, we're in the process of putting the cooperative test work in the same format. I think it's an excellent way of doing it.

MR. GERMAN: Okay, and when might we expect to see the Toyota data? Is that something that you'll get to us?

MR. MAXWELL: Will you supply the Toyota data, the raw data?

A VOICE: Second by second data?

MR. OKAWA: What kind of form do you need?

MR. GERMAN: I'm sorry?

MR. CULLEN: What kind of data are you looking for?

MR. GERMAN: We can work that out. We'd certainly like to have --

(Simultaneous voices)

MR. GERMAN: -- both the bag results and the second by second data.

MR. OKAWA: Yes, well, we have a data base. If you let me know what form you need, then yes, we can work it out.

MR. GERMAN: All right, that'd be great. Thank you.

A VOICE: May be getting -- the FTP frequency that's shown -- that far to the left? I think it went off at 45 percent frequency after it was lower intake air volumes, whereas the USO6 was up at the 30 percent and --

(Simultaneous voices)

MR. OKAWA: -- Yes --

A VOICE: -- much more over to the right -- double to Y axis left and right -- clarify that chart.

MR. MC CARGAR: Can you put up, please, the slide that's the plot of engine out NOx gram per second against intake air volume?

MR. OKAWA: This graph, you mean?

MR. MC CARGAR: That's the one. Not to take away from the qualitative conclusions you come from -- from that slide. I'm confused by whether it's just coincidence that there is a significant number of points that are exactly identical across all three of those plots?

(Voice out of microphone range)

MR. MAXWELL: Jim, you're out of mike range. The court reporter can't hear your question.

MR. MC CARGAR: It appears to my eye that there's a significant number of points that are exactly identical on all three plots, so that I'd just ask you to verify, at a later point that your plotting routine has actually picked up what it purports to illustrate, because I can pick up at least 12 or 13 points there that appear to be identical across all three plots.

MR. OKAWA: Well, I'm sure this data was taken by each individual cycles but I'll check on that.

MR. MC CARGAR: Okay.

MR. GERMAN: One other additional piece of information, if you could supply? You had a graph looking at the catalyst conversion efficiency versus the volumetric efficiency? If you could have just -- the kind of frequency chart that you did on some of the other -- other slides? If you'd do the same kind of frequency chart for the different cycles, you know, as far as frequency of the volume versus capacity, that would be very helpful too.

MR. OKAWA: Okay, I see. Okay.

MR. GERMAN: It gives us a sense of how often some of these areas in which the catalyst efficiency has fallen way off, how often they occur, actually occur in the cycles?

MR. OKAWA: I see. Yes. We're just having the maximum velocity here, so we haven't had time for any frequency data here, so.

MR. GERMAN: I understand. That's why -- prompted my request.

MR. OKAWA: Okay.

MR. MAXWELL: Thank you, that was very interesting, if a little fast.

Does that conclude the USO6? Or is there another piece of that?

MR. CULLEN: That concludes the USO6 presentation at this time and now we're ready to start in for A/C operation.

MR. MAXWELL: Okay. Just as a reminder, we do have a presentation from someone from NRDC (phonetic) scheduled for approximately 3:15, so just try to plan for that.

MR. GERMAN: For introductions, Rob French has now joined us. He's done a lot of the coordination on the air conditioning work that was in the proposal.

COMMENTS ON NPRM PROPOSAL: A/C OPERATION

BY GLEN HEISER

MR. HEISER: Good afternoon, my name is Glen Heiser, I'm from the emissions planning department at Ford Motor Company, and as a member of the AAMA/AIAM FTP Ad Hoc Panel, I have worked on FTP Revisions since 1990.

Today, I would like to cover an overview of the manufacturers comments regarding air conditioning. Following the overview, I will comment on the proposed air conditioning ntrol Drive Cycle.

Jerry Roussel will comment on the proposed stringency of standards and test procedures, and Harold Haskew will comment on air conditioning load simulation.

In a separate presentation, AIR will comment on the cost-effectiveness.

Regarding an overview of our air conditioning comments in general, through recent air conditioning test programs, manufacturers were able to determine that the current Federal Test Procedure does not adequately represent the air conditioning load on the vehicle. Assuming it is cost-effective, our objective would be to have a test procedure that takes into account real air conditioning loading such that an emissions calibrator takes this load into account when designing the emissions control system.

We believe that the appropriate drive cycle for this is a Hot LA4, and the standard should be based on actual data using current Tier I vehicles. This work is in progress.

We will also discuss a few points regarding the test procedure: First, testing with the air conditioning on in a full environmental cell is the golden standard. Unfortunately it is cost prohibitive. Thus, simulating the air conditioning load through the chassis dynamometer in a standard cell should be the working standard. This solution takes into account real air conditioning loads and will accomplish the previously stated objective. This work is also in progress.

While this option represents a step in the right direction regarding costs, cost-effectiveness remains to be proven.

Given this overview of our comments, I will now comment on the proposed air conditioning drive cycle.

In EPA's Final Technical Report on air conditioning, many rationale are listed regarding the appropriateness of the LA4 driving cycle. And you can reference Section 3 .2.2.4. Among these are the following:

The LA4 is a familiar cycle representing the majority of in-use driving. The air conditioning load is most prominent at lower speeds. Additional control of high speeds/loads is not necessary because emissions controls necessary for US06 will control A/C emissions.

High speed testing would have an added facility impact with minimal benefit because proper vehicle cooling would be needed up to 80 mph.

Engine starts and A/C operation are independent events, engine starts being cold, intermediate or hot; focus on catalyst light-off technology.

Air conditioning operation over these modes does not change calibration strategy.

Further, cold and hot start events are controlled with the current FTP bags 1 and 3.

In general AAMA and AIAM agree with the EPA assessment in their Final Technical Report on air conditioning. This agreement includes: The Hot LA4 is the appropriate cycle. Vehicle starts and air conditioning operation are separate issues. And the inclusion of a soak in an air conditioning procedure would duplicate soak control and add unnecessary length and cost to the procedure.

We do have some remaining issues. I'd like to go through some of those.

A issue is that EPA's proposed regulatory language is not in agreement with their final technical report. The regulatory language states that the air conditioning control cycle consists of an 866, which is the current bag 2 of the FTP, followed by a 10 or 60 minute soak and then SC01.

We believe that EPA changed the appropriate air conditioning cycle and added a soak in an attempt to consolidate procedures, in this case air conditioning, intermediate soak, and throttle dither.

We certainly appreciate any attempts to consolidate test procedures, however in this case we do not believe the tradeoffs encountered are justified.

The first issue is that the intermediate soak test is not necessary. You will hear more detail on this issue later in a separate presentation. Also, an additional soak adds unnecessary test time to the air conditioning procedure, which means added facilities, personnel, and cost.

Regarding SC01 in section 7.1.4 of EPA's final technical report on intermediate soak and start driving. EPA claims that SC01 is being proposed -- and I quote here -- "SC01 is being proposed because the Agency believes it is important to represent how vehicles perform in-use following startup." End of quote.

Our concern is that SC01 adds unnecessary complexity. Also, you will be duplicating start driving which is already present in the FTP 505, bag 1. Also, the start driving and throttle dither in SC01 have not been shown to improve control. Likewise, the necessity for this control has not been demonstrated. In your words, and I quote again, "EPA did not perform an evaluation of the emission impact of this area," end quote.

Another important consideration is that no test data has been generated over SC01 to determine the feasibility of the standards over the new drive schedule.

Our proposed solution would be to adopt the Hot LA4 as the air conditioning drive cycle with no engine starts or soaks included as part of procedure. This is in general agreement with the EPA Final Technical Report on air conditioning.

Next we'll have Jerry Roussel come top talk about standards and test procedures. I'd be happy to answer any questions about cycles if you have them now?

QUESTIONS AND ANSWERS:

MR. GERMAN: You stated that SCOR would add additional complexity. What complexity is that?

MR. HEISER: SCO1 is a new drive cycle. I mean that alone is added complexity. We're not familiar with it, you're not familiar with it. You stated you haven't studied the emissions impact of the cycle.

MR. GERMAN: When we say we hadn't studied the emissions impact with the air conditioner on. We have done some assessment of the additional speed variation that's incorporated into the cycle.

MR. HEISER: Basically we believe it's adding complexity that's not necessary, not knowing the emissions impact on the cycle.

MR. GERMAN: You can go ahead.

BY MR. ROUSSEL:

MR. ROUSSEL: My name is Jerry Roussel, I work for Ford Motor Company, I'm also the chairman of the FTP ad hoc panel. I'm a representative of AAMA/AIM.

I'm going to be commenting on the stringency of the standard and the test environment. Harold Haskew is going to then take us over and go through the issues of the load simulation.

I'm going to start off with the stringency of the standard and focus upon NOx, because NOx is the biggest issue when we talk about adding a A/C load to the drive cycle like the LA4.

Background, and this background should be familiar to most of the people who have been following this issue, is that we saw large tailpipe NOx increases of approximately 100 percent in the first ACR1 data. The new data suggest it's a 124 percent increase. And that's essentially caused by large increase in engine out NOx of the same magnitude.

Catalyst efficiency remained approximately the same between the A/C and off levels for NOx.

The next slide shows you the new data that was accumulated at -- I think it's a delphi, or commonly known to us as ACR. Here we're comparing A/C off to A/C on emissions for NOx. The clear boxes represent the A/C off value and the start boxes represent the A/C on values.

We have the Toyota, the Escort, the Mustang and the Towncar. And the last set of bars indicates the average of those vehicles. On average, with the A/C off, we were running at about .21; and that compares to .47 with the A/C on.

Also included in there is an estimate of where

EPA's control level is as described in the NPRM. The .26 number that you see there is a 25 percent bump on the .21 number there. So that's what that number represents.

And you can see your control level would force all of these vehicles to come down fairly significantly.

QUESTION: Just a point of clarification, if I could?

Proposed is a 25 percent bump over bag 3 levels. Is that what this represents?

MR. ROUSSEL: This is actually a 25 percent increase of the LA4. And the way I read your NPRM, that's what I recall your increase was, it was a 25 percent increase of the LA4.

QUESTION: Yes, I'm sorry, you are right. Excuse me.

MR. ROUSSEL: You saw a 100 percent increase in emissions in that first ACR data, and you wanted to control 75 percent of that increase.

QUESTION: Yes, thank you. Sorry.

MR. ROUSSEL: The thing that has to be qualified here is the .21. It's just the average of the vehicles that are shown there. That really doesn't represent an industry average, but if it did, that's how the numbers would fall.

Next slide. The primary issue here, as we've just described is that EPA has proposed to control 75 percent of the increase for NOx with the A/C on, over bags 2 and 3. This reduction can only come from reduced engine out emissions and/or an increase in catalyst efficiency.

Looking at engine out approaches, the extent of engine out reductions are unknown at this time, but the options include increased use of EGR, and adjusting spark retard.

Increased EGR use will reduce engine power. That's one of the issues that we have. And some applications may not be tolerant to a significant increase in EGR to get a 75 percent reduction.

The other option includes shutting compressor off during certain portions of driving. We perceive that there will be significant customer issues with this approach. And essentially the feasibility of the concept has not been demonstrated. And that is A/C compressor work is merely being deferred and it may not actually have any actual benefit in NOx reduction. We haven't done any testing to this area to make -- to indicate that this would be a solution that works.

Increased cycling may lead to compressor durability issues for some manufacturers as well.

That brings us to catalyst conversion efficiency approaches. And essentially what we have, we take a look at the data, catalyst efficiency has already been optimized for hydrocarbon, CO and NOx, over the FTP, with the A/C off. That's an assumption we're making, is the production vehicles with production calibrations. So that -- the calibration's essentially been optimized for these three constituents.

Now because catalyst NOx efficiency is going to go down with the A/C on, the calibration is very close to optimum level for NOx and there's very little room to further optimize the calibration for NOx with the A/C on.

We've discussed rich biasing, and we know that rich biasing will alter the optimization of HC CO and NOx. And there has been a report that's been submitted by GM and made part of our package that was submitted to the docket in January, that essentially did a bias study over the FTP with the A/C off, obviously; indicating that there was no benefit for NOx. In fact there a degradation in HC and CO performance.

And essentially what that's indicating is -- did a pretty good job optimizing this thing for HC, CO and NOx, and once you start playing around with biasing over the FTP you start impacting other constituents and changing optimum points between the three constituents.

In conclusion, and summarizing, tailpipe and engine out emissions increased 100-plus percent. EPA has proposed to control 75 percent of the increase.

The control levels proposed will most likely require hardware changes similar to that being made for LEV vehicles, less quick light off technology, because we're dealing with a hot transient driving condition here. We don't have start issues essentially for A/C operation.

And the basis of this comment is, is that LEV NOx standards require a similar type of reduction in NOx from Tier 1 levels.

We perceive the changes include catalyst volume and loading, tight air fuel control, enhanced EGR systems.

Now just as a point of reference, the cost from a Tier 1 vehicle to LEV vehicle has been estimated at $576 per vehicle. Now obviously not all this cost can be attributed to what it's going to take to comply with NOx for the A/C cycles, because we're not dealing with quick lightoff here. But some of that cost obviously is going to have to be incurred to get to 75 percent reduction in NOx.

EPA has estimated cost at $1.23 per vehicle. So what we're recommending in the bottom line, when it comes to the stringency of the standard regarding NOx, is that we need to revisit both the EPA and the industry proposal based on cost effectiveness, taking into account hardware and facility costs.

Now I put this up here just for reference. This is a non-methane hydrocarbon plus NOx approach. The industry proposed level of control is .33. This is based upon a .65 standard. You can essentially see that all of these vehicles are going to require significant reduction, with potentially the exception of the Mustang.

We're saying we need to revisit both EPA's intended level of control -- and our own -- based upon a cost effectiveness analysis. And we're going to get into the cost effectiveness discussion later on. Not in my presentation, but later on within the industry presentation.

All right, that brings us to the stringency of standards for non-methane hydrocarbon and CO.

Just a brief background. The original ACR data showed average increase in tailpipe HC and CO of 18 percent and 42 percent respectively. Some of the increase occurred from enrichment, which lowered catalyst efficiency for HC and CO. We suspect that the enrichment occurred due to the higher loads of the A/C operation.

EPA has proposed to maintain HC and CO levels with A/C on at A/C off levels. A preliminary look at the new data, tailpipe CO increased 88 percent, on average, with A/C on. Tailpipe HC increased 0 percent, on average, with the

C on.

And what our bottom line is, is that we really need to investigate HC/CO, and further, before an adequate level of control is determined.

And we also have to take a look at this from a cost effectiveness standpoint as well.

The next slide that I have is an analysis of the CO data. Again, the clear bars, or the open bars, represent the A/C off condition; the dark bars represent the A/C on condition.

You can see that there's a pretty wide range of performance here. The Corolla and the Escort showed very large differences between the A/C on and A/C off for A/C. Mustang, not too big of a difference. Towncar, some difference; but we're seeing an 88 percent difference on average here.

We move to non-methane hydrocarbons, we get pretty much of a mixed bag here as well. We see increases for the Corolla, the Escort; an actual decrease in the Mustang, which is why, if you look at a non-methane hydrocarbon plus NOx approach, the Mustang was close to compliance. It's because of this reduction in NHC. The Towncar remained approximately the same.

I should add that EPA's intended level of control is essentially the average of the off condition which is represented there.

Next, that essentially concludes the discussion that I wanted to go through about stringency of standard for A/C operation. I'd like to now shift the discussion to EPA's primary proposal for test environment.

I think everybody recognizes that the technically correct test environment is an environmental chamber that can simulate representative airflow, temperature, humidity and solar load. However this is a very extremely expensive alternative and -- I think EPA and industry recognize the need for a less costly approach.

The NPRM defined alternative to a full environmental chamber is ambient temperature 95 degrees Fahrenheit; fixed cooling fan speed of less than or equal to 15,000 CFM. Driver's side window down.

EPA's stated rationale in the technical support documents and in the NPRM is the testing with the A/C on allows for full interplay between engine calibration logic and the load imposed by the A/C. You can now include the A/C push as part of your calibration strategy.

Driver's side window being open, plus the single cooling fan represent a balance of emissions impact if the test was conducted properly.

Our problems with the EPA approach is that it's not representative of the real world. Essentially we have inadequate cooling across A/C condenser, with a fixed fan speed capacity not to exceed 15,000 cfm. And we have unrepresentative cabin loading with driver's side window down.

Essentially what we're saying here is two wrongs do not make a right. Inadequate air flow across A/C condenser, plus unrepresentative cabin loading doesn't equal a representative A/C on test. We believe this will force manufacturers to design to a test procedure rather than real world conditions.

Because test procedure isn't representative it doesn't provide manufacturers with an incentive to increase the efficiency of system -- essentially low energy "transmissibility" glass, solar powered cabin cooling fans and those types of changes.

What we'll primarily do is just certify to the shortcut procedure, not looking at these areas for A/C improvement.

And there is still a significant facility burden in that we need to have boxed in facilities to maintain adequate temperature control, which most manufacturers do not have at this time.

Our recommendation is essentially to adopt methodology such that a conventional test site can be used. And we believe this to be the chassis dynamometer load simulation, often referred to as Nissan 2.

Harold Haskew is going to take us through that and where we stand on the load simulation, but I'll take any questions that you guys have before Harold comes on.

QUESTIONS AND ANSWERS

MR. MARKEY: Jerry?

MR. ROUSSEL: Yes?

MR. MARKEY: One quick question. Are the vehicles that you've tested in this most recent test fleet, did any of them have EGR?

MR. ROUSSEL: Did any of them --

(Simultaneous voices)

MR. HASKEW: -- All -- I think all had --

MR. ROUSSEL: -- I think all of the vehicles had EGR to comply with the current FTP Tier 1 standards. I can't speak for the Toyota vehicle, but I'm fairly sure that the Ford vehicles all had active EGR system incorporated in them.

MR. GERMAN: I'll ask one of my standard questions, and that is when can we get the data?

MR. ROUSSEL: I don't know if I can answer that question right now. I don't know the status of the data, but we will make the data available in the very near future. And I thin it's very close to being ready and delivered to EPA.

Essentially the data supports the previous test program. The difference is we have 50,000 mile aged catalysts on these vehicles, so there's more credibility to the numbers.

MR. GERMAN: Yes, that's what we'd like to get our hands on.

MR. ROUSSEL: Correct. We agree.

MR. GERMAN: You made a statement that increase EGR use will reduce engine power?

MR. ROUSSEL: That's correct.

MR. GERMAN: Do you have any data that quantifies what the impact is?

MR. ROUSSEL: Ford did an EGR study as far as varying EGR and what that meant to engine power. And I don't have the data with me here, but we could set up a meeting and we could discuss that report, showing the impact of EGR on power.

MR. GERMAN: I'd appreciate that.

You also made a statement that the cost to go from Tier 1 to LEV vehicle has been estimated at $576 a vehicle. I just wonder whose estimate that was and what kind of assumptions were included in that?

MR. ROUSSEL: All right, that number -- and I might have to refer to somebody else here, but that number essentially comes from a Sierra Research report and it's a number -- it's an industry number that's been well established and well documented.

And, Mike, do you want to add something?

MR. BERUBE: Yes, Mike Berube, Chrysler.

Based on a Sierra report that's been published it's -- it's not quite industry data. Actually industry data was significantly higher than that. Industry provided data to Sierra Research, they did the analysis, they made a number of their own assumptions basically assuming quite a bit of learning, in a learning curve, what happened over the technology, and lowered the cost from industry's initial estimates.

So we have been -- industry has consistently quoted the more conservative Sierra numbers.

MR. GERMAN: Okay, but that's a report that's readily available, I assume?

MR. BERUBE: It is. And if you don't already have it we can get it to you.

MR. GERMAN: I'd appreciate it.

MR. MC CARGAR: The EPA went to some effort in its technical report materials to discuss the "representedness" of current LA4 for start driving. And you made a statement, which I can't come right to in here about the representedness of the LA4 in that respect. Would you reiterate whether you think, based on the survey data that we gathered, whether or not the manufacturers believe that the LA4 is representative of start driving?

MR. ROUSSEL: Of in-use start driving?

MR. MC CARGAR: Correct.

MR. ROUSSEL: I think that's a question that Glen, maybe, can handle.

MR. HEISER: Glen Heiser from Ford.

Again, I don't have it front of me, but somewhere in your technical report document you -- I was almost quoting your words that there is somewhat representedness in the 505 for the current LA4 off start driving behavior.

MR. MC CARGAR: But from the manufacturers' point of view do you consider the LA -- I understand you've reflected back that comment with respect to the 505. It certainly has some start driving aspects to it, but do the manufacturers believe that the LA4 is an adequate representation of start driving?

MR. HEISER: I don't know the answer to that. I guess we have been --

MR. HASKEW: (Interposing) The answer is yes.

(Laughter)

A VOICE: Harold says yes.

MR. ROUSSEL: What we're saying is, is that the LA4 is a good cycle to use for FAC control. We believe that's the cycle without a 10 minute soak.

Whether it's a representative cycle for start driving, when we put this presentation together we didn't specifically analyze that particular issue. We were looking at what's the control cycle that makes sense for A/C operation. And we believe that to be the LA4.

A VOICE: Just to paraphrase, make sure we have it, I think what you're saying is that you don't need a representative start cycle to control air conditioning emissions?

MR. ROUSSEL: That's correct. Those were handled elsewhere within the current FTP.

MR. MAXWELL: I have two questions which may be subject to future presentations. If they are, just say so.

One is on the chassis dynamometer simulation, are you going to present --

MR. ROUSSEL: (Interposing) Harold Haskew is going to present some information and where we're at on that particular program.

MR. MAXWELL: Okay, the other question is -- and again, maybe you're going to present something on it in the future, because I saw you had defeat device later on down. But in one of the earlier presentations you gave us -- I can't recall whether it was in your actual proposal that we referenced and put in the docket, or whether it was in your preliminary presentation of that around the November time frame, but you offered the notion of possibly using the full environmental test as kind of a defeat device, reference condition -- we go to sort out defeat device questions. Are you still including that notion in your proposal?

MR. BERUBE: Yes, essentially that's correct, absolutely.

MR. MAXWELL: Are you going to present any more on that when you talk about defeat devices? Okay, so I'll wait.

Okay, I guess, move to your next step, then?

MR. BERUBE: Okay.

BY MR. HASKEW:

MR. HASKEW: Thank you, Bob.

Again, I'm Harold Haskew from General Motors. My part of this is to explain where we stand, work in progress, on the A/C simulation technique.

Bob, if I may back up and kind of reiterate the industry's position?

What Jerry said is as a group we do not feel the primary NPRM proposal of testing with the driver's side window down in a 95 degree cell is a proper or right or an adequate A/C test. Okay? We reject that. All right?

So then you're left with what is the right way to do it? And Jerry alluded to the technically correct way to do it is in an environmental cell. Okay? We need representative airflow over the whole front of the vehicle, through the condenser, et al. You need solar load, et. al. And as we have done in the first part of the test procedure and in this, you need that as the primary reference way of doing the testing.

Now shudder to think that every development car and every certification vehicle would have to be operated in search of a facility for certification and eventual in-use testing. That is a prodigious workload.

So without abandoning the idea that that reference method is the best technical way of doing it, we're now working hard at finding a workable simulation that will give the same test results for the right reasons -- okay -- that we can use as a -- as a working or development test for certification and eventually for in-use testing. And I'd like to describe where we stand on that today.

Is that responsive to your question that you had earlier?

A VOICE: I think so. As you go into the presentation we'll find out, yes.

MR. HASKEW: Okay.

MR. MAXWELL: We'll be able to respond to that question and I think the way you handled it in the NPR, at least our reading of it, seems to be in line with what I think we kind of talked about at the October 21st meeting.

MR. HASKEW: Since this is work in progress, and you're seeing some of this for the first time, I would suggest that you interrupt for clarification or for definition as we go. It might be most appropriate. Your choice, of course, but I invite your questions.

We're talking about the Nissan 2 simulation. It is a alternative to the technically correct way of measuring air conditioning performance, which I'll get into in just a second. And it's alluded to Nissan because they first came up with the concept of using the -- the advanced electric dynamometer to replace the air conditioning load. And it turns out it is a very promising concept and one we're trying to follow up on.

Now this concept requires that we have an environmental cell and that we can measure vehicle performance in an environmental cell. We're not walking away from that. But then this would be the surrogate that you would use ultimately for development.

Now it's going to be based on actual compressor loads being measured in the reference cell. And of the data Jerry Roussel described there were four passenger cars and one truck. There was a Corolla, Mustang, a Towncar and miscellaneous -- I forget what the 4th one was. The Escort -- for the vehicles. And there was also a Ford Bronco. Each had instrumented air conditioning compressors, strain gauge shafts on the air conditioning compressor, and we've measured the compressor torque over the entire LA4 drive cycle as the vehicle was operating, and I'm going to show you some of that data.

We measured the engine speed, multiplied the engine speed times the pulley ratio to get the compressor speed. Compressor speed times torque for the appropriate constants -- gives compressor horsepower.

MR. MAXWELL: I -- to interrupt -- you did that in the environmental chamber?

MR. HASKEW: Yes, that was all done in replicates, in the environmental chamber, with valid tests, while measuring emissions simultaneously. And we'll show some of the emission results as we go.

We're going to say that this concept, using the dynamometer to duplicate this load has promise, but it is still under development, for reasons I'll go into.

Our concern for the cost of this is shown in this slide, which is a cross section of a current cooling tunnel used by General Motors. And I believe other companies have very similar facilities.

This chamber is used for studying cooling and -- and tries to get the right airflow at the front of the vehicle. The overall length is 135 feet. This particular one has a 500 horsepower fan driving the air through a long straightening nozzle -- to be very careful that the entry conditions at the front of the vehicle, from the ground up to probably mid-windshield, can duplicate the exact airflow you would have if driving on the road at speeds up to 80 miles an hour.

The vehicle shown there is a small pickup, but it is in scale. So it's about 135 feet long, about 30 feet high; and in cross section -- let's show the next slide -- about 20, 22 feet wide. This is an advanced vehicle shown, looking into the airflow nozzle. And the electric dynamometer is in the floor. You can push the nozzle forward or backwards, whatever.

We estimate the cost of this facility with -- to duplicate it with the emission test facility that would be needed, to be in the range -- the lowest I've heard is $5 million; and I think more appropriate about $10 million apiece.

We don't have any excess capacity for additional certification work and if this rule is finalized we will have to build these facilities. We -- General Motors has preliminary estimated that we would need 5 of these environmental cells, or $50 million in investment to do our test work if this were the only option available to us.

I've discussed this in some length with our internal cooling people, our platform people and all, and they are -- they're supportive of the idea that to do this right is going to require such a facility, that there are a lot of things they've learned over the years, not in emissions measurement, but in cooling measurement, of the subtle details that are necessary to do this.

We're looking for some sort of simulation method for, first running the vehicle in this kind of facility, actually measuring the compressor torque; and then coming back and duplicating that compressor torque using the normal emission test site dynamometer.

The next slide I'm going to show is a plot of some of the test results for one of the tests, and the first one is the Bronco.

Now let me orient you. That is a plot in time scaled 0 to 1400 seconds. Up high on the plot, the trace, you would recognize as the LA4 with the 18 speed bumps.

The upper red curve is the air conditioning system's high side pressure, or the pressure on a second by second basis, measured at the discharge side of the compressor.

Next down, in the blue, is a vent temperature. Not the scale is on the left -- scale -- that's the vent temperature and degrees Fahrenheit divided by 3; so that's starting out at about 85, 90 -- did I do that right? Times 3? About 90 degrees Fahrenheit; and then cooling down as the system starts to operate. That's a thermocouple in the air conditioning vent.

The more bold black trace appearing in about the middle is the compressor torque.

Now notice that the compressor torque is almost constant. It's kind of high at the start, but as the vehicle cools down, having followed its 10 minute soak, with the lights on and all. And as that -- then temperature comes down and is the high side pressure, and the lowest curve is the green low side pressure.

Compressor torque is fairly constant over the 1372 second test, and with about 10/foot pounds. Of all the vehicles we tested, around 10/foot pounds was a pretty good average result.

This vehicle I chose to show because the compressor did not cycle. The tests were done at 95 degrees Fahrenheit, 40 percent relative humidity. All of the other vehicles, the compressor cycled.

So the second set of curves I'd like to show is for the Lincoln Towncar. Again, the same parade of differences, except as you look at compressor torque, where it about 10 pounds constant, around the 400 seconds, it started cycling, cutting in and out. The air conditioning controls are saying cycle compressor off, based on, I believe, the high side pressure and the low side pressure in making a decision, that it had adequate cooling for those test conditions to where it was cycling on and off.

We did not see cycling in the first series of tests that we have shared with EPA, which were done under slightly more -- well, quite a bit more stringent conditions; but this is closer to what we think is the test procedure that is appropriate, and we did encounter cycling.

Now the load simulation measurement can handle this cycling in a very direct fashion.

Mike, could I back you up just once to the Bronco now? It's around the curve here.

Again, the compressor torque on the Bronco, which didn't cycle, is a fairly constant. It starts at about 15/foot pounds and drains down to about 10.

If we take that torque times engine speed, divide by the right constants, we could then get compressor horsepower, which is the next plot I want to show for the Bronco -- not the one in your hand, but the one under.

Okay, now there are two major plots at the lower side. Te black, going from left to right, is compressor horsepower. If we multiply 10/foot pounds of torque times the engine rpm, the engine rpm -- the engine rpm is shown in red and it's scaled divided by 100. This vehicle, the Bronco, was idling a little over 600 rpm and was gusting up to 2300 rpm on accelerations.

What we then get, with an engine speed that goes up and down, and a constant torque, is an A/C horsepower that is pretty much an image of the engine rpm.

So the compressor horsepower for this vehicle ranges from about 2 at idle, up to 6 or 7 on the accelerations with it going up and down with engine speed.

Now if we look at that horsepower, if we look at those plotted against mile per hour -- what I showed you first was horsepower versus time. Okay. Just a normal parade. If we go back and re-plot those all versus speed, each of the red circles there is a second of second of measured A/C horsepower, versus vehicle speed, we get this family, which we've all come to kind of recognize as being appropriate. And just for perspective, what I've put through the curve is the black line, which is the road load horsepower for this vehicle.

Now this is not the dyno horsepower that we're used to seeing, because for this Bronco, at 50 miles an hour, it's about 24. What this is, is the road load, the true road load for the vehicle, F of 0, plus F2 times velocity squared (phonetic).

And then we've superimposed on that the current A/C penalty, which is to add 10 percent to the windage. And the difference between the green curve and the black curve is what's currently reflected in the test procedure as an estimate for the A/C penalty.

Now this A/C horsepower, at lower speeds, is quite a bit higher than the road load. And of course at the higher speeds the A/C horsepower is a much smaller fraction of the road load horsepower.

But I want to make a shift here and I want to change from horsepower to force. If any of you worked in wind tunnels around you tend to know we talk about drag, vehicle drag, the force necessary on the vehicle.

This plot is a setup plot where, again, on the horizontal axis we've got vehicle speed. And on the vertical we've got drag or force in pounds. And the three lines are lines of constant horsepower. The highest one is 6 horsepower, 4 hoursepower in the middle and 2. Now 2 horsepower out at 50 miles an hour, is only about 20 pounds. But 2 horsepower at 2 miles an hour is a very large force. And any horsepower at 0 speed is of course infinite.

So if we look at what the force is that the dyno would have to supply, it's going to have this kind of relationship. It's going to be very very high at low speed and then decay down to some value that's not stable -- it's still going down, but relatively small.

If we look at the same data we just showed you for the Bronco, we've now plotted the measured values expressed in terms of rear wheel force as a function of vehicle miles pre hour.

Okay, now for the force term I've got to two components of vehicle drag that we normally use. The horizontal bar, at about 40-some pounds, is the friction term, that's the constant term, constant with speed. Then additive to that friction term, the black curve is the windage, the area of dynamic force which is increasing as a square of the speed.

The green is the windage plus 10 percent, and that is the current A/C penalty. That's what we're using today for A/C penalty in the certification process.

Now the values we're used to seeing are in fact the Clayton Twin Roll dynamometer horsepower (phonetic), which is just the net horsepower after we subtracted out all the losses between the tire and the cradle rolls, and that's a big part of the absorption. But this in fact puts in perspective that the air conditioning drag below, say, 25 miles an hour, exceeds the road load force by a bunch.

Okay, now what do I want to do? What I want to do is take the A/C horsepower or the A/C measured force as measured at the engine and replace it at the dyno interface. And to do that I'm going to have to do a transform that ends up with a force that is very very low at low speeds. Now it can't be applied at idle and it can't be applied just off idle, but we have been developing this using the dyno superimposed at a 10th of a mile per hour, okay, using the appropriate load by the electric dyno. And this something I think we've all learned is more positive than we though.

The sophisticated electronics in the electronic dyno allow us to input an additional force down to a 10th of a mile per hour successfully. Originally when we first talked at the panel I said, well, we need like a 2 mile an hour dead band because I was afraid of control problems right where you step in. Well, no. We can simulate the load right down to even a 10th of a mile per hour, although ultimately it's limited by the current carrying capacity of the dyno, which is about 1500 pounds. But I think we can do a real good job on that. So that made us real happy about the ability to put this load at the dyno.

What we've been working on is a real time simulation of air conditioning load using the dynamometer to do it. Now at this magnification you're going to have to take a lot of this on faith. But in fact that's the 1372 seconds for the LA4. You can probably see the LA4 cycle across the bottom.

And then there are two curves. I've used a logarithmic scale and the load to be applied by the dyno is shown for two tests, as green and red. The green kind of overwhelms here, and the only place where you can see where there's any different is where you see just a little bit of red.

I'm going to expand and look at just the first two cycles of that. This is the kind of load, expressed as a dyno load, that would be used to represent the air conditioning compressor load shown for the first 2 cycles. That's based on actual measured data from 2 tests showing excellent correlation of the force. Again, using a logarithmic scale. Some of those forces go up to the 1500 pound limit. But we can't do anything at idle, and of course that's one of the problems.

So we have run all the vehicles using the Nissan 2 simulation with the dyno load applied in this fashion, in real time, every second. We're using a measured second.

What we found, though, is that if we try and correlate, first the carbon dioxide, the CO_2, think of that as fuel burned -- probably the most direct measure of load.

Across the horizontal scale is the delphi, the old A/C Rochester test results, with data points that are circled, duplicate tests on the two vehicles, cross plotted against the real time simulation. If the data were directly correlated they would look like the lowest vehicle AC801, that is the Toyota Corolla. Both of those tests matched up very very good.

However the other 4 vehicles, the data points are all below the correlation line indicating some lack of load transfer, okay? And with CO_2 being pretty repeatable that indicates to me we're not getting all the load in there that we should.

The next plot, more disturbingly, is of the NO_x, grams per mile NO_x. In this case we seem to be underloading the NO_x by more than the CO_2. And while the tests on 208, that's the Bronco, are within some reasonable correlation level, the others indicate we've got a basic problem.

What we've found is while the dynamometer can do a real good job of loading and replacing the air conditioning compressor load, it can't do it at idle, which we knew, but it also can't do it on decelerations. When you decelerate the dyno, braking -- the dyno at extra load -- just looks like extra braking for the vehicle. That load does not make it back up to the engine.

Show cure. Again, this is showing the whole test. And we switch concepts here now and the two curves along the bottom are engine out NOx in milligrams per second, with the red being the real test, if you will, at delphi; and the green being the dyno load simulation that we've just shown you. And we'll show magnification here -- the next would show.

Well, this is the same thing on the Bronco. And then let's go for a magnification out around cycles 12, 13, out there; where again the red is the engine out NOx in milligrams per second and the green, while matching the red during the acceleration and cruises, tends to fundamentally undershoot on decelerations and of course at idle, is also off.

We believe this explains the differences that we're seeing between the measured data. Is there one more of those? That's the Towncar, there's the Bronco. Okay?

And what we need now is some way of simulating this load without using the dynamometer, because the dynamometer can't do the load on "decels" and at idles.

The concept that we have is to actually measure the emission levels with the engine running in a normal emission test cell with the A/C and with the A/C on at idle. Establish, if you will, a grams per second level, A/C off and A/C on. Take the difference between those two actual measurements on the vehicle, run the Nissan 2 simulation, which we believe correctly loads all the accelerations and cruises, add the time weighted idle and decel rate into the bag that you measure, divide by 1372 into it. That's work in process. We're very hopeful it'll work. It seems like it'll work. We're highly motivated to try and make it work and go on from there.

So if I summarize where we stand today, I think we've satisfied ourselves that the dyno can apply load properly and it can do it very accurately. And in terms of driver feel and the ability to drive the cycle, all of those concerns have been put aside.

We've got to come up with a way for correcting, though, for the decelerations and idles that were not currently measured, because the correlation has to be better than that. I've described how we intend to do that. We're about half way through the round of tests with the measuring the normal test cycle idle and we hope to have this developed by the close of the comment period and hope you can extend that comment period more than 30 days.

I'll be glad to handle any questions.

QUESTIONS AND ANSWERS

MR. GERMAN: The adjustment technique is something we talked about before for idle emissions. Have you done any analysis to determine whether the impact on deceleration is the same order of magnitude?

MR. HASKEW: No, John, we got the data to do that. Once we have this idle that we've measured in the normal emission test site and we factor that back in, then we'll do exactly that comparison that you're talking about and we'll be glad to share that with you as we do that.

MR. MC CARGAR: I guess I'm on the same topic, and I'm a little bit confused. How is it that you're determining -- are you determining emission rates at decel in the same way that you are on idle --

MR. HASKEW: (Interposing) no --

MR. MC CARGAR: -- or are you using the idle rate -- to --

MR. HASKEW: -- no, no. Jim, the supposition is, is that during decelerations the net increase in emissions is the same as it is at idle. We are at closed throttle.

MR. MC CARGAR: Okay.

MR. HASKEW: And it's just -- it's a longer idle. Although the vehicle speed is changing, the through-put through the engine is not much different than it is during the idle. That's the link we hope to establish, which will make this work.

MR. GERMAN: We talked about doing the assessment of what the proper load is in this environmental chamber. Is there any possibility of doing that work out on a track.

MR. HASKEW: John, if you've ever -- and I have. If you've ever tried to do track work, okay? It is never the same day outside twice, and you chase yourself silly trying to come up with correction factors that correct for wind, ambient temperature and humidity. Anyone that's done road load fuel economy, or road type fuel economies will know that -- short of building a track that's totally enclosed.

(Laughter)

MR. HASKEW: And that's been talked about, seriously, of just putting a long quonset hut over a long straightaway. Short of doing that, no. I think we'll have to do that inside.

MR. ROUSSEL: If I could comment on that as well? Another example of where it doesn't work very well is in the evaporative emissions rule where you have to do fuel temperature profiles outside, and test to test there's a lot of variability. And it's hard to get, you know, a couple of tests that look the same. And that is because, as Harold just indicated, one day does not look like that other day.

MR. BERUBE: You know, we all -- that's a problem of being located in Michigan.

(Voice out of microphone range)

MR. GERMAN: My other question -- I think I know the answer to this one, I just want to verify it; and that is the load curves that you are actually using, taking data and testing, those are based upon the actual measured load which would also be a function of the engine rpm?

MR. HASKEW: Yes.

MR. GERMAN: It wasn't because -- you had some -- here, which were speed based loads. It's not what you used, I assume?

MR. HASKEW: No. It was -- what we applied then was real time and I didn't go into that you have to correlate the time very well. When you go to apply that to the dyno you gotta make sure that the load apply synchronizes very well with the driver's synchronization.

MR. GERMAN: Okay.

MR. HASKEW: I think we solve that, but yes, it's applied in real time.

MR. GERMAN: So a sample -- if the compressor cycled that change in load would have been reflected?

MR. HASKEW: Yes, yes -- it shows up one for one, John. I think that solves one of the problems that you and I have talked about.

MR. GERMAN: Right.

MR. HASKEW: Throughout.

MR. GERMAN: Yes.

MR. MC CARGAR: Related questions to that?

When you take your raw data and then you generate the load curve -- I've been away from this for a while, so excuse me if this is something you've already dealt with -- the A/C team; but you use a higher order of regression that determines the actual fit to the real data?

MR. HASKEW: No, no. We've abandoned that. That was dropped about two generations ago.

MR. MC CARGAR: Okay.

MR. HASKEW: That was when we were thinking about using an averaging concept and applied just a load that was the sum constant or sum function of speed. Okay?

The shift we made, once we understood that the dynamometer could handle a real time file that we can put in, in the grade term, okay, we can put in a file, if you will, that's got a precise value for drag for every second. Once we realized that we could do that we said, "Hey, this solves the compressor on, compressor off; all of that." I mean you can go ahead and do that.

MR. MC CARGAR: Okay, so at a given time point in the cycle you're simply averaging however many end tests you had to generate the load point for that particular point in the cycle, and it accommodates whether or not the vehicle cycled on and off as well? What if they didn't cycle it precisely at the same time?

MR. HASKEW: Well, the reference test that would be run in the test cell would measure the compressor load over 1372 seconds and then that's golden, that's frozen. Okay?

Then, with the Nissan 2 simulation technique, we go to a normal emission test site at 75, 76 degrees Fahrenheit, normal emission test site with a new dynamometer; and we drive the LA4 cycle at the normal emission temperature and all and the dynamometer applies the load to the vehicle as if it were occurring at the compressor.

MR. MC CARGAR: Yes, I understand that, but when you're in the original test cell --

MR. HASKEW: (Interposing) yes --

MR. MC CARGAR: -- in the full environmental chamber, and you're determining the load in that chamber?

MR. HASKEW: Yes.

MR. MC CARGAR: You'd run multiple tests, right? You ran at least two or you just ran one?

MR. HASKEW: No.

MR. MC CARGAR: Okay, that was the confusion.

MR. HASKEW: Just ran one, and the plot I showed, where we showed two tests on the same vehicle, the repeatability was extremely good. That's the log of the plots that are included in the data.

A VOICE: That was the vehicle that didn't have any compressor cycle --

(Simultaneous voices)

MR. HASKEW: -- we've got it all and we'll share it all with you and you can see.

MR. ROUSSEL: If I could add a comment here? Even if you even if you take a look at the vehicles that had compressor cycling, the compressor cycling is very similar between tests, which was kind of a surprise to us.

The other thing that I think that directly addresses your question, Jim, is you would do something similar to what you do in the field tank temperature profile and that is you choose a worse case profile, or a worse case A/C load, actual real A/C load curve that you have, and that would be the curve that you would use, that you'd put through the simulation to run A/C load simulation test in your conventional test site.

MR. MC CARGAR: A worse case from the point of view of whatever variables, including cycling.

MR. ROUSSEL: Right.

MR. HASKEW: And let me comment on that. I don't want to minimize the amount of work that's going to be necessary to come up with these load curves for a full family of vehicles. And we're hoping that we would be able to do -- as Jerry's saying, use the measured A/C load from a worse case condition to represent a family of conditions --

MR. MC CARGAR: That's exactly where I was going.

MR. HASKEW: And that would handle two doors and four doors, on and off road tires, blue and black paint and, you know, all of those things. Basic drivetrains and body styles would probably be the selection variable.

MR. MC CARGAR: You hit exactly where I was going. I would recommend that in your written submissions you make it very clear what your intention would be on the applicability of the load curves that you'd derive from the environmental chamber, how many vehicles you would be using to generate those data and how it accounts for factors like you just mentioned, the worse case scenario based on cycling and other things like that. If we end up talking about two vehicles to represent all of the load curves for GM, I think it would make us a little nervous.

MR. HASKEW: Certainly, certainly. But we certainly wouldn't want to have the 1200 vehicle drivetrain combinations that we sell, either, you know -- have to do all of those. Somewhere -- the balance is somewhere in between. But let me just reiterate, the simulation that you and CARB have embraced in the NPRM with running just a normal -- normal test cell, but at an elevated temperature, at 95 degrees Fahrenheit with the driver's side window down is patently unacceptable. Okay. Those of us in the business think you can't make a whole bunch of wrongs come up with the right answer. Right?

And we're saying, and the NPRM gave us options, right, we can use the full environmental cell, which we'll have to do that, because as we know and understand what it takes to properly load or reflect the load of the air conditioning compressor, it's going to take the kind of cell I'm showing you.

If we're gonna do it we've gotta do it right. And -- and we are highly motivated to come up, then, with a surrogate that works, that enjoys all the representativeness.

MR. MC CARGAR: Recognizing that you believe that our approach is two wrongs and that doesn't make a right --

MR. HASKEW: -- (Interposing) The two of them are wrong --

MR. MC CARGAR: -- did you consider running it in EPA's configuration to see whether or not the correlation on emission results reflected the data that EPA got --

(Simultaneous voices)

MR. HASKEW: -- no, give the work load, the ambitious work load we've taken on in all these other areas I think we put that one in a dead on arrival.

MR. MARKEY: Early in your presentation you had identified, I think, one of your concerns about the A/C simulation and actually turning the vehicle on so that you know what are the different effects when you actually turn the A/C on in terms of emissions and then dyno simulation in terms of the emissions test would not do that.

Any comments on how to address that concern?

MR. HASKEW: Well, it's just -- I believe that ultimately we understand your concerns for gaining and defeat devices and all. And I think ultimately we've always thought that we would be held liable to running it using the master method or the reference method. Okay? And that would be the basic way of measuring, or the best way of measuring. But given the surrogate, or the simulation, that that would be the working master that you would use to run the bulk of certification and keep the cost of this rule down.

MR. MARKEY: So that the upshot of that is that you would say that under the defeat device policy you would be liable for calibrations that triggered something based on the A/C on switch not protectable for Nissan 2, but the obligation would be on EPA to test it in a full environmental chamber to pick up on that?

MR. HASKEW: It strikes me -- and I'll have to speak then, just as Harold Haskew, that that seems plausible.

MR. ROUSSEL: From a defeat device standpoint that seems reasonable, but what we want to be careful of is that the in-use tests match the certification test. We don't want to have the same thing happen that happened in the evaporative emissions running loss tests where we have two different types of test sequences and then two different types of in-use liability. We want to avoid that with this rule. I think we've made that clear to you guys a while back ago and I think you're proposal reflects that.

MR. HASKEW: I think what we're trying to say is we want that decision decided at certification where, you know, where we've got the real vehicle there and we certify it and satisfy certification with either method. Okay? And then in-use test with whichever way we certify.

We can expand on these, Jim, in the comments, to make sure you understand what we're fumbling with here.

MR. MAXWELL: Let me paraphrase back what I think you said, and then you can confirm it.

MR. HASKEW: Okay.

MR. MAXWELL: At least as far as the defeat device issue, you would see us sorting that out -- as if there was some question or concern. We might sort out the defeat device issue by going back to environmental chambers -- be concerned that nothing else is going on funny with the calibration. But once that was kind of decided in certification, then, that then that would also result at certification time, that the actual simulation was appropriate and therefore the in-use test would then use that simulation. Is that --?

MR. HASKEW: Jerry?

MR. ROUSSEL: That's correct. I believe that's what we've discussed, yes.

MR. MAXWELL: Hopefully there's no more questions, because even if there are I need to break it off here. We have NRDC scheduled for 3:15. She's here from another conference and needs to get back, a real time crunch. So

I've been holding off, hoping this would wrap up, but I think at this stage we need to pick it up again after she's done, if that's okay.

The agenda has listed as Sue Shprentz, it's actually Debra Shprentz from NRDC.

BY DEBRA SHPRENTZ:

MS. SHPRENTZ: Well, good afternoon. I'm Debra Shprentz. I'm a senior resource specialist with the Natural Resources Defense Counsel's clean air program.

NRDC is a national environmental organization with 170,000 members nation wide, and we've been working for the last 25 years to promote attainment of healthful air quality.

NRDC views this rule making as one of EPA's most important initiatives to clean the air. The implications for future air quality are potentially enormous and we commend the EPA staff for their leadership in recognizing the critical opportunity afforded by revisions to the federal test procedure. And we applaud the excellent technical work of the staff in defining the problems and in identifying practical solutions.

This is a difficult issue because of its highly technical and somewhat esoteric nature. It's not glamorous. But let me be clear, aside from the California low emission vehicle initiative, NRDC views this proposed rule as the most important proposal on the table to reduce emissions from new cars and light duty vehicles, trucks.

Today we're on the eve of the 25th anniversary of Earth Day, yet air pollution is still the most significant environmental threat to public health that we face.

While the air is noticeably cleaner it is filled with invisible pollutants that contribute to the three leading causes of death in our country, heart disease, lung disease and cancer.

In American cities 70,000 people die prematurely from heart and lung disease due to fine particle air pollution every year. Asthma rates are rising in young children. Public health is imperiled at levels far below the current EPA standards for ozone or particulate matter. Yet in almost every major metropolitan area officials are struggling to develop clean air plans merely to attain the current health standard.

In the Northeast, for instance, regional air quality models indicate that reduction on the order of 75 percent reduction in nitrogen oxide and 25 percent reduction in hydrocarbons will be needed in order to attain the national ambient air quality standards for ozone. And state and local officials are exploring every opportunity they can think of for achieving this level of reduction.

The reductions proposed by this rule making are eminently doable and will make an extremely cost effective contribution to the state efforts.

Automobiles are responsible for half of all urban air pollution. And this is true of ozone and carbon monoxide as well as for fine particle pollution. In fact the nitrates and the carbonaceous aerosols derived from cars and other sources of fossil fuel combustion, as opposed to primary particles such as diesel particulate, represent the major components of urban fine particle pollution, the pollution that's been linked to 70,000 premature deaths each year from cardiopulmonary causes.

Twenty five years ago the Clean Air Act established ambitious targets for a 90 percent reduction in automobile emissions and we've made tremendous progress towards that goal. But the emissions standard is only as good as the method for measuring compliance. If the test method is not an accurate predictor of how cars are actually driven we're just not getting the full benefit of the emissions standard. And in fact the studies by EPA have shown that federal test procedure is a poor predictor of emissions from cars in actual use for a number of common circumstances.

For instance the federal test procedure assumes no air conditioning, yet everybody knows that air conditioning puts a heavy load on engines and consequently increases emissions.

The federal test procedure assumes average speed as well as some high speed, but these assumptions are far lower than the way people actually drive and are not a good indicator of the emissions implications of aggressive in-use driving pattern. Also, people make many more short trips than are assumed in the federal test procedure, resulting in soak emissions that are unaccounted for and therefore uncontrolled.

Now I'm sure you're hearing a lot about costs from the automobile industry today. EPA estimates the cost impact of its proposal at from $12 to $16 per vehicle. This represents total costs per vehicle taking into account the costs of test facility construction and upgrades, engine recalibration, vehicle redesign, emissions control hardware and the cost of actual testing and certification.

In our estimation these costs are barely worth mentioning. Even if the estimates are off by a full order of magnitude the cost would still be utterly trivial relative to the cost of a new car or light duty truck.

The estimated benefits from the rule, after full phase in, are substantial and would make a large contribution to air quality improvement in urban areas, an 8 percent reduction in hydrocarbons, and 18 percent reduction in carbon monoxide, and a 14 percent reduction in nitrogen oxides from automobiles.

Now it's difficult for us to comment on the details of the specific test cycles that have been proposed, but I do want to mention that we're concerned about some of the industry proposal to modify or roll back particular testing requirements. In particular I understand that the industry has been urging a waiver procedure or, for the intermediate soak provisions, or for EPA to drop this test all together on cost effectiveness grounds. And we think the reductions that EPA has projected for this category are important and are eminently cost effective relative to other control measures that are available and we would urge EPA to pursue modifications to the test procedure to address the soak issue.

Secondly we would oppose the use of a simulated test procedure to address emissions associated with use of air conditioning, and are concerned that such a simulated procedure may not accurately reflect the actual engine operations and we would encourage EPA to develop modifications to the test procedures that are as close as possible to those conditions experienced by people in actual use.

And that, in fact, is the legal requirement of the Clean Air Act. Congress amended the Clean Air Act in Section 206(h) (phonetic) to specifically direct the agency to modify the federal test procedure to insure that it was an accurate reflector of in-use driving conditions. And that should be the principle legal argument that EPA uses as it moves forward to develop final rules.

I guess I'm a little bit concerned about the discussion on legal authority, that EPA feels it's somehow constrained in developing -- ah -- ah -- proposals -- ah --to modify the federal test procedure, that might have, um, implications for the emissions standard.

I think Congress is clear here, the test procedure is supposed to provide a way to estimate emissions in actual use. So it's not the modification of the standards that's at issue, but in fact you may need to consider modifications to the test procedure that would general substantial emissions reductions simply because it would provide a more accurate reflection of what -- actually being emitted by, ah, cars, in actual use. And the bottom line really is that we're not getting the emissions reductions that we thought we were getting from the federal standards because of these weaknesses in the federal test procedure. And that's really the opportunity that we have here, to make these modifications and move forward and achieve additional reductions given the current standard.

QUESTIONS AND ANSWERS

MR. MAXWELL: Could you clarify? When you made the statement that you felt EPA felt constrained on its authority somehow. Could you clarify what those constraints you've interpreted?

MS. SHPRENTZ: Well, it seems to me that in the preamble you talk a lot about the particular technical fixes that might be available to auto manufacturers in order to achieve the additional reductions that would be required with the modified test procedure. And the agency, it seems to me, finds itself feeling fairly constrained in terms of what it might be able to propose based on what sort of technological fixes might be out there and what those fixes might be.

And I think really the approach ought to be just to look at how to develop a procedure that accurately predicts the emissions behavior of cars in actual use and then let the manufacturers modify their automobiles to insure that they're meeting emissions standards under the full range of in-use conditions.

But one gets the sense, from the preamble, that the agency has, you know, somehow tied its own hands in terms of considering the degree of emissions -- of technical modifications and cost and emissions reductions that might flow from such changes. And I think that the mandate is to modify the test procedure to reflect in-use driving conditions.

MR. MAXWELL: Okay, thank you very much.

I propose that we take a brief break.

(Voices out of microphone range)

MR. MAXWELL: I was just informed we have to be out of here at 4:30, so I think we'll skip the break. Sorry, guys.

(Brief reces)

MR. MAXWELL: Okay, let's continue to our 4:30 deadline. Sounds like there's enough tomorrow that we should try to take up one more subject and cut off at 4:30 and pick up tomorrow on the balance then.

MR. ROUSSEL: Yes, we'll definitely have to continue on tomorrow.

MR. MAXWELL: Okay, so let's go ahead.

MR. ROUSSEL: Were there any follow up questions on the air conditioning before we move on? Were you done with that?

MR. MAXWELL: We'll look real quick.

I briefly introduced John Koupal once before, when he came up to the microphone. He's now sitting here because we're discussing intermediate soaks for which he was the coordinator.

INTERMEDIATE SOAK, INDUSTRY PRESENTATION
BY DOUG HOFFMAN

MR. HOFFMAN: Good afternoon. My name is Doug Hoffman. I'm from Chrysler Engineering and I'm here to give you the industry's views on the so-called intermediate soak.

I should preface this with -- that we'd like to acknowledge that the EPA really has done a good job in acknowledging or recognizing the the problems with the intermediate soak in the NPRM. They list the numerous problems that are there, and I'd like to go through and reenforce the issues imposed. Perhaps where we depart is what we then do, knowing what the problems are with the "I" soak, or intermediate soak.

Additionally we need to recognize that industry also recognizes, and we've been working with the agencies early on, that there's a need for the higher speed, higher load testing. And this represents a significant step forward with a multitude of issues and so forth to industry on the high load, high speed testing, and also improving the air conditioning loading.

We've been working with EPA and CARB for some time on these issues. However, we never have and we just cannot support the intermediate soak concept. We already have two soaks. We just don't see the need for the third. And we'll take you through that.

This is not news to the EPA and I'm sure you've heard these words before today as well. But we just want to be very clear about this for those that aren't clear on this.

(Laughter)

MR. HOFFMAN: The need for the soak is not justified and we don't believe it should be implemented.

Here are the issues concerning intermediate soak that I'll cover.

Firs the actual in-use soak distributions as measured by EPA and industry in a few programs. The emissions benefits are low, especially with the new Tier II/LEV type vehicles.

As mentioend before, and I'll cover in greater detail, the concerns with catalyst overtemperaturing. Here with insulation. The cost of insulation is very high. There's a facilities burden which is significant.

There's an exemption option mentioned in the NPRM, which essentially does not do the good that was intended.

Also, as mentioned before by Glen Heiser, we believe the SCO1 or 2 driving cycl;e should be eliminated.

The in-use soak distributions, there was a driving behavior analysis done with Baltimore data that clearly shows in our mind that the soaks between 0 and 10 minutes and 8 hours and beyond are the highest frequency soaks.

As shown in this histogram -- I think this is actually an EPA chart. You can see, again, the largest bars or the highest frequency occurrences of this event, of the restart events, are between 0 and 10 minutes and 8 hours and beyond. And we believe the current 2 soak periods that are accounted for in the current test procedure, that being 10 minutes and 12 hours and beyond, adequately cover what should be covered.

In the NPRM the EPA testing shows that Tier I vehicles will have lower restart emission times at all soak times when compared to Tier 0 vehicles. And this is what's expected because in general the Tier I vehicles have lightoff systems that are better.

And here is a chart -- this is out of the NPRM. And this shows pretty well what we have is, plotted against the various soak durations in minutes, we have three plots of non-methane hydrocarbon, carbon monoxide and NOx on the bottom.

The black squares are mostly Tier 0 vehicles with Tier I vehicles mixed in. And as you can see there is, you know, some increase in emissions for all three constituents as you increase the soak duration.

However, when you break out just the Tier I type vehicles, that is the improved technology vehicles, you can see there is a clear step down at all soak durations.

And the point that we suspected early on and will show to you here today, that with the LEV, or Tier II type technology vehicle there's another big step down.

Now the EPA did not have the benefit of having this LEV data and so they did the best they could at the time, I suppose. all they had was basically one Tier I vehicle to try to extrapolate the effects of the LEV effects in the cost/benefit analysis.

So we're now -- fortunately we now have some LEV, actual LEV prototype data and will be providing that today. And we think this really is a much better data set to use when trying to do such a cost/benefit analysis.

Here you see data from 4 LEV prototype vehicles from industry. They're listed as shown. There's a Ford light duty truck, a Chrysler light duty truck, T2 type; a Honda pass car and a Toyota pass car.

We have both the 10 minute soak emissions and the 60 minute soak emissions for hydrocarbon and NOx. The data groups fairly well. The averages are shown here. They're fairly low.

Here we have the same plot that you saw before, only for hydrocarbon, only we've blown it up a bit and we've put in the data from the 4 LEV prototypes at 60 minutes. And you can see there's a significant reduction in the emission at 60 minutes. And this is without any intermediate soak rule. This is just what happens as you go to the LEV or Tier II type technology.

And I should also point out at 120 minutes we have one data point off one of the vehicles. That's what that open circle is there, the lowest data point at 120 minutes.

And here we have the same, the same -- the same thing plotted for NOx. And again the 4 LEV prototypes represent a significant reduction in the NOx emissions at 60 minute soak.

We have large concerns with catalyst overtemperaturing if one were to use insulation. Insulation is of course one of the -- or, I guess a recommended or an example technology that the EPA has looked at of a way to lower emissions or approach the intermediate emissions issue.

What I'm going to show you, though, are some data from properly operating systems.

I need to explain this. It's a little bit busy, but this is worth going through. What you see here are three plots. And what these are, are 5 typical vehicles. They're Chrysler vehicles from a study that we conducted and we have -- we're showing hydrocarbon on the top plot, on the vertical axis, against miles. Those are thousands of miles. So we've got 0 through about 55,000 miles plotted.

We do the same thing for the engine out hydrocarbon and then the hydrocarbon efficiency of the catalytic converter, on the bottom plot.

These 5 vehicles were tested basically in 3 major groups. And if you look at, like at low miles, at 5,000 miles you'll see a bunch of data points. Those same 5 vehicles were then tested again at around 30,000 miles and the same 5 vehicles were tested again at around 50,000, 55,000 thousand miles. And the purpose of doing this -- this is an ongoing type of activity that we do at Chrysler, and I know that all of industry does this sort of thing. We take actual customer type driven vehicles and we evaluate their performance as they accumulate miles under real world conditions.

Let's take a look at what happened here. The tailpipe hydrocarbon, at low miles, is probably around a 10th of a gram per mile. Now it's crept up a bit and at, say, 50,000 miles it's definitely gone up. It's, you know, .15, maybe pushing .2 grams per mile. Well under the standard, I might add. But it definitely went up. Why did that happen? Well, if we look at the engine out hydrocarbon it's basically flat. There is some scatter. Maybe it went up just a little bit. So that really wasn't the reason. But if we look at the hydrocarbon efficiency we can see that the performance of the catalyst is definitely degraded and that really is the reason why the tailpipe emissions went up at 50,000 miles.

And what's important to recognize here is that there's nothing broken, there's nothing wrong with these case. These cars performed as we hoped they would.

But the best catalytic technology in the world that we know of, that we've seen, exhibits this behavior of degradation in use. And the reason for degradation, as has been mentioned before, is unavoidable thermal exposure. And for this reason, whenever we do an engineering analysis of the performance of any vehicle we never use low mile data, because we could be fooling ourselves by a large factor.

And here is, from the same set of vehicles, the NOx data set. Again we have tailpipe NOx on the top, engine out NOx in the middle and the NOx catalyst conversion efficiency on the bottom slide. And here the effect is even more pronounced, where we start off at perhaps a 10th of a gram per mile at 5,000 miles and we've essentially more than doubled the tailpipe emissions at around 50,000 miles.

Again, there's nothing broken but this is the windage or the expected behavior that the manufacturers have to design in. Plus, we try to limit that as much as we possibly can, which means we have to limit the exposure to temperature that the catalyst sees.

I guess I should also add that that was only for 50,000 miles. We're on the hook for 100,000 miles starting in 1994 and beyond. And so it becomes even more onerous because catalysts, they don't achieve a certain efficiency level and then just stay there. They keep degrading.

So the higher catalyst operating temperatures cause increased thermal degradation. It's primarily due to agglomeration of the dispersed precious metal throughout the catalyst biscuit itself, kind of usually, typically, kind of a honeycomb ceramic. And that leads to less catalyst surface area.

There's a known exponential relationship between this loss in activity in temperature. In other words temperatures, let's say you went from 1000 degrees Fahrenheit to 1100 degrees Fahrenheit. You'd have -- there's be some increase in degradation because of that. But going from, say, 1500 degrees Fahrenheit to 1600 degrees Fahrenheit, there would be a much, much, much larger concern due to that delta.

And the negative effects of high temperature exposure, they're cumulative throughout the life of the vehicle. Just little bits of exposure here and there. They don't -- it doesn't matter that it was only for a brief time period, the catalyst remembers that and they all add up and they come back to hurt you.

Temperatures are becoming higher and higher on our vehicles as we move to closer coupled catalysts, which we need to do to meet the new stricter emission standards. There's a lot of emissions that happen during cold start and we have to light the catalyst off as soon as we possibly can.

Ideally, you know, if we could get the catalyst to light off initially and gain temperature, that would be great. But after we get the catalyst lit off we don't want any more temperature.

Okay, so why did I go through all that? You've probably guessed. The catalyst insulation, again, the primary, the recommended method that the EPA has for addressing restart emissions, it does the wrong thing. It elevates the warmed up operating temperature of the catalyst. And at any increase at all it represents a significant jeopardy of overtemperaturing out in the real world.

In addition to moving the catalyst closer, where we see probably at 50 to 100 degree Fahrenheit increase, we're also seeing, as has been shown before -- and you'll see some more of this now -- we know that we're going to have to see even higher temperatures to meet the expected stringent USO6 CO standards, whereby we remove fuel, which does cause an increase in the catalyst temperature.

The fuel, up to this point, has been a very effective cooling mechanism. Now we are going to be able to use cooling it with a timer, but we still have -- there's still a burden. And you'll see that as we get into this.

What I'm showing you here is a temperature histogram, or a piece of it, the piece of that histogram which is of most interest to us, which is the highest temperatures, the highest temperatures. The low temperatures we don't care about, they don't hurt us.

This histogram is from an LEV prototype at Chrysler. It has a close coupled catalyst and what we have here are a significant amount of time that we're spending at 1500 degrees and higher. You can see at between 1500 and 1525 we spend 1 and 1/2 percent of the time there.

This vehicle has been calibrated, by the way, to pass what we thing the USO6 CO standard might be. So there is a time delay. When we go heavy throttle, or wide open throttle, we delay the cooling fuel enrichment.

If one takes this kind of a data piece and projects it for the full useful life of the vehicle, which in this case is 100,000 miles, we know that we're going to be spending over 250 hours at 1500 degrees Fahrenheit or higher. That's 820 degrees C or higher. And this represents higher temperatures than we've ever seen before.

And this particular vehicle, this system here is violating our internal Chrysler catalyst temperature max limits. Not by a huge, huge much, but it is violating them and right now we're kind of scratching our head wondering what to do about that. That's without insulation. With insulation we don't think we could live.

Here is some more data to reenforce what happens when you take away cooling fuel. This driving cycle is the "repo 5" cycle (phonetic), which is not the super extreme cycle like a USO6. This is a more representative type cycle. This is a Ford Escort. This is actually from the first Milford test program conducted out at GM.

The blue line is the production calibration. And you can see the temperatures are what they are. But going to stroichiometry -- that's in the red -- you can see there's some significant increases, sometimes over 100 degrees Fahrenheit. And those increases, like Kevin Cullen pointed out earlier, typically can occur at the highest temperatures that you're at to begin with.

Here's another good piece of data to look at to get a feel for what removing cooling fuel, having to stay at stoichiometry can do. This is data from a Ford 3.8 liter Windstar. This driving cycle is USO6. And again, we don't have insulation here one way or the other. This is strictly the effects of fuel.

And you can see the solid line is the production for the base line calibration and then the dotted line would be when we go to stoichiometry only. And the temperatures go up. We have the maximum from 1470 to 1540, max. That's a real healthy jump and typical of what you see when you take away the cooling fuel.

Here's another set of data from Ford that is particularly interesting. They have an internal durability evaluation cycle. They call it their R310, their high speed cycle. And the intent here was to evaluate on a couple of engines, the 1.5 liter, the 4.6 liter. What does it mean? What kind of temperature increases are they going to see on the catalyst? They're plotting the maximum of the catalyst mid bed temperature (phonetic).

Now the two bars on the left are the production configurations, then the two black bars are when they go full stoichiometry. That means not even with a timer. So I just need to impress upon you that the black bar would not be what they would put into production, but if they were you can see that there would be temperature increases that were large; 328 degrees and 324 degrees Fahrenheit.

Now by putting in the timers, though, on the 1.9 liter they just have the 10 second timer. In other words when they go wide open throttle they'll stay at stoichiometry for 10 seconds, then the cooling fuel will be allowed to happen.

The temperature, the max temperature really didn't come down very much. And on the 4.6 liter, the same for the 10 second and even the 5 second time, the temperature increases are still extremely high. Okay.

I need to comment on an analysis that was in the NPRM. And again, I believe that the EPA recognized the weakness of the analysis. They did what they could with what they had. This is always a difficult thing to do, that being to precisely quantify the in-use performance on emissions, the hit you would take due to any kind of increase in temperature. But we need to comment on it, nonetheless. And our understanding is that the analysis was based on, you know, some far reaching assumptions and was really over reliant on projections rather than conducting data.

They projected only a .04 percent loss in efficiency over the useful life of the vehicle. For example going from 90 percent efficiency only down to 97.96. We think that's way, way, way underestimating the kind of efficiency hit you would see.

The way we would do such an analysis would be to evaluate how would one bench age a catalytic converter? And probably some other components like the oxygen sensor? How would one increase the bench age of those parts to more accurately reflect what would happen with the increase in temperatures and then actually take those parts and bolt them on a real vehicle and measure the emissions difference. There's too many system interactions to be able -- we think -- to be able to predict what will actually happen.

Also, they assume that the hydrocarbon NOx efficiency losses would be the same. We think that's another weakness in that analysis. Typically they don't behave the same.

Also the EPA data, itself, it showed significant catalyst substrate temperature increases. For example there wan Intrepid that had close coupled catalyst, had a 90 degree Fahrenheit average increase with a maximum of 153. That was going from no insulation, pre-insulation. This is this representative type driving cycle. We think that's a very large increase. And again, like we said before, this increase would be over and above what we're already having to bite by taking away the cooling fuel for the USO6 cycle.

Now the EPA certainly is aware, as is everyone, that there is new catalyst technologies becoming available, such as the palladium catalyst (phonetic). These concerns are all still there even with that. The new catalyst technologies still degrade with temperature. Perhaps not quite as much, but we have yet to see a catalyst technology that does not degrade with temperature. If anyone knows of such a technology, please tell us, we'd like to hear about it.

We need to comment on the cost associated with using catalyst insulation if someone were to somehow get beyond the problems of -- that it causes technically, on the huge cost to modify all of the platforms for packaging to accommodate approximately a 1 inch layer of insulation, which essentially you have to double that because it goes around the catalyst perimeter. This would require floorpan and/or frame design, because many of our vehicles, right now, today, have like little bubbles or humps, if you will, in the passenger compartment, intruding upon passenger comfort. It impedes our ability to make acceptable vehicles. That's a concern as well.

And the tooling and the lead time -- the tooling is costing a lot of time to do these kinds of changes. It's difficult to assign precise cost to that but "A.I.R." is going to present a detailed cost analysis later. And I guess I should comment that neither the EPA cost analysis or even the "A.I.R." cost analysis is going to include the actual piece cost. We think, if anything, these are probably conservative cost estimates.

The impact on facilities is tremendous. The intermediate soak itself will more that double the amount of time required to conduct a full test on the dynamometer. These dynamometer test cells are very expensive. The company only as so many. And right now they're all being used to maximum capacity.

A 60 minute soak time with the start driving cycle would add 70 minutes of chassis dynamometer time just to do one test.

We test as many cars as we can every day. It's just -- it's a test that takes a long time already, to do. And due to the vehicle setup and take-down times it wouldn't be practical to remove the vehicle from the dynamometer while its soaking in there for 60 minutes. And so essentially those 60 minutes would be lost.

We would rather use that time more productively, to get the clean air the right way in developing for the current slate of new emission requirements that are already here. We really need that test time, we don't want to waste it.

In the NPRM there was proposed an exemption option that sort of sounds good at first glance, that being that perhaps we could do an exemption option by a cert demonstration. But the problem with that is we can't bank on that. If we don't get certified we can't build vehicles. If there's some -- if there were a very stringent intermediate soak requirement and then we weren't quite sure if a new system could meet that requirement or not we would have to develop from the outset. Certification is something that is done at the tail end of development. Development takes at least a couple of years.

And so we would dare not risk or jeopardize not being able to certify, hence not going to production, by assuming that we could get this exemption at the tail end. We would have to test all the way through.

Additionally there's an awful lot of engineering time and paperwork associated with obtaining exemptions. That's just the way it is, the mountain of paperwork that we have to live with.

The other point that we need to reenforce, as we said earlier, we don't believe that the start cycle is required, especially without the intermediate soak. All testing to date for air conditioning has been done on the LA4. We don't believe that the need for the SCO cycle has been demonstrated. We think that dither control beyond that that is already there in the current cycle, really, the need for that has not been demonstrated. Plus the NPRM has an appropriate throttle control measure that they've implemented and it's -- certain we haven't seen the cost effectiveness.

Okay, here I've taken this verbatim, right out of the NPRM. And I think this is an important one. And here again the EPA is recognizing that they think it's only necessary to move forward with an intermediate soak requirement only if a significant proportion of vehicles are certified to Tier I standards for a significant time period following implementation.

And if that's not the case, that it should be cost effective and feasible to do the intermediate soak control and vehicle certified to the new lower emission standards such as LEV and Tier II.

Well, we believe that even for Tier I vehicles intermediate soak requirement is not cost effective. There will not be a significant number of Tier I vehicles introduced in the time period that we're talking -- when the rule would take effect. Federal Tier II is very likely in that time period, and the California LEV, or 49 state LEV, will be in a large number of states.

And the options proposed for controlling intermediate soak emissions to a stringent level, it either jeopardizes the in-use emissions control, hence it could cause emissions to go up because insulation over temperature is the catalyst or it will not be cost effective. Something like electrically heated catalyst, we don't think that should be driven by this rule making.

That's the end of my presentation. Any questions?

QUESTIONS AND ANSWERS

MR. MAXWELL: We're discussing time constraints here. Hang on a second.

John's going to do one quick question and then we're going to have a discussion on time management, today versus tomorrow.

MR. HOFFMAN: Okay.

MR. KOUPAL: I was trying to acknowledge, we appreciate the industry testing LEV vehicles -- intermediate soak because it gives us some data, a common data base to work with in terms of evaluating issues, soak emissions over LEV vehicles.

I just have one question on that test program, what cycle were the vehicles tested over following the soak period?

A VOICE: I believe that was 505?

MR. ROUSSEL: The Ford vehicle is definitely a 505, following the soak period.

MR. KOUPAL: Okay, so then the gram per mile numbers in this graph are for the 505, is that correct?

MR. ROUSSEL: That's correct.

MR. KOUPAL: Okay, then the numbers that you're comparing notes to are against the STO1, which represents the first 240 seconds to start driving, so it's not -- in a gram per mile basis -- because you're using the 505?

MR. ROUSSEL: Well, you're right that it's not precisely the same driving cycle, but it's very similar, we think good enough for this comparison.

MR. KOUPAL: Actually with the 505 you're adding quite a bit of warmed up driving that brings the grams per mile numbers down significantly. So a more appropriate comparison would be to compare the -- I don't know if you collected second by second emissions, but to compare the start driving portion to the STO1, so you can reflect that same level of gram per mile operations.

MR. GERMAN: We've done some comparisons of just the STO1 to the SCO1 and there's a huge difference in the grams per mile numbers. The SCO1's gram per mile numbers are much much higher, and it's due to the additional amount of hot stabilized driving.

MR. HOFFMAN: Okay, well, if there's something we can do to make that more comparable we'll certainly look at that.

MR. KOUPAL: I think it's also worth looking at the -- the 10 to 60 minute reduction. I mean it's a good point I make so we have an apples to apples comparison. We can do that. We don't think we'll change the bottom line. And I think part of what we base that on is look at the 10 to 60 minute type numbers and present increases in those LEVs versus 10 to 60 minute on the Tier I and Tier 0s. I mean it's just a dramatic reduction. We'll run the numbers to confirm that for you.

MR. GERMAN: We appreciate it. Just that, you know, in view of the older data you're going to have to use the same 505 schedule and not STO1 to get a valid comparison, that's all.

A VOICE: Understand.

MR. GERMAN: Thank you.

MR. MAXWELL: I think that we have some questions, but seeing as we have to be out of here by 4:30, perhaps it would be best to leave them until tomorrow morning and just pick it up fresh.

Does anybody have a problem with that?

A VOICE: No, I don't have a problem.

MR. MAXWELL: Okay, the next issue we have is that our office director has scheduled a meeting tomorrow at 8:00 o'clock for us. And so we're actually seeing if people would be amendable to pushing the start time tomorrow back over a little later.

(Voices out of microphone range)

MR. MAXWELL: Okay, we'll start at 9:30 tomorrow, then. See you all at 9:30.

(Concluded at 4:30 o'clock p.m.)

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STATE OF MICHIGAN)
COUNTY OF WAYNE)

I, Philip Liburdi, court reporter, do hereby certify that this transcript, consisting of 205 pages, is a complete, true and correct record of the Public Hearing of the Environmental Protection Agency, in the Matter of: Proposed Regulations for Revisions to the EPA Air Docket Federal Test Procedure for Emissions From Motor Vehicles, EPA Docket No. A-92-64; held at Washtenaw Community College, Ann Arbor, Michigan; on Wednesday, April 19, 1995.

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