U.S. DEPARTMENT OF ENERGY
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PRELIMINARY ANALYSIS PUBLIC MEETING
ABOUT ENERGY CONSERVATION STANDARDS
FOR ELECTRIC MOTORS

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TUESDAY, AUGUST 21, 2012

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The Preliminary Analysis Meeting convened in Room 8E-089, U.S. Department of Energy, 1000 Independence Avenue, SW, Washington, D.C., at 9:00 a.m., Doug Brookman, moderator, presiding.

PRESENT

DOUG BROOKMAN, Public Solutions, Inc., Moderator
LUCAS ADIN, U.S. Department of Energy
EMMANUEL AGAMLOH, Advanced Energy
KIRK ANDERSON, Underwriters Laboratories

HISHAM ARAJI, Navigant Consulting, Inc.
TIMOTHY BALLO, Earthjustice
DALE BASSO, WEG Electric Corporation
THOMAS BISHOP, Electrical Apparatus Service Association, Inc.
ALEX BOESENBERG, National Electrical Manufacturers Association

ROB BOTELER, Nidec Motor Corporation
EDWIN BRUSH, Consultant to Copper Development Association, Inc.
KITT BUTLER, Advanced Energy
HAYDEN COOK, Navigant Consulting, Inc.
ROGER DAUGHERTY, National Electrical Manufacturers Association

DANIEL DELANEY, Regal-Beloit
ANDREW deLASKI, Appliance Standards Awareness Project

TOM ECKMAN, Northwest Power and Conservation Council
R. NEAL ELLIOTT, American Council for an Energy Efficient Economy
GEORGE FLOLO, The Flolo Corporation
KEN GETTMAN, National Electrical Manufacturers Association
WILLIAM HOYT, National Electrical Manufacturers Association
SANAEE IYAMA, Lawrence Berkeley Laboratory
MICHAEL KIDO, U.S. Department of Energy
WILLIAM KOHSE, Navigant Consulting, Inc.
FRANK LADONNE, Underwriters Laboratory
PAUL LIN, Regal-Beloit
ROBERT BRUCE LUNG, Alliance to Save Energy
JOHN MALINOWSKI, Baldor Electric Company
MATT NARDOTTI, Navigant Consulting, Inc.
AL PADILLA, Underwriters Laboratories
JAMES RABA, U.S. Department of Energy
LINDA RAYNES, Electrical Apparatus Service Association, Inc.
STEVE RUFFING, Nidec Motor Corporation
TIM SCHUMANN, SEW-EURODRIVE
CLARK SILCOX, National Electrical Manufacturers Association
CHARLIE STEPHENS, Northwest Energy Efficiency Alliance

MEG WALTNER, Natural Resources Defense Council
ROBERT WILKINS, Danfoss
DOUG RAWALD, U.S. epartment of Energy General Counsel
ATTENDING VIA WEBINAR

ERIC ANDERSEN, Pacific Northwest National Laboratory
AUSTIN BONNETT, Navigant Consulting, Inc.
BRIAN BOYD, Pacific Northwest National Laboratory
JOHN COCKBURN, Natural Resources Canada
HELCLO BLUM, Lawrence Berkeley National

Laboratory
RICK BUDZYNSKI, Motors
BIJIT KUNDU, Energy Solutions

HOWARD JORDAN, Consultant

ROBBIE McELVEEN, Baldor Electric Company

DOUG MOORE, Kentucky Service

CHUN CHUN NI, Berkeley National Laboratory

DEREK SANDS, Platts

ZOLAIKHA STRONG, Copper Development Association

GREG TOWSLEY, Grundfos

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(9:04 a.m.)

MR. RABA: Good morning, everyone, and welcome, whether you are attending today's public meeting in person or via the webinar.

This is the U.S. Department of Energy's public meeting about a preliminary analysis of energy conservation standards for electric motors.

My name is Jim Raba. I am the project manager for motors. I will be the presiding officer.

Today's public meeting will address the analytical framework and procedural framework, models, and other tools the Department of Energy will use to evaluate efficiency standards for this equipment. In all, the Department encourages you and other interested parties to discuss the analysis and submit information, data, and written comments. We want to hear from you.

Good morning and welcome.

MR. BROOKMAN: It is our tradition to start with introductions. I will start here to my immediate left. Please say your name and organizational affiliation. You can also get used to turning these microphones on and off. And since we are doing a webinar, you need to get the microphone fairly close to your face. So please, name and organizational affiliation.

MR. BISHOP: My name is Tom Bishop, Thomas Bishop with the Electrical Apparatus Service Association.

MR. BROOKMAN: Thank you.

MR. BOESENBERG: Charlie Stephens, Northwest Energy Efficiency Alliance.

MR. WILKINS: Robert Wilkins with Danfoss.

MR. BROOKMAN: Hang on, Robert. Please, just in time.

MS. WALTNER: Meg Waltner with the Natural Resources Defense Council.

MR. BROOKMAN: Thank you. Robert,

thank you.

MR. BOESENBERG: Alex Boesenberg, National Electrical Manufacturers Association.

MR. DAUGHERTY: Roger Daugherty, Baldor Electric, Member of the ABB Group. I am also here as the Chairman of the Technical Committee of NEMA's Motor Generator Section.

MR. BROOKMAN: Thank you.

MR. DELANEY: Dan Delaney with Regal-Beloit. I am also a member of the NEMA Motor and Generator Section.

MR. MALINOWSKI: John Malinowski, Baldor Electric, also representing ABB, Incorporated. I am the Chairman of the NEMA Motor and Generator Section.

MR. BOTELER: Rob Boteler, Nidec Motor Corporation, Chairman of the NEMA Energy Committee.

MR. BASSO: Dale Basso, Weg Electric Corp. I am also the Vice Chairman of the Motor Generator Section of NEMA.

MR. LADONNE: Frank Ladonne,

Underwriters Laboratories.

MR. AGAMLOH: Emmanuel Agamloh, Advanced Energy.

MR. DE LASKI: Andrew deLaski, Appliance Standards Awareness Project.

MR. ELLIOTT: Neal Elliott, ACEEE.

MR. LUNG: Bruce Lung, Alliance to Save Energy.

MR. KIDO: Michael Kido, DOE, Office of the General Counsel.

MR. RABA: Jim Raba, DOE.

MR. BROOKMAN: Why don't you just stand and say your name?

MR. ARAJI: Sure. Hisham Araji, Navigant Consulting.

MS. IYAMA: Sanaee Iyama, with the Lawrence Berkeley Laboratory.

MR. BROOKMAN: Louder, please.

MR. KOHSE: William Kohse, with Navigant Consulting.

MR. NARDOTTI: Matt Nardotti, Navigant Consulting.

MR. ADIN: Lucas Adin, DOE.

MR. RAWALD: Doug Rawald, Department of Energy General Counsel.

MR. SILCOX: Clark Silcox, NEMA.

MR. RUFFING: Steve Ruffing, Nidec Motor Corporation and also representing NEMA.

MR. BUTLER: Kitt Butler with Advanced Energy.

MR. BRUSH: Ned Brush, consultant to the Copper Development Association.

MS. RAYNES: Linda Raynes with electrical Apparatus Service Association.

MR. FLOLO: George Flolo with the Flolo Corporation representing EASA.

MR. ANDERSON: Kirk Anderson, Underwriters Laboratories.

MR. PADILLA: Al Padilla, Underwriters Laboratories.

MR. SCHUMANN: Tim Schumann, SEW-EURODRIVE also here with NEMA.

MR. GETTMAN: Ken Gettman with NEMA.

MR. ECKMAN: Tom Eckman, Northwest Power and Conservation Council.

MR. HOYT: Bill Hoyt with NEMA.

MR. LIN: Paul Lin, Regal-Beloit, also a member of NEMA.

MR. BALLO: Tim Ballo, Earthjustice.

MR. BROOKMAN: Okay did everyone get a chance to introduce him or herself? I think so.

Well once again, welcome and glad you are here. And welcome also to those that are joining us via the web. Can you tell us the names of those that are joining us via the web and read them into the record?

MR. GRAUL: We have got Austin Bonnett, Bijit Kundu, Greg Towsley, and Howard Jordan.

MR. BROOKMAN: So far.

MR. GRAUL: Yes.

MR. BROOKMAN: Okay. Thanks for joining us.

All of you received a packet of information as you came in to the room today. I am going to refer to the agenda first.

Immediately following this agenda review there is an opportunity -- well we are going to have brief opening remarks about the purpose of the public meeting and we will make an overview and opening statements from Jim Raba. Following that brief overview, there is an opportunity for opening statements. Anybody that wishes to do so can make an opening statement surrounding this rulemaking. Immediately following that, comments on the test procedure: market and technology assessment. We will take a break mid-morning around about 10:45 or so.

When we return from the break, screening analysis and engineering analysis, and then markups, energy-use characterization, and life-cycle cost and payback period analysis.

We will take lunch around about

12:30 or so. Returning from lunch, life-cycle cost and payback period analysis and national impact analysis. We will take a break mid-afternoon as we need to and where it fits appropriately.

Following the break or whenever we get there, preliminary manufacturer impact analysis. We will close out the day today with next steps and another opportunity for public comment. Any other issues that haven't been adequately covered, that would be another occasion when you can raise them at the end of the day.

We will have closing remarks from Jim Raba. We plan to adjourn today around about four o'clock, however we will go as quickly and efficiently as we can as the day proceeds.

Questions here at the outset on the agenda? I see none.

I would ask for your consideration, please. If you would, speak

one at a time. Please say your name for the record each time you speak. You don't need to say your organizational affiliation. All of you registered as you entered today. Typically, the Department will provide a photocopy of the business cards of those present, so we will have a record for you to take home with you.

I am going to be queuing individuals by name, as best I can. I would like to encourage follow-on comment among commenters. Please again say your name. Sometimes the back and forth is very useful for the Department as they review this record. There will be a complete transcript of this meeting available on the DOE website.

If you can please be concise, share the airtime. There is a lot to be said and I know that there is the potential for some extended commentary this morning, based on the petition and other events. So if you can be as concise as possible, that would be

helpful.

Please keep the focus here. Turn your cell phones on silent mode, if you would. Those of you who are on the webinar, if you keep your phones on mute, then we will have less feedback here in the room. And if you wish to speak, then you can raise your hand and our webmaster moderator will pass a note to me and we will get you in the queue for a comment. Please be patient and we will -- then when you un-mute your phone we can hear you in the room. At least that is the way it has worked for the last couple of meetings we have done this.

So additional questions before we proceed? Then I am going to turn it back to Jim Raba for an overview.

MR. RABA: Well thank you, Doug. And again, welcome to our public meeting about energy conservation standards for electric motors.

With the Energy Policy and

Conservation Act, as amended, prescribes energy conservation standards for certain commercial and industrial electric motors, the Department of Energy is considering further amendments to those standards.

At today's public meeting, again, we will address the procedural and analytical framework, models and other tools the department would use to evaluate efficiency standards for this equipment, present the results of information gathered thus far about motors, the results of the preliminary analyses. The potential energy conservation standards will be derived from these analyses.

In all, we encourage you and other interested parties to discuss these analyses and presentations and further submit information, data and written comments. We want to hear from you.

Throughout today's presentations, our experts from Navigant Consulting and Lawrence Berkeley National Laboratory, you

will see slides like this. And they will prompt certain issues. I mean discussion slides like this. Otherwise, comments about any part of the presentation are welcome throughout.

Before we address the regulatory history, steps in the standards rulemaking process, all the analyses, does anybody wish to make an opening statement or brief comments about the preliminary analysis and the potential energy conservation standards for electric motors?

Doug?

MR. BROOKMAN: So now as we had promised, an opportunity for opening statements. Neal, first. Please say your name, Neal.

MR. ELLIOTT: Neal Elliott and I am speaking on behalf of NEMA, motor manufacturers, and the energy efficiency advocates.

The advocates and manufacturers

have now had a 14-year partnership working on motor standards. And this has led to many of the steps that we are discussing today. In particular, the Energy Independence and Security Act of 2007 motor standards that went into place.

Two years ago in this room I had the opportunity again to speak on behalf of the coalition and present a concept for the next round of standards. Last week we formally submitted and is in the packet of materials that was circulated today a petition seeking consensus with respect to the standards. And I wanted to speak briefly in terms of what the coverage of that petition is and why I think this is important.

We have taken the approach in the petition of expanding coverage to cover almost all of the three phase induction motors one to 500 horsepower. The concept is in the original Energy Policy Act was to specify certain covered product. We think that it is

much more administrable rather to approach this by specifying that all motors, one to 500 horsepower polyphase induction should be covered products and then explicitly exclude those motors which we feel are inappropriate for the application of the standard.

We recommend that the vast majority of those motors be implemented at the NEMA premium, which is the NEMA MG1 12-12, efficiency level. We think that level is achievable by manufacturers without undue burden. The expansion of coverage and the raising of motors to the NEMA 12-12 level will result in significant savings of energy and also result in substantial cost savings to motor consumers in the marketplace.

We are pleased to see that the PTSD confirmed that indicating that almost five quads of energy would be saved during the study period from that proposal.

We also would note that by changing the approach and focusing on the fact

that all motors are covered except those that are explicitly excluded enhances enforcement. The coalition has been very concerned about enforcement issues. For many years we had extensive discussion two years ago when we met to initiate these proceedings with respect to enforcement.

We think by explicitly excluding a small group of motors and including coverage to all other motors, that this will enhance enforcement by the Department and by the folks at the Homeland Security.

We also think that this path forward will be beneficial on the long-term because this has the opportunity for motor manufacturers to take resources that would be allocated to meeting a higher efficiency target and deploy those toward building the next generation of electric motor. It is the feeling of the coalition that advance motor designs represent the future for efficiency within the motor marketplace and that it is

appropriate for the motor community to move forward with that.

I would note that NEMA has begun to explore the standards-setting process, including advance motor designs in the MG1 standards.

Finally, I did want to note that while we were very pleased to see the standard, our proposal ranked well and similarly to what we had analyzed within the PTSD. We, as the coalition, do have some concerns about the CSL Level 3 analysis and are concerned that we may not have captured the full cost in that analysis to the industry of the transition. And those members from the NEMA section will be discussing that in greater detail, as appropriate through the proceedings today.

I appreciate the opportunity to speak. Thank you.

MR. BROOKMAN: Thank you, Neal. And as you reference, I think all of you

received a copy of the joint petition. That was a part of the packet for today.

Who would like to speak next? Yes, Robert.

MR. WILKINS: Thank you. I'm Robert Wilkins with Danfoss.

I would like to start by commending the work that has been done in this PTSD and noted that for several types of motors, there are several CSLs provided. Most of the CSLs are around, near, or exceed 90 percent energy efficiency. And typically the cost for CSL 4 and 5 rise very sharply, yielding a lengthy payback period for perhaps one or maybe two percent improvements in energy efficiency. This reflects that for these covered motors we are reaching the point of diminishing returns in motor efficiency.

I would like to step back and call attention to the EERE study entitled United States Industrial Motor System Market Opportunity Assessment which was revised in

December of 2002, ten years ago. This study states that on average, manufacturing sector could reduce industrial motor energy use by 11 to 18 percent, using mature proven efficiency technologies. But it went on to say system efficiency can be improved by improving the match between the component size and load requirements and the use of speed control, instead of throttling in bypass mechanisms.

The report stated that while motor efficiency upgrades can achieve potential savings of 19.8 kilowatt hours -- billion kilowatt hours per year, system efficiency improvements are potentially much larger, 37 to 79 billion kilowatt hours per year. It goes on to cite the contribution of adjustable speed drives, also known as variable frequency drives or VFDs.

Motor efficiencies have indeed improved since 2002 but the points regarding the system efficiency opportunities remain largely valid to date. And VFDs have improved

dramatically in the ten years since this report, just as our cell phones, PCs, and other electronic technologies have dramatically improved. Yet, the technology remains largely underutilized in the U.S. compared to other countries.

I have had in written comments some explanation about how these devices save energy and I will pass that, in the spirit of brevity. But applying VFD to many motor systems can realistically save 20 percent, 30 percent, or more of the energy and the case studies abound.

Furthermore, applying VFDs on motor systems enhances the demand response capabilities for both peak load reduction and momentary or transient situations on the electric grid.

So comparing this to a possible one percent or maybe two percent efficiency savings by improving the covered motor efficiency, there is a dramatic difference. So

Danfoss urges DOE to consider the motor system, not just the motor. We should pursue the much greater energy savings potential that can be afforded by variable frequency drives that continuously match motor output to the actual load of the system, while enhancing demand response capabilities.

I appreciate the opportunity to speak today. Thank you.

MR. BROOKMAN: Thank you, Robert.

Other opening statements here at the outset? No additional comments at this time? Okay. Then let's proceed.

All of you received a packet of PowerPoint slides. As Jim referenced, this material will reflect the flow of presentation followed by discussion.

First we are going to hear from Hisham.

MR. ARAJI: Good morning everyone. My name is Hisham Araji with Navigant Consulting.

So as Jim previously mentioned earlier on, DOE will be presenting today some of the preliminary results of the Electric Motor Standards rulemaking. But before we dive into that, I would like first to give some statutory background on where this rulemaking comes from.

Going all the way back to the 1970s and the era of the energy crises, an Act of Congress called the Energy Policy and Conservation Act or EPCA signed into law in 1975 establishing energy conservation standards.

EPACT in 1992 directed DOE to establish efficiency standards for certain industrial and commercial motors. More recently in 2007, another Act of Congress called EISA updated those efficiency standards and also established new efficiency standards for motor types not previously covered, which brings us to today's rulemaking.

DOE is required by statute to

revisit the most recent standards for electric motors, which would be those standards set by EISA, and to publish a final rule determining whether to amend those standards. Any amended standards that DOE does establish would have a compliance date no sooner than December 19, 2015.

As directed by statute, DOE will determine whether to amend standards for electric motors and if so, what level those new standards should be set at, based on an in-depth consideration of three factors: technological feasibility, economic justification, and energy savings potential.

When determining whether a standard is economically justified, DOE considered seven different factors and it does so in eight specific analyses. Here you can see those factors and their corresponding analyses. So for example, the total projected energy savings is considered in the National Impacts Analysis. We will be discussing each

of these in greater detail today.

So there are four main phases of a standards rulemaking: framework, preliminary analysis, notice of proposed rulemaking, and final rule. Each stage includes a Federal Register notice to place information in public view. At multiple points in the process, DOE invites both oral and written comments on it analysis. Those comments can be in response to not only the Federal Register notice but also technical support documents and analytical spreadsheets posted on DOE's website.

The first phase for this rulemaking, the framework document was published on September 28th of 2010 and a public meeting was held a few weeks later here in Washington, D.C. The framework document provides an overview of the rulemaking process and encourages early participation by interested parties.

Yes, do we have a comment?

MR. BROOKMAN: Yes, Roger Daugherty.

MR. DAUGHERTY: Roger Daugherty, speaking on behalf of NEMA. Back at your slide where you indicated current rulemaking process, you do note that EPCA requires the DOE to determine the rule whether to amend the Energy Conservation Standard. However, you don't mention there that you are given 24 months to do that. Is there a reason you skipped mentioning that it is within 24 months?

MR. ARAJI: I think I will let GC comment on this.

MR. BROOKMAN: Michael Kido.

MR. KIDO: I don't think there is any reason why we just didn't indicate that in there. There is nothing insidious about it.

MR. ARAJI: I will state 24 months. You are correct.

So after the framework document, you go into the preliminary analysis stage,

which is the phase we are in right now.

This is where DOE presents its initial analytical results. Here you see the different analyses that form the preliminary analysis and we will go -- it's all done in greater detail today.

Eventually DOE may publish a Federal Register notice proposing a standard, called a Notice of Proposed Rulemaking or NOPR and hold a public meeting similar to this one to receive feedback on that proposal. I say "may" because DOE also has the option of publishing a determination asserting that these standards are not warranted. Here are the NOPR analyses, which also include a round of revisions to the preliminary analysis.

So if DOE does publish a NOPR proposing amended standards, then it will move on to the last phase of the rulemaking process, which is the final rule. In that phase, DOE once again revises its analysis and incorporates feedback received during the NOPR

phase.

So let's take a look at the timeline for all these steps. So here you can see all the milestones that we just talked about. So the notice announcing today's meeting was published almost one month ago on July 23rd of 2012. The next milestone DOE will publish either a notice proposing new standards or a determination asserting that none are wanted.

A final rule, if needed, will be published in October of 2013 and a compliance date of not sooner than December of 2015. That's another comment.

MR. BROOKMAN: Roger Daugherty.

MR. DAUGHERTY: Roger Daugherty. But that gets back to my previous question. 2013 is beyond 24 months and it is as much as the time that you are proposing there is 12 months' past. And that only leaves two years between the possible time of the determination and having to come into compliance.

MR. BROOKMAN: Michael Kido.

MR. KIDO: I think the Agency will take that into account when it sets whatever compliance date. And clearly with respect to the timelines, we have to make adjustments, given the current situation.

So to the extent that the Agency can stay within the timetables that have been set out in the statute, it will try to do so.

MR. BROOKMAN: Thank you.

MR. ARAJI: So --

MR. BROOKMAN: Andrew deLaski.

MR. DE LASKI: Just a brief comment on process because I think the petition, of course that we submitted to you, was just received last Wednesday. We understand that that is newly received, even though we have been making recommendation along these lines for, you know, at both the framework stage and at the RFI stage for the coverage.

But I just wanted to comment that

in the event the Department decides to treat this petition as a petition for a direct final rule, that would then change this process somewhat. And Michael maybe you want to comment on that just so on the record that process -- if the DFR process goes forward, it would look a little bit different than what you have just described. I just want to address that.

MR. KIDO: That is correct. That is a possibility, depending on what the Department decides to. If it treats the petition as a petition for direct final rule, those particular timelines could change. These timelines are based on the assumption that a more, for lack of a better word, a traditional notice of proposed rulemaking process is filed so there is a proposal, a comment period, and then a final rule is issued.

If a direct final rule process is filed, if that is followed, then those

timelines could alter somewhat. It could make for a more truncated timeline. It sort of depends on how the agency decides to treat the petition and I would imagine it would also depend on the timing of certain decisions as well.

MR. BROOKMAN: Okay, thank you, Michael. Thank you, Andrew.

MR. ARAJI: All right. Now that we have some background on the standards rulemaking, I would like to talk a little bit about the test procedure final rule for electric motors and some of the changes recently made.

So in December of 2008, DOE published a NOPR that proposed establishing test procedures for small electric motors and amending the test procedures for medium electric motors. However, DOE deferred amending the test procedure for medium electric motors to a later date and that later date was in January of 2011. That is when DOE

published a Supplemental Notice of Proposed Rulemaking or SNOPR to address the issues that were deferred by the previous NOPR.

For medium electric motors, that SNOPR proposed four things: (1) updating the referenced industry standards to more recent versions; (2) clarifying the scope of coverage for existing efficiency standards; (3) revising or adding definitions for certain terms; and (4) revising the guidance in Appendix A to Subpart B of 10 CFR 431.

So DOE received lots of feedback from interested parties and on May 4th of this year, published the final rule, which finalized many of the issues proposed in the 2011 SNOPR. However, rather than revise Appendix A as initially proposed, DOE elected to remove it from the CFR and will instead post updated guidance on DOE's website.

Now this slide just gives a broad overview of some of the clarifications made in the most recent test procedure final rule. So

EISA 2007 had previously struck the definition for the term electric motor. The May 2012 final rule went ahead and incorporated into the CFR a broad definition of that term, defining electric motor as a machine that converts electrical power into rotational mechanical power.

EISA 2007 also established efficiency standards for these four types of motors. Now, EISA did not provide definitions for two of them, NEMA Design B motors and fire pump motors. So the May 2012 final rule added definitions for these previously undefined terms and then clarified coverage for all four of these categories.

MR. BROOKMAN: Roger Daugherty.

MR. DAUGHERTY: Roger Daugherty. Again on behalf of NEMA we certainly welcome the clarification of the coverage and the definitions of subtype I and subtype II that were included. We would like to take this opportunity to publicly thank DOE to listening

to NEMA's proposal for that structure back at the framework document and NEMA written comments. However, seeing as how DOE sometimes technical term "tinker" with things, I will note that under the definition of subtype I in trying to cover IEC motors that you expanded on the definition of equivalent frame size to NEMA T frame with equivalent IEC and also trying to interpret those frame sizes that are between standard frame sizes.

In the definition of subtype II you duplicated the same definition. So in the interest of those who are manufacturing IEC motors to IEC standards, there is some confusion here as to whether or not an IEC say 180 metric frame motor is now a subtype I or a subtype II because you have defined it to be related through both definitions.

So efficiency standards are certainly different and this is a present day issue. This doesn't have to do with your proposal in the future. So it is a present

day issue as to whether or not IEC motors are being covered and included as subtype II's at lower efficiency levels than NEMA motors are required to meet that are equivalent as subtype I's.

So, if you could offer some clarification on why you structured the definition of subtype I and subtype II with respect to frames identical, we would certainly appreciate it.

MR. BROOKMAN: Okay. Well of course these comments, you will put them in writing and send them in. Correct?

MR. DAUGHERTY: Roger Daugherty, yes. They will be in writing.

MR. BROOKMAN: Yes and I am certain the Department will address them at that point.

MR. DAUGHERTY: Roger Daugherty again. But as I said, this is a present issue, which goes toward clarifying some of the additional scope of covered products. But

it would certainly help that we get this cleared up.

MR. BROOKMAN: Michael Kido.

MR. KIDO: Okay, to the extent that there is an issue regarding some confusion as to that particular aspect, maybe the best solution for that would be to articulate that in writing for the agency to consider as part of a guidance document or we have a process by which manufacturers and associations can submit questions regarding the application of our various regulations. So maybe that would be the best vehicle to ensure that there is some consistent and clarifying guidance provided to manufacturers as well as to the rest of the public.

MR. BROOKMAN: And Michael, what would you anticipate to be the timing for that question and response sort of thing?

MR. KIDO: I couldn't say exactly but typically in the past what the agency has done is when it has come up with draft

guidance there is a comment period for interested parties to provide some input on that draft guidance but we would first have to get some sort of initial question first. And I can't give you a specific timeline on when a response would be forthcoming. I would not anticipate it taking years or anything like that.

MR. BROOKMAN: Just to be clear, what I heard you do there was invite NEMA to submit their questions and comments to you with the hope that they would get a response in a relatively short time frame.

MR. KIDO: That's correct and it is through the -- there is a frequently asked questions section of our webpage that I believe that will enable you to do that.

MR. BROOKMAN: Okay, that's helpful. Thank you.

MR. ARAJI: So yes, thank you for bringing that issue up. So if it is an issue that currently affects the manufacturers, we

can try to address it in guidance.

Also as mentioned earlier in the meeting, DOE is considering expanding scope of coverage and if that happens, another test procedure will also have to be published to accommodate those new motors brought into coverage and at that point also changes to the test procedure could be made, based on comments or issues that manufacturers raise today.

All right, so also as I previously mentioned, the final rule also updated references to industry standards to more recent versions. And these referenced industry standards also include NEMA MG1-2009. Now DOE is aware that NEMA updated MG1 shortly before the publication of the test procedure final rule.

Now the preliminary analysis results presented today cite NEMA MG1-2011, which is the more recent version. And as I just mentioned, we are considering expanding

scope of coverage to other motor types. And if we do a test procedure to include those new motor types, we could also update references to MG1 to the more recent version as well.

And we will elaborate a little bit more on that when we get into that discussion in the next section, the market technology assessment.

So at this point, I would like to invite my colleague William Kohse up to discuss the market and tech assessment.

MR. KOHSE: Good morning, William Kohse, Navigant Consulting.

Okay, so again we see an overview of the preliminary analysis stage and we see that the market and technology assessment as well as the screening analysis are the two most upstream components of the preliminary analysis. We will start with the discussion of those. Also in this section, we will be talking about the issue of scope expansion.

So the market and technology

assessment or the MTA characterizes the electric motor market and industry, which includes defining the scope of electric motor types that are subject to energy conservation standards for this rulemaking. It also identifies technology options which are used to improve efficiency and it also establishes the equipment classes which are used downstream in the analysis.

Screening analysis filters out technology options for improving efficiency that DOE will not consider in the engineering analysis.

So here we see a diagram of the relationship between the MTA screening and engineering analyses. The MTA yields technology options that are considered in the screening analysis. The technology options that aren't screened out are renamed a design option and are considered in engineering analysis. The MTA also yields equipment classes, which feed directly into the

engineering analysis.

So before we continue with that discussion of technology options and equipment classes, let's talk about the expansion of scope of coverage. And a quick note here for the sake of brevity, I am going to use the phrase "scope of coverage" to mean scope of motor types subject to energy conservation standards for this rulemaking. And I may also use the term "standards" to refer to energy conservation standards.

So having said that, let me go over a bit of background on the topic of scope expansion. The first part of this slide lists the three categories of general purpose and fire pump motor types that are currently subject to standards as established by EISA in 2007. EPACT 1992's definition of electric motor only included general purpose motors with special and definite purpose motors separately defined. EISA 2007 struck EPCA's definition of electric motor and then, through

the May 4, 2012 test procedure final rule, DOE adopted a broad definition of the term electric motor which encompasses both special and definite purpose motors.

Consistent with the amended statute and DOE's recently promulgated definition of the term electric motor, DOE is considering requiring other motor types that do not fit into one of these three categories noted above to meet minimum energy conservation standards. This approach could include setting standards for motor types that DOE has not regulated in the past, including definite and special purpose electric motors.

In response to the September 2010 Framework Document, as well as the March 2011 RFI document, DOE received numerous comments that advocated the expansion of scope of coverage to include many of these special and definite purpose motors.

Commenters also stress this approach would save considerably more energy

than increasing the current standard efficiency levels for the categories of motors currently subject to standards.

So as a result of that, DOE looked into the issue after the framework and the RFI meeting and further discussed expanding the scope of coverage with NEMA, industry experts, energy advocacy groups, as well as motor testing labs. These technical discussions involved whether those motor types that are not currently addressed by standards are capable of being tested under the current test procedures as well as any characteristics a particular motor may exhibit that could impact its tested efficiency.

DOE came up with a list of motor characteristics shown on the bottom portion of this slide, which it believes describe the basic characteristics of a motor that should be able to meet minimum efficiency standards.

DOE feels that this list will help simplify guidelines for motor types that it

plans to include in the expanded scope of coverage and, as previously mentioned, it would also help enforcement efforts by the DOE.

Essentially, DOE plans to expand the scope of coverage to include motor types, exhibiting each of the characteristics in this list. Motor types that fail to exhibit each of these characteristics or motor types DOE believes should not be subject to conservation standards or whatever justified reasons will be specifically called out in any DOE-provided guidance as not subject to standards.

MR. BROOKMAN: Roger Daugherty.

MR. DAUGHERTY: Roger Daugherty. In your list on the previous slide of the common characteristics that are going to apply to the expanded scope of coverage, down toward the bottom you do indicate the correlation between continuous duty of MG1, its definition and duty type S1 of IEC. In the next line, again we come to this type of frame size issue

-- the next line not the next slide.

MR. KOHSE: Oh, sorry about that.

MR. DAUGHERTY: -- and you don't mention IEC. Just to note that that should be included there.

MR. KOHSE: Okay, we will take note of that. Okay, thank you.

So now that we have gone over a bit of background on the issue, let's look at the currently unregulated motor types that may be subject to efficiency standards, should DOE decide to move forward with scope expansion.

The table in this slide lists motor types that are currently not subject to minimum standards, but which DOE is considering to include in the expanded scope of coverage. Should DOE decide to include these motor types in the expanded scope, they will be subject to standards based on their NEMA design type.

For example, a NEMA design B integral break motor will be subject to the

same standards as a general purpose NEMA design B motor that has both the same horsepower rating, pole, configuration and frame enclosure.

So let's pause here for a minute and open the floor to any comment regarding the list of motor types that DOE is considering to include in the expanded scope, as well as any additional motor types that DOE should consider including in this list.

MR. BROOKMAN: Let's go back to the previous slide that shows them all, the list. Comments here? Roger Daugherty.

MR. DAUGHERTY: Roger Daugherty. But from your list of things that you are wanting to bring up, are you wanting to go through those definitions at this time?

MR. KOHSE: Yes, for these motor types. The definitions in the supplementary handout --

MR. BROOKMAN: Do we have the supplementary handout?

MR. KOHSE: I believe everybody should have a copy of that. It has got a -- I will have it up on the computer but it has got a table that looks like this.

MR. BROOKMAN: Thank you. Apparently Neal is holding up this copy. That's the way it looks apparently.

MR. KOHSE: Yes, it wasn't included in the original package.

MR. BROOKMAN: So maybe you can look on with your neighbor if you don't have one. Because at least half of you I believe have the supplementary document. Okay.

So Roger, definitions?

MR. DAUGHERTY: Roger Daugherty. Are you going to display the list and we will go through them or we will just go through them?

MR. BROOKMAN: Give us a sense, Roger. Do you have a lot of comments on these definitions or --

(Laughter.)

MR. BROOKMAN: No. It strikes me that you are doing diligence here quite a bit of detail and specificity. That's good and we want that either on the record now or in written comments in the same level of detail. And I am just, in my mind, I am asking what is the best way for us to do this.

MR. DAUGHERTY: Maybe it is just to give a few examples --

MR. BROOKMAN: Okay, that would be great.

MR. DAUGHERTY: -- and not try to cover every one of them. Roger Daugherty again.

But and I know my first comment also deals with a later slide where you talk about those which are to be excluded. And this is a general comment on definitions as to how the titles of items are labeled. And for example, you and I said this is later but it is a good example, you offer a definition of submersible electric motor for the purpose of

excluding that type of motor.

What appears to be in conflict is that there is a requirement in 431.2 that if those definitions are included in 431.12 of covered equipment and electric motors being covered equipment, then 431.2 requires any electric motor that is defined in the 431.12 is covered equipment, it would therefore imply its standards apply.

There is some precedence in the present definitions where DOE did not define NEMA Design B electric motors but instead defined a NEMA Design B motor. So that possibly the condition of 431.2 then did not apply because there was not a definition of an electric motor as a type.

Then there was the association between the NEMA Design B motor as being following those which fell into the subclass subtypes I and II as then being covered by standards.

So it is just a caution of when

you use the term "electric motor" as part of the definition.

Most of the other comments deal more with DOE's interpretation of maybe what the common meaning of things are and especially if I refer to the NEMA MG1 standard.

For example, if we go to encapsulated electric motors, then NEMA would like to point out that that definition which DOE proposes for encapsulated electric motors and attributes to MG1 1.27.2 is actually a based on the NEMA definition of a machine with sealed windings.

A definition of a machine with encapsulated windings was in MG1 back at 1967 but that definition was replaced in later years with a definition of a machine with moisture-resistant windings so that today there is no definition in MG1 of a machine with encapsulated windings.

The other issue here is that in

using the title encapsulated electric motor, it tends to imply that the motor is encapsulated, not that the item that we are talking about is that the windings are encapsulated.

So it is trying to clarify those kind of things and they will certainly be in the written comments of those particular type of things.

Another one that I think becomes very important in many of the new scope of covered products deals with a discussion in PTSD and I think it is in two different chapters and that has to do with component sets and partial motors and that the definition that DOE has proposed for component set states that these parts may consist of any combination of stator frame, wound stator, rotator, shaft, or endshields.

If you take that list as a whole, that list describes a complete electric motor but lacking just bearings. So I don't think

it is the intent of DOE to classify a complete motor as a component set. And so again, we are looking to try to help DOE clarify exactly what a component set is.

We suggest that if it is defined as a combination of motor parts that require more than the addition of two endshields to create an operable motor, then that will be a workable definition. And the reason we propose that definition has to do with our discussion of the partial motor, which is defined as one that requires the addition of two endshields.

So a component set would require more than the addition of the parts that are added to a partial motor to make it a complete motor.

So those are just a couple of examples but I don't think we need to go into a lot of detail on some of the other definitions.

You will find a couple

clarifications in the petition that we propose a modification of the DOE proposed definition to be more in harmony. So you will also find it in the petition.

MR. BROOKMAN: Thank you, Roger. Those clarifications are helpful.

Yes, John.

MR. MALINOWSKI: John Malinowski, Baldor Electric. I think I am speaking on behalf of NEMA in this.

William you do a good job of listing a lot of things here, as far as motor types. You mention IEC Design N but you have eliminated IEC Design H, which is the equivalent to a NEMA Design C. You might consider adding that to your list.

MR. KOHSE: Okay.

MR. MALINOWSKI: You refer to it in the report in Chapter 2.

MR. KOHSE: Okay.

MR. MALINOWSKI: The other part here that on the partial electric motor, one

of the things we have tried doing is adding all of these motors into covered product because there are companies that are trying to get around energy standards by modifying their motors.

Partial electric motor is a case where we as motor manufacturers would sell incomplete motors, typically a stator and a rotor set to another company. And in some cases, that other company would complete that into a product that should be a covered motor. And we would urge the DOE to add some notes where that company that is doing the conversion must register the motor with DOE and get their compliance certificates and such in line. We think that may be a misunderstanding in the marketplace.

And then again we liked the statement that was in Appendix A regarding inverter-capable motors. The DOE had a statement that said a Design A or B motor is not an inverter duty motor just because it is

run on an inverter. It is still a covered product under the rules.

So adding something back into the regulation, you know, just emphasizing that. In the marketplace, people would like to see inverter duty put on -- or inverter capable put on there. But to have that excluded would be a bad thing, using that as a loophole, if you will.

MR. KOHSE: Okay.

MR. MALINOWSKI: We want to eliminate loopholes in the new regulations.

MR. KOHSE: All right.

MR. MALINOWSKI: Thank you.

MR. BROOKMAN: Thanks, John.

MR. BOTELER: Rob Boteler with Nidec Motor Corporation. A couple of comments. On the chart with the air-over motor we note the test procedure revision is not necessary. And I think the answer would be that is necessary. There is no test procedure for an air-over because we don't

know that the air supply would be.

The other one would be that you have included in this the integral brake motor and I think you will note in our petition that while we considered the integral brake motor for quite a while, we have had a lot of discussion amongst the members of the coalition. We have concluded that it is a very, very small number of units and the units that are sold are all predominantly very low horse power. So the connected horse power is a very small number. And our conclusion was that it was, I guess, more trouble than it was worth to go through and try and sort through what the losses would be with an integral brake motor with the brake attached. And it would slow down the process of implementing. So we will recommend it in the petition to remove that.

MR. BROOKMAN: Okay, thank you.

MR. KOHSE: Roger, I will just clarify right quick -- I'm sorry -- Rob.

So air-over electric motors we don't have a test procedure revision for that because we don't plan to include it in the expanded scope of coverage.

MR. BROOKMAN: I saw both Frank and Neal at the same time. I'm sorry. Is it Dale? I apologize, Dale. Dale, why don't you start, since I misnamed you?

MR. BASSO: All right, thank you. Dale Basso. The concern was maybe that test procedure heading. Does it mean -- is it one sentence or is it two sentences? Test procedure meaning one exists and revision necessary is a second question or is it --

MR. KOHSE: It is one sentence. So does DOE feel that a test procedure revision would be necessary for this motor were it to be subject to standards?

MR. BASSO: So I think in that case probably several would be wrong because it is assuming there is a test procedure in place. And in the case of, as Rob said, air-

over, there is no definition for the amount of air on the test procedure.

MR. KOHSE: Right.

MR. BASSO: And immersible motors are really nothing more than a fan-cooled motor. So again, the definition of saying -- that one says yes, it is necessary and I'm not sure why. So we probably would have more comments about that.

MR. BROOKMAN: Okay, thank you. Frank?

MR. LADONNE: Frank Ladonne, Underwriters Laboratories.

While UL supports the incremental scope expansion, UL agrees and supports the statement of our colleague from the American Council for an Energy Efficient Economy in that far better clarity of intent and less ambiguity should be realized through making the statement that all motors except those specifically excluded are intended to be covered.

As the scope and definitions continue to expand, it would seem that navigation and interpretation of intent becomes increasingly complex.

MR. BROOKMAN: Got you. Okay, thank you. Rob and then back to Roger.

MR. BOTELER: I just had one comment that I noticed on the document. We have got to be careful with our terms because we have "test procedure" as the term. And several of us have had conversations amongst the coalition and with DOE that we are really not talking about changes to test procedures as much as just to the test configuration. When we look at some of the incremental product, the expanded scope of product, we are never changing going away from the IEEE or the CSA test procedures or test methods. All we are really looking at is some minor mechanical changes to the configuration, so that the product can be mounted to a dynamometer and tested using the existing test procedures

within the regulation.

MR. BROOKMAN: Got you. So those specifics would be very helpful to the Department. Thank you.

Roger.

MR. DAUGHERTY: Roger Daugherty.

I was just going to follow up on the statements with regards to the totally enclosed air or the air-over machines. While it is true that you have to be able to specify what the air flow air, the other significant problem in doing the test is many times that motor is connected with a fan and that is enclosed in a particular enclosure which helps to control that air flow that goes over the motor, according to the arrangement in the application.

So bringing that motor in and trying to put it on a dynamometer and simulate all its real operating conditions is the big problem, not just having air flow but it is getting everything correctly.

MR. BROOKMAN: Okay, thank you. Michael Kido.

MR. KIDO: I just have a couple of quick follow-up questions. With respect to that type of air-over condition for that type of motor, are there any assumptions that could be applied in applying, for example, those types of conditions and then factoring that in to calculate what the overall efficiency of the motor would be?

MR. DAUGHERTY: Roger Daugherty.

Well, certainly from the standpoint of the manufacturer with his design analysis programs, then he works with the customer who has his particular application and can calculate what the fan performance is, what the load is going to be on the motor, assumes that the temperature of the motor is going to be controlled. And within that temperature range that the [manufacturer] expects, he could calculate an efficiency using his AEDM.

The real aspect is whether then when the customer gets that in a prototype testing situation that he verifies that he has the right amount of flow, that the temperatures are staying where he expected them to be and everything is operating correctly. So there is a good deal of follow-up that would go. But back at the design stage, yes, we calculate and try to determine what the efficiency is going to be in the actual application. However, there may be instances where this motor that we are talking about, because it may have a very high air-flow stream over it, the power density in the motor may be significantly different than it would be in a NEMA Design B.

It may also not have to meet the performance requirements of a NEMA Design B, knowing it goes on a fan, in a particular fan, and what energy it takes to start the fan up. So it could dip under locked rotor torque required for Design B, so it can't be a Design

B. It is not a Design A and it is certainly not a Design C. So then it falls out of the range of these are the common characteristics and, therefore, it wouldn't apply in the first place.

MR. BROOKMAN: Neal, I think John has a follow-on comment and then I am going to Neal.

MR. MALINOWSKI: Yes, this is John Malinowski at Baldor. What I was going to say, Michael, is when we supply an air-over motor and it might be totally enclosed or an open motor, that motor goes in the application at the customer's location, let's say as a tunnel fan motor. It has the fan mounted to it and we supply the motor in most cases with temperature-monitoring thermocouples where the customer can run it in application and measure the temperature rise to make sure that we are in compliance there and certainly monitoring power input and such, he can determine efficiency in the application.

MR. BROOKMAN: Neal, please.

MR. ELLIOTT: Neal Elliott. I guess, Michael, what I would say is as we discussed this within our coalition, these are specialty products and they are really sort of one-offs in a lot of cases. They are designed for a particular client for a particular application. They represent a minute number of the motors sold out there. I think this is one of those that we thought fairly clearly was suitable for exclusion, simply because it is not a lot of savings. Their trying to do testing, trying to do certification for a product that is not an off-the-shelf type product just didn't make sense from a resource perspective. So we had recommended in our petition that we exclude this motor.

MR. KIDO: And just a quick follow up to that, would the same rationale apply to the exclusion of any of the brake motor variants, integral brake motor, external brake motors?

MR. BROOKMAN: I see, Dale. Please.

MR. BASSO: I think brake motors and air-over motors both apply in a way in a way that as manufacturers we feel we can come up with a number that is close to what we are looking for. Our biggest concern really comes down to the verification testing. If something is covered, you have to be able to verify it in a third-party lab situation. And brake motors, we have really struggled with it because even though we think we can build a premium efficient type brake motor, it comes down to being able to test down to the tolerances allowed, the actual efficiency of that motor in a laboratory condition without the brake losses being considered.

So it is really, it is something we have tried to figure out how to address but it really falls into the exclusion and becomes not quite worth the effort to gain the efficiency.

MR. BROOKMAN: Neal Elliott.

MR. ELLIOTT: Neal Elliott again, following up on Dale Basso's comment.

One of the things I think that is worth sort of keeping in mind here is this issue of enforcement and testing. You know, this again doesn't really -- it is not a big number from an energy savings standpoint. This adds to the complexity and diminishes administrability of the law. And so that is why we can get just the exclusion of these products has been the best interest.

MR. BROOKMAN: Did you say your name is Mano?

MR. AGAMLOH: Emmanuel Agamloh.

MR. BROOKMAN: Emmanuel, okay.

MR. AGAMLOH: Yes, I wanted to come back to the air-over motors and also the brake motors. I think that there are assumptions that can be made and there have been attempts in the past, especially for small motors, single phase motors to make

assumptions as far as air-over motors are concerned to test them based on the temperature rise. It is more complicated, I think, for integral motors primarily because of the testing that has been used, which is based on loss segregation.

So for regulatory purposes, it would not be a repeatable process if you make such assumptions. So I think it would be very complicated to make assumptions for that case.

MR. BROOKMAN: Frank?

MR. LADONNE: Frank Ladonne, Underwriters Laboratories.

I think when we start talking about air-over motors we are now going into the realm that one of my colleagues made in the opening statements that we need to start thinking more in terms of system efficiencies because it is really very similar to the situation you encounter when you take a half horsepower motor, you can test it and certify that the motor is going to produce

efficiencies in the mid- to high 90 percent. But if it is not properly matched in size and coupled with a load, you know, you could be 20 or 30 percent off. You know, I don't think that you are going to see those kinds of differences with making assumptions with air-over motors but I think it is more of a system issue than it is anything else.

MR. BROOKMAN: Okay, thank you.

Final comments on these issues listed in the scope of coverage because we are about to move on. Okay, we are moving on.

MR. KOHSE: Okay, great. So that takes us to the next table and this table lists motor types which DOE considered including in the expanded scope of coverage but is no longer planning to cover them because many of them present what DOE would consider insurmountable testing difficulties when testing with either IEEE Standard 112B or CSA C390. And here we see air-over motors in this list, component sets and submersible

motors from the motors previously mentioned.

Another example is liquid-cooled electric motors. It requires a separate and external cooling means, very similar to air-over electric motors. And DOE feels like that would present insurmountable testing difficulties or testing configurations, as we said earlier.

Other motor types in this list may remain not subject to standards because they don't meet all the criteria listed. Back in slide 25, for example, intermittent duty motors, they are not continuous duty rated. Single phase motors don't operate on polyphase power.

MR. BROOKMAN: We have comments from both Dan and Roger and also Robert. So you all can choose. I haven't heard from you yet, Dan. Go ahead.

MR. DELANEY: I'll go. Dan Delaney, Regal-Beloit. I just wanted to ask a question and ask for clarification on your

number one there on the totally enclosed air-over. You have that obviously identified as totally enclosed and the prior document we just reviewed being the air-over designation there. I wanted to understand from your perspective if there was a difference there. It is not defined as totally enclosed air-over.

MR. KOHSE: Right. So and I guess that is my fault. This table is not up-to-date with regards to that heading. It should just be air-over motors. Part of this stems from the decision to look at air-over motors with both open frames and totally enclosed frames. So by saying just air-over electric motor, DOE is trying to be a little bit more comprehensive in the motor types that it captures that heading.

So this totally enclosed, those words would probably drop off of this list.

MR. BROOKMAN: Robert.

MR. WILKINS: Thank you. Robert

Wilkins.

I would urge the DOE to consider adding for the sake of reducing or avoiding ambiguity or misunderstanding, add hermetic motors or motors for hermetic compressors to this list. And the reason is that these motors are integral parts of compressors. There is a rotor and a stator that is inherently designed into the compressor and optimized together with the compressor performance. So just simply measuring the motor performance is almost meaningless.

And furthermore, these devices are ultimately applied in products that are covered by the DOE, unitary air conditioning, for example, chillers. So the end product is covered, which obviates the need to have the subsidiary components covered and it would just add unnecessary work with little or no benefit.

But I do think it would be useful just to eliminate the ambiguity by making that

explicit on this list.

MR. BROOKMAN: Roger, John has a follow-on. John.

MR. MALINOWSKI: John Malinowski, Baldor. That is a good point. However, is that covered under component sets?

MR. KOHSE: Yes, it sounds a lot like a component set of a motor.

MR. BROOKMAN: Thanks. Robert, go ahead.

MR. WILKINS: It's Robert again. Yes, I saw that and I put a tick by it because in a sense it is component sets but it is such a big sector that it could be --

MR. BROOKMAN: Roger?

MR. WILKINS: Or you might say, Robert, again, component sets including hermetic motors is another way of doing it.

MR. BROOKMAN: Clarifications are helpful. Roger, go ahead.

MR. DAUGHERTY: Roger Daugherty. We certainly agree with your comment about the

difficulty of testing liquid-cooled but that is similar to the air-over situation that the reason that motor is liquid-cooled is generally that it is into a requirement that requires a very high-power density. So you are very restricted on size. And as we have heard and read a lot in previous rulemakings and through this PTSD, size carries a lot of weight in trying to determine what efficiency you can reach.

But it is just a point of clarification. It is not only a testing problem. It is again an application-related power density relation problem and trying to get to the same level of efficiencies that you are wanting for a normal general purpose design A and B motors is just not a practical thing to accomplish.

MR. BROOKMAN: Okay, thank you.

MR. KOHSE: Okay, great.

MR. BROOKMAN: We do have one more additional comment. Please use the microphone

and make sure it is -- stand up. Use the microphone and make sure it is turned on. Use the microphone right there. Yes, thank you. Is it turned on? Tap it.

MR. RUFFING: Steve Ruffing speaking on behalf of NEMA.

In the joint petition that Neal alluded to in his opening statement, there is an additional recommendation that integral brake motors be included on this list of excluded motors.

MR. BROOKMAN: Okay, thank you.

MR. KOHSE: Okay, so well here is a comment slide. We have already taken comment on a lot of the exempted motor types that are not included motor types. Is there any additional comment, especially with regards to I know you said integral brake motors but any other motor types that should be included in that list? Okay.

MR. BROOKMAN: John, please.

MR. MALINOWSKI: John Malinowski,

Baldor talking on behalf of NEMA.

NEMA Design D motors seem to be omitted from this.

MR. KOHSE: Okay.

MR. BROOKMAN: And Jim Raba just clarified over here that the list is for not covered. Correct?

MR. KOHSE: Correct.

MR. BROOKMAN: Just to make sure that is clear.

Okay, final comments on this and then we are going to move on.

MR. KOHSE: John, you are suggesting that NEMA Design D motors be put on this list?

MR. MALINOWSKI: Yes, they are not covered now. They shouldn't be.

MR. KOHSE: Okay.

MR. BROOKMAN: Roger.

MR. DAUGHERTY: Roger Daugherty. Not to counteract my colleague but if you put it on an exclusion list, then you have to

define it. And you have been pretty clear of this listed characteristics that are common to all this additional scope of product being Design A, B, or C to which you are defining A, B and C.

So isn't it rather obvious that Design D is not covered?

MR. BROOKMAN: Andrew deLaski.

MR. DE LASKI: Just to follow on, I think I agree with Roger on this. I think what needs to be excluded are things that fall within the scope of your definition on back to slide whatever it is, slide 25.

MR. KOHSE: Okay.

MR. DE LASKI: So if you are not within those bullet points, and D clearly is not, then you don't need to define it to exclude it.

MR. BROOKMAN: So John --

MR. DE LASKI: It just has to do with structure. It is the same point. It just has to do with how you structure what has

to be defined.

MR. KOHSE: Okay.

MR. MALINOWSKI: I understand it from that aspect but --

MR. BROOKMAN: John.

MR. MALINOWSKI: John Malinowski. I understand it from that aspect but we all know that somebody perhaps from Europe or wherever is going to be looking at this legislation and looking for whether Design D is covered or not. And if we can make it obvious that it is not covered, it would be better for enforcement.

MR. DE LASKI: And just to follow on to that, this is Andrew again, that just strikes me as belonging in the guidance somewhere.

MR. MALINOWSKI: Somewhere.

MR. DE LASKI: It is a guidance thing. It is not a regulation. It is guidance.

MR. MALINOWSKI: Right.

MR. BROOKMAN: Okay.

MR. KOHSE: Right and DOE is planning to provide guidance which lists all these motor types that would not be covered and which ones would be covered.

MR. DE LASKI: And I think to the extent that you can do it, you know, if it is outside the scope of that, you don't have to go to the trouble of negotiating over the definition so it will expedite the process.

MR. BROOKMAN: Provided there is guidance.

MR. DE LASKI: Provided there is guidance, yes.

MR. BROOKMAN: Okay. Good, that was useful discussion there. Meg.

MS. WALTNER: And just to follow on that point, there is a bit of inconsistency between the list on slide 25 or I guess redundancy we should say --

MR. KOHSE: Okay.

MS. WALTNER: -- between the list

on slide 25 and slide 28 now. So just clarifying for example, slide 25 already clarifies that it is a single speed motor and then you list multi-speed on slide 28.

MR. KOHSE: Okay.

MS. WALTNER: So just crystallizing that.

MR. KOHSE: Okay.

MR. BROOKMAN: Okay, good. So let's go.

MR. KOHSE: Great. Okay, so moving on. Now to discuss the new test procedure rulemaking, test procedure NOPR that DOE is developing in parallel with this standards rulemaking.

The new test procedure rulemaking will address new definitions and any additional test procedure guidance language or test procedure configuration language, which it believes will be necessary to test these motor types.

Now I should mention that DOE is

not planning to modify either the IEEE or CSA C390 test methodologies themselves but is only planning to issue additional guidance language, configuration language, or preparatory setup steps that would allow the motor to either be attached to a test bench or a dynamometer or to allow the motor to operate as a general purpose motor so that it may be tested.

DOE has initiated discussions with various motor testing labs and industry experts concerning the difficulties of testing some of these motor types, as well as how to get around those difficulties.

Discussions with these interested parties indicated that many of these motor types could be tested using current DOE accepted test methods with minor testing configuration steps.

For example, DOE may issue guidance that would allow a testing lab to machine a custom endplate and provide a deep-

groove radial ball bearing that would allow a partial motor to operate as a general purpose motor so that it may be tested.

Alternatively, DOE is also considering the possibility of allowing the original motor manufacturer to supply the endplate and necessary bearing component. So again, that the partial motor could be tested as though it were a general purpose motor.

The supplementary handout discusses more of these additional test configuration steps that DOE is considering so that all of these motor types may be tested in repeatable, manageable, and consistent manners, using currently accepted DOE test procedures.

So I know we have kind of looked at some of the test configuration steps but if there is any additional comments on these steps, specifically the test procedure configuration steps.

MR. BROOKMAN: We have begun to

cover that. Roger, please.

MR. DAUGHERTY: Roger Daugherty. Rather than go into detail here, I just note that that was considered in the submittal of the petition and that you will find in Appendix B of that petition some recommended arrangements to be able to test various types of these additional scope products.

MR. BROOKMAN: Okay, thank you.

Additional comments related to test procedure modifications that perhaps may not be in that appendix that was referenced. Any additions? No? Nothing additional? Okay.

MR. KOHSE: Great. Okay, so let's move on from the discussion of scope expansion and continue with the market and technology assessment discussion picking it back up with the discussion of how DOE divided covered motor types into its equipment classes.

When DOE amends energy conservation standards, it often divides

covered equipment into classes by statute. These classes are based on the type of energy used, the capacity of the equipment, or any other performance-related feature that justifies different standard levels such as features affecting consumer utility.

So DOE breaks down its scope of coverage into three equipment classes by the utility of the motor design. Equipment classes are important because each equipment class ultimately gets its own standard. DOE placed electric motors into three equipment class groupings or ECGs based on three NEMA design types. The equipment class groupings include a group that contains both NEMA Design A and B motors, a second separate group for NEMA Design C motors, as well as a third and final group for fire pump electric motors. Within each of these groups, there are equipment classes, which are based on all combinations of horsepower rating, pole configurations, and enclosure type.

MR. BROOKMAN: Just pause there. Roger, go ahead.

MR. DAUGHERTY: Roger Daugherty. The industry has quite a bit of concern about this equipment class and the way it is being defined. The reason is the DOE is also under another rulemaking in which an NOPR was issued this year concerning AEDMs.

And in that NOPR, it was DOE's proposal, and realize this NOPR covered more than electric motors. It covered all kinds of other products in the application of AEDM.

MR. BROOKMAN: Would you spell that out for us, AEDM?

MR. DAUGHERTY: AEDM is the alternative efficiency determination method. As it applies to electric motors, it is generally a design program that the engineer uses to design the motor, calculates the efficiency so that he knows that when it goes into production that he gets the efficiency that he expects to get and that it will be in

compliance.

That AEDM is substantiated in those requirements in 431.17 in 10 CFR, once he has substantiated that he can use it for the purpose of certification of product.

So the issue is that over in the other rulemaking process, the DOE has proposed that that AEDM must be substantiated for each and every equipment class to which it is applied. Now, the way DOE is proposing and using the definition of equipment class in this rulemaking is equivalent to what in 431.12 is the definition of rating, under which present certification compliance certificates are submitted to the Department of Energy.

So you are introducing a new identifier to an existing term that has been in place since 1999 and is covered by the labeling and certification requirements that are spelled out in 431 and now we have this significant concern of saying that an AEDM

that presently we can substantiate that that AEDM is applicable to the complete line of products from one to 500 horsepower, two, four, and six-pole open and enclosed under all of the subtype I types and subtype II types. The other rulemaking is proposing, I would have to substantiate the AEDM down to the point that I am talking about a 200 horsepower two-pole open motor. It totally defeats the whole purpose of the AEDM. And it is a significant benefit if you were not using equipment class over in this rulemaking in creating a problem with the other rulemaking.

And we have submitted a great deal of comments to the other rulemaking and our concerns about this but we recommend and have suggested in those comments that induction motors are recognized as, [for lack of] a better word, "class." And so the AEDM can be substantiated against this total class of induction motors, whether it is a one horsepower polyphase induction motor two-pole

or it is a 500 horsepower. Basically, it is the same technology is used in the components. They only differ in size and arrangement. So the calculation of efficiency and losses is not that different between the sizes.

So it is of our interest to try to be certain that we don't create a problem in this rulemaking that introduces a lot of difficulty with the AEDM rulemaking going by a different group within DOE, as I understand it.

In the small electric motor rulemaking, you just used the term called efficiency level. You didn't use the term equipment class. So I have noticed that there is a lot of dissimilarities between this rulemaking on what seems to be very similar to what went on in the small electric motor rulemaking.

So we want to encourage that rating is presently well understood and that you would not now go using that rating as the

definition and confusing it with equipment class, that you consider whatever nomenclature that you wish to use, that through this rulemaking it is identified that induction motors are one, large, single class and that somehow we can get that point over into the AEDM rulemaking process.

So we need to request that you are aware of what is going on in multiple rulemakings that are going on simultaneously at the present time. Thank you.

MR. BROOKMAN: Thank you. Thanks a lot.

So I want you to finish with the presentation and then we will take additional comments because you didn't take up on 34 yet, I do not believe.

MR. KOHSE: Okay, so here we see the details of the three ECGs, as well as the number of unique equipment classes in each ECG. There are 514 discrete equipment classes, which account for every permutation

of horsepower rating, pole configuration, frame enclosure, and NEMA design type. Note that Design C motors are only covered up to 200 horsepower and also lack the two-pole configuration coverage. This is because NEMA MG1-2011 does not define Design C motors above 200 horsepower or at the two-pole configuration.

So here we see the 2011 market details of the equipment class groupings by units shipped per NEMA design type. DOE used its own research paired with NEMA-supplied data to generate these numbers.

The shipment numbers include motor types that DOE is planning to include in the expanded scope of standards. DOE uses this information to focus its attention on the market segments with the highest quantity.

The numbers show that NEMA Design B motors have, by far, the highest shipment volumes with the proceeding highest numbers being NEMA Design A followed by NEMA Design C

and finally fire pump electric motors, which have the lowest shipment volume.

This data is also important in the national impact shipments as well as the manufacturer impact analyses which are all discussed later in this presentation.

MR. BROOKMAN: Pause there. Roger, you want to -- okay. Keep going.

MR. KOHSE: So after the market assessment, DOE conducts a technology assessment which recognizes potential technology options which may improve efficiency for the electric motor types covered in this rulemaking. Energy efficiency losses are grouped into five main categories which are stator I2R losses, rotor I2R losses, core losses, friction and windage losses, as well as stray load losses.

Designers have to balance the five basic losses in order to optimize the various motor performance criteria. There are numerous tradeoffs that have to be considered.

Efficiency is only one parameter that has to be met and reducing one loss may increase another, as well as what may be desirable on a four-pole motor may not be desirable on a two-pole motor.

MR. BROOKMAN: Yes?

MR. BISHOP: Tom Bishop, a minor comment.

MR. BROOKMAN: Microphone.

MR. BISHOP: I'm sorry. Tom Bishop. One minor comment but increased copper wire diameter should be increased copper wire area.

MR. KOHSE: Okay.

MR. BROOKMAN: Thank you. Yes, Andrew?

MR. DE LASKI: Andrew deLaski. We seem to be shifting to a technology engineering so I want to come back to the shipments because it seemed like a different topic.

So in the shipments, could you

describe a bit more, Will, sort of how you developed these estimates? You said you used the Department's own methodology. So I am curious what was entailed with your sources.

MR. KOHSE: Right. So actually Lawrence Berkeley National Lab developed a lot of the shipment data. So I may well have to have Sanaee chime-in on this.

MR. BROOKMAN: Get to a microphone, please.

MS. IYAMA: Sanaee Iyama with the Lawrence Berkeley National Lab.

So actually we worked with the data that we received from the motor coalition and we reviewed this data against data we collected through a market research report from IMS research and we combined -- so this report provided shipments data across different categories of AC induction motors but didn't necessarily fit the scope, the expanded scope that DOE considered in the analysis. So we combined that IMS research

data with breakdowns between the different categories of shipments that are considered in the scope. And our estimated shipments data was very close and agreed with what the stakeholders had submitted. So we ended up using the data provided by the motor coalition.

MR. BROOKMAN: Okay. Yes, sufficient? Yes. Rob, please. Thank you.

MR. BOTELER: Yes, your numbers are pretty close to what we submitted and I would just ask are all of the expanded scope covered in your numbers? So you are including partial motors? You are including three-quarter motors, gear motors, all of the various categories?

MS. IYAMA: Sanaee Iyama. Yes.

MR. BOTELER: You are. You are including them all. Because I think the IMS numbers, the numbers that I saw were actually a little more than ours. I think we came up with 5.2 million. Their estimate was over

six.

MS. IYAMA: So again, we adjusted those numbers because in the IMS research, they include all the AC induction motors, no matter the frame size, no matter the NEMA design. So we readjusted those numbers with estimates of how many AC induction motors are NEMA Design B. Like how much of the total AC induction motors are NEMA Design B motors, how much of these are continuous duty. So we disaggregated the IMS research data into different categories and then we only considered the ones that DOE wanted to add in the expanded scope.

MR. BROOKMAN: And so to just to confirm, what the Department is describing as potentially being covered, that is what you analyzed.

MS. IYAMA: Right. So the shipment numbers that we see on this slide represent the motor shipped that correspond to the expanded scope that Will just described.

MR. BROOKMAN: Great, Rob.

MR. BOTELER: Rob Boteler again. And you did include then imbedded motors that are imported into the country, imbedded in other pieces of equipment.

MS. IYAMA: Correct.

MR. BOTELER: Okay.

MR. BROOKMAN: Thank you. Rob, keep going, yes.

MR. BOTELER: One more. In the final expanded scope that we submitted, which is 5.2 million, we did add 56-frame polyphase enclosed motors with similar operating characteristics to the 140-frame. So that would maybe explain why our numbers are higher.

MS. IYAMA: Correct. And I think those were estimated to about a million.

MR. BOTELER: Correct. Correct.

MR. BROOKMAN: Great, thank you. Okay, that was good zeroing in there.

MR. KOHSE: Okay, so I just wanted

to add that different companies utilize different approaches for minimizing motor losses and DOE analyzed motor tear-downs to determine which combination of the displayed methods manufacturers may have used to increase the efficiency of their motors and took this into account in the next step, which is the screening analysis.

MR. BROOKMAN: So let's pause there. I see both Roger and Robert. Go ahead, Robert.

MR. WILKINS: Thank you. I would like -- Robert Wilkins -- just to comment on this chart.

I don't know exactly what it leads to but technology options is a little bit misleading to me because it is more about technology or design tradeoffs. And a couple of items for example, rotor I2R losses. Yes, you can increase the conductivity of the rotor bar. You can switch materials. You can change the air gap and enlarge or make a

smaller air gap but these all have tradeoffs to other design considerations, like the speed-torque relationship and you might have the most efficient motor in the world but it won't start. And so I don't know exactly where this goes but if we are going to discuss it in this context, maybe we ought to have a third column that illustrates the tradeoff or the design compromises the design engineers estimate.

MR. BROOKMAN: Okay.

MR. WILKINS: Thank you.

MR. BROOKMAN: Roger.

MR. KOHSE: So -- sorry, go ahead. I was just going to say DOE took that into account and the modeling that we did we verified that modeling data with, I guess, like to pull-up torque, break-down torque, locked rotor current on the software-modeled motors.

So we tried to take into account the balance that all these technology options

have to have in order to make an operable motor.

MR. BROOKMAN: Thank you. Roger.

MR. DAUGHERTY: Roger Daugherty.

On that list under core losses, you state "select lamination with less watts per pound." I know that you are aware of submittals during the small electric motor rulemaking and you refer to that in this PTSD of that type of an assumption, and that DOE went forward with that same assumption and continued it in this PTSD. Just by choosing some electrical steel that happens to have an Epstein characteristic of having less watts per pound at a particular flux density level means that you can then successfully use that in an electric motor to reduce core losses and that those core losses will change by that relationship given to the Epstein loss.

Now the data that you submitted during the small electric motor rulemaking that you refer to did not support that. And

that was test data of prototypes built using different types of electrical steel that reported to have very low loss per pound. It didn't work out when it was put into an electric motor. You didn't get what was expected and it actually ended up with more core loss than this electrical steel that was normally used.

Now in this PTSD, we will be submitting comments and I won't go into all the detail here, but is a different kind of example of a manufacturer specifying to various steel lamination for material manufacturers to purchase electrical steel according to the same specification and then built prototypes from receiving electrical steel from two different manufacturers, manufacturing prototypes of two different ratings, multiple prototypes, not single prototypes, conducted the testing based on Epstein test.

The Epstein test would have told

you let's say if we identify them that steel type B was better than steel type A. But when it was put into an electric motor, steel type A turned out to be better than steel type B.

The point is that the simplified analysis the DOE describes in the PTSD only discusses any current loss in hysteresis loss, which are those characteristics that are measured in the Epstein testing. And again, not to get too deep into this, but there are other losses in a machine that appear in the air gap and the flux level that is imposed on that electrical steel, which is not accounted for in Epstein testing.

There are also characteristics of stray load loss when the machine is loaded down that has an effect and is affected by the type of electrical steel. So while this manufacturer went out whole-heartedly, was getting the same electrical steel from two different suppliers, say for building up inventory whatever in research, it was found

that even that, depending on how that steel manufacturer manufactured his steel, then he got different levels of losses.

And what was said to be good by Epstein test was not the preferred electrical steel when it was put in an electric motor.

And that was the same information that was supplied in the small electric motor rulemaking where it actually compared different types of electrical steel and showed the same thing. You can't depend on Epstein test data to make a determination as to how that electrical steel is going to perform in a motor.

So the motor industry was very encouraged by reading a comment in a PTSD that DOE fully intended to look into building prototypes by which it could make a determination that by adapting some of these technology options, that it could be proven out. And we certainly encourage that DOE go ahead with those prototypes.

MR. KOH SE: Thank you. I will just add that we considered Epstein testing but what we actually used for our software model motors was a grade of electrical steel that was not above the highest grade electrical steel that we saw from motor tear-down, which I believe was M36. So we didn't actually end up using Epstein testing to develop our software model numbers.

MR. BROOKMAN: In this slide 36, you see the type of motor losses identified in the technology options, also identified additional comments on what you see in this table. Because we are due for a break.

And we should take a break. It is now almost ten minutes to eleven. We will take a 15-minute break, which means we will resume at five after eleven. Don't anybody go anywhere yet.

We got a really good start on the day. You must wear this badge visible inside the Department of Energy. There are restrooms

on both ends of the hall. There is a coffee shop on the ground floor. Go quickly -- sometimes they are stacked up down there -- because we will resume at 11:05 sharp. We'll see you back here then.

(Whereupon, the above-entitled matter went off the record at 10:48 a.m. and resumed at 11:09 a.m.)

MR. BROOKMAN: So starting back up, I thought the morning conversation was very, very helpful and I appreciate everybody, the breadth and depth of the comments and now we are going to proceed with screening analysis.

At the same time, the Department has prepared, as I mentioned earlier, a photocopy of business cards of the individuals that are here in the room. We are going to pass those around and we are going to hear back from William on screening analysis.

MR. KOHSE: All right. Okay, so in the screening analysis DOE removed

technology options that it will not consider in the engineering analysis. DOE evaluates technology options on four criteria. These criteria are technological feasibility, practicability to manufacture, install and service, adverse impacts on equipment utility or availability to consumers, whether or not there are any impacts on health or safety. Technology options which fail any of these criteria are screened out of the analysis.

So this slide discusses some of the technology options that were screened out for the analysis. Amorphous magnetic steels are non-crystal alloys characterized by high magnetic permeability and high electrical resistance. Amorphous steels could potentially be used to replace the standard electrical steels currently used in motors so that they may help reduce core losses and minimize eddy current losses. However, they are also thin and brittle, making it difficult to cut and machine the material into shapes

suitable for electric motor cores.

While some prototypes have been developed using amorphous core material, DOE is unaware of any polyphase induction motors that use amorphous core technology. Therefore, DOE does not believe this option is likely to be technologically feasible at this time.

The next technology is called plastic bonded iron power, or PBIP, which is based on an iron powder alloy that is suspended in plastic and then shaped into electric motor components using a centrifugal mold. Potential advantages of this technique include lower core loss, a reduced number of production steps, and increased efficiency. However, DOE is not aware of any polyphase induction electric motors that have been prototyped using this technology. Therefore, it does not consider this option to be technologically feasible and has also screened it out of the analysis at this time.

So we will pause here for a second and open the floor to any comments on PBIB or amorphous steel technology in electric motors, including any such efforts that are underway or prototypes that may be under development.

MR. BROOKMAN: Roger Daugherty.

MR. DAUGHERTY: Roger Daugherty. We certainly agree with the exclusion of those two particular types of technology as not passing the screening criteria. However, at this time, it is noticeable that you omitted from your presentation the inclusion of cast copper rotors as meeting all four screening criteria.

And I will try to keep this brief and there will be a lot of detail in the NEMA comments that will be submitted. In trying to examine this issue of cast copper as applicable to motors with one to 500 horsepower, two-, four-, and six-poles in open and enclosed enclosures of what DOE has estimated would need to be available for

approximately five million cast copper rotors available for production beginning in 2016 to be in compliance if efficiency standards were established on that basis. So we went back and tried to find how DOE could have successfully screened cast copper rotors as being a viable technology to meet that need.

First we looked at production in the United States for NEMA Design B electric motors manufactured with cast copper rotors, manufactured in the United States. We couldn't find any. We looked and noted that DOE had said that cast copper rotors were being used in present products. The only products that we could find were manufactured outside the United States.

We located two manufacturers making such products. Manufacturer A, in looking over those products, only made four-pole motors, only made ratings for one to 30 horsepower. None were Design B, they were all Design A. None of those of course were being

made in the United States.

We looked at the second manufacturer who has a product line manufactured outside the United States and while theirs covered from one to 20 horsepower, there were some gaps. There were some missing frame sizes within those ratings where there were no cast copper rotors. But again, it was limited to 20 horsepower. There were no eight-poles included in those availability products.

And if you look, and this will get more toward their scaling issue, but I will mention it now, if you look at the change in efficiency level that was obtained, if you look at two-poles, it was not consistent. Half of them attained two NEMA bands, higher efficiency. Half of them attained three. If you looked at the four-poles, they only attained one. If you looked at the six-poles, again there was a dispersion of what level efficiency is attained. Okay and that, as I

said, we will get to the scale in issue of how DOE scales things by assuming it is common across all pole numbers.

So that is the only scope of products that we could find and couldn't see how someone took that very limited scope and made an assumption that at the end of 2015, that technology was going to be applicable to the full range of product we are talking about.

Carrying feasibility a little bit further than the simplified statement that DOE says that they follow, we examined two recent technological feasibility studies that were conducted by the U.S. Army. The U.S. Army began a study in 2004 on ten horsepower four-pole motors to make an examination as to whether or not it was technically feasible using manufacturing processes in the United States.

As a result of that study, their first attempt in the first ones they designed

had very poor results. So they worked on refining the process to try to get better results. At the conclusion, they did have a ten horsepower four-pole motor that had a slightly higher level of efficiency, the NEMA premium. That study concluded basically with that result. There was no sort of any industry support. It was all that study.

But that study did recommend that they needed to investigate higher horsepower. So in 2007, they began another study looking into a 75 horsepower two-pole motor. And the purpose of that motor was a replacement for an existing motor at Fort Bragg. So it had both an application assigned to it where they could test it out in real operation, as well as seeing if they could get higher efficiency. At the same time, they had an available replacement motor from the market cast aluminum rotor that had an efficiency level of 95.0, I believe it was.

So their design goal was they had

to beat that. So this group of electric motor designers, the only industry in the U.S. that was really familiar with trying to cast copper rotors and various other support groups tried to design a 75 horsepower two-pole motor that had higher efficiency than available in the marketplace.

To say the results were disappointing is putting it very mildly. The efficiency that they obtained was substantially lower than the cast aluminum motor that they could purchase as a replacement but they did go ahead and they put that motor in place.

So the only study that I know of that has looked into higher horsepower motors is that study funded by the U.S. Department of the Army and it was not successful in making a determination that this process is technologically feasible for motors up into that horsepower, let alone larger horsepower ratings.

Then you also have your second requirement is the practicality to manufacture, install and service. And that requirement states if mass production of a technology and commercial products and reliable installation and servicing of the technology could be achieved on a scale necessary to serve the relevant market at the time of the effective date of the standard, then DOE will consider that technology.

I put it to the DOE to be able to demonstrate that that technology will be available for mass production on such a scale in the United States to support the range of products that would be impacted by that technology.

The third is adverse impacts on product utility or product availability. In this case, we have heard and you can read in the PTSD problems, and you heard them earlier this morning, of it is not so easy to make changes in motor design to achieve efficiency

without the impact it has on a lot of the other performance requirements.

So when you look at a lot of this, and especially into the increased scope products, going to cast copper rotors could make those products unavailable to the market. You have not satisfied condition three in terms of utility and availability.

The fourth item is adverse impacts on health and safety. I'm sure DOE, since they referred to it and have been made aware of it, that one reason cast copper rotor technology is not in use by manufacture in the United States is you cannot purchase the cast copper casting machinery. And if you do a little research, you will find why that manufacture withdrew that equipment from the market.

So you have successfully screened and passed cast copper rotor technology as completely technologically feasible over all this product range, practical to manufacture

as mass manufacturing effective January first -- actually December 20, 2015, should standards be based on that, that it would have no adverse effect on product utility or product availability and it would have no adverse impact on health and safety trying to work with this very high molten metal temperatures.

It is NEMA's contention and the industry's contention that DOE was improper in successfully screening this technology for application in electric motors and that this technology should be used over to the list of technologies that were screened out and that the PTSD should remove any engineering analysis that is based upon the use of cast copper technology. It cannot have successfully passed screening.

MR. BROOKMAN: Okay, thank you.

MR. KOHSE: We will take those comments into consideration.

MR. BROOKMAN: Are there other --

yes, Michael Kido.

MR. KIDO: Just a real quick clarifying question. Those two reports that you cited, are those reports that NEMA can at least provide the citations to so we can track those down a little more easily or are those things that you have in hand that can be submitted for the record?

MR. DAUGHERTY: Roger Daugherty. I would expect the Department of Energy -- or the Department of the Army had some identifier assigned to them, so we can try to find what that identifier was to provide you a reference.

MR. BROOKMAN: Thank you. It is Ed?

MR. BRUSH: Ned.

MR. BROOKMAN: Ned, please say your name.

MR. BRUSH: Ned Brush, representing the Copper Development Association, consultant to them.

I am a metaler, just by background, who was part of the team that developed the die casting of copper. I worked with Siemens, for instance, which was one of the companies that Roger has just mentioned. They completely did a redesign optimized for copper because as Roger indicated, there are many factors there and when you change the conductivity of the conductor and the induction rotor, you are on a different place in the torque curve, for instance. So you have got to do a lot of things that are different from the traditional die cast aluminum rotors.

Siemens quite successfully has entered that business and commercialized it in February of 2006, I believe. So they have one through 20 horsepower available, two-, four-, six- and some eight-pole. They manufacture in Mexico with a manufacturing cell, as well as in Germany for IEC frame sizes and the frame market.

So I think it is feasible. We worked with them. They have resolved a whole range of the issues that we dealt with in the development process. SEW-EURODRIVE has been using it. There are some manufacturers of die-cast rotors supplying other people, including I think Danfoss as well as Grundfos and so on, FAVI in France, Breuckman in Germany. We have a number here in the United States that have also supplied at least moderate quantities but Siemens produces for itself in Mexico.

So there is some feasibility there. It is not of a scale that we are talking about the five million units available yearly sold and so on, at this time. But I think it is technologically feasible. It has been demonstrated and now it is production by people like Siemens and SEW-EURODRIVE.

MR. BROOKMAN: So you will submit those as written comments?

MR. BRUSH: Yes, we will.

MR. BROOKMAN: Thank you, Ned.

Okay, Roger.

MR. DAUGHERTY: Roger Daugherty.

Yes, as I stated in my comments, we recognize that the technology was being used in a very limited scope of product. But the screening criteria should be based up on all the electric motors that you are talking about. It does not serve the industry for DOE to base efficiency standards of certain particular ratings in this whole grouping on one type of technology, other ratings on another technology, and other ratings on another group of technology. Industry doesn't work like that.

And so my comments were when you look at the full scale requirement as defined in the screening criteria in reference to the total scope or product we are talking about, then it is difficult to understand how you successfully pass the screening process.

MR. BROOKMAN: Okay. So can you

go to slide 38? The next slide.

Yes. So I just want to get additional and perhaps final comment on technology options that were screened out. Any additional comments here before we move on?

Let's hear from this gentleman and then back to Roger. Please say your name.

MR. SCHUMANN: Tim Schumann with SEW-EURODRIVE.

With reference to the copper rotors, yes we do market those globally, even here in the United States. It is not on a full-scale basis. Our premium efficient line only offers three models. It is very limited due to the cost, the expense incurred. The trouble we go through to cast those copper rotors is very difficult and it is not something we market on a full-scale basis.

MR. BROOKMAN: Okay, thank you. Roger.

MR. DAUGHERTY: Roger Daugherty.

I would like to direct your attention now away from cast copper rotors and give you an example of a technology that I know we sit here and we talk about and you used in your analysis. It sounds like it has been in use for a long time but maybe it needs a re-screening because of the scope to which you are talking about applying it. And that is hand winding. Over the past 30 to 40 years, the emphasis on winding stators has been to move to as much automated winding as possible. So while certainly hand winding existed before automated winding and hand winding exists today in those which may not be in technically mass production, whatever mass production is.

My point is, that when you really consider hand winding and you are looking at slot fills in making your engineering analysis that would force potentially, if the standards were based upon slot fills based upon hand winding and moving to hand winding, a

reversing a 30-year trend to the industry toward automation and putting it back into hand winding.

The infrastructure that would have to be created and put in place to have all those hand winders available on December 20, 2015 and if you consider the well-known adverse impacts on health and safety that are related to repetitive operations because now you are talking about a very significant increase in manpower or womanpower, whichever you wish, who are working with their hands and installing these windings, so if you look at it does have an adverse impact on health and safety.

So I toss it out to DOE to really consider maybe you should have examined hand winding when you are talking about applying it on such a scale as you are talking about in looking at higher efficiency standards. Thank you.

MR. BROOKMAN: Other comments

before we move on? Yes, Rob.

MR. BOTELER: Yes, Rob Boteler, just to pick up on the hand winding. The other thing that we all know will happen if that technology was necessary is we as global manufacturers would be forced into low-cost countries in other to meet the requirements. And pretty much all of us sitting at the table are now globally positioned to do that without a whole lot of difficulty.

MR. BROOKMAN: Okay, thank you. Okay, we are going to move on.

MR. KOHSE: Okay, so that brings us to the end of the screening analysis and we will move on to the engineering analysis.

The purpose of the engineering analysis is to develop a relationship between the efficiency of an electric motor and the manufacturer's selling price or MSP for that particular unit. Also, the engineering analysis evaluates the design options that improve efficiency and uses these options when

modeling higher efficiency motors.

The cost efficiency outputs of the engineering analysis are then used downstream for the lifecycle of costs and payback period analyses, as well as the national impact and manufacturer impact analyses.

So this slide shows some of the key steps that DOE followed in the engineering analysis. First, DOE identified representative units for analysis within each equipment class grouping which were developed in the MTA. Then DOE purchased, tested, and tore down models representing increased efficiency levels for each representative unit.

DOE verified nameplate and NEMA design performance criteria by testing models using IEEE 112-B, as well as lock rotor current testing.

Next, DOE used a motor modeling expert to create higher efficiency motor designs. DOE then developed candidate

standard levels or CSLs, based on torn down motor efficiency as well as software modeled motor efficiency. The CSLs are used to identify specific levels of efficiency which are used in the analysis.

Next, DOE developed cost inputs such as material prices, markups and labor hours. Finally, DOE scaled the results from the representative units to the unanalyzed equipment classes. DOE uses scaling because there are 514 permutations of horsepower ratings, pole configurations, and frame types, and individually assessing each combination would not have been feasible.

So this slide shows some of the NEMA design type horsepower ratings, pole configurations, and frame enclosure types for the representative units of each equipment class group. DOE used a five, 30, and 75 horsepower representative unit to represent all motors in equipment class group one. For equipment class group two, DOE used a five and

a 50 horsepower representative unit to represent all motors. Finally, DOE based the analysis of equipment class group three on the analysis of equipment class group one. And therefore, the analysis of fire pump motors is based on the same representative units that were used in equipment class group one.

DOE chose these representative units by analyzing catalogue efficiency data to find horsepower ratings that were sufficiently spread out among all representative unit efficiencies. For equipment class group one, which are NEMA Design A and B motors, DOE chose a five horsepower motor to represent all motor permutations from one to ten horsepower. DOE chose a 30 horsepower motor to represent all motor permutations from 15 to 50 horsepower. And lastly, DOE chose a 75 horsepower motor to represent all permutations above 60 horsepower.

Note that all of the selected

representative units have a TEFC enclosure as well as a four-pole configuration. DOE chose motors with these characteristics because they are the most popular design options for the motors addressed in this rulemaking.

So this colorful graph is a visual representation of the motor horsepower ranges and their representative equipment classes. Now, in addition to looking at efficiencies, DOE also looked at the "D" dimensions of frame designations in an effort to pick motor types that were evenly dispersed throughout the range of "D" dimensions.

The "D" dimension is the length from the center of the shaft to the mounting feet of the motor and determines the NEMA motor frame designation.

The bold colors indicate the actual motor horsepower rating analyzed by DOE and the lighter shade regions of the same color are the equipment classes that were indirectly analyzed through these

representative units. Note that for NEMA Design C motors, DOE chose a five horsepower motor to represent motors from one to 20 horsepower and a 50 horsepower motor to represent motors above 25 horsepower -- sorry -- 25 horsepower and above.

So I will stop here for a second and open the floor to any comments regarding the selected representative units.

MR. BROOKMAN: Roger.

MR. DAUGHERTY: Roger Daugherty.

As you are fully aware in the comments on the framework document, NEMA submitted a recommended group of motors as at least a minimum list to look at for both engineering analysis and the test analysis. Very few of those motors made it into your criteria. You based everything on four-pole motors.

In the PTSD, you discount the importance of pole configuration by failing to understand that based upon that pole

configuration there is a different relationship between the amount of material and the size of the rotor relative to the stator, that the rotor diameter grows as the pole number increases. That has a significant impact on the distribution of losses between the stator windings and rotor cage and the stray load loss and the core losses.

You failed to seem to understand the difference between in two-pole motors there may be a greater proportion of friction and windage loss related to those than there are in four-pole and in six-pole, and eight.

So while the proportion of losses that you seem to concentrate on trying to minimize in the stator winding, in the core, in the rotor cage, you don't really address what happens when you go to the two-pole motor and now the friction and windage becomes a higher proportion of your total. And so all your minimization on the ones you have concentrated on may not give you the

efficiency increase that you saw in the four-pole. Similarly for the six- and eight-pole.

You failed to differentiate the difference between open motors and totally enclosed fan-cooled. NEMA MG1 in Part 13 establishes a table of the standard horsepower assignments given to particular frame size in open motors. There is also a corresponding table for totally enclosed fan-cooled. If you compare those two tables, for the same rating and pole number, you will generally find that there is a difference in frame size between the motor of that rating in open compared to enclosed. And in many cases, you will find that there is a difference in frame series; that what may be in a 180 frame series in one for that rating is in a 210 frame series for the other rating in the other configuration.

So the purpose of why NEMA supplied the list that it supplied was to try to encourage that you did examine those characteristics and how things change between

as a pole configuration and how they change as an enclosure configuration. But you failed to do that in making your choice that you were only going to concentrate on four-pole types of machines.

The other is that other sides in your PTSD where you talk about selecting the ratings, you have a chart based upon total shipments of motors in which your chart shows that the five horsepower motor had the highest level of shipments. You based your selection of the five horsepower, according to the PTSD, on that five horsepower which had the highest shipment, that shipment of units. If you had changed your chart so it recognized that different units had different horsepower levels and different energy use, then in your chart the ten-horsepower motors have approximately an eight percent shipment.

In your paragraph where you talk about choosing the five horsepower, you say it has a 15 percent. Well eight percent shipment

at ten horsepower is more energy use than 15 percent at five horsepower. So had you examined in terms of energy use, and the whole goal here is energy savings, then it questions whether or not you made an appropriate choice, based on only looking at shipments.

You contain a statement that in selecting the 75 horsepower motor that you looked at the largest frame size. But in your chart where you identify the frame size, that frame size is two frame sizes lower than the largest frame series. Again, that is why NEMA encouraged that one of the motors that NEMA suggested was higher than 75 horsepower.

You also make the observation and in your chart that you presented here, the efficiency tended to flatten out as you got into higher levels of horsepower. If you were to recognize that flattening, you may have recognized the difficulty of getting those higher horsepower ratings up to higher efficiencies. But if you base your

conclusions on those motors where it may be easier in your analysis to arrive at the higher horsepower levels and then you use that as your scaling factor and say it applies all the way to 500, in reality you may have created a situation that is not achievable with the technology under which you analyze and said it was achievable.

So again, NEMA had a very good reason and tried to explain those reasons when it submitted those ratings, enclosures, and pole numbers that it recommended that you include. It doesn't mean you had to only include those. Those were just a recommended starting point. And we certainly encourage that you go back and that you look at if you had looked at those ones that NEMA had recommended, would you have achieved the efficiency gains that you observed here on the five, 30 and 75 horsepower. So do those three really represent for proper application of your scaling criteria, do those three really

properly represent the total scope of product that we are talking about?

MR. BROOKMAN: Do we have additional comments on choosing representative units? Anything additional? Yes, please. Microphone and your name again.

MR. RUFFING: Steve Ruffing speaking on behalf of NEMA. Is the microphone working properly?

MR. BROOKMAN: Yes, that's good.

MR. RUFFING: NEMA also has a concern with the plan to base the possible amended energy conservation standards for fire pump motors off of the analysis of the Design B equipment class. The reason being that there are additional requirements for fire pump motors that don't apply to standard Design B motors.

In the National Electrical Code, it specifies that fire pump motors, the circuit protection for fire pump motors shall be able to withstand locked rotor or overload

currents indefinitely and only short-circuit currents should trip it and a similar statement appears in the National -- NFPA 20, National Fire Protection Association 20.

So the fallout of that is that a fire pump motor is required to withstand the currents, the locked rotor currents under stall conditions for a significantly long period of time, potentially.

Motor designs that are suitable for that need to have lower levels of locked rotor amps and those lower levels of locked rotor amps then tend to be conducive to lower efficient motor designs.

MR. BROOKMAN: Okay, thank you. Final comments on representative units? Okay.

MR. KOHSE: Great. Okay, so the table we see here illustrates the four efficiencies represented by the four motors that DOE purchased, tested, and tore down for the representative units of equipment class group one. Note that DOE included in its

analysis unregulated motor types that it is considering for inclusion in the expanded scope of coverage. Therefore, some of the purchased motors have efficiencies below the currently allowable federal standards, which are EPACT 1992 levels or also NEMA Table 12-11 levels.

For equipment class group two, DOE, which is not shown on this slide, DOE was only able to purchase representative units at the EPACT 1992 efficiency levels and this was due to the low available product selection for NEMA Design C motors, namely, Design C motors that were below EPACT 1992 levels.

So here we see a sample bill of materials for a NEMA Design B five horsepower motor tear-down. DOE conducted tear-downs on the purchased motors to determine design and material changes that the motors exhibited as they increased in efficiency. DOE measured and recorded material weights and conducted metallurgical analysis on the electrical steel

in order to determine the grade of steel used.

DOE uses the bill of materials to develop a materials cost, an important input when calculating the MSP discussed later in the analysis.

Hardware, insulation material, and bearing component costs were kept constant across incrementing CSLs and the frame material costs were scaled based on the stack length of the motor.

So I will hold here and open the floor to any comments regarding the approach DOE used to develop the materials costs input, namely, whether or not hardware, material, frame material, or insulation have a heavy impact on the efficiency of a motor.

DOE then conducted software modeling to represent --

MR. BROOKMAN: Hang on second. Dale, go ahead.

MR. BASSO: This is Dale Basso.

A question. As you are doing the

material analysis, I see it talks about the tear-down but did you do electrical tests on all of these motors to verify the characteristics before evaluating the materials?

MR. KOHSE: Could you -- you mean like locked rotor current?

MR. BASSO: Like making sure that they actually met the locked rotor, what their actual efficiency was because there is a tolerance allowed.

MR. KOHSE: We did. We performed NEMA -- sorry -- IEEE 112-B tests on them and then we also did locked rotor current testing on them to make sure that they met all of the nameplate details that the motors had. So we verified that they were in fact NEMA Design B motors or NEMA Design C motors.

MR. BROOKMAN: Thank you. Roger Daugherty.

MR. DAUGHERTY: Roger Daugherty.

I guess I was interested in

whether or not -- I know here you only talk about materials cost. But in trying to go from one CSL level to another, how did you account for whether or not a change in material had other costs associated with it?

Because I noticed that in Figure 5.6 and the other figures that refer to manufacturer's selling price which DOE calculated, it is not necessarily the real selling price, that when you went from level CSL 3 to 4, which was a change in basically electrical steel type and core length, and corresponding stator winding and rotor cage, there was a very significant increase in cost from around $375 to $525. But when you replace the aluminum with copper, the increase in changing to that new technology, everything that is encompassed in trying to cast that cast copper rotor motor, you only went up $50.

So how -- do these numbers that you came up with, are they just purely based upon the fact that in one of the motors your

aluminum went from two pounds and you ended up using nine pounds of copper. And you said that copper was 2.7 times the cost of aluminum at the time you did the study. Was that the total basis of the increase in selling price related to changing from aluminum cast rotor to a copper cast rotor?

MR. KOHSE: So we did use a different overhead markup when we switched from aluminum rotors to copper rotors and that accounts for most of that price difference.

We found out from a strictly materials standpoint, although copper costs more, you don't use as much of it as you would aluminum. So there is a little bit of the price differential is balanced out by that.

MR. BROOKMAN: I see John has a comment. Oh, let's have a follow-on from Navigant.

MR. NARDOTTI: This is Matt Nardotti. Yes, the answer is yes. We simply -- it is based -- the MSP that we calculated

in the engineering analysis is just based on the costs of the materials.

You know the costs that manufacturers would incur to change their production lines, those costs for capital conversion would be accounted for in the manufacturer impact analysis, which we will get into a bit later. But yes, the MSP is that we calculate in this analysis is strictly based on the material costs.

MR. BROOKMAN: John, follow-on.

MR. MALINOWSKI: I'll wait until we get into it later.

MR. BROOKMAN: Great okay, back to Roger, then.

MR. DAUGHERTY: Roger Daugherty.

But as a follow-up, though, somewhere you came up with the motor costs and the incremental costs to do the LCC analysis. Are you telling me that that doesn't include any additional costs that would be the real cost to the user of trying to get a motor that

is of the change in technology?

MR. BROOKMAN: This is Matt. Go ahead.

MR. NARDOTTI: So the LCC analysis takes as inputs the outputs of the engineering. So yes, just the MSPs that we calculate in the engineering based on just the materials cost.

Again, this additional cost would have to be considered in the MIA.

MR. BROOKMAN: John.

MR. MALINOWSKI: John Malinowski, Baldor. I expect we will cover this in more detail later but even CDA will admit that to use a copper rotor machine correctly, the whole lamination set has to be retooled to optimize the use of the efficiency of the copper rotor. So we are going to have complete costs of new lamination dies, progressive stamping dies, retooling of our winding equipment, as well as however we are going to cast these rotors and those are

significant costs.

We stated before and we looked at it again that to retool the line between 140 and 440 frame is somewhere in the 80 million dollar range for two-pole, six-pole, eight-pole. And we have gone back and looked at those numbers again and those are real numbers. We can break those down. We will break that down in our written comments. And that doesn't include the incremental engineering cost to change 100,000 plus specs. We will get into that more when we get into section seven. But you know, your cost assumptions are grossly incorrect. When we were doing interviews we said these things are not scalable and you used scale and made some assumptions that are grossly wrong.

MR. BROOKMAN: Okay, thank you. Have we covered this now? We have covered it, yes? Okay, we are moving on.

MR. KOHSE: Okay. DOE then conducted software modeling to represent motor

efficiencies that were not commercially available for purchase. DOE utilized different design options to increase motor efficiency within higher CSLs. DOE also used tear-down and motor testing data in order to correlate its software to ensure an accurate modeling platform.

This slide shows some of the design options that DOE utilized in order to create higher efficiency designs.

So I will stop here again and take comment on this slide concern the design options or modeling used to improve the efficiency of software model motors.

MR. BROOKMAN: Dale first, then Roger.

MR. BASSO: This is Dale Basso. I just had a question on when you talked about burying the stack length. Did you have limits based on motors that you had torn down of what you limited, the maximum overall length of the stack and the coil heads to be or did you

allow them to expand beyond current envelopes?

MR. KOHSE: So we did base it on some catalogue data. We looked at tear-down data, you know, measured the stack length. And then we looked at the overall length of the motor and came up with a ratio of stack length to length of the motor. And then we looked at catalogue data of I believe it was the "C" dimension of motors, the overall length of a motor and applied that ratio from the tear-downs through that catalogue "C" dimension and kind of came up with a theoretical maximum stack length that we used for software modeling.

MR. BROOKMAN: Okay? John Malinowski.

MR. MALINOWSKI: Yes, John Malinowski, again.

Again, we get back into slot fill issues, slot fill of 82 percent is about the technological maximum for machine winding. You had some slot fills that are above 85

percent, which our manufacturing people, showing them that, they are skeptical that you could actually do that in hand winding. Certainly, it would be very difficult to do that in volume production of five million motors.

And again to Dale's point, everything you did was modeling. You have not tried any of it to know that it works. So it is hypothetical.

MR. BROOKMAN: Bob.

MR. BOTELER: Yes, just picking up on that, we had this discussion during the small motor rulemaking is the AEDM used by the Department, was it one that had gone through the same scrutiny as the manufacturer's go through where we have submitted our 25 samples to correlate our estimated computed data with actual test data.

MR. BROOKMAN: Okay. Roger?

MR. DAUGHERTY: Roger Daugherty.

I also have a question on the

software, but that is in relationship at the present time to the test data. So you have purchased a variety of motors. You tested a variety of motors. I am assuming that you have modeled that variety in the software. In making the comparison between software and test, did you compare the calculated efficiency to the test efficiency or the calculated efficiency to the nominal efficiency?

MR. KOHSE: So Howard Jordan did a lot of our software modeling and that may be a question I will have to ask him but we did correlate -- you know, we did remodel the torn down motors in his software. And I believe he looked at tested motor efficiency when comparing the two. But that is something I will have to follow up with you about.

MR. BROOKMAN: Follow-on, Roger.

MR. DAUGHERTY: Roger Daugherty.

I guess I will ask what probably should have led up to that. So just bear with

me and I will try to keep this short.

But you make a comment that DOE selected that they only had to purchase one motor of each to test, to use that test results to assist them in their analysis, confirmation of the design and their software. DOE cites that the reason for that is because they tested in accordance with 431.16 and that they did not have to test in accordance with 431.17.

The only thing that is in 431.16 is testing shall be done in accordance with Appendix B to Subpart B. And Appendix B to Subpart B says first that efficiencies shall be determined in accordance with NEMA MG1 and then in accordance with IEEE 112 or CSA standards. Okay, that is all that is there; how to do the test and get an efficiency value.

DOE then, through -- and this is in Chapter 5 -- so I tried to come up with an example as to the impact of only testing one.

And I know that Rob has already alluded to the small electric motor rulemaking and every time I bring that one up, I get a rolling of the eyes, so I won't bring that one up.

I tried to think of a good example that I could bring when I realized the most perfect example I could think of is in Chapter 5. And in Chapter 5 for that 30 horsepower four-pole motor, DOE went out and based upon I assume catalogue data at the time, they were looking for a motor that had a 93.6 percent efficiency. They purchased that motor, it was marked on the nameplate at 93.6. They did the test. The test came in at 94.2 in some odd figure.

DOE made a conclusion that that motor can't be 93.6, that it was improperly marked and that it was really 94.1 and, therefore, they threw out the test results and substituted a software model for that motor.

It is interesting that the reason given for throwing it out, the most supporting

reason given was because they went to a website and they found 94.1 percent on the website. So despite the catalogue, despite the actual marking on the motor, the website ruled and was the basis for throwing it out.

Now if we look at the way it should have progressed, at least in the industry's opinion, if you followed all the rules and understood NEMA MG1 and the rules that are in 431, you would have gotten that motor. You tested the motor in accordance with 431.16. You were now faced with this problem 94.2 percent versus a nameplate of 93.6. You go back to NEMA MG1, definition of NEMA nominal efficiency that is marked on the nameplate or you go to 431.12's definition. Those two differ in only one important word and that is the word "large" before population is missing in the DOE definition. However, that definition merely says that the NEMA nominal efficiency that is marked on the nameplate shall not be greater than the

average efficiency of the large population of motors.

Okay, fine, 93.6. You tested 94.2. There is no indication that 93.6 is not a proper marking. Your test data so far supports that the average of the population based upon one is above what is marked. It is in conformance with the MG1 standard. It is in conformance with 431.12.

If you go to 431.17 is the only place that you have guidance to make a determination as to whether or not the sample passed screening criteria to make a determination if it was representative of the total population.

In 431.17, the guideline is whether or not the average of the sample, in this case we only have one, the average must be it, that it has an efficiency value that is not less than the marked efficiency, nameplate efficiency, plus five percent additional losses. So it is a slightly lower than

nameplate. Obviously, 94.2 passed that criteria.

The other criteria is that no motor out of the sample have an efficiency that is lower than that based on 15 percent additional losses. Obviously, we passed that requirement. That is not a problem.

If we were really looking at this from the enforcement viewpoint and this goes back to around 1994, for those of you who were around in 1994, Appendix A to Subpart U uses a 20 percent criteria, instead of 15. The reason it uses 20 is because of a NEMA round robin that was done and agreement between Department of Energy and NIST and NAVLAP and manufacturers that part of the NEMA minimum associated with a nominal value recognizes a variation in test facilities that result in test.

So DOE took away five percent in certification, assuming the manufacturer did all his testing in the same facility. Added

in the five percent when it comes to testing in some facility that the manufacturer didn't test in to allow for this variation. So we passed that requirement. No problem.

If we look at the LCL requirement that is Appendix A to Subpart U, we have to have a determination of our sample as appropriate size. Well, you can't do that when you have got a sample of one. There is no standard deviation and you can't apply the rule. It won't apply.

If you go to NEMA MG1, Table 12-10 the DOE refers to in the PTSD, there is an associated minimum with each nominal. Associated with that value of 93.6 is a minimum that is two NEMA bands below that. Well, we are talking about a statistical population where nominal represents the peak of the distribution. Just as likely as you could have a motor that was down two NEMA bands below the nominal, you could have a motor that is two NEMA bands above the

nominal. Two NEMA bands above 93.6 is 94.5. The motor as tested meets all guidance and all rules the DOE has written and is in accordance with the NEMA MG1 standard.

So now the problem is that DOE is faced with a motor that they tested and purchased as a NEMA Premium motor CSL 2 that had an efficiency level above the one they purchased for CSL 3. How can that be? Well maybe the manufacturer had a good day. He had all the best materials, the best processes and everything and he ended up with a motor that met the criteria. But the point is that motor, as far as we know, on the sample one was representative of that product. So DOE threw that one away and substituted a software model.

If we look at some of the others, it even becomes more interesting because DOE went out and purchased an 89.5 percent efficient motor for one of their other designs and it tested at 88.5. DOE had no concern

about that, that it was a whole NEMA band below what the nameplate was. But they were concerned when they were a NEMA band above. So they didn't throw that one out and replace it.

And the reason I asked about the software program and what comparison was being done was that in all of the charts of data related to CSL levels, the efficiency that is carried forward in those tables are the NEMA nominal efficiency values. They are not test data values. So for the motor that had the tested efficiency of 88.5, DOE concluded no, that is really 89.5. And this tear-down analysis that they did supports 89.5, not 88.5. But in this other motor that tested better than the nameplate data, that tear-down analysis supported what that efficiency was but DOE discounted it in that case.

There seemed to be a preference to only accepting motors that had efficiency lower than nominal, except for one case. And

there was one that was just slightly above nominal and DOE accepted that one.

But my main concern is that I have expected that the software analysis was compared against the tested value for confirmation of the software analysis. How often that software analysis, if they were to model the motor that tested 88.5 and confirmed that their software calculates 88.5, how could they confirm that the software then corresponded to a nominal of 89.5? Why would the software be known to be always calculating on the low side? And if it is always calculating on the low side, when you look at those that tested higher than NEMA nominal, why would then the software be calculating the value that is on the high side?

So things don't jibe in the tables, when you look at everything together that DOE used. And the importance of course is that it affects what you attribute to your tear-down analysis, how you looked at

efficiency, how you calculated energy savings, how you calculated the LCC. Everything is all related and in a way, it all ties back to the choice of testing one motor. It just leads to a lot of mis-conclusions throughout the analysis.

MR. BROOKMAN: Okay. We are on slide 51. Additional comments on modeling high efficiency designs? Yes, please.

MR. RUFFING: Steve Ruffing, NEMA.

I just would like some clarification on one of the design options listed in Chapter 4 that was listed as a potential option for reducing stray-load loss and that is improving of motor bar insulation. And I would just like some explanation as to what DOE meant regarding the nature of that. Is that some sort of coating that is applied to the punch surface of the rotor lamination slots prior to die casting or is that some sort of heat and quench process after the die casting that separates the two or what is

exactly the nature of that as it pertains to die cast rotors?

MR. KOHSE: I'm going to have to get back to you on that. I don't know off the top of my head.

MR. BROOKMAN: Yes, Dan?

MR. DELANEY: One more comment, just to Roger's point on this software modeling that was conducted.

Roger already alluded to some of the issues obviously of using a single model or a single motor to go through that analysis. One other point we wanted to make sure from NEMA's perspective was that calibration of these models are extremely important. And using multiple models, again back to equipment class groups across multiple, these models don't come about in a matter of one year. They come about as a generation of these product lines and it is a very key point of the calibration of those models. And the new AEDM rule, which is a note at this point, is

putting attrition to that fact of the minimum number of samples that are needed to be tested but the calibration of those models are very important to the lack of interpolation of what they are doing here.

MR. BROOKMAN: Okay. Roger?

MR. DAUGHERTY: Roger Daugherty. I would just like to expand a little further on what Dan was just referring to. It is one thing to calibrate a software model against motors that you can test. It is another thing to have a calibration against motors you didn't test and against technology that you don't really have any information on.

And that is what happened in the Department of Army's two studies. There were expectations of performance in loss characteristics that were not experienced when the prototypes were built. And so while they were using a program that was well calibrated to cast aluminum with the expectation it was going to perform similarly with cast copper,

the end results were rather dismal because there were characteristics that occurred from the cast copper process that influenced losses that were not expected. And those are all detailed in the report but the point is that until you built a prototype, you really have not calibrated your program to know that what you are calculating is going to be right and it has not been shown so far in at least two government sponsored feasibility studies.

MR. BROOKMAN: Okay, thank you. Yes, John?

MR. MALINOWSKI: John Malinowski, Baldor. I just wanted to emphasize the amount of calibration that is done. We have got two full-time engineers, Roger and another, that constantly upgrade our AEDM programs, our motor design programs here. And we have people in Europe that model and input the ABB design programs. It is something that is a continuous, if you want to call it a continuous improvement. We want it to be as

accurate as possible when we design things.

And you just don't buy a program off the shelf, design a motor and expect it to be this performance because chances are, it is not. I mean to certify a program the DOE expects us to build five motors of multiple different designs before you will certify our AEDM program. And the number of motors that were designed and built by the DOE's program was zero. So you would not even certify your own program.

MR. BROOKMAN: Okay, thank you.

We are going to try and keep moving here. And shortly in ten or 15 minutes, we are going to pause for lunch. Let's keep going, though.

MR. KOHSE: Okay, great.

So this chart shows some performance and properties of the 75 horsepower representative unit that was purchased and software modeled. The data for purchased motors are in white and the data for

the software modeled motor designs are in yellow. Note that the software model motors utilized copper rotor technology, which accounts for their heavier than typical rotor conductor weights.

Here we see the steel grades, slot fills, stack lengths, and material weights change as we increase inefficiencies.

So I am going to stop there and see if there is any comment on this slide before I have Hisham come back up and finish the engineering section.

MR. BROOKMAN: Comments here? No? We've covered it sufficiently? Okay, then to Hisham.

Yes, John, one comment.

MR. MALINOWSKI: John Malinowski. It kind of comes to the question Dale brought up before on end turns and the winding length, does it fit into the mechanical restrictions we have in the frame? And when you go from a ten and a half inch long stack to one that is

13 inches long, and you go from a 70 percent slot fill to an 85 or an 83 percent slot fill, one would expect the end turns to be substantially larger, as well as the stack going to be two and a half inches longer. It is probably not going to fit in the mechanical frame endplates, which would mean that part of the motor would have to be redesigned, which would mean that it is probably not going to fit into the space where the old motor fit and the end user is going to have problems with it.

I know we are going to cover that later but this is a good slide right now to illustrate that.

MR. BROOKMAN: Okay, thank you. Yes, Steve?

MR. RUFFING: One additional question, which you may not have the answer to but I am just curious as to where the large stator copper weight increased between the CSL 2 and CSL 3 levels came from considering that

they have approximately the same stack lengths and the slot fills is reported to be the same.

I am just wondering if there is an error there somewhere or maybe the number of stator slots increased significantly.

MR. KOHSE: Yes, so that was software model. And it may be an increase in stator slot size. I will talk to Howard Jordan and follow up with that.

MR. BROOKMAN: Okay. Okay, Hisham.

MR. ARAJI: So Hisham Araji, Navigant Consulting.

So now I am just going to talk about how we developed the CSLs for the engineering analysis.

So once DOE had physical and modeled motors for the engineering analysis, it developed candidate standard levels to identify specific levels of efficiency for the analysis. These CSL spanned a range of efficiency levels from the baseline to the

maximum technologically feasible.

When selecting CSLs, DOE considered several criteria. First, DOE selected levels that were either commercially available or achievable in software modeling. Second, DOE considered the NEMA standard nominal efficiency levels in MG1 Table 12-10 for the increments between the baseline efficiency level and the max-tech efficiency. Table 12-10 is essentially a list of standardized efficiency levels that manufacturers use when labeling their motors.

Throughout the presentation today, I will refer to the increment between two consecutive NEMA nominal efficiencies as a "NEMA band."

And then lastly, DOE considered several benchmark efficiency levels, such as NEMA "Energy Efficient" or "NEMA Premium."

So this slide shows the efficiencies of the CSLs for the equipment class group one rep units. Baseline

efficiency for CSL zero is based on the lowest observed efficiency levels in manufacturer catalogues for the motor types that DOE is considering extending coverage to.

CSL 1 is based on NEMA MG1, Table 12-11, which NEMA now calls "Energy Efficient." And CSL 2 is based on NEMA MG1, Table 12-12, which is called "NEMA Premium." CSL 4 and 5 also represent software modeled motors as we have discussed before. And the reason DOE used software modeling for these CSLs is because there were basically no commercially available motors at these efficiency levels.

Also note that CSL 4 and 5 for the 30 horsepower rep unit have the same efficiency and this is because a three NEMA band increase over "NEMA Premium" levels was not achieved in the software model for that rep unit like it was for the other rep units.

So at this point, we have an issue box seeking comment on the tentative CSLs that

NEMA selected for its rep units.

MR. BROOKMAN: Let's hear from Neal first, then to Roger.

MR. ELLIOTT: Somewhat to Roger's point earlier, the NEMA nominal efficiency represents the midpoint on distribution and the distribution is by definition two NEMA bands.

So the CSL 3 being one NEMA band above CSL 2 is not statistically different from CSL 2. So therefore, a motor that would be CSL 3 in likelihood would probably actually be nominally a CSL 2 motor. So I just want to make that note.

In all the work that we have done over the last 20 years we always say if you are going to raise the efficiency level, you have to raise it two bands. Because if you are not doing it two bands, it is not statistically different than the band one band down.

MR. BROOKMAN: Okay. Roger?

MR. DAUGHERTY: Roger Daugherty.

As noted on your slide, you present the CSL levels purely based upon incremental increase in NEMA bands. The problem that can lead you into and it actually did lead you into is that when you look at the three NEMA Design B motors that you examined across the CSL levels or look at the NEMA Design C, those two motors, under each CSL level as you got higher, you mixed up technologies. So that you may be making one of those motors of the common class using a different technology under that CSL level than you were the other motors.

And as I mentioned earlier, manufacturing, and I am aware that several of you visited manufacturing facilities and I am aware of what goes on in manufacturing, manufacturing again does not randomly select what materials to pull out of inventory, send through lamination presses and build, whether it be hand winding in this case or machine

winding in another case, but now we are just trying to stick with technology.

So I encourage that DOE, in defining the CSL levels, go beyond the efficiency level but also associate with those levels a technology. That is what was done in the small electric motor rulemaking. So that when everyone sits down and says CSL 3, they know it was a common group of technologies that was used across that class. The same for CSL 4 and 5.

And it is easy to do that because based upon your tables of 5.5, 5.9, 5.13, and 5.16, besides the definition you have given to the CSL levels here, from those tables you can also realize that CSL 2 uses M47 for electrical steel and it's an aluminum cast rotor. CSL 3, the commonality would be M47 again in aluminum rotor. Again because you have said CSL 3 uses present technology in construction.

CSL 4 would move to the M36

material and aluminum cage and CSL 5 would be both M36 electrical steel and the cast copper rotor technology. Again, it is NEMA's position that CSL should not exist if it depends on cast copper because that should have been screened out of the process. But I am just addressing the way you presently present the tables.

Similarly in the tables for the NEMA Design B, A and B, you were not hesitant at putting empty entries into the table when it was not achievable. So when you look at what you did for NEMA Design Cs, you redefined what CSL 0 was. You took the EPACT levels that in Design Bs are CSL 1 you moved them down to CSL 0. That is causing confusion as people talk and sit, you know, sit and talk and say okay I am talking CSL 3. Well are you talking CSL 3 in Design Bs or are you talking CSL 3 in Design Cs? Because they have different meanings.

So again it is encouraged that the

same as you can leave empty spaces, you can leave any entries for CSL 0 out for Design C and start at CSL 1 as being EPACT, so it is common across both equipment groups, class groups.

And then from there on for Design C you can build up on what technology of electrical steel and aluminum construction would apply to the appropriate levels as you go up from there. Again, that way you are doing your analysis the way things really get manufactured and the way materials get utilized in the industry and not mixing things up and causing a lot of confusion.

Well this one I designed, if you happen in this particular group of motors, you use M36 instead of M47 in order to achieve this. And again, some emphasis has to be put on real world manufacturing and what the processes are. And it is not impossible to structure these CSL levels with that in mind to keep track of it.

MR. BROOKMAN: Okay, Robert.

MR. WILKINS: Thank you, Doug.

I note on this chart that a move from CSL 2 and I picked these moves arbitrarily, but a move from CSL 2 to CSL 5 would result in a two percent efficiency improvement in one case and a one percent efficiency improvement in two other cases.

And I do realize that this docket is about motor efficiency. I get the point. But in a larger sense, it is about improving the energy efficiency of American industry in a cost-effective manner. We need to be sure we are doing that in reaching the broader goal, as well as the micro goal.

So far we have discussed a microeconomic analysis in motor efficiency. And that is very appropriate. We should do that. But I would also urge DOE to take a macro view of the analysis at the same -- in parallel.

Now I will draw a little

comparison. It seems to me what we are debating here is a little like trying to improve the miles per gallon of an automobile. And we are talking about spending multiple millions of dollars to totally redo the engine design to get another tenth of a mile per gallon, when we could do it as an industry much more cost effectively by changing the tires. I think that is what a macro analysis is all about.

Or said another way, how can American industry users of motors save energy in the most cost-effective way? We can spend a hundred million dollars, a figure I have heard to save one or two percent. But if we look at it from a macro point of view, there is a better way and more cost-effective. Off the shelf, variable frequency drives can save 20 to 30 percent.

Now, I know this isn't a docket for variable frequency drives but the question is it really cost effective to try to eke out

one percent motor energy efficiency might bore down into the motor when if you stand back and look at the bigger picture, there are much larger opportunities.

So I would argue that this is a relevant consideration in deciding the future motor efficiency and would urge the DOE to stand back and take a macro view before deciding that we want to bore down and try to eke out a half or one or even two percent.

MR. BROOKMAN: Okay, thank you. Additional comments on this series of slides, developing candidate standard levels?

MR. ARAJI: I just had a quick follow-up to Roger's suggested approach.

MR. BROOKMAN: Yes.

MR. ARAJI: If we understand that manufacturers often use different technology options to achieve the same efficiency levels, so manufacturer A might use a different combination than manufacturer B. So in your suggested approach if you could maybe in your

written comments, just recommend a set of technology options for each CSL that you suggest that DOE go with, we would appreciate that.

MR. BROOKMAN: Roger?

MR. DAUGHERTY: Roger Daugherty.

Well, yes, it is certainly true that different manufacturers take different approaches, not only the choice of materials which is the only thing I have limited this to, material technology, but they also take different approaches to how they design their frames, what diameters they use for their laminations within those frames, how long they make the frames, trying to stay within the NEMA mounting dimensions, et cetera, and not have too much overhang on them.

So there is so much that goes into play that yes, one manufacturer may have an arrangement with an electrical steel supplier that he uses one particular type of electrical steel and another manufacturer uses another

that he has adapted to all of his processes.

But my point was that by you mixing things together, you are actually imposing that kind of mixture on everyone. They are not really being free to try to choose what is best for them. Anytime that you have to take the viewpoint that in order to get this level of efficiency, I have got to deviate from all the rest of my product by using this particular steel because it is the only way I can get there, then you have got to look at well that manufacturer may choose I am not going to do it. So I can't achieve it. It removes that product from the market. It reduces availability and utility of that product and then you don't meet your screening criteria.

So it is very important with respect to your screening criteria and production that you use a common technology for each of these groups and you have enough groups and you have already demonstrated the

importance of certain technologies at particular CSL levels that you can do that.

MR. BROOKMAN: Final comments on this series develop CSLs? Additional comments?

Let's go to lunch.

(Whereupon, the above-entitled matter went off the record at 12:34 p.m. and resumed at 1:34 p.m.)

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

(1:34 p.m.)

MR. BROOKMAN: By my count, I think we left off with Slide 56. We're going to resume and hear from Hisham.

MR. ARAJI: All right. So, picking up where we left off, we just discussed how DOE developed CSLs. Now we're going to get into the process of developing the manufacturer selling prices for the rep units.

All right. So, after developing CSLs, DOE had to develop manufacturer selling prices for rep units that we analyzed. Now, the manufacturer selling price is a key output of the engineering analysis, and it's used later on in the downstream analyses that we'll talk about today.

So, as Will mentioned earlier, DOE had already figured out what's inside of these motors by doing tear downs. This gave us the material cost inputs. From these tear downs, DOE was not only able to quantify how much

steel, copper, aluminum, and other materials were inside the motors, but also labor hour estimates and whether the motor was hand- or machine-wound.

DOE determined material prices and labor requirements through conversations with manufacturers and industry experts and markups and labor rates were derived from Census data and SEC filings.

This chart shows the manufacturing markups that DOE applied to its labor costs and raw tear down costs when developing the manufacturer selling price. You'll notice that DOE used higher non-production markups for motors over 30-horsepower. This is to account for the extra profit margin manufacturers may receive on larger electric motors that are sold in smaller volumes.

So, at this point we are seeking comment on three issues here. First one, DOE's 5-year average for copper prices, pricing copper. And then current year prices for all

other materials. And we're requesting comment on that decision to use a 5-year average for copper and the current pricing for all other materials.

Second issue is, we're seeking comment on the higher non-production markup for the 30- and 75-horsepower rep units.

And the final issue on the slide, we're welcoming comment on the decision to use aggregate domestic and foreign fully burdened labor rate. And then balancing each of these rates based on an estimate of how much of the work we believe is done overseas and how much is done domestically.

MR. BROOKMAN: Maybe you could go back to slide 57, so we have that slide on the screen. Roger.

MR. DAUGHERTY: Roger Daugherty. My question is actually on the one prior to that slide. But since you went to the trouble of doing the tear-down analysis and calculating production cost and trying to get a

manufacturer selling price, did you compare that to the actual manufacturer selling price for each of the motors that you purchased? And how well did that compare?

MR. ARAJI: I believe it varied based on model. You know, sometimes we bought the motors lower than the manufacturer's suggested retail price because of volume discounts for certain motors. Other models ended up actually being a little bit higher, so it varied. But I think the general trend varied.

MR. BROOKMAN: So, then go back to the next slide -- or go forward to the next slide. Comments on -- the three issues are: copper's large price fluctuations, how that was handled; the higher non-production markup for its 30 to 75-horsepower representative units; and the balancing decision they made in Issue 13. Comments, please. Yes, Rob?

MR. BOTELER: I have a question on the labor, where you say you did aggregate

cost of domestic and offshore. Did you look at the two labor rates and just average 50-50, or how did you arrive at that?

MR. ARAJI: This is actually weighted more towards the foreign manufacturing, if I recall correctly, so it wasn't a 50-50 balance.

MR. BOTELER: Okay, so that $33.46 an hour includes -- are you making assumptions of hand winding, moving product offshore or was that just looking at today's mix?

MR. ARAJI: It was just based more on feedback from manufacturers and their estimates of how much they do abroad and how much they do here. We understand some manufacturers do everything here, some do most abroad, but it was just an estimate. So, I would welcome comment on it.

We didn't factor in hand-winding or machine-winding in this rate. That was more accounted for in the labor hour estimates.

MR. BOTELER: Okay. I mean, my

personal comment, I think, is if it includes a lot of offshore that it seems high to me, but I'm not directly involved with that part of our business, so it just seems high.

On Issue 12 on the markups, and we're all competitors so we're not going to talk a whole lot about that. But, again, looking at the markups, you acknowledge that there's a lesser markup on the lower horsepower which I think is probably true. I don't know if the break is really quite as low as 30-horsepower, but looking at the markups that you have, the percentage markups, again in both cases I would tell you that they seem a little bit high to us.

MR. BROOKMAN: Okay. Dale, do you want to follow on?

MR. BASSO: A couple of comments. I think you're doing the best you can with trying to aggregate everything together. And, unfortunately, it is a very complex analysis. When you talk about fully burdened hourly

rates you're going the full range from small to large on that, and in many manufacturers we would break that up to different cells for different rates depending on the sophistication, the cost of the equipment that goes with it and everything. And you sort of made up for that, I think, by taking a different approach with the SG&A markups. And assuming markup where maybe our markups aren't the same but hourly rates are higher. So, in aggregate it's the best you can get for an estimate. It probably couldn't be applied accurately to any one rating.

One concern I have is that, when you do this analysis and you based it on both a domestic and offshore rates it may lead to an accurate analysis of the present state, but it would certainly encourage, the analysis would favor more production going offshore in the end when you make a decision based on this. So, it probably goes against one of the rules that DOE would like to follow of

domestic employment.

MR. BROOKMAN: Thank you. Three comment boxes, 11, 12, and 13, take a peek. We'd like to receive your comments on those. Yes, Charlie Stephens.

MR. STEPHENS: Charlie Stephens. One question looking ahead. When you go to actually do the life cycle cost analysis and you have to pick a motor cost from that, will these -- is the range of costs that you're going to pick from in terms of a distribution of costs going to allow for perhaps these being the cost of the variation in that distribution? Are you going to have a -- I can't remember now how that ultimately gets applied and how wide the distribution of, for instance, a 30-horsepower motor cost is when you go to select it in the 10,000 runs that are typically done in a Monte Carlo run.

MR. ARAJI: So, basically, these go into -- are then fed into the next analysis which is the markups analysis. And Sanaee

Iyama from LBNL can speak more to that.

MS. IYAMA: Sanaee. So, what happens after the engineering is that we take the manufacturer's selling price which incorporates the manufacturer markup, and then we apply the rest of the markups that are between the manufacturer and the end user. So, that's going to be what I'll talk about in the next section. But very briefly, to answer your question, we applied log normal distributions on the distributor markups, distribution channel markups.

MR. STEPHENS: Okay. Charlie Stephens. The reason I was asking this is I was wondering if -- I mean, ultimately you take a range of prices paid by end users when you do the life cycle cost analysis.

MS. IYAMA: Right. And each iteration is going to pick a markup that's within that log normal.

MR. STEPHENS: Within the band, so you're going to end up in that analysis with

a range of prices that may -- you won't know why the price is 10 percent higher or 10 percent lower as you select them, but many of these effects -- this part here seems as important or more important in the manufacturer impact analysis, then ultimately when you get to start picking motor prices for the life cycle cost analysis, you'll end up with a distribution without reference to cause of the distribution of why it's 10 percent lower or why it's 10 percent higher. It just comes from a distribution of prices with all effects included. Right? Because you could arrive at the same price with a high distributor markup and a low manufacturer markup as you do with a high manufacturer markup and a low distributor markup, and get to the exact same price.

MS. IYAMA: Right.

MR. STEPHENS: But you don't distinguish as to how you got to any particular price.

MS. IYAMA: Well, I mean, if you look at the aggregated results you won't see that. But if you look at the specific one iteration in the life-cycle cost amongst the 10,000 iteration then you would see why.

MR. STEPHENS: Right. Well, you would see the effect.

MS. IYAMA: You would see exactly which markup assumption was made for each of the market players in the distribution channel.

MR. STEPHENS: Yes, I can see what the assumptions, but what I'm saying is when you can get to the same price in your analysis with a low manufacturer markup and a high distributor markup as you can with a high manufacturer markup and a low distributor markup, then you've kind of covered the bases. You're not saying that --

MS. IYAMA: I think I'm going to check in with Hisham on this, but I don't believe -- we only get a single MSP from the

engineering, which includes the manufacturer markup so there's no statistical distributions over that value.

MR. STEPHENS: Right. Yes, I guess what I'll look at later is the -- how wide the band of pricing is. And as long as the manufacturers are reasonably content with the band of pricing that you come up with in the marketplace, and they think that's representative, then I don't think coming up with a single MSP and then going from there will be a bad thing necessarily.

MR. BROOKMAN: Okay. Yes, John Malinowski.

MR. MALINOWSKI: John Malinowski, Baldor. I guess I'm a little skeptical of the numbers you have there for 37 and 45 percent. As Rob said, you know, talking specifically would violate some antitrust things, but those seem high.

The last year that our company reported in an annual report our earnings were

like 14 percent, and that was a record in 90-some years of the company, so I wish they were this high, it would have been higher than that.

MR. BROOKMAN: Thank you. Additional comments on these comment boxes listed?

MR. ARAJI: Yes, just to be clear, non-production isn't strictly profit. There's other things, too.

MR. BROOKMAN: What are they?

MR. ARAJI: R&D, research and development, insurance, warranty risk premiums.

MR. BROOKMAN: Okay. Speak up.

MR. ARAJI: Sorry. I was just mentioning that non-production isn't strictly profit. There's other stuff in there, research.

MR. MALINOWSKI: I understand. I'm just -- again, I can't speak to this because of antitrust.

MR. BROOKMAN: Okay.

MR. MALINOWSKI: Just trying to give you an idea. Motors are not extremely profitable.

MR. ARAJI: Okay, any other comments? All right, moving on.

So, the final step in engineering analysis is to scale to efficiency levels, scale the efficiency levels of the representative units we selected to the equipment classes that were not directly analyzed.

Efficiency Levels for Equipment Class Group 1 were derived from the Design B rep. units. Efficiency levels for Equipment Class Group 2 were derived from Design C units. And as for Equipment Class Group 3, which is fire pump motors, those efficiency levels are derived from the rep units for Equipment Class Group 1. And as we mentioned earlier, DOE did this because the shipment volumes were really low for fire pump motors

and so were the run times.

So, in both approaches that DOE considered for scaling, the efficiency levels for CSLs 1 and 2 were based on MG-1 Tables 12-11 and 12-12.

Now, the main differences between the two approaches were how the higher CSLs were developed. The first approach was to look at the efficiency levels in 12-11 and 12-12, and try to develop power law equations to characterize each table. Any perceived pattern in these equations could then be used to model similar tables for higher CSLs.

The second approach simply incremented each subsequent CSL by one NEMA band. Ultimately, DOE decided to use the second scaling approach of one NEMA band improvements because it was more simple and more straightforward.

So, this slide summarizes the second scaling approach I just discussed. I just want to mention that because DOE is

considering expanding coverage to motor types not previously covered, the efficiency levels for CSL-0 in Equipment Class Group 1 are based on the lowest efficiency values that were observed in motor manufacturer catalogs for the scope of motors we're intending to expand coverage to.

The next two CSLs, CSLs 1 and 2 are then based on 12-11 values and 12-12 values, and then each subsequent CSL above that goes up by one NEMA band.

And as we've mentioned throughout the presentation today, DOE divided up equipment classes into smaller subsets. On this slide they're highlighted in blue, red, and green. Now, the analysis of the equipment classes in each highlighted portion are based on a representative unit within that highlighted portion. So, for instance, in the red section of this chart, if a 30-horsepower rep unit in Equipment Class Group 1 was only able to achieve a two NEMA band improvement in

efficiency above "NEMA Premium," then all the equipment classes based on that rep unit would be assumed to have a max tech efficiency of only two NEMA bands above "NEMA Premium," as well.

So, now we reach another one of DOE's issue boxes. We're basically seeking comment on the scaling methodology that we've elected to use to generate the efficiency levels for the other equipment classes.

MR. BROOKMAN: Roger?

MR. DAUGHERTY: Roger Daugherty. The initial scaling that you tried to examine looked at CSL-1 and CSL-2, is a comparison based upon, basically, the same technology, across those two. And you say you observed some change. But when you move into different levels of technology as you go into CSL-3, 4, and 5, and then you've mixed up technology in different motors that you examine, and different designs, what in your scaling method in the way that you've applied it would have

predicted that at least 30 percent of the designs could not be achieved, the efficiency level you were looking for couldn't be achieved? So, how could you scale from those that it could be achieved into those to which it could not be achieved? Your scaling method seems to fall down once you move into additional technology, or consideration of higher technology for higher efficiency.

Because you're going from one common relationship between CSL-1 and 2, then you're trying to introduce different technologies, but your own report says that you couldn't obtain certain efficiency levels in certain CSL classes without considering a different technology for that particular rating. And to me that says, okay, at least 30 percent of the ratings in all the equipment classes can't be met by using the technology that you were examining for the rest. So, to me it says the scaling method based upon any particular set of technology is not scalable

across all the equipment classes, and that's where you're applying it.

And, again, that comes back to the point that you didn't examine any two-poles, six-poles, or eight-poles and what effect there would be there, and you didn't examine open machines, which are in different frame sizes than the totally enclosed fan-cooled that you actually looked at.

MR. ARAJI: Yes, so with that in mind, we do have limited resources on how many rep units we can actually directly analyze. But if you guys here today have any recommendations on how we can scale given the fact that we do have limited resources, we can only purchase a certain number of motors, please submit them in written comments. This is the kind of stuff we're looking for. If you don't feel like you could scale from four-pole to two-pole, or we need to incorporate some other factors when doing that, that's the kind of stuff we'd like to know.

MR. BROOKMAN: Either one of you. Go ahead, Rob.

MR. BOTELER: I think we would say that we really don't think scaling is the way to do this sort of an exercise. It just has too many issues with it, and there's too many variables.

We have guys sitting at the table that are Ph.D. electrical engineers that have spent 35 years trying to do this, and they don't scale like this. So, it's kind of something that I don't think DOE is going to figure out a way to accurately come up with this sort of an exercise.

MR. BROOKMAN: Okay, Neal, and then back to you, John. Neal.

MR. ELLIOTT: Neal Elliott. I just wanted to comment. I mean, there's this idea that there's some underlying fundamental physical theory associated with Table 12-11 and 12-12. And having actually dealt with this now for a quarter of a century, not as long as

certainly some of the other gentlemen like Mr. Daugherty over there, but it's fairly a heuristic exercise where those things came, and there's a lot of judgment and a lot of market legacy that went into those tables. So, the instant I saw the word "regression" on 12-11 and 12-12 I immediately sort of went, mmm, there's not an underlying theory here. So, that's just a gut, for whatever it's worth.

MR. BROOKMAN: So, one thing in your written comments or now to suggest how the Department might actually do this if they're not going to scale. That would be helpful. Rob, keep going, then to John.

MR. BOTELER: I think we have recommended that. We've submitted our direct petition, and I think that's what we would want to fall back to. That's our recommendation.

MR. BROOKMAN: Thank you. John, you have a follow on?

MR. MALINOWSKI: I think Rob has

answered what I was going to say.

MR. BROOKMAN: Okay. Roger.

MR. DAUGHERTY: Roger Daugherty. Just to try to answer your question about use of resources. One way is that it doesn't take that much effort necessarily to do the software analysis if you can get your hands on the basic design that you start from to check it out. That's part of the main concern. But if you just look at some of these technologies, as I said earlier that have been tried to be advanced, they certainly don't fit any of the scaling relationships that you're trying to fit things into. It just doesn't work out.

MR. BROOKMAN: Okay, thank you. We're about to move on. Are we finished with this one? Yes.

MR. ARAJI: All right. Thank you. At this point I'd like to invite Sanaee Iyama from Lawrence Berkeley National Labs to discuss the markups and energy

characterization analysis.

MR. deLASKI: Doug, this is Andrew deLaski, if I could just interject.

MR. BROOKMAN: Please, Andrew. I was going to cue you, yes. I'm sorry.

MR. deLASKI: Okay. I wanted to come back to a point that was raised earlier when Rob and Sanaee were having the interaction over the shipments, and it's just a discrepancy between a point that I want to highlight, that the discrepancy the Department has outlined in its definition and the scope of coverage that we recommend in the joint petition.

On page 3 of the joint petition, page 2-3 we outline the motors that would highly recommend treatment of groupings of motors. And one of the areas where we recommended that DOE cover at Table 12-12 efficiency levels is to cover 56 frame motors that are outside the scope of the Small Motors Rule, integral horsepower.

In the DOE definition back to page, whatever it was of the slide, it referenced three digit frame sizes being the limit.

MR. ELLIOTT: Slide 25.

MR. deLASKI: So, I think Rob in that discussion -- there's a lot of motor shipments here.

MR. BOTELER: Yes, I think agreed on that, that the 56 was missing in that. That would really bring our -- the 56, if we added those would bring our number up very close to what IMS showed, kind of in the middle.

MR. deLASKI: So, I just wanted to highlight that point, and I wanted to bring it back to that page 25. So, I think someone else earlier highlighted that IEC frame size on that second to last bullet needed to be performed in there, the point that Roger made.

And another point here would be another -- that a three digit NEMA frame size is something that needs to be either another

bullet to address 56 frame or to somehow capture the 56 frame is outside the scope of the Small Motors Rule --

MR. BROOKMAN: Okay, thank you. Thanks for bringing that back up.

MS. IYAMA: Hi, I'm Sanaee Iyama. I'm with the Lawrence Berkeley Lab, and I'll present the next sections of the preliminary analysis. Is that better?

MR. BROOKMAN: I think you need to maybe get it a little closer to your mouth, like hang it on the edge of your blouse or something.

MS. IYAMA: Try this. And I'll start with the markups analysis.

MR. BROOKMAN: Is that better? Speak up.

MS. IYAMA: So, the purpose of this analysis is to determine consumer motor prices for baseline efficiency motors and higher efficiency motors. And this information is used as an input to the life cycle cost

calculations.

So, first we characterize how motors are distributed from the manufacturer to the end user. Then, for each party involved in the distribution channels we established markups, and then we used these markups to convert the manufacturer selling prices into consumer price data.

DOE identified six main distribution channels that are represented on this diagram. And the different percentages that you see represent the estimated shares of units of motors sold through either of these channels.

So, after doing this, we estimated markups for each party involved in the distribution channel so we had the original equipment manufacturers, the distributors and the contractors. And here we have listed the different sources of data that we used. We also applied a sales tax rate based on 2012 Sales Tax Clearinghouse data.

So, for each of these parties involved in the distribution channels we established both a baseline and an incremental markup. So, before I go into details of what these two markups represent, I just want to mention that DOE has been using this approach for quite some time, so this is not something new in this analysis.

The baseline markups relate the consumer price to the cost of goods sold prior to a change in efficiency. It covers all the business' expenses and profit, as well as direct labor costs.

The incremental markups relate the change in consumer price to the incremental increase in cost of goods sold due to increased efficiency. The basis for using such approach is that the purchase price of a piece of equipment is not strictly proportional to its -- I mean, the selling price of a piece of equipment is not strictly proportional to its purchase price, so when the cost of goods sold

increases due to efficiency, only a fraction of the business expenses increases. And some others like direct labor costs remain constant.

So, the incremental markups only account for those business expenses that will vary with the cost of goods sold, and is only applied to the incremental increase in the cost of goods sold.

So, applying this approach and using the data sources that I presented on the previous slides, as well as the different shares of motors sold by distribution channels, we calculated an average overall baseline markup of 1.63, and an overall incremental markup of 1.50 for all equipment classes.

And here we have a comment box about any comments you might have on any alternative approaches or sources of information that DOE could use to develop product prices.

MR. BROOKMAN: Yes, Rob.

MR. BOTELER: Rob Boteler. If you go back one slide, no, forward one, forward, forward, right there. You made the comment that on direct labor, you said that "the direct labor costs remain constant."

MS. IYAMA: For example, so here we're assuming that if you're a distributor and you're selling a baseline motor you have a certain markup, and then if you're selling a higher efficiency motor, for example your rental -- what you pay for your building cost, this will remain constant. It's not going to vary with the cost of -- with the manufacturer selling price of the motor.

MR. BOTELER: Okay.

MS. IYAMA: So, basically, we calculate an incremental markup to translate that, the fact that some business expenses don't scale with this cost of goods sold, but then we only used this incremental markup on the incremental increase of the cost of goods

sold.

MR. BOTELER: Okay, thank you.

MR. BROOKMAN: You can see the comment box there. Do we have comments here? No? Okay.

MS. IYAMA: So, next I will talk about the energy use characterization. The purpose of the energy use characterization is to develop annual energy consumption data for electric motors based on field operating conditions. And we do this for each efficiency level considered in the engineering analysis.

This annual energy consumption data is then used in the life cycle cost calculation in order to develop the electricity costs.

The method used in this section relied on using typical motor operating profiles associated to different applications in different sectors. And we considered variability in the field through the use of statistical distributions for inputs such as

operating hours and motor load. We also accounted for reactive power demand as another necessary input to the life cycle cost.

So, for electric motors the energy used by the motor itself actually refers to the energy losses in the motor, and the rest is converted to useful mechanical shaft power. The annual energy used which combines both the motor losses and mechanical power is calculated through this formula on the slide, so it relates to the motor capacity, motor load, annual operating hours, and efficiency at the considered load. And at the bottom of the slide we have the formula used to calculate motor losses.

So, the next couple of slides I'll go through each of the inputs used in the annual energy use calculation. I'll start with the annual operating hours, then motor load, then efficiency at the considered load.

So, before I go into the details of the use of --

MR. BROOKMAN: Sanaee, hang on. Roger wants to comment here.

MR. DAUGHERTY: Yes, before you leave that slide, your last calculation --

MR. BROOKMAN: Use the microphone.

MR. DAUGHERTY: Roger Daugherty. The equation you have at the bottom for calculating losses, I thought we cleared this up quite a few years ago, that that's not the equation for calculating the losses in a motor on the basis of efficiency. It's one over the efficiency minus one, multiplied by the motor energy that gives you the losses.

MS. IYAMA: Okay.

MR. BROOKMAN: Thank you. Yes, Frank, follow-on. Microphone, please.

MR. LADONNE: Frank Ladonne, Underwriters Laboratories. And I think we've said this before, but I think it bears repeating and maybe a suggestion on how to proceed. But I think the first equation assumes that the motor is perfectly matched to

the load. And as soon as you depart significantly from that, the efficiency drops way off.

I would like to see some work done on -- in the field, how well motors are being matched to load, and what is the actual realized efficiency of the system?

MS. IYAMA: I might touch upon this in the later slides.

MR. LADONNE: Okay.

MR. BROOKMAN: Okay.

MS. IYAMA: So, before I go through the actual details of how we develop the usage inputs, again the annual operating hours, the motor load, and the efficiency at the considered load, I want to add that motor field operating conditions depend on the field where the motor is -- on the sector where the motor is used, and on the application where the motor is used. So, in order to account for those differences we developed a model of motor population and established estimates of

the share of motors used in the commercial sector, industrial sector, and agricultural sector by horsepower range. We also established distributions of motors by application for each horsepower range, and equipment class.

So, here on the left -- on the right we have -- I mean on the left we have an example of the distribution by sectors for all equipment class group, for motors within the 6- to 20-horsepower range, and then here we have another example which is an example of the distribution by application for Equipment Class Group 1 motors between 6- and 20-horsepower.

So, what DOE did is that we established user inputs specific to applications and sectors, and then we used those types of distributions to aggregate into an annual energy use -- average annual energy use data.

So, again for each sector and

application, DOE derived usage inputs starting with annual operating hours, so here we have an example of the usage inputs in terms of average operating hours in the industrial sector.

MR. BOTELER: Hey, Doug, call on me.

MR. BROOKMAN: Rob. Sorry, I was immersed in the table. I'm sorry. Rob, go ahead.

MR. BOTELER: Rob Boteler. I just wanted just to comment on this table, that in our analysis that we submitted in our petition for direct final rule we didn't go into this level of detail, and this is great. We just simply selected 4,000 hours across the board, and we did that for all of the horsepowers and speeds that we -- we did it with connected horsepower. We calculated the connected horsepower that would be impacted and then stuck with 4,000 hours at 100 percent load.

MS. IYAMA: Right. And these values

are higher than the 4,000 but these are for the industrial sector only. And in other sectors in the commercial sector and agriculture we have much lower annual operating hours assumptions for the different applications. But here I was just showing this as an example.

So, we developed average values. We also used statistical distributions to account for variability in the field. So, again that's only an example for the industrial sector in the different applications considered.

So, we did this for the annual average operating hours. We also did this for load. So, we determined average motor load values throughout the year by application. We also established statistical distributions but I'm not showing them here on the slide. I'm just showing the average annual motor load that was used as inputs to our energy use calculation.

MR. BROOKMAN: Rob.

MR. BOTELER: And I understand where you have to get to an average load, but if we look at the DOE study it tells us that 40 percent of motors, industrial motors are operated below 40 percent load. I think kind of Frank's comment a minute ago, if you do it at an average load like this it tells you a pretty kind of level story that the efficiency hasn't degraded a whole lot when you're in the 65-70 percent load.

MS. IYAMA: Right. And this table here again only shows the average value, but in the actual LCC calculation we used statistical distributions around those values so we have different bins.

MR. BOTELER: Okay. So, you did use some below --

MS. IYAMA: And I believe half of the motors are below 50 percent operating load.

MR. BOTELER: Okay. Good, thank

you.

MS. IYAMA: So, in order to account for the fact that motors don't operate at full load we established part load efficiency based on the engineering test data, and here they're just translated into losses versus load values at the different operating load. So, basically we derived a polynomial equation between losses and load based on the engineering test data.

So, using all the inputs I just presented we calculated average annual energy consumption by efficiency levels. And these results are for -- are an average across all sectors and all applications.

So, here we have a slide presenting DOE's request for comments. So, we're interested in comments or any additional sources of data that could be used to establish the distribution of motors across sectors by horsepower range, trying to improve our estimates on this. Same for the sector-

specific distribution of motors across applications. And we also seek any additional sources of information on field data for motor operating hours and load, specifically in the commercial sector and agricultural sector. In the industrial sector we have a pretty good data set of -- plant assessment data that we used. We didn't have that many data that we could use in the commercial and agricultural sectors.

MR. BROOKMAN: Neal.

MR. ELLIOTT: Not so much -- this is Neal Elliott. Not so much a point, but for the record the DOE undertook a market -- or undertook two market analyses to look at commercial and industrial motor use in the late 1990s. The intent was that those were to be updated every three years. We have not seen those updated in the last --

(Off microphone comment.)

MR. ELLIOTT: Yes, but they never updated. They just did the technical

corrections, so there is pending as part of the INGAA legislation a direction to the Department or to the Secretary to undertake such a study. And we have approached the Department, EERE about possibly undertaking the study with existing authorization.

And I would just note that the motor community would welcome the opportunity to see the Department undertake such a study without necessarily direct Congressional direction.

MR. BROOKMAN: Thank you. Dan, did you wish to comment?

MR. DELANEY: Yes, Dan Delaney, Regal-Beloit. I guess my biggest question, when we come back we look at the industrial, as you mentioned, you don't -- you have a very limited amount of commercial information that's here. Some of the information going back a couple to -- one more, right there. On these operating hours --

MS. IYAMA: So, again, these are

for the industrial sector.

MR. DELANEY: Industrial, correct. And, again, looking at the percentages that seem very high to me looking at these, that this is only 25 percent of the values as you look back here. Noting that commercial is being 75 percent, is as we roll these values up --

MS. IYAMA: Right. And, again, these -- this split by sector is just for the 6- to 20-horsepower range. In the larger capacities you would see much more industrial motors, and much less commercial applications.

MR. DELANEY: So assuming --

MS. IYAMA: So, this is just an example for illustration, but it's kind of -- it kind of reverses as you go further in increased motor capacities.

MR. BROOKMAN: Rob.

MR. BOTELER: Yes, I think that's part of our question. When we're only looking at the 6- to 20-horsepower, the hours of

operation that you have even in the industrial arena seem very high to us. We sold high horsepower motors, you know, we start talking 1,000-, 2,000-horsepower motors, we expect them to run continuously. But in a lot of cases when we sell smaller, the 1 to 5-horsepower and the 6 to 20, they go into applications in industry that are intermittent operations that might run a couple of hours a day throughout the day. So, having an average of four or 5,000 hours seems high to us.

MR. BROOKMAN: Dan, follow on. Then I'm coming back to Frank.

MR. DELANEY: Yes, Dan Delaney, Regal-Beloit. Again, just to fall back to that 75 percent and to drive that home, the point is that the percentage of those hours, the 75 percent is considerably less than the values that are being presented in industrial, so I just wanted to make that comment. And that obviously drives a huge percentage when you look at those CSL levels in extrapolation of

a determination and recommendation of those CSL level 3. I just wanted to make that point. It's a huge point, is the amount of hours and as well as I would also argue that the load goes the same percentage on that, the loads would be even lower than those percentages on the commercial end of the 75 percent.

MR. BROOKMAN: Thank you. Frank, microphone.

MR. LADONNE: Frank Ladonne, Underwriters Laboratories. I just want to amplify Rob's comment. In particular, the numbers look a little strange to me when I look at fire pump motors. I mean, by definition that's a lot of hours for a fire pump motor to be running. You know, you would assume from these numbers there's a lot of buildings burning down.

MR. BROOKMAN: Okay, thank you.

MS. IYAMA: So, again, if you think some of these numbers -- I mean, it's very useful to know what your perception of these

values are, whether they're too high or too low. But if you have any data that we could actually use to backup your comments that would be even more helpful to us.

Okay. So, next I will talk about the actual life cycle cost calculation and payback period analysis. The purpose of this analysis is to determine the LCC impacts and payback period for the consumers of electric motors under the considered efficiency levels. The results are expressed in terms of life cycle cost difference between a particular standards case and a base case.

The base case represents a situation where we have no new or amended standards. The life cycle cost includes two components, the total installed cost and the sum of annual operating costs discounted to a particular base year.

The analysis models the uncertainty and variability of the inputs using a Monte Carlo approach which

characterizes inputs as probability distributions. And we implement this analysis under Excel, combined with Crystal Ball which allows using inputs in the form of probability distributions.

And here we have the overall flow chart for the life-cycle cost and payback period analysis calculations. So, the top part of the chart represents the development of the total installed cost, and the bottom part represents the calculation for the operating cost. Both the total installed cost and the lifetime operating cost go into the life-cycle cost. And we calculate the payback period as the total installed cost divided by the first year of operating expenses.

And the total installed cost includes the motor price and the installation cost, and it also includes the shipping cost, which is derived from the weight of the motor.

The operating expenses include the electricity costs that we derived from energy

consumption data, also includes repair costs and maintenance costs.

So, in gray here we have represented all the inputs to the calculation, in green we have the intermediate results, and in yellow the final results. And in the next slides I'll go through the inputs that we haven't yet covered in the engineering analysis, the markups analysis, and the energy use characterization. And I'll start with the electricity price.

Electricity prices are used to convert the energy use data into electricity costs. We considered regional electricity prices by sector, and we used current and projected information on energy prices from the Energy Information Administration, and more specifically from the Annual Energy Outlook. And we also collected data on reactive power prices. And on the next slide I have represented the average electricity prices that were used in the analysis, by

region and sector. And also an example of the electricity price trends that were used in the LCC calculations.

Another important input to the life cycle cost are the discount rates. DOE uses the discount rates to determine the present value of lifetime operating expenses. It derives those discount rates from information on the cost of capital for companies in the commercial/industrial sector that use motors.

Next I'll go over the installation, maintenance, and repair costs which are also inputs to the life cycle cost calculation.

DOE evaluated how installation, maintenance and repair costs change with increased efficiency. We looked at data from RS Means, Vaughens, other manufacturer literature, also inputs from stakeholders and experts. For installation costs, DOE assumed no changes in installation costs with

increased efficiency. And that was based on the fact that we stay within the same motor frame designations.

For repair costs we developed a model of repair costs based on Vaughens data. This model basically estimated repair costs based on the motor horsepower, enclosure, pole configuration and efficiency level. And for maintenance costs so far we didn't find any information supporting any changes in maintenance costs with increased efficiencies, so we assumed these also remain constant across efficiency levels.

Another thing that's not mentioned here are the shipping costs. Again, these were calculated directly based on the weight data from the engineering analysis.

MR. BROOKMAN: Yes, Tom. Turn on your microphone, please. Tom.

MR. BISHOP: Tom Bishop. The question I have is where it says develop a repair cost model. Is that repair -- what's

involved in that repair? Does that include a -- is it a rewind and an overhaul, or is it þ-

MS. IYAMA: It's a rewind. The basic bearing replacements were considered as part of the maintenance cost.

MR. BISHOP: Okay.

MS. IYAMA: Next --

MR. BROOKMAN: Yes, Rob, please.

MR. BOTELER: I just have a small point. On the installation cost, depending upon the level of efficiency, if we were to go to, say, level 3 and we looked at what we have in our proposal of moving from a special purpose or definite purpose which has no regulation today, we may find that the end user has motors that are running at significantly higher speeds because we have the premium efficient motor, the 12-12. In that case, we don't really know, but the installation may require changes, it may be move from a Design B to a Design A. It may require some electrical changes to the system.

It more likely would require some changes to throttling valves or veins to accommodate for the higher speed in order to maintain the performance of whatever operation that they're doing.

And it's something that I think we have to be aware of. I don't know how we quantify it because it varies dramatically based on what the system is set up for today. But I think the reality is that it could occur that the end user would have to make some pretty significant changes to his system to accommodate a higher speed motor.

MR. BROOKMAN: So, I want to be specific. You referred to the proposal and that is the petition from the Motor Coalition.

MR. BOTELER: Yes.

MR. BROOKMAN: Thank you. Okay.

MS. IYAMA: Next, another item that we took into account in the life-cycle cost analysis is that not all repairs are performed following industry-recommended practice, so in

some cases repair might affect the efficiency of the motor.

So, DOE assumed that one-third of repairs were performed following industry-recommended practice, and in that case we didn't see any changes in the motor efficiency before and after the repair.

We also assumed that two-thirds of repairs do not follow industry-recommended practices, and in that case we would see efficiency drops between 0.5 and 1 percent depending on the motor size.

In terms of average repair frequency, we assumed motors would be repaired on average after 32,000 hours of operation, that roughly corresponds to 5, 16, and 15 years of operation depending on the sector. And for fire pump electric motors we assumed there is no repair due to the lower operating hours.

And here we have a slide that specifies the requests for comments. So, any

comments on how to determine the motor repair cost. Also seeking comments on additional sources to estimate the frequency of motor repair. Also we seek comment on data on maintenance costs and installation costs.

MR. BROOKMAN: Go ahead, Tom, please.

MR. BISHOP: The question I have is where you have that one-third/two-third, what was the source for that breakdown?

MS. IYAMA: We used a study by the Bonneville Power Administration, it's called Industrial Motor Repair in the United States. It's -- I think it was published in the '90s, in the late '90s, but that's the most recent -- it was basically a survey of 60 repair shops, and that's the data we could find to try to estimate that breakdown.

MR. BISHOP: Is that citation in the TSD?

MS. IYAMA: Yes, it's part of the TSD references in Chapter 8.

MR. BROOKMAN: Please say your name.

MR. FLOLO: George Flolo with Flolo Corporation representing EASA. I have a couple of questions that I'd like to go back to your Vaughens's pricing. Can you give me some sort of a period of time that you obtained that pricing from Vaughens. You pronounce it differently, but --

MS. IYAMA: Oh, yes. We used the publication from 2010, I think.

MR. FLOLO: Okay, because your pricing that you've shown on that chart is significantly lower than what the current Vaughens pricing is. So, that's one.

MS. IYAMA: Okay.

MR. FLOLO: Number two, question on the one-third and two-thirds, also. Is that units of repair, or is that service centers or what is that number? And then an additional question is, because you're using the word repair rather than rewind, okay, do you have

any kind of statistics that talk about how many rewinds really occur versus how many what we would call repairs or reconditions that occur? And after you've answered that I'll explain maybe why I asked that.

MR. BROOKMAN: Is a repair the same as a recondition?

MR. FLOLO: A repair would -- we would have used the term repair as the same as recondition. If it's a rewind, we would always use the word rewind.

MR. BROOKMAN: Okay.

MS. IYAMA: So, here by repair we meant rewind. And then the 32,000 hours of operation for the rewind frequency was an estimate we established through mostly inputs from Austin Bonnett.

MR. FLOLO: Well, I wasn't as much referring to that as --

MS. IYAMA: Okay.

MR. FLOLO: -- much as I was referring to how many units actually get

rewound. And let me better explain why I'm asking. It's because if you would take our company along with many other EASAs especially in the '90s we all employed two, three, four winders. Right now I have a part-time winder. I know of other firms that have gone from four winders down to one winder. And, therefore, the amount of windings that are taking place or rewinds is such -- it's a much smaller number, and that's attributable to the electronics in across the line starters doing a much better job of protecting the windings as well as variable frequency drives. So, I just want to point that out to the group that, you know, the amount of motors that are honestly getting rewound is getting to be a much, much smaller number than what you would have had in some of your databases, especially since one of them takes you all the way back to the 1990s.

MS. IYAMA: So, again for the frequency of the rewind here in the LCC we're

looking at one motor, so that's the perspective we're taking. So, I don't have information on the number of motors that are being rewound each year.

MR. FLOLO: Right, but that would be a significant issue in your energy consumption, especially since you're considering degrading efficiency during a rewind process. And if you don't know that number how do you justify its damage to the environment?

MR. BROOKMAN: Charlie Stephens.

MR. STEPHENS: Just to follow-up as a question. Are you suggesting that the 32,000-hour number is no longer as valid as it once was, perhaps?

MR. FLOLO: That's exactly right. I think it's much higher than that between repairs. And that's number one. Because, let me give you an example. My business went from 20 percent rewinds out of 1,000 motors a year, and it's less than 6 percent currently, so

that's a significant drop. And that's all due to -- so, most of the problems that we get in are bearing issues, it's environmental issues. It is not winding issues.

MS. IYAMA: Right. So, again any information or additional sources of information that you could recommend to help us assess or estimate the frequency of motor repair would be really helpful to try to readjust maybe that 32,000-hour number.

MR. FLOLO: Yes, I don't -- that's hard for either EASA or anybody to exactly come up with. However, the source, if you start looking at -- if you guys went out to some of the large users, whether it be the Fortune 500 or Fortune 1,000 that do asset management to a high degree you would be able to obtain that kind of information.

MR. BROOKMAN: I was not certain we got the lexicon squared up here. You said that repair means rewind from the perspective of DOE.

MR. FLOLO: Right.

MR. BROOKMAN: You used some other words in there. Differentiate this for us.

MR. FLOLO: Okay. First of all, when a motor comes in for repair, there's two things that can happen; it gets reconditioned which is --

MR. BROOKMAN: Yes.

MR. FLOLO: -- new bearings, clean it up, do any mechanical work. If the winding has failed, then we call it a rewind.

MR. BROOKMAN: And that's A plus B.

MR. FLOLO: A plus B would be a -- a rewind is also a recondition.

MR. BROOKMAN: Gotcha.

MR. FLOLO: Yes. I'm sorry, that's a good point.

MR. BROOKMAN: Yes, okay. Thank you. I'm not -- okay, thank you. Good.

MS. IYAMA: Thank you.

MR. BROOKMAN: Now we can move on.

MS. IYAMA: Okay, so we went

through the discount rates, the electricity prices, the repair costs, maintenance costs, installation costs, so next I'll go through the lifetime.

DOE assumed -- DOE developed mechanical lifetime in hours for each horsepower range considered. And this was done for all equipment classes grouped together. And then in the life cycle cost calculation we derived lifetimes in years using the annual operating hour estimates. So, these are the results for the estimated average lifetimes in years for Equipment Class Group 1. So, again, these are derived from the mechanical lifetimes I just presented combined with the different annual operating hour estimates in the industrial sector here, and commercial sector, and agricultural sector.

Another item that DOE included for motor lifetime is that for motors below 75-horsepower which are most often embedded in larger pieces of equipment we assume that the

motor is retired when it reached this lifetime or when the equipment of which it's part of reaches its lifetime, so whatever happens first. So, if we have a motor embedded in a pump and if the pump breaks down, then the motor is assumed to also retire.

And on lifetime here again we have a comment box, and DOE is interested in any comments or additional sources of data on motor lifetime that could be used to validate our estimate of motor mechanical lifetime. Are there any inputs on the method to estimate motor lifetimes?

MR. BROOKMAN: Neal?

MR. ELLIOTT: Neal Elliott. Not so much a comment but a question. Motors below 75 horse are assumed to retire. What happens to motors above 75 horsepower?

MS. IYAMA: So, for the larger horsepower motor, we assumed they were not used as a component of a larger piece of equipment, so they would not retire -- they

would follow these assumptions of mechanical lifetime. It's just that for the smaller motor, since there's a possibility that they could be embedded in an equipment that could fail before those mechanical lifetimes are reached, then we account for those potential shorter lifetimes.

MR. BROOKMAN: For the larger motors it would be more direct replacement?

MS. IYAMA: They would just --

MR. BROOKMAN: Along this --

MS. IYAMA: -- be retired after these amounts of mechanical lifetimes.

MR. BROOKMAN: Yes. Frank.

MR. LADONNE: Frank Ladonne, Underwriters Labs. I really have nothing to base this on, and I guess I would rely on our colleagues from EASA but it seems to me that 75 is a pretty big number. It seems to me that you're probably more talking about a 40 or 50-horsepower motor because even with a 50 there's significant capital costs, and most

users would prefer to have the motor rebuilt or rewound.

MR. BROOKMAN: Let me note for the record that we have several heads in the room nodding up and down in assent. I thought I saw John, or was it Rob, or Dan? Norm, please go ahead. George.

(Off the record comments.)

MR. FLOLO: I would like to point out that, for example, BP has a standard that at 60-horsepower, they don't even consider having the motor repaired. It's a throw-away item. I will say that, unless the motor is pretty doggoned special, when you start getting around 40-horsepower, it's pretty hard for me with my labor costs to be competitive against new. I would not -- that value of 75, I'm sure there are various users and various EASA repair service centers that certainly still could be a replacement item and not a considered repair.

MR. BROOKMAN: Okay. Dan.

MR. DELANEY: Dan Delaney, Regal-Beloit. Can you go back to the prior issues? I got confused because the numbering is different than our side. If you go back to the prior questions, the last one, Issue 20, on our's it's Issue 22. I wanted to make a comment here -- a question as well as maybe a comment.

You talk about technology options that could drive motor mechanical configuration. I go back to the commercial world and your OEM configuration where this could drive maybe possible higher repair rewind for very specific OEM applications where length and some other things drive more efficient motors to that additional cost, especially at the lower end which would probably end more in the commercial end. Was that the point of this comment/question on this, or was it in regards to another area?

MS. IYAMA: So, we're mostly interested in knowing whether an increase in

efficiency of a motor may also result in higher installation costs. So, in the engineering right now, we try to keep the dimensions of the motor and the frame designation constant, but if there is any information we should consider to help us quantify -- if there is an increase in installation costs, then we would welcome such information.

MR. DELANEY: I'll make a point on a definite and special purpose product that is not regulated today, motor starters and you had essentially most of the motor starters and/or switchgear that may be available for some of that product, really the breaker systems for that could have an issue if it is at the threshold at the definite -- at the standard designs what they are today. I could certainly see as having to -- I don't know if I'd say mechanical configuration but certainly electrical performance type of upgrades necessary to accommodate higher efficiency on

a definite -- special purpose that came from no regulation of efficiency all the way up to let's say Table 12-12. So, that's a pretty large jump in efficiency.

MR. BROOKMAN: I see George is still standing back there, so go ahead, George.

MR. FLOLO: All right. One last point, and I just want to reemphasize the mechanical considerations. Even when we are replacing motors for our end users, it's amazing to me even with the different manufacturers that we represent the difference in the C dimension on these motors, so that we are cognizant even in today's standards of that C dimension when we're replacing a motor. I struggle with you being able to increase to the next level and maintain that C dimension. And what you're going to force the user to do is exactly what you're talking about. He won't be able to obtain a motor that fits in his machine anymore, and now that motor will

become a special motor.

MR. BROOKMAN: John, and then to Charlie.

MR. MALINOWSKI: Yes, John Malinowski, Baldor. And I'm going to speak a little bit on behalf of the ABB side of our company in this answer.

MR. BROOKMAN: Excuse me. What's the ABB side?

MR. MALINOWSKI: ABB is our parent company.

MR. BROOKMAN: Thank you, that's fine.

MR. MALINOWSKI: And they also make electric motors of the IEC type that are sold in North America worldwide.

When we look at -- to George's point, when we've looked at some of these motors at the higher efficiency levels, we've added active material stack length and added slot fill which adds end turns, so that would mean that we're going to have to come up with

a longer frame.

That machine isn't going to fit where the old machine perhaps was in some user applications, but by your own numbers you said 50 percent of the business goes to OEMs, so this could mean that the OEMs have to redesign their machinery to fit these motors. Dan talked about that a little bit on special purpose and definite purpose motors, but whether it's a small one-horse motor or a large 500-horse motor, if it's bigger, it's probably not going to fit.

MR. BROOKMAN: Okay.

MR. MALINOWSKI: And in the case of IEC motors, they're more closely tied to size and space than we are. They don't have the service factor, and a little bit more design. Roger will probably jump in here and get me down the right path, but it's tougher for an IEC motor to raise the efficiency without jumping frame sizes. And what the IEC world would do is go to a larger diameter rather

than go longer. So, now you're going to have a machine, maybe a packing machine for the food industry that came in with IEC motors on it that we're going to replace with a new motor, and it's bigger in diameter, and it's not going to fit.

MR. BROOKMAN: Gotcha. Charlie.

MR. STEPHENS: Yes, I had a question. Charlie Stephens. Is the data that you're able to access for motor lifetime and motor repair frequency, have you got enough sources to see any trends in that that you could actually pick out?

MS. IYAMA: I don't know, but what kind of trends exactly?

MR. STEPHENS: Well, there's been some comment here that suggests that, because of the applications, repair cycles are getting longer potentially. And I guess that would cause me to reiterate Neal's point, that the study that we really need to get some more data is probably more important than ever.

MR. BROOKMAN: Thank you. This has been very productive. Rob, keep going.

MR. BOTELER: I'm on -- what page am I on here? Page 92 with the chart on motor life expectancy. Right there. You know, I don't think I could cite any studies necessarily that we've seen, but as manufacturers, we sell polyphase motors into the agricultural world, and agriculture doesn't do a real good job of maintenance.

The motors that both John and I sell, the vast majority of them operate underwater in irrigation systems seasonally. Yes, they sit in a field for seven months and then they turn them on.

MR. ELLIOTT: And we should note that he is not referring to submersible motors here.

MR. BOTELER: No, they're not submersibles; they're irrigation drives. And I think we would also tell you that industrial applications, industrial customers are more

inclined to take better care in service and maintenance, and agriculture and commercial are less likely. So, when I look at your --

MS. IYAMA: So, do you think the agricultural numbers are too high, or the industrial numbers are --

MR. BOTELER: Yes, I think the agricultural are too high, and I think the industrial are too low. And I'm probably okay with the commercial.

MS. IYAMA: Okay.

MR. BROOKMAN: Yes.

MR. BOTELER: Okay, John says 29 years is too high, but 29 years in a 200 to 500 on industrial, I've been in industrial plants where I found motors that are 40 and 50 years old.

MS. IYAMA: And, again, those are average values, so you know, LCC --

MR. BOTELER: Well, that's a good question. Yes.

MS. IYAMA: -- calculation we

actually account for a distribution around these numbers.

MR. BOTELER: Yes.

MS. IYAMA: So, you'll see motors that actually operate much longer lifetimes or much lower lifetimes.

MR. BOTELER: Right, right.

MR. BROOKMAN: Neal, follow on.

MR. ELLIOTT: I mean, I -- and Linda was up there nodding, so -- but my sense is that a 200 to 500-horsepower motor, you know, you're talking about hundreds of thousands of dollars of capital cost. And that's the bread and butter for a lot of the repair shops because those things, you never want to let them die because you've already invested. The point is that a lot of this stuff, at least the guys I've worked with in the industrial sector, a lot of these are IEEE 841 motors so that they're not just a standard motor, so they're a huge amount of capital cost.

And I guess the last time I looked 841s were running about twice what a standard motor, but something on that order, so we're talking about a lot of investing, a lot of capital investment in these things, and so there's a lot of motivation to keep them running.

MR. BROOKMAN: Okay. So, any data, any actual data that you have, noting that this table reflects averages, that would be especially helpful. Alex next, and then I'm coming back to you, Dan.

MR. BOESENBERG: Alex Boesenberg, NEMA. Speaking on behalf of myself and my own personal experiences, I'll have to back up what Rob said about the agricultural side of things just from my personal growing up in the country. And then I have a friend who is a farmer right now about 30 miles from here.

I've never seen anybody in my experience do any preventative maintenance on a motor. They turn it on and expect it to

work. When it doesn't, they beat it with a crow bar until it does, and they use it, and then they turn it off and they go, boy, I've got to look into that. And they don't do it again until the fall when they need it again. And then they beat on it until it works, you know. I've grabbed a motor because a starter failed, and you grab the belt after pulling the guard out of the way so you can start spinning it and say okay, turn it on.

MR. BROOKMAN: Gotcha.

MR. BOESENBERG: Yes.

MR. BROOKMAN: Dan.

MR. BASSO: Dale Basso.

MR. BROOKMAN: Dale, thank you. Dale.

MR. BASSO: Just a comment. I think where everybody is going with this obviously is the agricultural years are long, and I'm sure the way you came up with it was the mechanical lifetime times then the hours of operation --

MS. IYAMA: Right, so it might not necessarily account for the --

MR. BASSO: And that math led you down a path, and unfortunately we do build different kinds of motors. We build industrial motors, we build commercial motors, we build farm-duty motors, so when it really comes down to it, you're working with the big picture numbers. And I think you just fell into a trap that didn't account for a farm-duty motor that nobody takes care of and last three years. And yes, it still runs those hours that you calculated but the mechanical lifetime is much shorter for those products that don't get maintenanced. So it tends to skew your whole assumption here, and that's -- it's a hard number to come up with I realize, but I think what you'll find in talking to the farmers of the world is that it's just -- you're talking very few years with a motor in a farm before they just throw it away and replace it. And most of it is much smaller. You know, there's

not that many of the big motors out in the farms.

MR. BROOKMAN: Rob.

MR. BOTELER: Yes, just picking up on that, just kind of to Neal's comment. The industrial motors, that market has moved almost totally to cast iron, and a lot of that to the cast iron 841 motor where the agriculture is still a lighter duty steel frame motor, so the mechanical construction is not nearly as robust as the industrial.

MR. BROOKMAN: Interesting. Okay, thank you. Andrew deLaski, please.

MR. deLASKI: So, you would expect longer lifetimes out of these --

(Off microphone comment.)

MR. deLASKI: Right. And do you think these numbers are representative of that, or you said they're a little low is --

(Off microphone comment.)

MR. deLASKI: Okay.

MS. IYAMA: Thank you.

MR. BROOKMAN: Okay.

MR. deLASKI: And I wanted to -- on that, so now you -- on Slide 91 you say various literature sources. So, are -- what were the key sources for this, can you say? Do you remember?

MS. IYAMA: So, we actually started by lifetimes in years in the industrial sector. And this was based on information we got through our motor expert. And then we used that combined with our annual operating hour assumptions to get to estimates of mechanical lifetimes. And this became sort of the reference for the lifetime of the motors. And then we derived the lifetimes in years in the other sectors, in the commercial sector and agricultural sector based on these mechanical lifetimes.

So, again we chose that approach because there is some data on lifetime in the literature. We have some in -- I don't remember all the references but the problem

with the data we found in the literature is that it wasn't clear if it was considering the repair cycles -- it wasn't clear on the definition of the lifetime, so we sort of had to start from scratch to be sure that we're talking about what we want to talk about, which is lifetime from when the motor is sold to when it's completely retired from the market.

MR. BROOKMAN: Neal.

MR. ELLIOTT: I mean, I think this is part of the issue. And I'm sitting here looking and it's not jiving with what I've sort of looked at. The assumption -- and, again, this goes back to what George and Linda understand. And there's repair and there is þ- - there's repair which they -- which I mean basically you go in, you clean the motor, you redo the conductors, you replace the bearings, seals, things like that. That's what I mean when repair, and that's routine, and that happens I would say every three to five years

in an industrial application, maybe five to seven years. George?

Anyway, so you've got that. I would assume that that motor is going to go through quite a number of reconditioning cycles before it ultimately gets retired.

MR. BROOKMAN: George, follow-on. George.

MR. FLOLO: Yes, that is quite true. Matter of fact, there's obviously -- and some service centers do it, but also a lot of users do their own, and that is predictive and preventive maintenance. They have -- matter of fact, in some of the steel mills they have crews of guys they call oilers and greasers, and that's all they do all day long. So, the point behind it is, yes, if there's a proper predictive, preventive maintenance program, we won't even see that motor, to be honest. And what you're really starting to deal with is the mechanical bearing life aspect which is -- can be calculated. And I think all bearing

manufacturers do have that kind of data that's readily available.

MR. BROOKMAN: Okay.

MR. ELLIOTT: Just as a follow-up, you may want to check with the ABMA, American Bearing Manufacturers Association. I think they do have some data, as George indicated, available on bearing life. So, they may be actually a very good source of information.

MS. IYAMA: Right. So, another --

MR. BROOKMAN: That last comment was from Neal.

MS. IYAMA: I'm sorry.

MR. BROOKMAN: Keep going, Sanaee.

MS. IYAMA: I have a question then. Do you think bearing replacement would change across efficiency levels?

MR. BROOKMAN: Who can comment on that? Now, I see a bunch of manufacturers shaking their heads no.

MS. IYAMA: Because that's --

MR. BROOKMAN: George, go ahead.

MR. FLOLO: Unless when we buy bearings we're told those are the same specifications that the motor manufacturers purchase also. So, I see no reason for that to have any degradation on efficiency. And then when you couple with that, when a motor comes in for reconditioning we're using micrometers, and we're measuring the bearing journals as well as the bearing housing. And when that motor leaves it's to the exact OEM specifications of the motor manufacturer. So, there should be absolutely zero degradation as a function of efficiency.

MS. IYAMA: Right. And I guess the question was also more in terms of, does the cost of a bearing replacement for a baseline efficiency motor, will that significantly change now if we have a higher efficiency motor?

MR. FLOLO: No, there is no relationship there at all. Efficiency, the fact that it's a high -- a premium efficient

motor versus an EPACT, a bearing, is a bearing.

MS. IYAMA: Okay.

MR. FLOLO: Makes no difference.

MR. BROOKMAN: And the substitution is exact.

MR. FLOLO: Exact.

MR. BROOKMAN: Okay, glad we clarified that. Yes? John.

MR. MALINOWSKI: I just wanted to get back to the comment about going to look at L10 bearing life. You have to remember that those bearing calculations are lab calculations. Under an ideal loading in a clean environment, that's what you're going to get. You take the motor and you put it in an industrial, commercial, or certainly agricultural application and it's going to get contamination in it. It's probably not going to have the right lubrication cycle, could be under-lubed, over-lubed, wrong grease, so L10 is like a wish list of life. It's not real

world.

MR. BROOKMAN: Okay. We are now -- I think we've concluded 23. We need to keep moving, but maybe we should take a short break now. It's been about an hour and a half. Just 10 minutes, go quickly to the restrooms, and make it back here, which means at 10 minutes after 3:00 we'll resume. We're doing pretty well, I think. Let's keep pressing on. See you back here in 10 minutes.

(Whereupon, the above-entitled matter went off the record at 3:01 p.m. and resumed at 3:13 p.m.)

MR. BROOKMAN: We are going to press on here, folks, and back to Sanaee.

MS. IYAMA: So, I'm going to continue on the life cycle cost analysis. So next inputs to the life cycle cost analysis are the base case efficiency distributions. So, as mentioned earlier, the results in the LCC are expressed in terms of life cycle cost difference between a standards case and a base

case.

And the base case efficiency distribution basically accounts for the fact that not all motors considered in the analysis are covered by the current standards, so some may have efficiency below the NEMA 12-11 tables. Not all consumers purchase motors meeting the current minimum standards, meaning some may purchase motors with higher efficiencies above premium. So, the life cycle cost analysis recognizes that consumers already purchasing motors at efficiencies greater than or equal to a perspective standard level will not be impacted by the standard. So, again the life cycle cost results are expressed in terms of life cycle cost difference between a standards case and a base case. So, if in the base case you're already purchasing a motor that has an efficiency equal or greater than the projected standard, then you will not be impacted by that standard.

In order to establish those base case efficiency distributions we used data from catalog manufacturers and we looked at 2011 catalogs. We used this data to establish the distribution -- the efficiency distribution by equipment class groups and horsepower range. And here we have an example of the efficiency distribution for Equipment Class Group 1, and for motors between 1 and 5-horsepower motors -- between 1 and 5-horsepower.

And here DOE seeks comments on the estimated base case efficiency distributions for all equipment class groups. And any additional sources of data that could be used to derive those efficiency distributions.

MR. BROOKMAN: Dan.

MR. DELANEY: If you want to go back. Yes, in this table on thing that's somewhat misleading about the definite purpose, special purpose is you're going to find that not all that type of product is

going to be a catalog type of product. A good percentage of that, 5 to 5-1/2 percent is going to say low, as well as you're not going to see efficiency levels always provided for definite and special purpose type product because that is not the driving factor for that type of product anyway. It is for torque or for mechanical options, or other. So, that's why I think that 5-1/2 percent is low by a good percentage.

MR. BROOKMAN: Michael, do you want to --

MR. DELANEY: Yes, so what would be an appropriate number?

MR. BROOKMAN: Dan, do you want to take a stab, or you want to let Rob try? Rob.

MR. BOTELER: If you go back to our petition, our estimate is again at about 49 million connected horsepower is sold every year, and in today's world we cover about 18 million connected horsepower. And that would be covered by either 12-12 or 12-11. So, that

leaves 31 million connected horsepower that's not covered, so that's going to be special purpose, definite purpose, offshore, gear motors, partial motors. And I think that number which is about 60 percent of the total number of connected horsepower would fall either into Category Zero or Category 1. There's certainly some of that that is EPACT, but I think there's a very large percent of it that is not -- it falls into a Category Zero.

MR. BROOKMAN: Okay, thank you. Yes, John.

MR. MALINOWSKI: Maybe another way of looking at this, what you're doing is looking at what models are in a catalog. And that really doesn't tell you how many of those units are sold. And I think that's really what you're trying to drive to, because we've got a lot of things in the catalog you might sell 25 of, and we've got stuff in the catalog that's tens of thousands.

So, if we can go back to some

numbers, and we could probably get accurate numbers out of NEMA. If we look at where we were prior to enactment of EISA, premium motors at the 12-11 -- I'm sorry, 12-12 level was probably in the low 20s, 20 percent of our three-phase, 1 to 500-horse production was at 12-12. Since then it's probably pushing 70 percent.

MR. BROOKMAN: Wow.

MR. MALINOWSKI: Well, that's --

MR. BOTELER: Because if you look at our expanded scope of 5.2 million units, that's not true.

MR. MALINOWSKI: That's true, but we're also -- well, we're looking at things that are mandated at 12-11 today, EPACT level that customers are choosing to go above. So, maybe the 70 percent is a little high, but it's substantially larger than the 20s.

MR. BROOKMAN: These are very helpful comments for the Department.

MR. MALINOWSKI: And we can get an

exact -- we'll put a more exact number in our written comments.

MR. BROOKMAN: Yes.

MS. IYAMA: Thank you.

MR. MALINOWSKI: That's my estimate, that's not agreed on by my colleagues.

MR. BROOKMAN: Rob, do you want to add on here, or did you say it?

MR. BOTELER: This is Rob. We'll put it into our written comments. We'll discuss this.

MR. BROOKMAN: Okay, thank you. Thanks a lot. Alex, I'm looking at you. Yes. Okay, okay. Keep going.

MS. IYAMA: Okay. So, using all the inputs that I presented in the previous slide in the base case efficiency distributions that were derived from the catalog data, these are the results of the life cycle cost calculation. And here as an example, I'm providing the results for Representative Unit

1, and then on the next slide for Representative Unit 3.

So we have the average LCC, and here we see that the average LCC savings is positive up to C Cell 3. And then we get into negative savings. And we have similar results for the 75-horsepower motor.

So, next I will cover the National Impact Analysis.

MR. BROOKMAN: Please, Rob.

(Off microphone comment.)

MR. BROOKMAN: Yes, there's no -- that's okay.

MR. BOTELER: Can you go back to that slide? Yes, right there. When you're doing the life cycle analysis, back to Roger's comment on the formula on page 73, if that formula changes would that then change all of your calculations on the life cycle? You used the formula for the motor losses.

MS. IYAMA: We used the top formula.

MR. BOTELER: The top formula.

MS. IYAMA: Yes.

MR. BOTELER: Okay, you did not use the lower formula.

MS. IYAMA: No.

MR. BOTELER: Okay. So, Roger --

MR. DAUGHERTY: Roger Daugherty. Yes, I'm assuming that when they were over here with the LCC analysis that they calculated the actual energy use of each CSL level, and then you take the difference in that energy use.

MS. IYAMA: Right.

MR. DAUGHERTY: So, it's not dependent upon the other relationship.

MR. BOTELER: Okay, that's all I'm -- that's my question, thank you.

MR. BROOKMAN: Thank you. Dale.

MR. BASSO: This is Dale Basso. Just one last thought on this, as far as the -- with these calculations it all starts with the price assumption. Correct? So, in that

price assumption I think you stated that these don't include any manufacturer impact that might change other factors that could increase the price. So, as we get into the discussion later on manufacturers that doesn't actually happen until the NOPR. Right? Where you would look at manufacturer impact, and you would then go back and adjust these numbers based on any impact finding?

MS. IYAMA: Not in the LCC or in the engineering analysis. It's a separate analysis, but it would be taken into account in any decisions.

MR. DAUGHERTY: Okay, so you're basing decisions on this number, but you're not putting all of the cost into the number? Is that what I'm understanding?

MS. IYAMA: So, the life cycle cost is one of the many analyses that DOE performs, so it's considered in the decision making process, but the NIA is also another component, and the manufacturer impact

analysis is also another component.

MR. BROOKMAN: John.

MR. MALINOWSKI: Yes, John Malinowski, Baldor. We've already talked about the cost assumptions you've made on these motors that they're wrong. If we look at the incremental cost differences between a level zero motor and an EPACT without getting in trouble with antitrust, in industry we've talked about ranges of 15 to 20 percent. Then we saw another 15 to 20 percent in ranges between an EPACT and a premium.

One might expect some additional material to get to the level 3, and then more material, copper to get to level 4 and 5. We've not taken into effect any hand winding additional cost. You've only added for the copper, you've not added for any of the additional infrastructure, new laminations needed for 3, 4, or 5, new manufacturing equipment.

It's going to skew these things

and make the payback longer than you have, particularly by the time you get to 4 and 5. The hours that you had in that chart for industry and particularly commercial and agricultural maybe too many hours in some cases, not enough hours on maybe some of the small industrial.

The whole life cycle cost of the study is -- needs a fair amount of review. I mean, everything you've got here is probably understated. It's probably a lot longer on these higher, particularly 4 and 5, maybe even a little bit to level 3.

MR. BROOKMAN: Rob.

MR. BOTELER: Yes, John mentioned a lot of the things that happened in the factory as far as material and equipment, but one of the things that you need to realize and why the manufacturers are -- the Coalition is supporting expanded scope and staying at level 2 is because we have already developed the electrical packages, the wound-stator

assemblies and we've proven those that meet the level 2 efficiency.

When we expand the scope of product what we can do is, we have the ability in our engineering systems to do batch changes where we change that particular component in hundreds of builds and material relatively easily. We don't have to go back and do a lot of retesting and reconfiguring to make sure that end turns, I was accused yesterday of saying interns, end turns fit within the frame. If we move even just one level, it then requires us to go back and re-engineer the complete electrical package, and then determine will it fit in the mechanical package so it adds a tremendous amount of engineering for what we pointed out, what Neal pointed out is pretty much a rounding error in efficiency gain. And I think we need to recognize that.

So, in your numbers here you show a very significant increase when we go to

level 4, and our concern is that there's a similar increase when you go to level 3. And that there's some significant engineering costs that need to be considered.

MR. BROOKMAN: Okay, thank you. Please say your name. Is that on? No, it's not on.

MR. LIN: Paul Lin with Regal-Beloit. Just a process question. Are you going to go back and adjust your LCC based on the feedback that you received today?

MS. IYAMA: In the NOPR we have an entire -- the first phase of the NOPR stage. And in the next steps, I'll detail this, consists of revising all the analysis we presented here today with either the comments we've received or newer data that we can come across.

MR. LIN: Okay. I guess when you do that why wouldn't you include some of the capital costs that we've talked about, because the concern I have, taking my Regal hat off,

and taking the NEMA hat off is the DOE reports are utilized by a lot of people as reference material. And if they're not accurately reflecting the costs, it could lead others down the wrong road. And that's why I want to make sure that in the report that all the cost analysis is done with everything in mind because the people who read the report may not have the benefit of sitting in this room and understanding what's in and what's out of that particular life cycle cost analysis.

MR. BROOKMAN: Okay.

MR. LIN: That's only my comment.

MR. BROOKMAN: Thank you.

MS. IYAMA: Okay. So, I'll move on to the National Impact Analysis. The National Impact Analysis actually includes both the shipments analysis and the National Impact Analysis. And I'll start with the shipments analysis.

The purpose of this section is to estimate shipments projections both in the

base case and in the standards case. So, we used the current information on shipments and projected those values assuming that shipments are driven by economic growth and fixed investment in equipment including motors.

We based that assumption on a high degree of correlation found between historical shipments of motors and fixed investment in selected equipment. So, here on this graph we have the historical shipments represented by an index in blue, and in red the product fixed investment in selected equipment including motors.

This correlation was derived from a linear regression represented by this equation here, and it allowed calculating estimates of shipments, and the predicted shipments based on private fixed investment projections which were based on data found in the Annual Energy Outlook. So, we projected the fixed investment and then we used that equation to project our shipments.

Here I'm just repeating the data we saw in the market assessment, the different shipments for the year 2011, so we took this data and applied the equation in order to project those shipments over the analysis period from 2015 to 2044.

The shipments analysis also includes a breakdown of motor shipments across equipment class groups and equipment classes. So, in order to establish those breakdowns we used data from different market research reports, inputs from interested parties as well as U.S. Census data. We also used plant assessment data as proxy. And all of these breakdowns are detailed in Chapter 9 of the TSD.

And here DOE seeks any comments on any additional sources of data on motor shipments that could be used to validate our shipments model and projections.

MR. BROOKMAN: Any additional that haven't been mentioned already data sources?

MS. IYAMA: Okay. So, as mentioned earlier the purpose of the shipments analysis is to establish both a base case shipment projection and a standards case shipment projection. The shipment projections are expressed both in terms of quantities, but also in terms of efficiencies.

For the base case efficiency distributions, DOE assumed there would be no changes in motor shipments efficiency during the analysis period, so the base case efficiency remains constant and equal to the 2011 one that I mentioned during the LCC analysis.

So, here we request comments on this decision to use constant efficiencies throughout the analysis period in the base case scenario. And any data that could help us characterize trends in efficiency would be helpful. And again, that would be in a base case situation.

MR. BROOKMAN: Rob.

MR. BOTELER: Yes. I don't know if this one would fit here, but there certainly is a trend as the fellow, Robert, from Danfoss mentioned. There is a trend of more and more product that's in the categories that we're talking about moving to variable frequency drives. So, I mean, the efficiency levels are going to change as they become more integral to the system and benefit from the variable frequency drives. But what that would be -- you know, we all talk about the percentage of product we sell, and try and estimate the number of units that are going to be used with drives, but we don't have any real solid NEMA data on that subject, but it could have an effect over the period.

MR. BROOKMAN: Okay, thank you.

MS. IYAMA: So, we did this for the base case situation. We do the same for the standards case. For the standards case, the standards case shipments projections,DOE is aware that increased electric motor prices

could affect the repair versus replace decisions and, therefore, impact shipments.

However, in the absence of data to quantify and estimate the impact of increased motor prices on shipments, we assumed that the standards case shipment projection would be equal to the base case shipments.

Now, in terms of efficiency we derived standards case efficiency distributions from the base case efficiency distribution and applied a roll-up scenario.

And here's that a comment box. We would be interested if you have any information that could help us quantify the impact of increased motor prices on motor shipments in the different standards case.

MR. BROOKMAN: No additional comments.

MS. IYAMA: So, next we have the actual National Impact Analysis. The purpose of this analysis is to estimate national energy savings for motor ships -- for motors

shipped from 2015 to 2044, as well as to estimate the national economic impact on electric motor users.

So, DOE calculates national energy savings by multiplying unit lifetime energy savings by the projected shipments, and accumulating this projected value over the 30 years. And I'll go in the details of that calculation.

DOE also calculates the net present value for the national economic impact by accumulating the difference each year between the energy bill savings and increased equipment expenditures for all motors shipped over that 30-year period.

So, here we have the overall flow chart for the calculation of the national energy savings. It starts off by the shipments analysis and we use the base case projections, and standards case shipments projections. So, in the base case we calculate the base case lifetime energy consumption for motors sold

each year over the 30-year period analysis, we convert that base case lifetime energy consumption by -- into primary energy. And we accumulate those values over 30 years to get to the base case cumulative energy use. So, we do this in the base case situation, we do this in the different standards case situations, and the differences gives us the national energy savings.

Next we have a similar diagram describing the calculation for the net present value. Again we start off with the shipments projections. We use the shipment projection to calculate the lifetime energy cost of motors shipped each year over the analysis period, so we do this in the base case and in the standards case projections.

We also use the shipments to calculate the lifetime repair, maintenance, and installation costs, total installation costs for motors shipped each year over that 30-year period.

We calculate the cumulative energy cost savings by taking the difference between the standards case and base case energy cost, and we calculate the cumulative non-energy cost increase by taking the difference between the standards case and the base case repair, maintenance, and total install costs.

We use a discount rate to convert those time series of monetary values into a present value, and the difference between the non-energy cost increase and the energy cost savings gives us the net present value.

Now, this slide summarizes all of the inputs that were used into the National Impact Analysis, so we've gone through all of them in the previous sections, except maybe for the discount rate. In the NIA we use 7 percent and 3 percent discount rates. This is OMB guidance.

Another thing I will go into details in the next couple of slides are the total installed cost. The total installed

costs are the sum of the motor price and shipping cost. We didn't include the installation costs because they're assumed to stay constant across efficiency levels, and here we're looking at results in terms of difference between standards case and base case.

So, the motor price is derived from the manufacturer selling price by applying markups, and the shipping cost is derived from the motor weight by applying an average shipping cost.

The engineering analysis provided manufacturer selling price and weight data for the represented -- for the representative units only. So, in order to calculate total installed costs for all equipment classes we had to extrapolate on this information for the representatives units, and develop estimates of total installed costs for all equipment classes. And that's what I'm going to detail in the next slide.

We used similar methodologies to extrapolate --

MR. BROOKMAN: Sanaee?

MR. BOESENBERG: Yes.

MR. BROOKMAN: Meg?

MS. WALTNER: Meg Waltner from NRDC. A quick question on this slide. Are you not using learning rates in this analysis, or is that not part of this?

MS. IYAMA: So, we looked at learning rates and it turns out that for motors, the biggest drivers are the material costs. And it was -- we didn't find enough data to be confident to project and use a learning rate so we assumed a constant price in the default scenario. But as a sensitivity analysis we included different learning rates.

So, we used a similar methodology to calculate and scale manufacturer selling price and weight data from the representative units to all equipment classes. So, here I'll just talk about the manufacturer's selling

price but we did the same for the weight.

We developed scaling relationship at each CSL. So, for example, the Equipment Class 1 the engineering gave us manufacturer selling prices for four-pole enclosed 5-horsepower motor, 30-horsepower motor, and 75-horsepower motor.

We used a power law regression to estimate manufacturer's selling prices across all horsepower ranges in that motor configuration, four-pole enclosed. So, we did that at CSL 1, 2 -- CSL 0, 1, 2, 3, 4, 5.

Then we used an index, we established an index to describe how the manufacturer selling price varied by pole and enclosure, and we did that through a statistical analysis of manufacturer catalog data of over 10,000 motor configurations.

So, using that database and statistical analysis we derived an index for each horsepower rating that allowed to scale the manufacturer selling price that we had for

the four-pole enclosed motor across all of the other pole and enclosure configurations. So, this allowed DOE to estimate total installed cost for all of the equipment classes.

And here we have a comment box on this approach for extrapolating the manufacturer selling price and weight data from the representative units to all of the equipment classes that were considered in the analysis.

MR. BROOKMAN: So, comments related to these comment boxes, methodology for scaling, manufacturer selling price data, and comments on scaled values for motor weights.

MS. IYAMA: Okay, so next -- so, we've been through the methodology, the inputs used, and on the next slide I'll present the results of the National Impact Analysis starting with the national energy savings. Here we have the summary of the national energy savings in quads for the three equipment class groups, and for each of those

CSL levels considered in the analysis.

We see that due to the lower shipments the savings are lower for a NEMA Design C motor in comparison to the NEMA Design A and B motors. And another thing that I want to add is that in 2011 DOE published a policy -- a Notice of Policy stating its intention to add full fuel cycle as a metric in the NIA, so we actually included that in the preliminary analysis, so you'll find in the TSD chapters results that are very similar to this, but expressed in terms of full fuel cycles. It's basically a multiplier that's applied to those primary energy savings in order to convert those savings into a full fuel cycle metric.

MR. BROOKMAN: Rob.

MR. BOTELER: Rob Boteler. I guess the number that just jumps out at me on this chart, I just really struggle with, and I know we've talked about this all day. If we go back to our original earlier charts, the 5-

horsepower example, the level of efficiency at level 3 versus level 2 is 7/10ths of a percent. The 30-horsepower is 5/10ths of a percent, and the 75 is 4/10ths of a percent. When I get to this chart my savings with small, really small increment between level 2 and level 3, I'm saving almost double the savings in quads? I go from 4.4 to 7.5 on savings on each unit of 7/10ths down to 4/10ths. That just amazes me.

MS. IYAMA: I think it might be due to -- I mean, there is a lot of things that go into these calculations, but one of the main drivers I'd say is also the efficiency distributions. That would explain the jump you see.

MR. BROOKMAN: Matt, please, find a microphone.

MR. NARDOTTI: Matt Nardotti from Navigant. So, in other words you're saying there's just a lot of motors that are already at CSL 2. Right? There's a lot of motors being

shipped already at the NEMA premium level, so going up to CSL 3 you're now pulling all of those motors up, as well, so the shipment is being affected as a driver in the energy savings.

MR. BROOKMAN: Rob.

MR. BOTELER: Yes, and in our proposal we're taking a huge number, we're taking 31 million connected horsepower and moving it to level 2. And what you're doing is you're doing the same thing moving it to level 3. And then you're also moving the 18 million connected horsepower that we already have and moving that to level 3.

MS. IYAMA: Right.

MR. BOTELER: Right. So, it just seems like a huge difference to me.

MR. BROOKMAN: Okay, thank you. Yes, Charlie.

MR. STEPHENS: I'll add on to what Rob was saying. I think there is a big difference between the estimates that are

behind this proposal in terms of how much is already at what level when it comes to the categories that are not covered right now, which I think are substantially underestimated, potentially, in the current analysis. So, I think some of these things may get ironed out when some of the numbers get reconciled a little better, I think.

MR. BROOKMAN: Okay, thank you. Yes?

MS. IYAMA: Okay, so I'll continue on the results of the National Impact Analysis, and I'll go through the net present value results. So, here I have a slide for Equipment Class Group 1. So, we have the NPV for the two discount rates considered, and here we present the results for all horsepower ranges, as well as for individual horsepower ranges. And we see that past CSL 3 we get into the negative net present value results.

For Equipment Class Group 2 similar results, and here we have the negative

values highlighted also in red starting at CSL 2. And then Equipment Class Group 3 all of the net present value results were negative across CSLs. That's for fire pump electric motors.

MR. BROOKMAN: So, there's no comment box here, but should anybody wish to comment on these results please do so. Alex Boesenberg.

MR. BOESENBERG: Alex Boesenberg, NEMA. Please refresh my memory on what the difference between a positive and negative net present value result is on these slides.

MS. IYAMA: Okay. So, the net present value is the difference between your cost savings and the incremental cost of purchasing a new motor. It also includes the incremental cost of repairing a higher efficiency motor. So, the net present value here is calculated as the difference between the non-energy cost increase and the energy cost savings.

So, for example, you buy a more

efficient motor, you're saving on your energy bills but it's a higher investment to begin with. So the NPV is sort of the tradeoff between the two. And it's negative when your initial investment and operating lifetime costs are greater than the payback.

MR. BROOKMAN: Is it lifetime or at the 30-year?

MS. IYAMA: Here it's -- so, it's the lifetime of motors shipped over 30 years.

MR. BROOKMAN: Yes. Thank you. Yes. Charlie.

MR. STEPHENS: Charlie Stephens. I'll add that basically it's saying that your costs don't outweigh your initial investment, but when you use the 7-percent discount rate you're discounting all of your future savings substantially. The near-term dollars matter much more than the year 15 to 30 dollars, so the numbers look a lot worse when you use the 7-percent discount rate, than they do if you use a 3-percent.

MR. BROOKMAN: Okay. So, then moving on.

MS. IYAMA: Right, so moving on I'll let Hisham continue with the preliminary manufacturer impact analysis.

MR. BROOKMAN: So, let me just take a quick poll in the room. How many of you have participated in the manufacturer impact interviews in the past? Just a few of you, okay. I think they're familiar with much of this material.

MR. ARAJI: All right. So, I'm going to talk a little bit about the preliminary manufacturer impact analysis right now, and where it comes into the preliminary analysis stage. You could see here it's a little bit separate during this part of the rulemaking process.

So, the purpose of the preliminary MIA is to qualitatively and quantitatively assess the impacts of amended efficiency standards on manufacturers of electric motors.

A key output of this analysis is the change in industry net present value resulting from amended standards.

DOE normally performs the MIA in three phases. In the first phase, DOE creates an industry profile that builds on the market and technology assessment. This market profile is then updated through interviews with manufacturers, and this typically takes place during the preliminary analysis which is the phase of the rulemaking that we're in right now.

During this time, DOE identifies the key issues concerning manufacturers. In Phase 2, it spans the NOPR and final analysis, I'm sorry, final rule stages. DOE builds a strawman industry cash flow model called the "Government Regulatory Impact Model," or GRIM, to forecast free cash flows in the industry. It does this for the base case and the standards case scenario, and calculates an industry net present value which is the main

output of the GRIM.

Also in Phase 2, DOE develops an interview guide that it will use to guide its subsequent discussions with manufacturers during the MIA interviews, which will take place in Phase 3.

Now, during these interviews DOE speaks with a variety of different manufacturers to receive feedback on the items listed in the interview guide. We'll be scheduling these interviews soon after this meeting, and we'll start conducting the interviews some time after the close of the comment period.

I would also like to mention at this point that these interviews are nearly always conducted with a non-disclosure agreement in place so that no proprietary information could be shared publicly, but rather aggregated across all the responses.

Following the interviews, DOE will refine the GRIM and evaluate other qualitative

issues such as manufacturer capacity, direct employment impacts, and impacts on competition.

So, taking a step back to what was done for the preliminary analysis stage, during our preliminary MIA, DOE identified three key issues affecting manufacturers. Now, a lot of these issues were brought up throughout the meeting today, but we'll repeat them again here because they are important when we are considering impacts to manufacturers.

First, manufacturers indicated that higher efficiency standards may drive consumers to rewind older, less efficient motors rather than buying new more efficient motors that are more expensive. Now, as Sanaee mentioned, DOE does acknowledge that this increase in electric motor prices could affect the "repair versus replace" decision for consumers, so DOE is welcoming and seeking comments on data sources that it could use to

better estimate the impacts of this scenario on shipments.

For the second key issue, DOE identified several concerns related to switching to more efficient copper rotor motors. Manufacturers indicated that because copper has a higher melting point than aluminum it's more dangerous to fabricate. Also, the higher molten temperature of copper increases energy costs of manufacturers and leads to quicker degradation of tooling that's used in fabrication.

Now, manufacturers also indicated that electric motors with copper rotors have reduced starting performance compared to those with aluminum rotors. This means higher inrush current and lower locked rotor torque. So, to compensate for these reduced performance characteristics manufacturers often have to adjust other design characteristics, such as slot design to maintain NEMA performance requirements just so basically they stay

within the bounds that NEMA prescribes for Design A, Design B, and Design C. Now, these adjustments to these other characteristics could potentially negate the improvements in efficiency gained from switching to copper rotors.

Additionally, manufacturers indicated that not only is copper a more expensive raw material compared to aluminum, but there are significant costs associated with retooling their entire production lines for this design option. And a lot of people have brought that up today.

Third key issue, domestic manufacturers have indicated that they may be disproportionately affected by new efficiency standards if DOE does not broadly enforce efficiency requirements for all covered motors, including those imported from foreign countries.

MR. BROOKMAN: Roger.

MR. DAUGHERTY: Roger Daugherty.

While under the copper rotor motors and throughout most of today you've tended to concentrate on only the parts of the MG1 standard that differentiate between design types, Design A, B, and C. There are many parts of the standard that apply commonly to all the design types, and those performance criteria must also be met in the design.

One of the things that's difficult in the cast copper rotor is that in order to achieve sufficient starting torque with a more conductive material, and you allude to this in various discussions, is having to shape the rotor slot so that you minimize the amount of material that's active at the time of starting, so you get a very high power density loss in that material.

The MG1 standard has requirements for at least being able to start twice from a cold start condition, or once from a hot start condition with a certain amount of inertia and a certain assumed load torque. But one of the

more difficult criteria is, is there's also a specified stall time, and that's related to the fact that many of these motors are protected by a standard class type of protective device that will keep that motor on line in a stalled condition if it's unable to start for a significant period of time. The MG1 standard is 20 seconds, so it's also important, and I didn't see that discussed in the PTSD.

So, it's really necessary that when you're making a decision of any technology, so I'm not just restricting this to cast copper rotors, that the entire standard be considered and not just the parts that differentiate between design types. But, again, I just reiterate you won't need to do this evaluation if you screen out cast copper rotors in the first place. Thank you.

MR. BROOKMAN: Thank you. John, and then to Steve.

MR. MALINOWSKI: John Malinowski,

Baldor. On the last bullet point you have on enforcement, I just wanted to clarify that one of our concerns is when we talk about domestic manufacturers being affected by energy standards, that's beyond just motor manufacturers, it's OEM manufacturers. And they're affected by non-complaint motors coming into the country embedded in machinery. We're having that problem today. It would be worse in the future if domestic manufacturers try complying with whatever new laws. The delta between compliant and non-compliant motor would be even greater than today, and that would be job losses for machinery builders here that would be going overseas.

MR. BROOKMAN: Thank you. Steve, yes.

MR. RUFFING: Steve Ruffing. We had -- the conversation had again kind of gone back to design changes that are necessary to compensate for negative performance aspects related to, let's say, copper rotors. And we

got -- Roger then mentioned there was emphasis placed on complying with the NEMA specifications related to the design letter specifically B. And there's one thing I wanted to point out when I saw in Chapter 5 where the various CSL levels, the 4 and 5 were reported to be in compliance with NEMA Design B. So, one of the things I noticed was some of the margins that the calculated values met them by were -- I guess I'd characterize those as razor thin. For example, the 30-horsepower four-pole Design B CSL 4 level design is required to meet a level of 200 percent breakdown torque to comply with NEMA Design B. And the level that was reported per the design calculation program was 202 percent. Now, keep in mind that 200 percent is a minimum value that has to be met, not a nominal value. So, what that's essentially saying is that -- is this what I presume to be a nominal level of 202 percent for the program accounts for not only inaccuracies that might exist in the

program, but then also manufacturing variation from one motor to the next. And all that is taken up with a 2 percent margin.

Similarly, on one of the 75-horsepower designs, I'll just look up the numbers, the NEMA Design B limit for locked rotor amps is 542.5, and the CSL 5 design has locked rotor amps of 541.3. So, again, inaccuracies in the program plus manufacturing variations would only account for one amp of tolerance there, which seems a little overly optimistic in my opinion.

MR. BROOKMAN: Okay, thank you. Ned.

MR. BRUSH: Ned Brush. I wanted to comment on the copper rotor question. Roger raises a number of very important points about using copper rotor as opposed to the aluminum die-cast rotor. I would point out that Siemens did this, but it was a basic redesign for North America for 60-hertz motors, and it was a slot design that at approximately 3-

horsepower you change to the double bar design, and so on to be able to control that inrush, as well as achieve very respectable torques, and so on.

It is possible, but it does require redesign. You're just in a different place in the torque curve because you've changed the conductivity of the conductor in the rotor.

I would also point out that, for instance, our friends in China on copper die-casting last year did about 80,000 rotors, a little more, up from 20,000 the year before. And a number of their motor companies, for example, are shipping around the world, many of them to IEC standards, some to IEEE. We also people working in South Korea, and in Taiwan, as well as in Germany, and in France and so on, so there are quite a number of people that are producing motors, some to 60-hertz for use in North America like Siemens, and others for IEC.

I might add that the Chinese, one operation does only the die cast copper using our manufacturing cell technology and so on, and that 80,000 that they produced last year for commercial is up from 20,000 the year before. And they only started the year before that, so there is growth. And many of their customers are reported to be sort of looking at this as a product line at a time in terms of making the transition. And I believe some of them, anyway, have said that it was at a time when their stamping dies were wearing out, so they had to buy new -- they had to build new stamping dies, and make that investment, anyway. So, they changed the design, but they did make major design changes to be able to stay within inrush, to be able to achieve torques and so on, but it is possible.

MR. BROOKMAN: Okay, thank you. Yes, John.

MR. MALINOWSKI: Yes, I'd like to

just comment that the motors that I think Ned is talking about are, as he said, IEC motors, and the general purpose IEC motor would be a Design N motor. And in a Design N, that includes both what we would call NEMA Design B, as well as NEMA Design A. So, we're talking Design B motors, and the copper motors that we've identified coming into the U.S. are Design As.

MR. BROOKMAN: Thank you. Alex.

MR. BOESENBERG: Alex Boesenberg, NEMA. I won't -- I'll try not to repeat anything that's already been said, but I want to build on the topic of the feasibility of increasing hand winding, and also the comments on jobs or cost of retooling, and then how that factors into enforcement.

Using the Battery Charger and External Power Supplies rulemaking as an example of what can happen to a particular sector, and what they do about it. As has already been noted, cast copper rotors, hand

winding, and some of the other distinct have to make a lot of changes solutions will force businesses to make decisions about where to add that capacity. And several manufacturers have already commented they probably can't do it in the U.S. because of the cost.

So, what happens then is it goes overseas, and politicians get interested because of the U.S. job loss. And I know the GRIM model has some factors in for that, but beyond the strict economic factor, the feasibility of carrying out a rule starts to come into question. And that's why I mentioned the Battery Chargers rule.

I know of a bill in progress to exempt an entire product class because it happens to be a single U.S. manufacturer that has to close down. And there was another manufacturer, I was sitting right here, and he was sitting over there during that rule and he said, "We're the only U.S. manufacturer this size, 12-volt charger. If you make me meet

your NOPR, I'm going to shut down my plant and just contract it out to China, and all those U.S. jobs gone."

And while that -- I know there's tradeoffs on jobs, et cetera, in the GRIM, it's inescapable of the political climate, as well, and I hope the DOE will bear that in mind.

MR. BROOKMAN: Thank you. Do we have other final comments as suggested here, key issues related to preliminary manufacturer impact analysis, because we need to keep going. We're going to keep going.

MR. ARAJI: Thank you. And now I'll hand it over to Sanaee who will talk about the NOPR analysis.

MS. IYAMA: All right. So, we finished the preliminary analysis. So, in the NOPR we'll start off by revising the preliminary analysis, and then we'll cover some new analyses that are not included in the preliminary analysis. And these are the

customer subgroup analysis, the employment impact analysis, the utility impact analysis, the emissions analysis, the monetization of emission reduction benefits, and the regulatory impact analysis.

So, first on the revision of the preliminary analysis, what we'll do is that we'll consider the comments and the inputs from the stakeholders while making our revisions. We'll also consider any new information that we'll come across, and we'll do this for the main analysis of the preliminary stage.

Next, I'll go over the customer subgroup analysis. The purpose of this analysis is to analyze the economic impacts of standards on specific groups of consumers that may be significantly more impacted by a standard compared to the general user population. So, we'll use the same LCC spreadsheet analysis, but we'll modify the inputs to the specific subgroup of users that

we want to look at. And here, DOE welcomes any comment on any specific subgroup that would be appropriate to look at in this rule.

Next, I'll go through the employment impact analysis. The purpose of this analysis is to assess the overall impact of standards on national employment. And here we'll be looking at indirect employment impact. Hisham just covered the direct employment impact. And the way to do this is by using the impact of sector energy technologies, the ImSET model that will help us evaluate the indirect employment impacts. And here, DOE welcomes feedback on its proposed approach to analyze indirect employment impact with ImSET.

Next, the utility impact analysis. So, the purpose of this section is to estimate the overall impacts of standards on domestic electricity suppliers, and that would be done through the use of a modified version of the national energy modeling system model which is

called NEMS-BT. The NEMS model is the model used by the EIA to produce the projections you see in the Annual Energy Outlooks. And here again we have a comment box on the proposed approach to use NEMS-BT to conduct the utility impact analysis.

Next, I'll go through the emissions analysis. So, in that section DOE will report emission impacts resulting from amended or new energy conservation standards. It will also include emissions on the based full fuel cycle emissions.

We'll report carbon dioxide emission reduction, mercury and nitrogen oxide for the 22 states where these emissions are not capped. For the states where these emissions are capped, and for sulfur dioxide where we have an existing legislation capping sulfur dioxide, DOE assumes that the impacts of standards are minimal. And here we also seek inputs on the intent to use NEMS-BT to conduct the emissions analysis.

So, after quantifying the emission reduction another step is to use monetary measures or conversion factors to translate those emission reductions into monetized values. So, here DOE intends to use the most current social cost of carbon values given by OMB to convert the CO2 emission reduction into dollar values. And on this slide we have the rates that we will be using. And we also do this for NOx emission reductions. And here another comment box on this approach.

And then I'll move on to the last section of the NOPR, which is the regulatory impact analysis. So, in this section the purpose is to investigate the national impacts of non-regulatory alternatives compared to the impacts of mandatory energy conservation standards.

Some of the non-regulatory alternatives that may be considered in this section include consumer rebates, tax credits, manufacturer tax credits, voluntary efficiency

levels, early replacement programs, and bulk government procurement programs. So, the way we would evaluate the impact of those non-regulatory options would be to use a similar National Impact Analysis model, and estimate the same outputs, the national energy saving, the net present value associated to those non-regulatory alternatives. And here we have the last comment box inviting comments on any non-regulatory alternatives that should be analyzed in that section.

And with that, we're done.

MR. BROOKMAN: We've taken it to the slide on how to submit comments, and I'm going to -- and before I turn it over to Jim Raba for closing remarks, another opportunity for anybody that wishes to do so to comment, issues that haven't been covered fully, other things you wish to say here as we move towards closure. Roger.

MR. DAUGHERTY: Roger Daugherty. This has to deal with how to submit the

comments. I notice that in the presentation today the issues were numbered differently than they are in the handout. I also note that in the Executive Summary, there was a list of issues to which DOE wished comments.

In Chapter 2, we identified at least 49 places where DOE requested comments or information. Obviously, some of those were not presented today. There are various places throughout the PTSD that warrant comment, and DOE's discussion in different chapters is different on the same subject. So, it's a matter of trying to organize comments in a very short period of time, and exactly how to organize those. If DOE has a recommendation how to go about this, it would be very appreciated.

MR. KOHSE: I think just following the numbers in the presentation would probably be the most simple approach.

MR. DAUGHERTY: The handout?

MR. KOHSE: Yes, the handout.

MR. BROOKMAN: So, that was not on the record. The recommendation for the record is to follow the -- to make your comments based on the numbers that are in the handout, today's handout.

MR. DAUGHERTY: Roger Daugherty. But then to go beyond those, because like I said, in Chapter 2 there's 49 different places, and you only hit 34 or 35 here. And in the Executive Summary, so we attach those as another set of separate and isolated comments?

MR. BROOKMAN: Michael?

MR. KIDO: I was just going to suggest maybe to the extent that you've got specific comments related to those chapters that are in the TSD, maybe you could have some sort of appendix or something that says comments related to Chapter 2, comments related to Chapter 3, et cetera. That way it's easy for you guys to organize and it's easy for us to sort of figure out what the comments relate to. Would that be workable?

MR. BROOKMAN: Alex.

MR. BOESENBERG: Alex Boesenberg, NEMA. Right now my draft is keyed to page number and clause, like page 14, 4.3.2. Will that work for you guys? Good, because then I don't have to renumber 53 pages.

MR. BROOKMAN: Yes, thank you for that. Okay, Andrew.

MR. DELASKI: So just to kind of close where we began, which is to reiterate the support of the Motor Coalition for the joint petition, which we think represents a way to move forward expeditiously towards issuing a final rule with really broad support of the stakeholders, many of the stakeholders represented here today.

And I think a lot of the concerns that you've heard today, I would say virtually all the concerns you've heard today have to do with levels beyond the levels that are recommended by the Motor Coalition. So, I think a lot of the -- whether it be copper

rotors, or whatever the issue might be that's raising the need for additional and deeper analysis, that occurs by going beyond the levels recommended by the Coalition. So, part of the reason for the recommendation is it gives us a path forward that can be accomplished within a really -- within the statutory limits, which is by December 17th. Otherwise, we can't meet. And I know the Department meets obligations otherwise to show that the criteria under the statute have been met, but I think what you're hearing from this community today is that the Coalition's recommendations meet those criteria, and we spelled that out in the petition.

So, I would just close by urging the Department to move forward to adopt the recommendations in the joint petition filed last Wednesday. They deliver enormous savings, LCC benefits that are solidly within the life cycle of the products, and address the concerns that have been raised today about

some of the other aspects of the analysis.

MR. BROOKMAN: Thank you, Andrew. Yes, Alex.

MR. BOESENBERG: Alex Boesenberg, NEMA. I'll second Mr. deLaski's statement.

MR. BROOKMAN: Speaking on behalf of NEMA?

MR. BOESENBERG: Speaking on behalf of NEMA, yes, not my farmer friends or anybody.

(Laughter.)

MR. BOESENBERG: To build on my last statement about enforcement, and jobs, and everything, perhaps it's obvious but I want to restate that a rule that everyone can agree on is one that logically most, if not all, stakeholders will immediately then begin to adhere to, versus in the case of the example I mentioned, the product class that is seeking total exemption from the rule that is about to be published for battery chargers means that all energy savings are lost in that

product class because the exemption they're pursuing is to say that DOE may not dedicate funds to enforce this product class, which means the whole thing is gone.

They didn't like CSL 3, but if they would have agreed to a painful CSL 2 then you would have saved the jump from 1 to 2. And that's certainly the sort of things we want to avoid in this rule.

MR. BROOKMAN: Final comments? No additional comments. So, for my part I thank you. This was a very constructive day. We covered a heck of a lot of ground very efficiently. And, particularly, for all of you that gave a lot of really good and very useful information, very, very helpful to the Department. Thank you. Congratulations on that. And back to Jim Raba for closing remarks.

MR. RABA: We conclude today's public meeting with expressed appreciation from the Department of Energy for your

participation. As Doug pointed out, it's been a very informative meeting, very productive. And thank you, thank you all. And, also, to thank our presenters Will Kohse, Hisham Araji from Navigant Consulting, Sanaee Iyama from Lawrence Berkeley National Laboratory, our technical crew back stage who made possible the webinar portion, Jack Graul. And, of course, our excellent facilitator, Doug Brookman. Thank you, and safe travels.

We look forward to your written comments. The written comments and safe travels.

(Whereupon, the above-entitled matter went off the record at 4:21 p.m.)

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C E R T I F I C A T E

This is to certify that the foregoing transcript

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Date: 08-21-12

Place: Washington, DC

was duly recorded and accurately transcribed under my direction; further, that said transcript is a true and accurate record of the proceedings.

Neal R Gross

Court Reporter