UNITED STATES DEPARTMENT OF ENERGY

+ + + + +

ENERGY EFFICIENCY AND RENEWABLE ENERGY

BUILDING TECHNOLOGY PROGRAM

+ + + + +

NOTICE OF PROPOSED RULEMAKING PUBLIC MEETING FOR ALTERNATIVE EFFICIENCY DETERMINATION METHODS

+ + + + +

TUESDAY

JUNE 5, 2012

+ + + + +

The Public Meeting convened, in Room 8E-089, Department of Energy, Forrestal Building, 1000 Independence Avenue SW, Washington, D.C., at 9:00 a.m., Ashley Armstrong, Department of Energy, Building Technology Program, presiding.

PRESENT
ASHLEY ARMSTRONG, DOE, EERE, BTP, Facilitator
KARIM AMRANE, PhD, Air-Conditioning, Heating, and Refrigeration Institute
LAURA BARHYDT, DOE, Office of the General Counsel
ALEX BOESENBERG, National Electrical Manufacturers Association
DEBRA BRUNK, Navigant Consulting
DAVID CASE, DOE, Office of General Counsel
ADAM CHRISTENSEN, PhD, Appliance Standards Awareness Project
ROGER H. DAUGHERTY, PhD, Baldor Electric
PAUL L. DOPPEL, Mitsubishi Electric
MARK FLY, AAON, Inc.
MIKE GARST, Lennox International
HELMUTH GLATT, Nidec Motor Corporation
CHARLES HON, True Manufacturing Company
JILL HOOTMAN, Trane
JEFF KLEISS, Lochinvar, LLC
REBECCA LEGETT, Navigant Consulting
HARMON S. LEWIS, American Panel
DICK LORD, Carrier Corporation
KAREN B. MEYERS, Rheem Manufacturing Company
MASSOUD NESHAN, Southern Store Fixtures, Inc
DOUG RAWALD, DOE, Office of General Counsel
CARL ROBERTS, Zero Zone Inc.
HARVEY SACHS, PhD, American Council for an Energy-Efficient Economy
FRANK STANONIK, Air-Conditioning, Heating, and Refrigeration Institute
MIKE STRAUB, Heatcraft Refrigeration Products
COREY TUCKER, Navigant Consulting
JAMES VerSHAW, Ingersoll Rand
ROBERT WILKINS, Danfoss

C-O-N-T-E-N-T-S

Call to Order 5
Ashley Armstrong
Department of Energy
Introductions 6
Opening Remarks, Agenda Review 10
Ashley Armstrong
Department of Energy
Karim Amrane 11
AHRI

Harmon Lewis 12
American Panel
Massoud Neshan 13
Southern Store Fixtures

Mark Fly 14
AAON
Alex Boesenberg 15
NEMA

Mike Garst 16
Lennox International
Dick Lord 16
Carrier

Harvey Sachs 17
ACEEE
Carl Roberts 18
Zero Zone

Paul Doppel 18
Mitsubishi
Craig Messmer 19
Unico

C-O-N-T-E-N-T-S (CONTINUED)

Opening Remarks (Continued)
Roger Daugherty 20
Baldor Electric

Rulemaking Overview 23, 28, 51
and
Definitions and Scope of Coverage
Ashley Armstrong
Department of Energy

Questions and Comments 24, 29, 52

Substantiation Requirements 79, 101
Ashley Armstrong
Department of Energy

Questions and Comments 79, 103

Number of Testing Rounds 165
Ashley Armstrong
Department of Energy

Questions and Comments

DOE Validation 181, 183, 229
Ashley Armstrong 233, 236
Department of Energy

Questions and Comments 182, 184, 231
233, 236

P-R-O-C-E-E-D-I-N-G-S

9:01 a.m.

MS. ARMSTRONG: Good morning, everyone.

My name is Ashley Armstrong, and I would like to welcome you to our public meeting to discuss the proposed rule on alternative efficiency determination methods.

I would like to welcome everyone that came in person on such short notice, as well as all those attending by webinar on the phone.

We are going to try something new this time to open up the webinar line, so that they can communicate with the people in the room as well. So, for those of you on the line, if you want to talk, please just raise your hand. There is a way you can do it from the webinar and then wait to be called on, and we will unmute your line and you can speak freely to the rest of us in the room. So, you can participate in the meeting itself.

Before we start, we are going to go around the room and do introductions. Please say your full name as well as your company affiliation for the record. I ask that each time you speak you do that as well, and speak clearly into the microphone.

So, with that --

MS. BARHYDT: I am Laura Barhydt. I am with the U.S. Department of Energy, Office of General Counsel.

MS. ARMSTRONG: Ashley Armstrong, Department of Energy.

MR. GARST: Mike Garst, Lennox International.

MR. AMRANE: Karim Amrane, Air Conditioning, Heating, and Refrigeration Institute.

MR. SACHS: Harvey Sachs, American Council for an Energy Efficient Economy.

MR. VerSHAW: Jim VerShaw, Ingersoll Rand, Trane Residential.

MS. HOOTMAN: Jill Hootman, Trane,

Ingersoll Rand.

MR. LEWIS: Harmon Lewis, American Panel.

MR. WILKINS: Robert Wilkins, Danfoss.

MR. FLY: Mark Fly, AAON Incorporated.

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

MR. GLATT: Helmuth Glatt, Nidec Motor Corporation.

MR. ROBERTS: Carl Roberts, Zero Zone.

MR. HON: Charlie Hon, True Manufacturing.

MR. LORD: Dick Lord, Carrier.

MS. ARMSTRONG: And so, I also ask the people in the back if you can make your way to the sides, where there are microphones, and introduce yourself with your name as well and your company affiliation for the record, please.

MR. NESHAN: I am Massoud Neshan, Southern Store Fixtures.

MR. ROY: Aniruddh Roy, AHRI.

MR. STANONIK: Frank Stanonik, AHRI.

MR. STRAUB: Mike Straub, Heatcraft Refrigeration.

MR. CHRISTENSEN: Adam Christensen, Appliance Standards Awareness Project.

MR. DAUGHERTY: Roger Daugherty, Baldor Electric, member of the ABB Group.

MR. RANSOM: David Ransom, McDermott, Will and Emergy for Goodman.

MR. HOLT: John Holt, National Rural Electric Cooperative Association.

MS. REAMER: Laura Reamer with Regal-Beloit Corporation.

MR. NOE: Gary Noe with Regal-Beloit.

MS. LEGETT: Rebecca Legett, Navigant Consulting.

MR. HOYT: Bill Hoyt, National Electrical Manufacturers Association.

MS. BRUNK: Debra Brunk, Navigant Consulting.

MS. TUCKER: Corey Tucker, Navigant Consulting.

MR. CASE: David Case, DOE, Office of General Counsel.

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

MS. ARMSTRONG: All right. So, the purpose of this public meeting is to really gather feedback on the Department's proposal, understand where there may be issues, questions, or concerns. So, we really encourage participation.

With that, we have a brief presentation, but feel free to chime in whenever you would like.

As you can tell, I am the moderator for today as well as the presenter. So, I am going to present from here, just to

make life easier, a little bit.

So, if you need to hold sidebar conversations, please go outside. Bathrooms are to the left. Coffee shop, all the way at the bottom.

Just let us know when you want to speak. Some of the ground rules: if you are not speaking, I ask that you put your microphone off because, that way, it minimizes the feedback that we get from the microphones all around the room and the webinar.

Here is a brief agenda review before I open up. This is just what we plan to talk about today.

Okay. So, the purpose of today's meeting, as I said, is to really present the notice, some of the key items in the proposal as they relate to AEDMs, to provide a forum for public discussion, encourage you guys to submit all kinds of data as well as comments on the Notice of Proposed Rulemaking, to help better inform the Department's final rule, and

just to allow a forum for discussion.

So, at this time, I am going to go ahead and welcome and turn the floor over to opening remarks. Please say your name and your company affiliation for the record, and we will go around the room, as well as I will open up the webinar lines if anybody wants to make comments at the outset of the meeting.

Anybody? Sure, go ahead, Karim.

MR. AMRANE: My name is Karim Amrane with the AHRI. Of course, we would like to thank DOE for issuing this proposed rule. It is well overdue. It is very important for the manufacturers for air conditioning, heating, water heating equipment, refrigeration equipment as well.

I would like to raise an issue that has not been addressed in the NOPR and which has to do with the effective date by which manufacturers of commercial equipment will have to comply with the certification requirements to the Department of Energy.

As you all know, that date has been set as January 1st, 2013. Honestly, even if this is completed tomorrow, there is no way that the manufacturers can comply with this effective date. Many manufacturers don't have AEDMs. We don't know yet what the requirements of the AEDM would be. Of course, we have the NOPR in front of us, but still that rule has to be finalized. So, there is no way in four months or six months that manufacturers are going to be ready by January 1st, 2013.

So, AHRI would like to officially request that the effective date of compliance with certification reports to DOE be postponed by at least 18 months from the date this AEDM rulemaking is finalized.

Thank you.

MS. ARMSTRONG: Sure.

MR. LEWIS: Harmon Lewis with American Panel.

I would like to second that

motion.

MS. ARMSTRONG: Thank you.

Anybody else want to make opening remarks at this time before we go into the presentation? Sure.

MR. NESHAN: This is Massoud Neshan with Southern Store Fixtures.

And thank you for setting up this meeting.

We manufacture commercial refrigerated equipment. We have been waiting for over a year for a definition or clarification from DOE to tell us what is the definition of a basic model, since everything is based on a basic model, and we have still yet to hear a response from DOE. We are talking about methodology to put into place; whereas, we do not know what is the definition of basic model. And that is extremely critical for us for the purpose of testing or modeling these basic models.

MS. ARMSTRONG: Okay. Thank you.

Anybody else? Please feel free.

MR. FLY: Yes, Mark Fly with AAON.

Just following up on that, the basic model definition is very important, especially with my company, but I think to everybody in this room. For example, our complete model string has about 100 characters, and each one of those characters has 25 options underneath it. So, the combinations and permutations of all these options can create thousands or millions or trillions of different models, depending on how you wanted to define a basic model. So, we need some clear definition on what that is.

Many of these options will only minorly affect the energy. It may be a different kind of filter, which might affect some of the fan energy in a minor way. Or it might have an economizer or it might have a heat recovery device that isn't really covered in the testing standard, but will impose a static pressure drop on the fan and cause an

energy increase.

So, if we are going to define a basic model by any change in energy consumption, that is going to generate so many basic models that none of us can deal with it.

MS. ARMSTRONG: Sure.

MR. BOESENBERG: Alex Boesenberg, NEMA.

Like everybody else, I want to thank the Department for having this meeting today and for the draft. I am looking forward to see how the webinar audio goes. Thank you for trying that. We have had trouble in the past and appreciate the efforts that DOE has made, then, to repair that.

As to the short notice, we will thank you in advance for giving us at least 30 days next time, not just to afford time in schedules, but because of the expense of airfare and hotels. Some people could not be here today due to a 250 percent difference in the price of a ticket bought on short notice.

Thank you.

MR. GARST: And just to add to the basic model issue, there is also product class, and I think we need some clarification on what a product class is.

MS. ARMSTRONG: Anyone else before we move to the presentation itself? Sure.

MR. LORD: Yes, Dick Lord with Carrier.

One of the things that we have kind of hinted at, but really haven't addressed is there are products that really aren't designed to run at standard rating conditions. I will give you a good example. You can put an energy recovery wheel on a rooftop and actually save significant energy, but when you rate it at the standard rating point, it is actually going to show a little lower efficiency, which really aren't addressed by a lot of these procedures. So, we have got to figure out how to do those and how to handle them.

MS. ARMSTRONG: Go ahead.

MR. SACHS: Harvey Sachs, ACEEE.

The new concern I would express is how the information we are using for this will play with other programs that will yield much more information on performance for use by designers, modelers, and others, such as the recently-announced AHRI initiative for release of supplemental information across product classes.

And it would seem very worthwhile for us to all be thinking about how the AEDM and programs like this evolve together rather than leading to duplicative effort without giving any additional help to anyone who needs to use the information.

Thank you.

One additional note. Harvey Sachs. I am not saying AHRI is right.

Thanks.

Laughter.)

MS. ARMSTRONG: Does anybody else

wish to make opening remarks at this time? Sure.

MR. ROBERTS: Carl Roberts, Zero Zone.

We do appreciate this move. It is a big step in the right direction. I just wanted to mention or keep in mind that the 95 percent confidence interval one-tailed T-value wasn't taken into account at the time the standard energy levels were set. So, what this is doing is raising the bar.

Thank you.

MS. ARMSTRONG: Anyone else? Last call. Sure.

MR. DOPPEL: Paul Doppel with Mitsubishi.

I also want to support Karim's suggestion that we have 18 months before implementation effective date.

MS. ARMSTRONG: Thank you.

All right. Moving along, so what are AEDMs? They are basically computer

simulations, mathematical tools, modeling, engineering simulations that are used to predict the performance of non-tested basic models. Use of AEDMs allows manufacturers to rate and certify their performance of their equipment without actual testing, once the simulated energy use or efficiency results are derived, as well as we believe it may reduce testing burden because there is only a subset of the whole model offering that would have to be tested.

So, Craig Messmer also would like to say something at this point.

MR. MESSMER: Good morning, everybody. Sorry I couldn't be there. Thank you, Ashley.

This is Craig Messmer with Unico.

We are classified as an ICM, and we noticed that the ARM has seemingly been deleted from the regulations. We don't really have a problem with that. We are wondering why the ARMs for specific products, especially

ICMs has been removed. We thought the AEDMs were primarily for other products than commercial. So, anyway, that is more of a question, but very much of a concern.

Thank you.

MS. ARMSTRONG: Okay. Thank you.

We will get to answering, I think, some of those in a little bit. But, as they come up, if you have additional questions, Craig, just let us know.

So, just to set the stage with some background -- go ahead.

MR. DAUGHERTY: Roger Daugherty, Baldor Electric.

Back on your definition of AEDM, I also notice that inside the NOPR you stated that you referred to an AEDM since it could be used to simulate testing under DOE test conditions. Is that some other type of AEDM other than that which you have defined that can also be used? And what is the intent of that meaning? That is on page 32041 in The

Federal Register publication.

MS. ARMSTRONG: Okay. So, I am not quite sure exactly what you are referring to. I have 41 open here, and I am happy to take this conversation a bit offline.

But the definition generally in the back, in the actual regulatory text just is a general definition and describes any type of calculation or algorithm, engineering algorithm, that predicts the efficiency as measured by the descriptor in DOE's regulation. So, it doesn't specifically talk about, at least in the regulatory text, it doesn't specifically talk about test procedure conditions.

That being said, if you had an AEDM that would simulate use over a wide variety of conditions, I mean, it doesn't preclude that, if that is what you are asking.

MR. DAUGHERTY: Roger Daugherty.

I guess what I am trying to get at is I understand what my AEDM and its method of

calculating losses in electric motors, in small electric motors, to determine efficiency. But I was trying to figure out why DOE seems to be relating it to the way that motor would be tested; whereas, that doesn't take into account that I am using an IEEE 112 test method to determine losses. It is totally different. So, I was just trying to get clarification on what you mean by this, or if it is not intended to be stated the way it is in the NOPR.

MS. ARMSTRONG: This is Ashley from DOE.

And other manufacturers in the room may speak up as they wish. It is meant to predict the efficiency that you would also get from testing. That being said, if you implement an engineering equation or an algorithm, obviously, that may be different than the actual testing. However, it is meant to get results that are comparable to those that you would get under the actual DOE test

method.

Does that make sense? Does that help? Okay. Thank you.

Okay. So, just to set the stage with some background, currently, DOE's regulations permit the use of the AEDMs for commercial HVAC equipment, commercial water heating equipment, distribution transformers, as well as electric motors. In addition, as noted earlier in the presentation, manufacturers of central air conditioners and heat pumps are allowed to use ARMs to rate their equipment currently.

So, DOE issued a Request for Information a while back, a little over a year ago, about other types of equipment that may be similar that could benefit from the use of AEDM regulations as well as what procedural changes the Department could consider for their AEDM regulations, including tolerances.

We sought comment on a variety of issues. Some of those topics are, then,

addressed in this proposed rule.

All right. The proposal. So, just on its face, naming conventions, DOE is proposing to marry the terms "ARM" and "AEDM" and just use one single naming convention across the board for simulation methods. We are proposing to use the term AEDM. So, therefore, to Craig's point earlier, we are proposing to get rid of the term "ARM," although we are proposing to allow the use of simulation methods still for central air conditioners and heat pumps, just to clarify that. Okay?

MR. AMRANE: I guess I have a question. Are you now requiring the old ARM to be consistent with the requirements that we have in this proposed rule?

MS. ARMSTRONG: Yes.

MR. AMRANE: Okay. So, manufacturers that have ARMs today don't have to revalidate their ARMs based on this proposed rule?

MS. ARMSTRONG: Upon the compliance date of the new provisions, the ARMs in use to date would have to meet the provisions as they are written here.

MR. AMRANE: Okay. Then, we have a problem as well because those residential central ACs have to comply today with the DOE requirements. And today they are not using exactly what is proposed in this rule. So, are you going to provide any time for those manufacturers to have time to comply with the new one?

MS. ARMSTRONG: Sure. DOE would consider a compliance date. It would be very helpful if we could hear what a necessary timeframe might be and why.

MR. AMRANE: Well, the time necessary to revalidate, to develop a new AEDM.

(Laughter.)

MS. ARMSTRONG: This is Ashley.

So, I think we understand why. It

is a matter of what that magnitude should be, the number.

MS. MEYERS: Ashley, this is Karen with Rheem.

So, just so I understand, we have now expanded the scope of this rule to include all residential air conditioning and heat pump systems? Is that what we were saying here?

MS. ARMSTRONG: Correct.

MS. MEYERS: Wow.

MS. ARMSTRONG: Yes?

MR. LORD: Just to kind of reconfirm what I think you told Karim, basically, we have an ARM that is all qualified today. We are going to have to get all new units, retest all those units --

MS. ARMSTRONG: Go ahead, finish.

(Laughter.)

MR. LORD: That's enough. You are getting my drift.

MS. ARMSTRONG: Okay. So, the answer is possibly. So, it depends on what

your ARM is based on. If you have an ARM today that meets the criteria as written -- so, you have tested a unit from each product class. You have tested no less than five basic models, one of the lowest capacity, one of a capacity in the highest 25 percent, if you have basically done that and you have tested ones that are compliant with the current standards and current test procedures, then you are good to go, I mean assuming that these get adopted and the tolerances as well, assuming these get adopted as final as they are proposed.

But that being said, if not, and you need to make minor tweaks, then you are going to need to make minor tweaks. It might require more than minor tweaks.

And to Karim's point, if it does require major changes, we are interested in knowing what a reasonable compliance date should be for the Department to consider.

MR. LORD: So, maybe to just

restate it, say we had three units that were already tested that we could use.

MS. ARMSTRONG: Uh-huh.

MR. LORD: And we just show that data, maybe add two more units?

MS. ARMSTRONG: Yes. So, that is a great segue to this next slide.

DOE is proposing no preapproval. You don't even have to show that data. You just maintain the records. And, yes, if you had three, you would just test two more, assuming that that is the minimum set of criteria that need to be met. But, yes, you would be fine.

So, DOE is not proposing to add a preapproval process for AEDMs. This is currently, for those that have AEDMs, this is currently how the regulations go for AEDMs now. For ARMs, it is a change. We would not require any kind of notification to the Department. You would just, when you certify your products, you would have to state that

you used an AEDM to rate those untested combinations.

MR. STANONIK: Frank Stanonik with AHRI.

Ashley, residential AC manufacturers have used ARMs for 10, 15, 20 years. Is there anything procedurally that prohibits DOE from essentially grandfathering those methods and just saying that, without meeting the letter of whatever the AEDM criteria come out to be -- there is a long history of testing and compliance. Can't they just be grandfathered?

MS. BARHYDT: This is Laura Barhydt at DOE.

This isn't exactly in answer to your question, but I will say that we are concerned that some of the ARMs currently in use were granted, were approved a very long time ago. And we are concerned about the validity of the test data that they are based on.

And so, part of the idea here is to get everybody onto a level footing where the ratings are all being based on a similar methodology to make sure that everyone's ratings are in accordance with the current standards and test procedure.

MR. SACHS: Harvey Sachs, ACEEE.

I am not asking this judgmentally, but my inference from this slide No. 12 is that the AEDM is fundamentally a simulation of equipment performance, and the Department will treat this as a black box for which the manufacturer confirms or asserts compliance with test data. But the underlying algorithms will not be seen by the DOE, the public, competitors, or anyone else.

MS. ARMSTRONG: Yes, that is correct. That is the proposal as written.

MR. SACHS: Thank you, I think.

MS. ARMSTRONG: I mean, that being said, I will say that part of the proposal is that records be maintained and, upon request

from the Department, all of that information would be made available to the Department, if we had a reason to request such information.

MR. SACHS: Harvey Sachs again.

My concern, Ashley, is that this works fine with long-established, legitimate manufacturers, but I think that in some other industries we have seen this kind of thing used as a loophole generator to do, shall we say, a shady batch of code, and when finally challenged, just drop the certification of the non-complying models, climb into a hole, or go bankrupt.

So, my concern is whether this will actually lead to a level playing field among all the manufacturers without imposing even greater burdens to entry than we have now. I don't know the answer, but I think it is a question that does matter.

MR. GLATT: Helmuth Glatt, Nidec Motor Corporation.

We are kind of on the opposite

side of that. We love our AEDM, and we don't want to share the source code of it with anybody. So, treating it as a black box needs to be highly emphasized at this point.

So, by underlying records, that definition is basically correlation between test data and the AEDM output?

MS. ARMSTRONG: Yes, I would say we are going to get to part of that. But, yes, I mean, it is any test data used to substantiate your AEDM, any subsequent verification that you may do just on your own, anything that supports how you came about with your AEDM. All those records you would maintain. And then, if we ever got into a situation, I think, where we needed to discuss those records with you, we could talk about more details as to what exactly the Department wanted to see and stuff like that.

But I would maintain it all in terms of what you have rated with your AEDM, what you used to substantiate your AEDM, all

the testing underlying that, et cetera.

MR. VerSHAW: Jim VerShaw, Ingersoll Rand.

Two questions. The first one is, when looking at residential ARMs, today we have to have testing on the basic model with the highest sales volume combination. When you go to an AEDM under the definition, do we no longer have to do that testing? We just simulate everything?

MS. ARMSTRONG: So, simulate everything is not quite right. You do have to do some testing. There is a different subset of testing that has to be done. It is not necessarily the highest sales volume combination for each basic model.

MR. VerSHAW: You had to do so much testing to substantiate the AEDM. Once that is substantiated, then, are you eliminating the requirement to have the highest sales volume test combinations tested?

MS. ARMSTRONG: Yes.

MR. VerSHAW: Okay.

MS. ARMSTRONG: Are you advocating that we retain it?

MR. VerSHAW: No, I am just trying to get clarification. I haven't thought it all the way through yet.

The second question is, with this setup where you don't prequalify/preapprove simulation methods, and now I see you eliminate the need for a lot of testing ongoing, are you planning on setting up a much more robust or aggressive enforcement plan to do a lot of testing by DOE outside of maybe other industry groups? Or is that driving that? Or if you did preapproval, would that reduce the need to do that ongoing testing by DOE? And maybe I am looking at spending and cost and duplicate programs and everything. It raises some questions in that area.

MS. ARMSTRONG: I don't think there is any specific intention to increase testing or decrease testing in terms of

verification and enforcement one way or the other that is driving these proposals.

I think the majority of the comments that we got in response to the RFI kind of pushed for the balance between getting approval quicker for ARMs and AEDMs generally versus, you know, manufacturers assuming the responsibility to make sure their AEDMs and ARMs are in accordance with our regulations and maintaining that data and DOE getting it upon request.

I mean, as you can tell, we are expanding -- it is on the next slide -- but we are expanding the scope of ARMs and AEDMs quite a bit here. So, to say that we were going to, then, preapprove all of them would be quite an increase, not only in DOE reviewing them, but the information that manufacturers would have to submit.

So, we were more concerned, I think, with the comments that were worried about the delay in getting an approved

simulation. We have also proposed more reoccurring means by which testing has to occur. If the models used to substantiate aren't tested with the new test procedures each time they are amended or don't meet new standards, they also have to be resubstantiated. So, those types of things.

MR. VerSHAW: All right.

MS. ARMSTRONG: Okay. So, we had a question come in on the line. It said, "What would the basic model definition be for mixed systems and ICMs?" This is for Craig Messmer.

So, I mean, I think for the context for the AEDMs, and I realize that the basic model definition and the testing and the certification is a little mixed, but I don't think the basic model definition changes with respect to the AEDM itself. It is just the AEDM allows for a wider applicability of simulating the results of each combination that may be a basic model rather than actually

testing it.

MR. FLY: Yes, Ashley, kind of related to the point, and I think this is an error -- I hope it is an error -- but in The Federal Register, on 32055, toward the bottom of the last column, it would be 429.7(C)(2), you stated that the "test of at least one unit of each basic model to which the AEDM is applied in accordance with the applicable provisions". I am hoping that it was supposed to have been one unit of each class, not each basic model, because that kind of infers that we are going to have to test every basic model to validate our AEDM, which would kind of negate the whole idea of an AEDM.

MS. ARMSTRONG: You're correct, it is product class. Sorry. Thank you. That is a good one.

MR. LORD: Ashley, along with that, it would be good to put a definition someplace on what a product class is.

MS. ARMSTRONG: Yes, that is one

of the issues for which we sought additional comment. We will get to that, as to what type of information or what direction you all may need as to what exactly a product class is as it may relate, since you are testing one basic model from each product class with certain characteristics, correct.

MR. AMRANE: If I may, Karim Amrane.

I guess there are certain products, like commercial refrigeration, where you have maybe over 20 product classes today. So, you are going to be asking manufacturers of commercial refrigeration to test for all those product classes? I mean, I think that you need to maybe look at product-by-product category and see in this particular case, and see what the burden is going to be.

MS. ARMSTRONG: So, as drafted, that is the intention, that the manufacturers of commercial refrigeration equipment, even if they have upwards of 30 equipment classes,

would have to test one from each.

That being said, if there is a way, if there are models that may be similar or if there is a way to pare those down, or if you have specific ideas of how that could be different, or maybe that is reasonable because it is only 30 models versus 300, or something, I don't know, you know, please feel free to speak freely. There are different rating conditions or different configurations. So, I encourage you to please speak up to that.

MR. NESHAN: Massoud Neshan, Southern Store Fixtures.

In a way, you have already defined those classes in the different energy level that is allowed for each category or each of equipment. I don't know why you want to go beyond that, since you have defined it. You have been working on that for the past five-six years, to define those classes, and now you are talking about additional ones? And now, also, not only you have defined these

classes, but one thing you haven't defined is the basic model. It still is an issue with not defining basic model.

MS. ARMSTRONG: Okay. One second. Just to your point, the equipment classes are going to be the same as the ones that are defined by the standards. So, for commercial refrigeration, the ones that are common that you know about, that are in the standard rulemaking -- there are 30-some of them, I believe -- those are the same ones we are talking about here. It is less obvious for some of the other products that we are talking about here, specifically for the ASHRAE table that make things a little more complicated as to what an equipment class actually is.

But let me go over here just for commercial refrigeration, and then I am going to go back there.

MR. HON: Charlie Hon, True Manufacturing.

Unfortunately, the classifications

have secondary nuances built into them to make them totally different, and you will end up with well in excess of 100 models in some of our manufacturing facilities. So, that is really a large amount of testing that we have already taken most of it and it is done. So, now we are redefining it again way late in the game, because these models should have been tested a year ago to meet the standard which was in effect.

MS. ARMSTRONG: So, can I ask you a question? Do you advocate retaining the requirements to test each equipment class, test at least one basic model from each equipment class?

MR. HON: We should have already done that years ago.

MS. ARMSTRONG: So, your point of view would be that manufacturers should already have that data? They could just use that data, then, for the AEDM?

MR. HON: Yes.

MS. ARMSTRONG: But it is not an increase in testing burden?

MR. HON: It is not an increase in testing burden, but it gives an advantage to those who haven't done their homework and are not up-to-date. Since we have no reporting requirements, they are still not reported; those who have cheated on the standard are going to get a payback on their lack of effort.

MS. ARMSTRONG: Okay. Thank you.

MR. KLEISS: Jeff Kleiss, Lochinvar and A.O. Smith.

The term "product class" may be something that is well-known, I guess, within the ARMs, but as boilers and water heaters, I am not familiar with that term. Could you please define or characterize what that means or represents?

MS. ARMSTRONG: So, I don't think we have a specific definition, and perhaps that is something we need to consider. If you

look in the standards tables, there are specific different energy conservation standards for different product losses. So, I will give you an example.

For water heaters, it is electric storage versus gas storage versus oil storage versus electric instantaneous versus gas instantaneous. So, those are the five product classes for water heaters.

MR. KLEISS: Okay.

MS. ARMSTRONG: So, they are pretty aggregate levels. Usually, they are either defined by capacity-related features or fuel types or any other attributes that affect the energy performance. We usually define them through our standards rulemaking processes.

So, if you look in our standards tables, that speaks to our product classes, but I hear the need and we kind of foresaw the need to, yes. Okay.

Sure.

MR. FLY: I just want to clarify that just a little bit. So, are you saying that a product class is any group of equipment for which a minimum federal standard exists, a unique minimum federal standard exists?

MS. ARMSTRONG: Yes.

MS. HOOTMAN: Jill Hootman, Trane.

So, to further that explanation, the ASHRAE table would be for commercial HVAC below 65,000 btu's, 65 to 135, air-cooled, obviously --

MS. ARMSTRONG: Correct.

MS. HOOTMAN: One thirty-five to 240, 240 to 63 tons.

MS. ARMSTRONG: Correct.

MS. HOOTMAN: Is that correct?

MS. ARMSTRONG: That is correct. And then, depending on the type of heating --

MS. HOOTMAN: Right.

MS. ARMSTRONG: -- the .2 difference.

MS. HOOTMAN: Right.

MS. ARMSTRONG: And then, ACs and heat pumps are different.

MS. HOOTMAN: Right. And then, the water-cooled --

MS. ARMSTRONG: Air-cooled, water-cooled, evap, yes.

MS. HOOTMAN: And then, 65,000 and below, single-phase and three-phase?

MS. ARMSTRONG: Correct, because one is residential; one is in commercial.

MS. HOOTMAN: Okay.

MS. ARMSTRONG: Yes, ma'am.

MS. HOOTMAN: Thanks.

MR. DAUGHERTY: Roger Daugherty, Baldor Electric.

You are getting me a little bit confused here between basic models, product classes, and now you are using a term called "equipment classes". We have been using basic models for electric motors since the final rule was published in 1999. It has been very workable. It has been a very good definition

of basic model, and it has been used to substantiate our AEDMs with a well-defined process of doing so in Part 431.

However, if you switch over to product classes, then during the rulemaking process for small electric motors recently, for the eight power ratings of those motors, you came up with 72 product classes.

Then, during the present rulemaking that is going on right now with respect to electric motors, then you broke those and you said that there were basically four product classes, and then you introduced something called 10 representative product classes.

However, if you went back to the same type of definition that you used in the small electric motor rulemaking, that comes to roughly 24,014 product classes for electric motors. The test time to do that exceeds 185 years of testing to cover those product classes.

So, our problem with electric motors and small electric motors there has never been a clear definition of what a product class is. If you look at electric motors, all the electric motors are polyphase squirrel-cage induction motors. No difference, whether it is a 1 horsepower or 500 horsepower, whatever; they are all basic, you might say they are basically the same. They are just a different size.

If that was a product class, you would be telling me I test one motor from 1 to 500 horsepower out of that product class. Our present requirement is to test five different designs because of the definition of basic model. And that is why I say basic model for electric motors and small electric motors is a very workable definition, and we would not like to see a change from that over the product classes.

MS. ARMSTRONG: Okay.

MR. LORD: Yes, just to follow up,

you kind of quickly said on rooftops and packaged units that the two-tenths for other heat would be another product class?

MS. ARMSTRONG: Confirmed, yes. It is a different level, right?

MR. LORD: But it is very mathematically-predictable.

MS. ARMSTRONG: So, that could be a comment.

MR. LORD: Yes, we can provide a comment. We will.

(Laughter.)

MR. KLEISS: Jeff Kleiss with Lochinvar and A.O. Smith again.

This goes back to the scope of coverage.

MS. ARMSTRONG: Uh-huh.

MR. KLEISS: Currently, residential air conditioning, heat pump units are covered by AEDMs and ARMs. Has it been considered adding those to residential water heaters, residential boilers? If not, is

there a reason why not?

MS. ARMSTRONG: Okay. So, I am going to table that for just one second.

MR. KLEISS: Okay.

MS. ARMSTRONG: And I will go back.

So, any other comments before we move on to scope of applicability on preapproval? Just whether the Department should or shouldn't review and preapprove AEDMs before they are allowed use. Is there general support for preapproval? Is there general support for no preapproval?

MR. GARST: I would say -- Mike Garst with Lennox -- I think we would support no preapproval. The only concern we would have is if someone new comes in the market, that DOE has some way to at least do some assessment testing, so that they don't get in the market a long time, if they have got a problem.

MR. LORD: Yes, Dick Lord,

Carrier.

Yes, we support no preapproval, and you stated it somewhat in the document, is define exactly what has to be documented. So, it is very clear to a newcomer what he has to do.

MR. ROBERTS: Carl Roberts, Zero Zone.

Eliminating preapproval is a good and necessary proposal to make compliance practical.

MS. ARMSTRONG: Anyone else?

MR. AMRANE: Karim Amrane, AHRI.

I think we would support that as well. And I am not even sure the DOE has the capabilities of approving all the AEDMs.

MS. ARMSTRONG: You have so little faith in me.

(Laughter.)

MR. VerSHAW: Ingersoll Rand can support no preapproval.

MS. ARMSTRONG: Okay. Thank you.

Okay. Back to the topic of applicability, so we have proposed it to expand the use of AEDMs to other types. This includes commercial refrigeration equipment, automatic icemakers, small electric motors, beverage vending machines, walk-in cooler and freezer (refrigeration systems only), and then, continue the use for commercial HVAC and water heating equipment, distribution transformers, electric motors, including small electric motors, as well as CACs, central air conditioners and heat pumps.

So, to answer your question in the back about did we consider expanding to other types of residential equipment, you know, when we issued the RFI and received comments, the Department mainly got comments about the need for AEDMs to rate custom-built, low-volume-type equipment. And I guess from the Department's perspective, and we would like to hear comments on that, as to how residential water heaters and residential maybe boilers

fall into that custom-built, made-to-order type of classification or characterization, if we should consider, and why we should consider.

You guys are already testing and rating and certifying your equipment now. So, I ask what you do now to get the ratings. Do you test currently all those?

So, I will open the floor at this point.

MR. AMRANE: Karim Amrane, AHRI.

We did submit comments to DOE asking, did you expand the AEDM coverage to other residential products? Yes, manufacturers today do test. But, again, we are talking about reducing the burden of testing. So, an AEDM would be helpful to those manufacturers as well.

MS. ARMSTRONG: Can you turn your microphone on?

MR. STANONIK: Yes, I got it.

MS. ARMSTRONG: Thanks.

MR. STANONIK: Frank Stanonik, AHRI.

Ashley, one specific point that actually has kind of gotten lost here in the NOPR is that, in the case of residential boilers, one subclass of products has something akin to an AEDM and the other doesn't. And specifically, the rule has always allowed cast-iron sectionals to do something like an AEDM.

And we would certainly suggest that, at least in the case of residential boilers, make it equal for all boilers and allow them all to have that option. In the case of boilers, you are dealing with a market that on an annual basis is probably in the 200,000s. Maybe in a good year it was 300,000, but a large number of models.

We can talk water heaters; it is totally different. You are talking about a market of 9-10 million units. In the case of boilers, you don't have that magnitude of

sales. And yet, you have a disproportionately-large number of models. And so, while they may not be made to order, they certainly don't have anywhere near, let's say, the number of sales per specific model. And so, it is kind of a unique situation for residential boilers.

MS. ARMSTRONG: Go ahead, Harvey.

MR. SACHS: Harvey Sachs, ACEEE.

Ashley, the concern with the contrast between real production-line products and things with a large degree of customization is an important one. I am glad to see it reflected.

On the other hand, if an AEDM's underlying algorithm is robust and sound, then even for things which we think of as large production volumes, the opportunity to use it reduces the burden of innovation. It makes it more likely that a manufacturer might respond to a potential market, for example, for a very small central air conditioner for a very well-

insulated house.

And here, we have that balance between not knowing how the AEDM will extrapolate versus wanting to encourage that kind of innovation. I think it is a pretty serious question, but we should not automatically exclude new products from classes that we typically think of as being large-scale production.

MS. ARMSTRONG: I mean, this is definitely something we have sought comment on, including the proposed scope of applicability. So, if there is a wider net that needs to be considered, we welcome comments on that. I think the majority of the comments that we have received so far have surrounded the idea of the low-volume custom order. That being said, we are open.

And Frank, to your point about boilers, I mean, there is no change for the existing test procedure linear interpolation for the certain types of boilers, obviously.

That is inherent within the test procedure, and that is the same as we have in certain types of -- other types of commercial applications also have inherent extrapolation or estimation-type methods. Those still remain intact, even with this rule.

Okay. So, we have a bunch of questions here. One question is, what is the difference between an equipment class and a product class? And I apologize. That is probably myself mixing up the terms.

We use covered product for residential products, covered equipment for commercial products, product class for residential, equipment class for commercial. The terms are synonymous in their meanings. One is just the residential market, and one is just the commercial market. It is just a DOE terminology thing. So, I apologize for causing confusion there.

Okay. So, this one is just a comment, not a question.

"Under the current mixed/matched AC/heat pump split system ARM rating rules for ICMs, the ICM using an ARM must simulate its rating based on the matched system's highest sales volume tested combination rating. For each matched system, basic model may under your proposal no longer need to be tested. It is wise to be doing a computer simulation on someone else's computer simulation" -- I am not sure exactly what the last one is, but that is what it says.

So, Mr. Craig has a question regarding, "Why are AEDMs not available for walk-in cooler enclosures?" If you mean walk-in coolers, the whole box, our test method recently promulgated for walk-in coolers and freezers is a test method based on components. There is a different test for the panel. There is a different test for the refrigeration system. There is a different test for the doors.

So, what we have tried to do here

is allow the simulation, and we explained why we didn't allow it for other components in the actual NOPR, but allow the simulation for the refrigeration system, which we feel was the most necessary.

Any other comments or questions on applicability at this point? Please.

MR. DAUGHERTY: Roger Daugherty, Baldor Electric.

With regard to the small electric motors, the AEDM was actually added to Part 431 by the final rule of July 7th, 2009. That final rule added the sampling procedure to select your basic models, to substantiate the AEDM, and how you compare it against test data to substantiate the AEDM.

One problem is that this NOPR deletes that AEDM from Part 431 and does not add any information to Part 429 covering small electric motors. So, now we are left with we had an AEDM, now it has gone away. Yet, in 429.70, you do apply requirements for the AEDM

on tolerances and average tolerances, but you will find there is no section that describes how to substantiate the AEDM for small electric motors, since you have eliminated it from Part 431.

I might also note that I assume it is an oversight, but throughout the NOPR you refer to the commercial equipment and other type of equipment. Small electric motors and electric motors are classified as industrial equipment, which is part of the title of Part 431. So, I am assuming your references to commercial may also be referring to industrial equipment.

MS. ARMSTRONG: That is correct.

MR. DOPPEL: Paul Doppel with Mitsubishi Electric.

VRF systems aren't specifically mentioned here. Should they be included?

MS. ARMSTRONG: Okay. So, I believe -- and cross-check my math here -- but in the ASHRAE rule, DOE added VRFs as a type

of commercial air conditioning and heating equipment, and AEDMs apply to all commercial air conditioning and heating equipment.

MR. DOPPEL: Okay. Thank you.

MS. ARMSTRONG: Just make sure that the reg text -- we will check it as well, but make sure that that is in. That was the intention, though.

MR. STRAUB: Mike Straub, Heatcraft Refrigeration.

We appreciate the ability to utilize AEDMs on the refrigeration systems for walk-in coolers and freezers. The issue that we have is the definition of product classes. You stated that the product classes would be defined when the performance standards are revealed, but that was supposed to be January of this year. That hasn't been done. Is it a matter of manufacturers submitting information to you on what we believe product classes should be? Or do we have to wait? Because we would like to be doing our testing to develop

AEDMs now.

MS. ARMSTRONG: So, first of all, we would welcome information that suggests what product classes should be. That being said, the rulemaking is also ongoing considering standards for them. I am sure the preliminary analysis at least speaks to some of that. So, I would cross-check with that.

But, yes, you are right, the final product class or equipment class wouldn't come out until amended standards. And so, we could deal with that here.

Yes, thank you for pointing that out.

Okay. So, we have talked about most of this, but the idea, the premise that the Department had was that we believe that manufacturers should have the ability to come up with a single AEDM or multiple AEDMs at their discretion for use across a wide range of their product offering. It could be one simulation for all the products. It could be

multiple ones. Really, our proposal is just that. It is left to your discretion.

So, we have gotten a lot of comments already on what are product classes and equipment classes in terms of that. We noted that we would be interested in knowing if you needed additional clarification on that.

But we wondered what you guys thought about the use of a single AEDM or multiple AEDMs or leaving it at your discretion to use a single AEDM across a wide range of product classes in your entire product offering, if you so choose to and they met the substantiation requirement.

So, I open the floor for that proposal.

MR. LORD: Dick Lord with Carrier.

We favor that. I mean, you can leave it to our discretion whether we want to do it for a small product or a large product class. So, we support that.

MR. FLY: Mark Fly with AAON.

I, too, support that. The basic components that are going into all these products are the same are similar, and we have product models developed for each component. And so, the AEDM is a balance of all the components that we have put together. So, it seems reasonable that we can do that.

Now are you going to discuss at some point the tolerances on the AEDM?

MS. ARMSTRONG: Yes, that is next, and I might seek a break before that for my own benefit.

(Laughter.)

Does anyone else want to -- sure. Sorry, Harvey.

MR. SACHS: Harvey Sachs, ACEEE.

To turn back to your example of product classes, which might be electric resistance water heaters, gas water heaters, tank and tankless, and all the other permutations that we have now as product

classes, you can certainly take Dick Lord's approach and have different modules and call that a single AEDM. Or you can be using different models for product class. And the question is, does or should DOE have an interest in which way a manufacturer chooses to do his AEDMs?

I might be a manufacturer who only does super-insulated tank water heaters. Do I need to have a broadly-applicable AEDM?

MS. ARMSTRONG: So, this is Ashley.

Okay. So, what we tried to do was allow the manufacturer the discretion to have the broadly-applicable AEDM or have the not-broadly-applicable AEDM. In other words, it doesn't require broad applicability.

If they are only going to use it for a single product class, then it only has to be tested with that product class, although the minimum number of models is five. So, it would be five models, period.

But I get where you are going with this, but it doesn't have to have like this wide-range applicability if it didn't need to.

MR. ROBERTS: This is Carl at Zero Zone.

Based on working with this over the past couple of years, the reality is that we have to use AEDMs in order to rate untested basic models for compliance to be practical. In all reality, we end up testing several models from each product class or equipment class.

And it is necessary to use more than one AEDM, even within a particular equipment class. That is how it works out so far. And even then, it is going to be difficult for small manufacturers to comply.

MS. ARMSTRONG: I am going to ask a followup. Can you explain why that is? And do you have a suggestion to help? I mean, what would you change?

MR. ROBERTS: That is a good

question. To answer the question why, testing is very complex. And for a small manufacturer or a startup, it would represent a very large part of what they are doing. It might exceed the effort put into manufacturing.

I am not sure what the answer is, you know, how do you solve that problem. I guess one possibility is that you give very small manufacturers a pass or some permutation of that. That is all I can think of.

MR. NESHAN: Massoud Neshan, Southern Store Fixtures.

I would like to add to what was just stated. We are a small manufacturer of commercial refrigeration equipment, and we manufacture highly-customized and unique and different display cases on a daily basis.

In our standard catalog, we have over 500 basic models. And then, on a daily basis, we design new equipment. And we might only sell one case of that unique design in a given year, but the effort that goes into

testing that or developing AEDM is the same as when we manufacture a thousand of the same model. So, it is a very back-breaking process and costly process that kind of prohibits innovation and providing what the customers require.

What is the solution? It is very simple. And I know we have discussed this in the past, but the answer has been no. But you have to set a limit on, if you sell two pieces of equipment a year, does it need to be going through the same process? That is the question. Or should it be a limit of 10 or 20 or 50? I don't know what the answer is.

But there has to be a solution, so that it would allow us, as a small manufacturer, to design, manufacture, and sell the piece of equipment that we need to do.

Under current test conditions, we have to test at least two units before we can enter that unit into commerce. Well, picture this: we manufacture one. We sell one. But

we have to manufacture two to test. It just doesn't make sense.

I mean, we waste more energy manufacturing the second unit than we would ever save in the entire life of that unit that was sold into the marketplace. It just doesn't make sense.

Maybe we have to look at what some Europeans and other countries have established. They have established, for example, Australia and New Zealand, if you import less than 50 units per year, they are exempt from their requirements, which is practical.

Thank you.

MR. WILKINS: Robert Wilkins, Danfoss.

Just an observation that this has to do with materiality. Materiality from the manufacturer's point of view, but also materiality from the customer and from the market-at-large point of view.

You might be able to deal with some of these kinds of issues by a materiality provision that puts a cutoff, that sets some limits or thresholds. Just an idea.

MS. ARMSTRONG: Thank you.

Sure, Karim, go ahead.

MR. AMRANE: Karim Amrane, AHRI.

I guess I have a question for DOE. Does DOE have the authority to, for example, put the limit on a minimum, a production limit or something like that? Or does it need some legislation?

MS. BARHYDT: Can I respond to that after the break?

MR. AMRANE: Sure.

MS. ARMSTRONG: Okay.

MR. DAUGHERTY: Roger Daugherty, Baldor Electric.

I think it is becoming obvious that over the many years that we have been working on the various final rules and NOPRs for electric motors and small electric motors,

that those are being lumped over and looked at like some of these other products. Once we get into electric motors, as I said, just at a single mechanical configuration, you are looking at 24,000 basic models covered by the present standards in Part 431. Add on those for the small electric motors.

So, if you were to define the product classes the way you did for small electric motors, this idea of testing one basic model from each product class just is inconceivable for electric motors and small electric motors. That is why I encourage you to reconsider what is in presently Part 431 for electric motors and small electric motors as to how to properly select at least five basic models that cover the ratings that are covered by the standards and make substantiation of AEDM from that.

And it may be necessary that in Part 429 that you bring that information over for electric motors and small electric motors

and not do the substantiation on product classes and things like you are doing it for other equipment.

Thank you.

MS. ARMSTRONG: Thank you.

MR. DOPPEL: Ashley?

MS. ARMSTRONG: Yes?

MR. DOPPEL: Paul Doppel with Mitsubishi Electric.

In The Federal Register on page 32056, and this is under paragraph 5, "Additional Test Units," "Each AEDM must be supported by test data obtained from physical tests of current models."

MS. ARMSTRONG: Right.

MR. DOPPEL: That is kind of an implication that every time you change your model lineup you have to change your AEDM. Is that the intent there?

MS. ARMSTRONG: That is not how -- well, perhaps we need to clarify.

But this is Ashley from DOE.

If one of the models you use to substantiate your AEDM is discontinued, you need to replace it with an active model. That is what it means. In other words, if a new standard goes into effect and three of the five units you use to substantiate your AEDM will no longer meet the standard and are either (a) redesigned and rerated or (b) discontinued, then you need to go through and make sure, resubstantiate your AEDM.

That does not necessarily imply that you need to change your AEDM, but if you rerun it and the results are no longer valid for the simulation, you would need to retest those models with actual testing, compare it to the simulation. And for each model beyond the 5 percent, if the mean is not within the 3 percent, then you would need to do something at that point, whatever it may be. Okay? There is like a more reoccurring thing rather than a never.

Yes?

MR. SACHS: Do you want to get into the substantiation part now or do you want to wait?

MS. ARMSTRONG: No. No, let's take a break.

(Laughter.)

MR. VerSHAW: I have got a question, though, first.

MS. ARMSTRONG: Oh, sure.

MR. VerSHAW: You know, I think if you look at each type of product you are trying to cover -- oh, Jim VerShaw with Ingersoll Rand -- you know, we do air conditioning and heat pumps and heating. For air conditioning on the residential side, it is the same engine that does the simulations, whether it is a heat pump or an air conditioner. And we are relatively, you know, one and a half to five tons, it is fairly straightforward.

If you get into the bigger equipment, and I don't see any difference

between a 15-ton and a 25-ton in terms of how you would simulate that. It still has got a compressor. It has got two coils and it has got a couple of fans.

So, why you need to go into those air conditioners and have one from each one, it might be better to know which of those models are the ones that are pushing the design the hardest, which one is most compact or most open or that type of thing. Whether or not it is gas heat or electric heat may not be an issue.

I think we need to have an open mind by product family as to how you would go about doing that. I think that we may be asking for more tests upfront than are really necessary. Or maybe it is too easy to pass it in some cases, you know, if you want to cherry-pick some of those.

We will be making comments on that, but --

MS. ARMSTRONG: Yes, I mean, at

this point, the Department is open. It was very clear when we wrote the notice -- hopefully, it is clear to you as well -- that we would consider alternatives. So, suggestions are welcome both ways.

So, at this point, we are going to take about a 15-minute break. We are going to come back to talk about substantiation requirements.

Please come back at about 10:30 or so.

(Whereupon, the foregoing matter went off the record at 10:13 a.m. and went back on the record at 10:34 a.m.)

MS. ARMSTRONG: Okay. Getting back, before we get into substantiation requirements, we have two questions on the phone.

So, the first one I am going to go to is Robert Barry.

MR. BARRY: Yes, hi. This is Robert Barry with Unico.

This is a question pertaining to ICMs. Before the break, we talked about the conditions under which a manufacturer would have to resubstantiate their own AEDM. I was just wondering, going back a step, what is the responsibility of ICM manufacturers to resubstantiate their AEDM if one of the manufacturers with whom they pair has to resubstantiate their AEDM? And what is the responsibility of an ICM for modeling results, tolerances, for the overall mixed system, especially in light of the black-box nature of each manufacturer's simulation methods and algorithms? And would DOE consider providing data or standard AEDMs for the various classes that ICMs could use in lieu of manufacturer data for the purposes of ratings and substantiation from systems?

MS. ARMSTRONG: Okay. So, I am going to go one-by-one because that was a lot of questions.

MR. BERRY: Yes, sure.

MS. ARMSTRONG: Okay. So, I am going to start with the last one first. Right now, this proposal doesn't contemplate like a DOE kind of an overall AEDM. That is the first thing. Right now, it just allows manufacturers at their discretion. So, at this point, we have not considered anything like that.

As far as ICMs go, and if a condensing unit specifically is discontinued that you built your AEDM off of for the ICM, even though you are not the manufacturer of the condensing unit, you know, it doesn't specifically separate requirements between an OEM and an ICM, and maybe that is something the Department should consider. Right now, it seems to read the same.

So, if a model was discontinued, like a condensing unit was discontinued for what you used to substantiate your AEDM, it seems -- this is just the way I read it -- that you would need to replace that unit by a

new condensing unit, test it in the same way an OEM would. And to the extent you have certain suggestions that we should consider specific to ICMs, we would welcome those.

Okay. So, the next question is from Ron Shebik.

Okay. Ron?

MR. SHEBIK: Yes, hi, Ashley. Can you hear me?

MS. ARMSTRONG: I can hear you. Just make sure you talk pretty closely to the phone.

MR. SHEBIK: Okay. Hey, Ashley, I would just make a comment that, in general, I agree with the discussion on page 16, but I think maybe a useful exercise, since there seems to be some confusion amongst the people in this meeting, a useful exercise may be to look at product classifications, basic model groups, and equipment classification, and maybe discuss how they all relate to each other.

MS. ARMSTRONG: Sure. Thank you.

MR. SHEBIK: Thanks.

MS. ARMSTRONG: Okay. So, if we don't have any other general questions before we move into substantiation requirements, we are going to do just that.

So, the AEDM tolerances, currently, the Department, for those products for which we have simulations where we have two tolerances -- well, we have three -- one is 1 percent and one is 5 percent and one is 10 percent, and they vary by product type.

So, in this rulemaking, DOE has individual tolerances for most of the equipment, commercial HVAC, refrigeration-type equipment, residential CACs and CHBs at 5 percent. So, each individual unit tested must be within 5 percent of the AEDM simulation results.

Yes?

MR. VerSHAW: I just find it interesting -- Jim VerShaw, Ingersoll Rand --

that motors have a 10 percent tolerance and HVAC, which takes -- what? -- 95 percent or 99 percent of this energy comes from three motors, maybe four, and we are only doing 5 percent, along with scroll and piston machining and prop fans and blower wheels, and all the other things that you get variations in, along with an extreme amount of lab variation.

MR. WILKINS: Robert Wilkins, Danfoss.

I was just going to comment on the lab variation inherent in unitary air conditioning compared to motors.

MS. ARMSTRONG: Can you speak to what you think the magnitude of each of those is?

MR. VerSHAW: This is Jim Vershaw.

Through work at Ingersoll Rand and, also, with AHRI, we have been digging into this lab issue. There is a lot to it. If you look at repeatability, a major third-

party lab does round robins with a single unit, and they think they are doing well if they are plus or minus 2 percent from the test from facility-to-facility.

Now, if you have a unit that essentially has a performance of one, but you test it in one room and you get .98 and you test it another room and you get 1.02, the DOE rules won't allow us to rate it at the mean. It is too far apart. And that is just repeatability from room to room.

Now in terms of variability, instrumentation for measuring volts and all these things has been improved over the years. However, the subsystems that they are used on haven't. In fact, work that has been done by the AHRI subcommittee has found that there are inadequacies in the ASHRAE standards for psychrometers, for mixers, for damper boxes. And there is really five things.

So, measuring wet bulb, which is key to the air conditioning, is not done very

well. Measuring airflow is not done very well. In fact, we have found substantial error, depending on which nozzles you were using. Mixer boxes aren't defined well enough. The sample trees in which you try to sample the air going into the heat exchangers are not well-defined.

And so, there are about five things, and each one of those five things has a variation of about 1.5 to 3 percent effect on testing. Now does that add up to 15 percent? No, but 5 percent is really a stretch on those things.

Now let's put on top of that you have got the 10 percent motor variation. And compressors tend not to come out of the box at mature performance. Most compressors, especially scroll manufacturers, will supply a compressor to us that is somewhere between 95 and 97 percent of its rated performance, which after about 75 hours of run time is probably pushing, then, closer to 99 to 100 percent.

So, lots of issues in here as far as what can happen. We have been dealing with the 5 percent tolerance for quite a bit of time through the AHRI program. Of course, we conservatively rate equipment and the like. And so, I think that some of these numbers like 3 percent is difficult.

MS. ARMSTRONG: So, just to clarify, are we okay with the 5 percent, but you are advocating a 5 percent for motors?

MR. AMRANE: Karim Amrane.

I guess I think what we need here, we need to revisit all those tolerances and those percentages. I mean, why 5 percent? Why 10 percent? On what basis is DOE picking 10 percent for motors and 5 percent for air conditioners? I think those things have to be revisited. They have been there for many, many years, but I think it is about time to review them.

MS. ARMSTRONG: We will go to the back one second.

MR. DAUGHERTY: Roger Daugherty, Baldor Electric.

I think I can clarify some of the confusion here. But, first, what I think is a rather simple question to DOE. When a final rule is published and makes changes to one of the parts, when are those changes effective? I ask because, in preparing comments on this NOPR, there is a final rule May 4th of this month that made changes to things that are being changed by this NOPR.

So, I would like to know whether or not that final rule is in place and the comments go against that final rule or if the final rule, then, replaces over this NOPR, which means the change is made through this NOPR, get replaced by that final rule.

MS. ARMSTRONG: So, these are proposed. These would overwrite the final rule changes.

MR. DAUGHERTY: Okay.

MS. ARMSTRONG: So, the comments

go to this docket.

MR. DAUGHERTY: Okay. Now, to try to clarify what is here -- and I found it very interesting that, under the present procedure for electric motors and small electric motors, for substantiating the AEDM, the tolerance that is applied of 10 percent is to total losses, not to efficiency. Yet, in preparing this NOPR, DOE has changed that to be a tolerance on efficiency.

Was that the actual intent of DOE to change the tolerance for electric motors and small electric motors to be based on efficiency rather than total losses? And I only point that out because that is a substantial difference between the tolerance on efficiency values.

MR. HON: Charlie Hon, True Manufacturing.

I am sitting here looking at commercial refrigeration equipment, self-contained materials. I can tell you for a

fact that I can take the standard procedure, the test procedure available to us today, within the scope of the range of electrical current, ambient temperatures within the room, and the temperature inside the cabinet, and keep them all in the specification, and come up with about 8 percent variation unit-to-unit on the same unit.

MR. VerSHAW: Yes, this is Jim Vershaw again.

There has been some work done, the ISO group, a working group on looking at efficiencies, again, for HVAC-type equipment where you do an entropy balance. They are pushing for a 10 percent uncertainty because they found it was close to 7 percent for air conditioning in that work, which kind of supports the issues that I brought up earlier.

MR. ROBERTS: This is Carl from Zero Zone.

With regard to CRE, there is a number of things that affect this percentage.

There is a surprising amount of variability in the manufacturing of things like the glass doors. In fact, our tolerance from our glass door vendors for the heat on the glass doors, plus or minus 10 percent. There are a number of things that are hard to measure, short of having a million-dollar lab, such as mass flow. There are things that are hard to regulate, such as voltage and humidity.

For a reasonably-equipped third-party test facility, I think the 5 percent and 3 percent is too tight. I think 10 percent and 5 percent might be more like it.

MR. FLY: You know, having mostly air conditioning guys having been testing with ARI for a number of years, and comparing it with one lab, which does chamber-to-chamber tests that are in the 2 percent range, we have all calibrated our ratings, basically, to the results of that lab. That is the meter stick today.

My big concern is, if we start

going out to other labs and we are just using some ISO standard that basically says I have got smart people running the place, and that my equipment has been calibrated, we all know who are sitting in this room that there is a whole lot more to getting repeatable results than that.

I would strongly encourage, when you are looking at these tolerances, that you look at tolerances only on one side, whichever, so that we can conservatively rate equipment and even conservatively calibrate our AEDM, so that we are sure to not only account for our lab tolerances and our manufacturing tolerances, even if they happen to be beyond what we see up here.

So, the ability to be able to not do plus or minus when we are looking at the AEDM qualifications, to fall along the same lines as you have done with the testing and the confidence levels, so that you only go to the negative side, would be very helpful.

MS. ARMSTRONG: Yes. So, before I keep going, I am just going to answer that. Throughout 429 in the individual product sections, you will notice that we restructured a bit. Perhaps you haven't had a chance to fully read through this.

But what it does is the first part, it sets forth any representative value from testing. And then, the second part, it sets out any representative value from an AEDM. What it allows is either to use something more conservative than the AEDM value all the way up to the AEDM value. So, I believe that is what you are asking for, and that is in the proposal for each product.

MR. FLY: Yes, but within the 3 percent average of the mean is plus or minus.

MS. ARMSTRONG: I understand.

MR. FLY: Which means I have got to have test data that falls within that 3 percent and I have to be at the center of it. I may want to conservatively rate or

calibrate my AEDM to be lower than that, so that I can ensure that I can account for any lab-to-lab.

MS. ARMSTRONG: You would rather just go to the negative range? Okay.

Keep going around.

MS. HOOTMAN: Yes, I was going to say I agree just on the negative range --

MS. ARMSTRONG: Okay.

MS. HOOTMAN: -- and let the upside potential be there.

MR. SACHS: Harvey Sachs, ACEEE.

We have no objection on policy grounds for manufacturers who wish to mislead the public by selling products that are more efficient than their ratings would indicate.

(Laughter.)

We support the negative.

MS. ARMSTRONG: Sure. Sure. Thank you.

Go ahead.

MR. GARST: Mike Garst at Lennox.

Just support the negative only. It is really especially important for the ICMs because they have got very limited information from the high-side manufacturers, and they have to be conservative.

MS. ARMSTRONG: Sure.

MR. LORD: I have a little bit different take on what you are asking here. The way I understood it, I test five units and they have to be within 5 percent and the average has to be 3 percent. Now that proves my AEDM.

Now I can add an additional 2 percent, 5 percent, whatever I want, to my AEDM when I publish my ratings. So, I am conservative, right?

MS. ARMSTRONG: That is correct.

MR. LORD: Yes.

MS. ARMSTRONG: That is exactly correct.

MR. LORD: So, this just validates your test --

MS. ARMSTRONG: This is validating your rating. Your rating, then, I mean, you can then use your AEDMs, once they are substantiated, to get the certified ratings for everything else and those can be conservative all the way down to the standard.

MR. LORD: Yes.

MR. FLY: So, what point is the 3 percent?

MR. LORD: So, basically, you have five tests. And I can keep going. I will answer it. I won't do that.

(Laughter.)

You have five tests. In those five tests, none can be more than 5 percent off, plus or minus 5 percent, and the average has to be plus or minus 3 percent. That substantiates your AEDM.

Now, when you publish, you can say we don't feel confident; we are going to add another 2 percent safety factor. And that is what she is saying is okay.

MS. ARMSTRONG: That is correct. I mean, his explanation is right.

Go ahead. Go ahead. Yes.

MR. WILKINS: Robert Wilkins, Danfoss.

I would like to reiterate a point Karim Amrane made about maybe stepping back and taking a fresh look or a deeper look at some of this. And some of the dimensions that I would like to comment on are you have a wide range of equipment listed up there. Some equipment is self-contained. It is factory-charged. It is factory-sealed. It is very controllable by the manufacturer.

Some of that equipment is field-connected and even field-charged or at least field-topoff. And in the lab, there are some restrictions as to how much tweaking of the refrigerant charge is appropriate. And even if the manufacturer specifies that certain amount of adjustment is in order, it may not be done in the lab.

And so, there is a wide range of variability attributable to the type of the equipment that might be considered here as well, self-contained versus field-connected and field-charged, for example.

MS. ARMSTRONG: Okay. Go ahead.

MR. LORD: Yes, maybe to add, and I was going to bring it up later, but this is probably a good point. When you get into commercial equipment, it is a very complex piece of equipment. Most have microprocessors on it.

I know on our equipment, and I think a lot of the competitors also do the same thing, we require factory commissioning. You know, they have to set it up because the average guy is not trained to set up that piece of equipment.

So, I know you have allowed that on VRF systems. We need to also consider that on large commercial equipment.

MS. ARMSTRONG: Okay.

MR. WILKINS: My one rule would be anytime factory commissioning is required in the field, it should be considered in the laboratory as well.

MS. ARMSTRONG: Okay.

MR. VerSHAW: Jim VerShaw, Ingersoll Rand.

For the testing, these tests, Test X-1 on, are those manufacturers' tests or are they third-party tests?

MS. ARMSTRONG: No, there is no -- this is Ashley from DOE -- there is no third-party testing requirements. They are manufacturer tests.

MR. VerSHAW: Oh, I guess it is manufacturer setup then.

(Laughter.)

MS. ARMSTRONG: Correct. I think he was referring to verification and enforcement potentially.

Sure. Please.

MR. DAUGHERTY: Roger Daugherty,

Baldor Electric.

With regard to this plus or minus 3 percent, throughout the discussion in the NOPR, in the actual title of Figure C-1, it says, "except for electric motors and small electric motors," but that exception is not in the text, in the actual 429.75(i).

MS. ARMSTRONG: Okay.

MR. DAUGHERTY: Oh, I guess it is four, under "Average Tolerances".

And maybe give a little bit more information. I realize, again, there is this thing of electric motors and small electric motors, and they are treated very differently than many of these other products.

In EPAct in 1992, they were the only equipment that was actually required to have to be tested in an accredited test facility. And so, in the 1990s, between NEMA in conjunction with NIST/NAVLAP, so that they could create an accreditation program, we conducted round-robin testing to determine

what the tolerance was as a factor of testing, both during the round robin, so we could see between test facilities, and also see just for testing motors within a facility.

And as a result of that, we actually conducted a second round of round robin after modifying the IEEE 112 test standard and created the NAVLAP Handbook 150-10 for the accreditation program.

So, there is a very great deal of background that goes into the various levels of tolerances that are in the test requirements for testing a sample of five of a basic model within Part 431, as well as the comparison to AEDM. So, while I would suggest for electric motors and small electric motors that you reconsider what is in Part 431 and the use of the word "tolerance" against total losses, but also that tightening that up would be extremely difficult. And you need to go back into the history that really supports all of that information.

Thank you.

MR. FLY: In looking for some of this information on your website --

MS. ARMSTRONG: State your name. State your name.

MR. FLY: Oh, Mark Fly with AAON.

In looking at some of the information on your website, it looked DOE had been running a round-robin test. Is any of this information that you have got here based on any -- I haven't seen any results of that -- of any round-robin lab-to-lab test data on HVAC equipment?

MS. ARMSTRONG: So, the round robin we have run so far is mostly for residential household appliances, not necessarily for this type of equipment yet. And most of these were informed either by -- we have existing sampling procedures which have test tolerances for actual testing, as well as comments we received in response to the RFI from manufacturers.

Karen?

MS. MEYERS: Yes, this is Karen Meyers with Rheem Manufacturing.

My question was similar. I was just curious, you know, what was the analysis that DOE used to come up with this 5 percent, 10 percent, and 3 percent? How do we know? I mean, where do those numbers come from? Are they just --

MS. ARMSTRONG: It is the same thing I just said.

MS. MEYERS: Yes. So, I mean, I think it would be, if we are going to set a rule on how we should do this, there should be some type of statistical analysis to find out, are these, in fact, the right percentages? I mean, I don't know; maybe they are. But it seems like there should be some type of analysis, then, to substantiate these percentages.

MS. ARMSTRONG: Okay. We have a couple of questions from the phone.

Steve Ruffing, you should be unmuted.

MR. RUFFING: Okay. I wanted to expand on a previous comment that Roger Daugherty made about whether the electric motor and small electric motor tolerance is based on efficiency or total losses.

What is presently codified in 10 CFR Part 431 is a tolerance based on total losses. So, for instance, if you had a nominal full-load efficiency of 91.7 percent, if you took 10 percent greater losses than that, you would actually end up with an efficiency of 90.9 percent. And if you took 10 percent lower losses than that, you would end up with an efficiency of 92.4 percent.

So, the tolerance on the efficiency is presently codified. It is, actually, in this particular case plus or minus 1 percent. But what is being proposed here in the NOPR is to change the tolerance to plus or minus 10 percent on the efficiency,

not the total losses.

So, going back to this example of a nominal efficiency of 91.7 percent, that would widen the tolerance range to 90.9 percent to 101 percent. And that is a substantial change, as Roger pointed out.

MS. ARMSTRONG: Okay. Thank you.

So, we have another question from the phone from Kunal Kapoor. Oh, maybe it was just a question.

Five percent, is that plus or minus 5? And the answer is yes, the way it is written right now.

Okay. Any other comments on tolerances specifically?

(No response.)

Okay. Now we are going to talk about selecting units for substantiation. Test a minimum of five basic models, including at least one from each product class. So, if you have less than five product classes, you still have to test five. If you have more

than five product classes for which you want to apply an AEDM, you must test more than five.

Distribution transformers is different, and it is retained at the same requirement it is today. Test the smallest and largest capacity basic models from the product class of the highest field volume. That largest capacity is within the 25 percent of the largest capacity. Test the model with the highest sales volume the previous year or the basic model which is expected to have the highest volume sales.

And then, obviously, the test data -- this is something new -- the test data underlying the substantiation must be current. So, it must meet the existing federal energy conservation standards and be tested with the applicable test procedure. So, if there is a test procedure change or if there is a standard change and those models weren't tested in accordance with whatever the new

regulations are, they would need to be retested.

So, at this point, I will open the floor to questions and comments on those.

Sure, Frank.

MR. STANONIK: I am Frank Stanonik with AHRI.

I certainly appreciate the idea to try to keep this simple. But if someone -- and you can't rule it out -- but if someone chose to have an AEDM that only applied to five basic models, this would say, yes, that company has to test each one of those five basic models. And yet, if I had an AEDM that applied to 50 basic models, I still only have to test five.

Without having a specific proposal at this time, it seems like it might make some sense to say that if you -- again, this might be a rare circumstance -- but if you had an AEDM that was only applicable to five or six models, then you should maybe only test three

of them, or something like that. In other words, maybe a little subcategory that, if there is that rare case where an AEDM is actually not very expansive, let's say, then you don't necessarily have to test all the models, because at that point you are kind of undermining why have an AEDM. If I have to test all my models, I will just test all my models. It is a fine point, but I think it is something that makes some sense.

MS. ARMSTRONG: Okay. Thank you. Sure.

MR. LORD: In the selection of the models, you said meet the requirements. Is it okay for units to exceed the requirements?

MS. ARMSTRONG: Of course.

MR. LORD: So, like we use Energy Star so we can cover --

MS. ARMSTRONG: Of course.

MR. LORD: Okay. Good.

MR. DAUGHERTY: Roger Daugherty, Baldor Electric.

A couple of items. With respect to testing 25 units for distribution transformers, I think you will find that that is also true for electric motors and small electric motors. The actual rules for distribution transformers were actually created from the establishment of those for electric motors.

The last item about, if standards, test standards, or so, were to change -- for example, the IEEE 112 Working Group is presently meeting to modify that test standard. In the present final rule, the recent final rule on test standards, DOE adopted the 2004 version; whereas, presently, we were testing under the much earlier version that existed.

Most of those changes are numerical calculations. There are no changes in the actual test procedure itself. They are just trying to fine-tune how you determine some of the individual losses in the

calculation.

So, at what extent does a change in a test standard require going back and repeating all the testing to substantiate an AEDM?

MS. ARMSTRONG: So, I mean, I think your point is a good one. At this point, it does not clarify which way it goes. I mean, for all intents and purposes, if the exact test is the same, the calculations are different such that the numbers would be different, it could be one plausible situation or outcome could be one where you don't necessarily retest because the test data is the same. You rerun all the calculations, though, feed that into your AEDM to make sure the substantiation requirements are still met, and then go from there. But that is not something right now that is specific in the rule.

MR. DAUGHERTY: Would that be made specific in a final rule?

MS. ARMSTRONG: It could be, yes. It could be.

MR. DAUGHERTY: Thank you.

MS. ARMSTRONG: Sure. Thank you. Sure. Jill?

MS. HOOTMAN: Jill Hootman, Trane. Okay. So, we said before the product classes for commercial HVAC, air-cooled, were those ASHRAE classes. If I am reading it correctly, I have to do the smallest and largest basic models from that product class. That is 15 tests, if I add that up.

MS. ARMSTRONG: Fifteen. So, I don't have the numbers, but you have to do it from just the product class with the highest sales volume. So, highest and lowest is just one --

MS. HOOTMAN: So, it is the five plus the two?

MS. ARMSTRONG: Plus one, right? So, one of those will be the five, and the

other one. So, that is six. But, obviously, there is more product classes than five.

MS. HOOTMAN: Right.

MS. ARMSTRONG: So, there will be more, but I can't imagine it is more than 20 or 30, off the top of my head. I could count them, though, at break, if you wanted to go through that.

MS. HOOTMAN: Right. Okay. Let's do that.

MS. ARMSTRONG: Okay. Sure. Please.

MR. KLEISS: Okay. This goes back to, I guess, the product classes and how those apply to these. If I am understanding correctly, validating an AEDM, that we have to validate an AEDM for each different product class that we are involved in. Is that correct?

MS. ARMSTRONG: That is correct.

MR. KLEISS: Okay. So --

MS. ARMSTRONG: But you don't have

to -- okay, keep going, first of all.

MR. KLEISS: Okay. In the case of, say, commercial boilers, commercial boilers are classified by The Federal Register in large and small.

MS. ARMSTRONG: Correct.

MR. KLEISS: Now we could have one product family, I will say, that uses the same kind of construction that bridges the gap between small and commercial. And the small boilers, they would be measuring thermal efficiency and large boilers they would measure combustion efficiency. So, a different test methodology there.

Now setting up those boilers could take a couple of days to a couple of weeks in order for us to be able to do those tests. It is to our advantage, when we are setting up those small commercial boilers, that we would test both commercial and thermal efficiency. And when we set up a large boiler, we would test both thermal and commercial efficiency.

Now, since the efficiencies are not covered by the ruling, can we use those efficiencies measured outside of the product class to still determine our AEDM for the product? By definition, we can't use data that falls outside of the product class --

MS. ARMSTRONG: Oh, no, no, no.

MR. KLEISS: -- based on what you said earlier.

MS. ARMSTRONG: Okay.

MR. KLEISS: You are getting where I am going with the question?

MS. ARMSTRONG: I understand your question --

MR. KLEISS: Okay.

MS. ARMSTRONG: -- if that is what you are asking. I think I do at least. Let's try the answer and see if it works.

MR. KLEISS: Okay.

MS. ARMSTRONG: So, this is Ashley from DOE.

At your discretion, you can use

any additional information you may want to substantiate your AEDM. If that is different metrics, if that is other units, like if you wanted to test 50 instead of 20, you could always do more. However, you can't switch out a non-regulating metric for a regulating metric. But if you did combustion, in your example, if you did combustion and thermal, and for the one -- I don't know off the top of my head, but if it is small, it is combustion, then you would use combustion. You could also use thermal if you wanted to tweak something there.

And then, for the larger ones, if you wanted to use thermal but you also used the combustion data point to shrink your simulation for whatever, you could do that, but you couldn't swap it as one of the ones.

Does that make sense?

MR. KLEISS: Right, right. We wouldn't use a different test methodology --

MS. ARMSTRONG: Correct.

MR. KLEISS: -- in order to generate a data point, but we would want to use a boiler that is outside of the range of coverage in order to generate a data point to validate that AEDM?

MS. ARMSTRONG: I think the answer is yes. Perhaps we can look at what exactly you are talking about. You know, there is no problem with doing more, let's put it that way.

MR. KLEISS: Okay.

MS. ARMSTRONG: It is just this is the minimum set of requirements. As Frank alluded to, we tried to keep them simple, maybe too simple; I don't know. But we tried to keep them simple.

MR. KLEISS: Yes, and this is not a matter of trying, just saying we want to do extra testing --

MS. ARMSTRONG: But --

MR. KLEISS: -- but, rather --

MS. ARMSTRONG: Understanding.

MR. KLEISS: -- we are bridging some gaps, and we are wanting to make sure that we can do the appropriate testing, but without setting up more units than what we have to.

MS. ARMSTRONG: Sure. Sure.

Okay. Mark?

MR. FLY: Mark Fly with AAON.

On several of the HVAC products, DOE has listed, basically grouped everything up to 63 tons on products that traditionally have not been under any kind of listing program at near that high a rate. So, like for water-source heat pumps, air-source heat pumps, and some of these products, there are not labs in existence that can test a 63-ton air-source heat pump, independent or most manufacturers. There may be some manufacturers, but they don't really want to test my equipment, and I don't really want them to.

I think, on the upside, that is a

problem, that we do have a discontinuity between the traditional AHRI rating standards and the limits and what DOE has listed.

MS. ARMSTRONG: Okay. I am not 100 percent sure I understand you. So, perhaps you and I can look at this table at the break, so I do understand it, because I think it is important.

Sure. Jill?

MS. HOOTMAN: What was the methodology in picking the smallest and largest of the basic model from a product class? I guess I am asking that methodology because usually in a lot of cases when you are substantiating AEDMs and outliers that might be causing conditions different, it is not always the smallest and largest. It could very well be a design issue within a product class that you are then looking at. For instance, it could be something like the cabinet size and how much is being fit in that particular cabinet size. And that might not fall in that

smallest and largest. So, if you are trying to find what is defining the outliers of an AEDM, smallest and largest isn't always it.

MS. ARMSTRONG: Right. This is Ashley.

I think we were trying to, for the most part, bound the range. So, at this point, if we open up the AEDM applicability across the board -- you can use one AEDM for everything, whether it is a 6-ton or a 69-ton unit, I mean whatever it is. The idea here would be getting a test point somewhere toward the lower end of the range and somewhere toward the higher end of the range to make sure. And that is just one test.

If there is a different way to do it or maybe a better way to do it, we are open to it, but that is the idea. And this doesn't show it on the -- it is 25 percent of the largest basic model or the largest capacity, because we do realize that the largest capacity could be quite challenging, may not

even be built on a regular basis.

So, like I said, though, we are open here. We were just trying to get some sense of bounding, a range there, because of opening up the scope to the wide range of applicability there.

MR. NESHAN: Massoud Neshan, Southern Store Fixtures.

The use of AEDM, at least for CRE, was discussed about last year when we started talking about how to reduce the burden of testing on the basic model definition that exists. My question is now for us, as a small manufacturer, how this AEDM is going to help us when I am designing one case, manufacturing one case, selling one case. How is all this process going to reduce that burden of testing, question No. 1?

Specifically, you haven't even defined the basic model yet again. I keep on coming back to this because the foundation of this thing is not settled yet and you are

talking about what we should be doing on the 10th floor.

So, what is AEDM? How is it going to reduce the burden of testing on our kind of equipment?

MS. ARMSTRONG: Okay. So, I don't know off the top of my head all the product lines and offerings. So, I am going to give an example that is just theoretical here in nature.

But say, as a commercial refrigeration equipment manufacturer you manufacture 100 different models, just 100 different models. Those span 20 different equipment classes as defined by the standards. So, they are either like semi-vertical, vertical; they are opened or closed. They are self-contained or remote. There's 20 there, right?

So, of those 100, you need to test 20. Those 20 need to meet these characteristics. Actually, it would be 21.

The 21 need to meet these characteristics, and the 79 others you could use the AEDM and not test those. That is my example of how it would work for your company.

I don't know if that example is a good representation of your company, but that is how it would work in theory. Okay?

MR. FLY: Mark Fly with AAON.

So, I am just trying to get my head around this. Do you have to test the largest and smallest in each class? Or you just have to test one in each class and the smallest and largest across a product line?

MS. ARMSTRONG: You have to test one in each class and the highest and lowest in the class with the highest sales volume.

MR. FLY: Okay.

MS. ARMSTRONG: I realize that there is some confusion generally because there are multiple classes that can span the range, right? So, I get that part. That will be something we need to clarify.

MR. ROBERTS: This is Carl from Zero Zone.

Just a quick comment on the last item on slide 20 here, "The test data used for substantiation must meet the applicable DOE test procedure." We are constantly rewriting the procedure. It is a moving target because the equipment itself is a moving target.

It might make more sense to say that the test data used for substantiation must meet the applicable DOE testing procedure or properly adjust to the applicable DOE testing procedure. In other words, to adjust the test data within the AEDM to represent the current test procedure.

MS. ARMSTRONG: This is the first time I have ever heard that our regulatory program is a fast-moving target.

(Laughter.)

But I thank you for that, that compliment.

I do want to point out that, when

we talk about it here, I realize that a lot of your test procedures, due to either the great work done by AHRI committees or ASHRAE committees or IEC committees, whatever it may be, it is constantly under revision or they are thinking about changing things.

What we are talking about here is the actual version in the DOE regs, which in some cases is a moving target, but is a much slower moving target than the ASHRAE standards. You know, it is when DOE actually issues a new final rule, we adopt it with a compliance date of a new test procedure. That is when whatever is in our regulations, if it is different, if it causes changes in ratings, if it is a different test procedure, those base models would need to be retested.

So, that is what I meant there. That doesn't mean we shouldn't consider other things, and we are open to them. As you can see, we are open to a lot of changes here, but that is what the intention was there.

Hang on one second. Let me get to a couple of people on the phone because they have been patiently waiting for a while.

So, Tom Petrosino, I apologize if I am saying anyone's name wrong.

You should be on.

MR. PETROSINO: Yes.

MS. ARMSTRONG: Hi.

MR. PETROSINO: Hello.

My question relates to the highest-volume requirement for AEDM basic model testing. If we did a test in 2009 using the highest-volume basic model that year or expected for that year, and this year it is no longer the highest-volume basic model, but still a valid basic model, do we have to retest to replace that unit with today's highest volume?

MS. ARMSTRONG: So, I would say that we didn't specifically articulate one way or the other. So, do you have a suggestion, or does anyone else in the room have a

suggestion, as to whether it should be at the time of substantiation, whatever the highest sales volume is, or if that highest sales volume changes over time, whether that should also be lumped into the substantiation package?

MR. PETROSINO: My suggestion is that you not get into that kind of requirement because it is a constantly-changing picture. Would you have to monitor this daily, monthly, yearly? I think as long as you did the AEDM at a time and followed and it was applicable, and you didn't subsequently discontinue that model, and you have no other reason to repeat an AEDM, then I think it should stay.

MS. BARHYDT: This is Laura Barhydt with DOE.

In terms of the highest sales volume, since it is tied to the product class and not to a particular basic model, would that reduce the need to test something new? Does the highest sales volume product class

actually change that frequently?

MR. PETROSINO: The highest -- I am not sure I understand that question. Are you saying that, for a given product class, you want the highest-volume product class unit tested? I'm unclear.

MS. BARHYDT: Okay. So, this is different from the current CAC ARM provisions. What this is proposing is that, if you have models in multiple product classes, you look at where your highest sales volume is. Is it in the first product class, the second product class, the third product class? Whichever one has the highest sales volume, you select the smallest and largest capacity basic models from that product class.

And so, if your highest sales volume remains in that product class, then that is not something that is changing from year to year, would be my guess. But certainly that is something we would like more information on.

MR. PETROSINO: Actually, this is related to distribution transformers. So, that particular requirement would not apply.

MS. BARHYDT: Okay.

MS. ARMSTRONG: That's correct.

MR. WILKINS: Question. Robert Wilkins, Danfoss.

Could you apply some tolerance there on these kinds of things, maybe a little clause that says highest volume within the past three years or "X" years? So that you are not constantly having to shift from one, and, oh, my God, that shifted back to the other, and now I've got to redo it again.

MS. ARMSTRONG: Sure. Or, I mean, one of the reasons we migrated, I think, to the highest sales volume product class, because we didn't think it was as much of a moving target as highest sales volume model. But that being said, sure, there is always ways for improvement.

MR. KLEISS: There is a potential

pit there in terms of the boilers. I would say that the highest sales volume boilers -- well, no, I'm sorry. I'm thinking of residential. This only applies to commercial.

(Laughter.)

MS. ARMSTRONG: We're okay? Okay. Thank you.

Frank? And then, we will go across. Or either one.

MR. LORD: I think you are right. Take, for example, we do an AEDM on packaged rooftops. It goes 65 to 760,000, less than 65, or say it goes 65 to 760,000; 65 to 135 is always going to be the highest sales line. It is never going to change, not in that category, yes.

MS. ARMSTRONG: Okay. Thank you.

Frank?

MR. STANONIK: Yes, I would suggest that we should look at this as kind of analogous to certification versus verification, certification of a model versus

verification of your production.

The AEDM has to be substantiated as a valid tool. Okay? Whenever you do that, it only makes sense that you want to have that justification based on, let's just call it your most popular models. You want to have the closest correlation to the things you sell the most of. Okay?

But once you have got that substantiation, once you have determined, okay, I have a good tool and it meets the requirements of, let's say, acceptable predictability, or whatever, it is a valid tool until something changes relative to either test procedures or the minimums, or whatever, or you totally redo your product line or something.

But I don't think there is inherently a requirement here for, let's say, continued substantiation. Verification of your AEDM will occur as you go forward and models are tested under whatever program, you

know, randomly-selected models, or whatever. And that will either show that your AEDM was proper or not.

But substantiation, I think we should consider as a one-time thing until circumstances change. As a one-time thing, it should be based on, again, those things that you sell most of.

MR. FLY: Mark Fly with AAON.

I think one of the concerns here, especially in the substantiation, is not that we think that we are going to have a big tolerance on our AEDM, because if you put the same numbers in, you get the same numbers out every time.

But the test data, if we have a large tolerance like we talked about previously in the test data that falls outside, say, that 5 percent range, that is going to make it very hard to validate that AEDM or get that AEDM to tune within the average of these five or ten or twenty tests

that we have got.

So, the tolerance on the AEDM is really driven by the tolerance on the test more than anything else, assuming that we can all model our equipment and get it close to the reality, once we have the test data to do it with.

MS. ARMSTRONG: Right, and the tolerance on the test I think is already established in our regs, right? I mean, that is the 95 percent confidence limit thing, and that is established.

MR. FLY: But what's behind that, and is that really the right number?

MS. ARMSTRONG: I understand. I mean, I get that part, but that is established.

So, let me jump to one on the phone. Can you unmute Ron?

So, Ron, you should be unmuted now.

MR. SHEBIK: Hi, Ashley. I am

sorry, I wanted to go back to your scenario. You ran with 100 different models and how that compares to what is outlined on page 20.

I may have misunderstood or may have missed something, but you said there was 100 different models. And of those 100 different models, they are represented by 20 different equipment classifications.

Based on that, you came up with you test 21 cases. But when you look at page 20, it says you are testing a minimum of five basic models, including at least one from each product class. So, I just want to make sure I understand. How are you equating the 20 different equipment classifications to your basic models? Are you saying there's four product classes?

MS. ARMSTRONG: No.

MR. SHEBIK: Or are you saying the classification is equal to a basic model?

MS. ARMSTRONG: Yes. So, what I said was the 100 models span 20 equipment

classes. The first requirement on there means you need to test at least one from each equipment class, which would get you 20 that you would have to test, because there's 20 different equipment classes for those 100 models.

And then, No. 3, test the smallest and the 25 percent of the largest capacity, which would get you two units from one equipment class. So, that would add one more. So, you would test 21 of those 100, and then you could rate with 79, with the rest.

MR. SHEBIK: Okay. So, the equipment classification is equivalent to a product classification?

MS. ARMSTRONG: Product class, correct. Equipment class and product class are synonymous. One is commercial; one is residential. Sorry. Yes.

MR. SHEBIK: Okay. That is my confusion. Okay. Thank you.

MS. ARMSTRONG: Thank you.

MR. DAUGHERTY: Roger Daugherty, Baldor Electric.

I don't know if it might help if you sort of consider what has been going on with electric motors. Since 1999, we have been using this concept of the AEDM. It has the rule of trying to select at least one of the basic models from the highest volume of motor.

When you realize that once you have substantiated the AEDM, the manufacturer is using that AEDM not only to design motors that are in compliance with the efficiency standard level, but also with those motors that have to comply by being higher than that level.

So, when the next final rule came out more recently that raised those levels for electric motors, that same AEDM is applicable. There has been no change in the technology. There is no change in how you calculate the losses. The only change is in how much

material you put in to meet the new efficiency standards.

But that motor that you may be designing is the same one that you designed in 1999 for that same efficiency level. So, the fact that the standards changed really had no effect on the AEDM or its model. And so, consideration should really be given that, unless there is a real change in technology or the test standard, and not necessarily the efficiency standards, that you should not have to resubstantiate the AEDM just for changes in the standards.

But, again, I encourage you. This has been in place. It has been working very well since 1999. Look at the way that has been working. That might help you towards some of these other products.

MS. BARHYDT: This is Laura Barhydt at DOE.

One point I want to clarify is that let's say you had tested five models that

were all below the change in standards. Then, when the standard changed, you would end up with an AEDM that had no test data that actually showed a motor that met the new standard. If you had three motors that were below the new standard and two that were above the new standard, but that had been tested back before the new standards came into effect, you would effectively have two tests that could continue to be used to substantiate the AEDM. You would just have to test three new motors to replace those three that didn't meet the standard.

So, this proposal -- and this would apply to all the different product types -- the idea is that, if you have some of your tests underlying your AEDM that were well above the standard, and the standard changes, those wouldn't necessarily be kicked out. You could continue to use those. It is just that anything that didn't meet the standard could not continue to be used to substantiate that

AEDM.

Does that make sense?

MR. DAUGHERTY: But Roger Daugherty, if I could follow up on that, though. But when you substantiate the AEDM, you substantiated it, and, technically, usually, there are some motors that are tested that use a higher efficiency because at that time those might have been the ones that had the highest volume of sale.

But the AEDM is a set of calculations and simulations that determine how losses are calculated. As I said, that technology doesn't change just because you change the efficiency level. It only changes the components that you put in and the size of those components.

So, if that AEDM was substantiated by testing to those motors that had efficiency standards of 1992 that were in EPAct, and it worked for the motors that have premium efficiency levels, which are those that were

put in EISA in 2007, and it has been working since 1999, then why does it not continue to work just because you change the standards? There has been no change in technology, no change in the test standard, no change in anything.

So, if the manufacturer has been in total compliance with those premium efficiency motors using that AEDM, why would there be an issue now that, just because you change the standards and eliminated the production or distribution of motors of the lower efficiency levels below the premium levels, that that raises any issue at all with respect to the AEDM?

MS. ARMSTRONG: Okay. Harvey.

MR. SACHS: Harvey Sachs, ACEEE.

I have found this dialog just now between Laura and Roger to be very instructive. I would like to try to translate into terms that some of the rest of us may think about.

In particular, what I am hearing from Roger, as I am looking at polyphase induction motors as one large class, and I am saying that my simulation model for those will extrapolate well, that is, behave well, beyond the calibration dataset, which may not have included motors of as high efficiency as we are now selling.

And I am hearing DOE implicitly not ready to accept, and perhaps not understanding, as I don't, the limits of what that smooth extrapolation might look like. For example, again, in the motors class, it is not clear to me that this simulation for polyphase induction motors would work well on some other class of motors, that it would be applicable, just as I earlier asked whether an AEDM applicable to an electric resistance tank water heater would necessarily be applicable to a condensing-gas tankless.

So, I think that is where our misunderstanding is at this point. I hope

that is a helpful observation.

MR. VerSHAW: Jim VerShaw, Ingersoll Rand.

You know, when you think about -- and I will bring it back to air conditioning, what I know best. So, you have got the compressor and a couple of coils and some airflow, and whether it makes 13 SEER or 22 SEER, it is the same basic engine. So, if the standard currently is a 13, if it goes to 14, and because we had to do a lot of 13s because they are the highest sales volume, we were using that rating to do, that AEDM or ARM to do all those other ones. And it fundamentally doesn't change the physics. Now, if I put in a microchannel heat exchanger or if I put in some other new technology, that is another whole thing.

But the point, I think, at least from our aspect, if you are not changing technology, I am not sure why a change in standards or a model that drops out of

production is going to disqualify the AEDM.

MS. ARMSTRONG: But, Harvey, can I actually chime in on that one real quick?

That's fine. You can go next.

I guess from the Department's perspective, we based it off standards, understanding that technology changes may be needed to meet those standards. We don't actually know when a technology change will occur. We know when the efficiency level is going to change.

We don't necessarily know when the technology is going to change. And that technology change may be different timing-wise for different manufacturers. So, we don't know, like in your example, when a manufacturer is going to employ, say, microchannels to meet a given standard level or make that migration or a different type of motors.

And so, what we were trying to do here is just make sure that the AEDM is

current, that we don't have a situation for which the AEDM was substantiated in 1950 and hasn't been touched since.

And maybe that is okay that it hasn't been touched since or maybe it isn't. But that is for comment.

Harvey, do you want to go back since I kind of cut you off?

MR. VerSHAW: Well, first, 1950 wasn't that long ago.

(Laughter.)

It depends on your perspective.

MR. WILKINS: Robert Wilkins, Danfoss.

I think I understand your concern about extrapolation of performance outside of a certain range. I think the people have commented that maybe there is really not much difference between a 13 SEER unit and a 14 SEER unit. And so, why prohibit extrapolation?

But if you are going from 13 SEER

to 18 SEER, then you are deploying other technologies. You may have microchannel heat exchangers. You may have variable-speed compressors.

But maybe the answer is not to prohibit extrapolation, but put some bounds on it. So that maybe a bound of "X" percent improvement in efficiency would force the elimination of the extrapolation or a change in basic technology in the unit. Just add a little flexibility to it maybe is the point.

MS. ARMSTRONG: Sure. Go ahead.

MR. LORD: Yes, Dick Lord with Carrier.

What may be confusing a lot of people is that there are a lot of ways to approach an AEDM. Some of us think it is a full physics-based model with all the heat transfer coefficients. Somebody might take a simplistic approach and just say, "I've got a bunch of ratings. I am going to put factors up and down as I add features." And then, I

could see you would want to substantiate it because your base has changed.

So, a lot of depends on how you do your AEDM. You guys are not going to know that. So, you kind of in a way have to do what you are doing really.

MS. ARMSTRONG: Okay. Thank you.

Go ahead. And then, I am going to go to the phone.

MR. DAUGHERTY: Roger Daugherty, Baldor Electric.

I would just like to answer that the idea of extrapolation doesn't apply to the electric motors and small electric motors, at least as far as I know the AEDMs are. If you want more efficiency and you put in more material, if you put in six inches of core instead of five, you determine the losses in that six inches of core instead of the five.

You account for the change in copper wire that you had to put in. You account for the changes in the aluminum that

you had to put in the rotor. You are calculating five different losses in that machine and adding them up, and they are all very well-defined calculations and physics involved. There is no extrapolation that goes on.

Maybe part of the problem here is that we have not gotten to it yet, but the other part in Part 431 for electric motors and small electric motors is the revalidation that is done. And maybe that is where, by continuing to validate the AEDM over time, rather than go back and say, because the standard changed, now you suddenly have to go back and retest a certain number of models, and right now it is annual for electric motors. But this continual revalidation of the AEDM would take care of the issue of the AEDM being up-to-date when there are changes in standards, efficiency standards, and changes in test standards.

Thank you.

MS. ARMSTRONG: Okay. So, before I follow up on that idea, I am going to go to the phone for two things.

One, Kunal Kapoor.

Can you please unmute that line?

Okay. You should be good.

MR. KAPOOR: Yes. Hi. Ron Shebik already asked the same question I wanted to ask. So, no more questions at this time.

MS. ARMSTRONG: Oh, okay. Thank you.

Aaron Meyers?

MR. MEYERS: Thanks for taking my question.

My question is really related to timing as it relates to the highest-volume production basic model, or whatever, being tested, coupled with a change in the efficiency standard.

So, just to give you an example on this from the distribution transformer world, under normal operating conditions, the highest

basic model for our company -- it may or may not be this, but it is a very popular one -- would be 25 kVA, single-phase, with a primary voltage of 7200 volts, secondary of 122/40, 95 kV BIL. And the efficiency level would be the absolute minimum required by the DOE, so 98.91.

Now, if the efficiency level changes in 2016 -- say it goes up to 99 -- our most popular basic model from the last 12 months will be a non-compliant basic model. So, my question is, do we substantiate with the highest-volume basic model from the previous year, which would be non-compliant? I don't think that is an option, from what I am hearing.

Or the second option would be, do we take that basic configuration, so 25 kVA, 7200 volts, 122/40, 95 kVA or kV BIL, and say, okay, do I test that configuration with the new efficiency level? Because when we migrate to 2016, that will most likely be the highest

volume. Or do I look at what the highest volume was of a product that met the new standard, but in late 2015, so that I can continue using an AEDM once the new standard goes into effect?

And that could be just based on random luck, some customer who is buying a higher-efficiency unit than what is required by the standard 2015. And then, it would drop off the face of the earth in terms of production volume once the new standard goes into effect. So, there is really a lot of uncertainty there.

MS. ARMSTRONG: Okay. Thanks, Aaron.

MR. MEYERS: I know that was a mouthful. I don't know how you want to answer it, if you have clarifying questions.

MS. ARMSTRONG: I am going to try to answer it. We are going to see.

So, that is one of the reasons why we put "or the basic model which is expected

to have the highest sales volume for newly-introduced basic models." And maybe it needs to be expanded not only for newly, but continuation of existing. That is something we could do. But it would be your estimation of what you think the highest sales volume would be over the next year from when those standards come into effect, so that you could continue with your AEDM. It would not be the non-compliant model.

MR. DAUGHERTY: Roger Daugherty, Baldor Electric.

Maybe what is being overlooked is you have a very important paragraph in a conclusion of this section that you didn't put on your slide. And that is down on page 32056, under 429.75, and follow all the stuff, but it is the bottom of the left column.

"In any instance where it is not possible for a manufacturer to select basic models for testing in accordance with all of these criteria, the criteria shall be given

priority in the order in which they were listed. Within the limits imposed by the criteria, basic models shall be selected randomly."

So, if you read that, that may overcome some of the obstacles that are being imposed here, trying to follow every one of these items exactly.

MR. KLEISS: Jeff Kleiss with A.O. Smith and Lochinvar.

When you were going through the example, you know, your theoretical example with the coolers, I feel like I don't understand what I thought I understood about the process.

So, for our example with the boilers, dealing with commercial products, there are two different product classes, if I understand correctly. There would be the large and the small.

So, based on that, and say I have eight different families of models, are we

required to run only five tests, so that we would do two to substantiate our AEDM on the highest-volume product family, and then that AEDM could be applied to both different product classes and the eight different model groups?

MS. ARMSTRONG: Okay. So, not quite, but almost.

MR. KLEISS: Okay.

MS. ARMSTRONG: So, I am not sure I agree with the premise that there is only -- well, currently, there may be only two product classes for boilers. We should look at the product classes for commercial boilers. Hot water/steam, that impacts it as well. So, I am not sure I agree with you that that is the premise.

But if I did and it was two, your example, the number is six; it is not five. And it is six because the highest sales volume and the lowest has to be from the same. Well, I guess it could be five. It could be five.

I'm sorry. It could be five; you're right. So, you've got it. But I think your premise of two is not right.

MR. KLEISS: Okay.

MS. ARMSTRONG: And I can show you that in the regs.

MR. KLEISS: Okay.

MS. ARMSTRONG: Yes.

MR. KLEISS: But, just to be clear, we don't even have to provide test data from every family of models --

MS. ARMSTRONG: No. Once you have five, you can go.

MR. KLEISS: Okay. Thank you.

MS. ARMSTRONG: Unless, I mean, are you proposing something, that the Department consider something different?

(Laughter.)

MR. KLEISS: No. No, it is just -- thank you.

MS. ARMSTRONG: So, you support this as written, kind of?

MR. KLEISS: Yes, I do.

MS. ARMSTRONG: Okay. Thank you.

Frank?

MR. STANONIK: Well, I don't want to lose sight of this. But that puts a significant responsibility on the manufacturer to have a very robust AEDM. In your example, that would be able to encompass those eight model families. Okay? I mean, so it is not a trivial thing.

MS. ARMSTRONG: I will say, just as a follow-on, that with the rest of those model families, it is your responsibility to make sure those tolerances are kept. If you happen to do checking or whatever, if anyone else did checking, the 5 percent would need to come in. But the substantiation requirements for that example would be five.

Let's go here, and then we will go to Karim.

MR. HON: Okay. I have some very serious negative comments about this project

so far because a lot of the products that are on the market today are already regulated and standardized, and the testing should have already been completed for hundreds of models, not just a few.

That means that several of us who have what we would consider base models in the hundreds have already expended huge amounts of capital to develop information bases. And this is opening a can of worms that will be unbelievable because the next question I have for you is, how are we going to have, shall we say, protest of someone else's product?

Because the minute you start this modeling that you are doing here, you are going to open the can of worms that I don't know that the government can control, that we can come in and show that our competition is not within 5 percent or some target number of theirs.

And then, we are going to have this context started that no one will ever

stop on what is accurately rated, because their models aren't any good. There are some very unusual models in our industry that are very difficult to model. If I test one of those and come up with some idea of how it fits with all the other models, it may consume twice as much energy per unit as one, and then the next one which may be a little different, even though it fits in the same, quote, "category," it may have twice as much glass surface area on it, which means it is far less efficient.

But in the models, if you are only testing one unit, how do you know how that is? Your physics has to have a basis on science and tests. This is so broad and so encompassing when you have such vast product differences.

If you are a motor manufacturer, the motor manufacturer controls the components much more tightly than those of us who buy componentry and assemble the equipment. We do

not have control of the compressor. We can specify compressors. We do not necessarily have control, complete control, of the way the coils are built. We do not have complete control of several other components in the system, some of the controls sometimes. And any of these variables can suddenly blow up in our face. That is the nature of it. And so, we have constant, ongoing testing.

But this system could be relying on 10-year data, but all these variables may have changed. Without a consistent program of verification, without a consistent program set up so that protests can be built into it, we are just opening the door to do whatever anybody wants to do.

MR. AMRANE: I have a different question, related but different, though. And I am sorry if this question was addressed before; I was out of the room for a half an hour or so.

I think, as I read the NOPR, it

says that you have to test a minimum of five models, five different basic models to substantiate AEDM. But let's say we have a small manufacturer, and that small manufacturer has only two basic models.

It was already addressed? I'm sorry. Oh, we think alike? Okay.

(Laughter.)

So, I don't want to repeat the question then.

MS. ARMSTRONG: That is good for interoffice dynamics.

MR. AMRANE: But I think we need to revisit that because it doesn't make a lot of sense to ask a manufacturer with two basic models to test five units of the same two basic models.

MS. ARMSTRONG: I mean, I guess I am going to turn the question around. This does not indicate that the Department is not open to providing something like that.

But if you only had two basic

models, is it really worth the resources to come up with a simulation as compared to just testing it? I mean, are those provisions actually necessary?

I guess my preconceived notion would be it would be just easier to test them. But if there are just really two, and that is all you are going to offer -- I mean, this is really, you know --

MR. STANONIK: Absolutely. What resonated with me is more -- well, let's use as an example Jeff's boilers, okay? Let's say you have a boiler company that has been making traditionally atmospherically-vented products. Okay?

And at some point, they are developing a line of condensing boilers. Okay? And so, initially, this first offering is going to be five basic models with condensing boilers.

In that kind of a circumstance where the company is, let's say, evolving its

product line, that would possibly require a new AEDM. Okay? And in that kind of situation, to me, it would make sense to say, wait a minute, I shouldn't necessarily have to test all five to create, to substantiate the AEDM for this, in my case, this new technology that I am now making part of my product line.

So, that is kind of more the situation I was thinking about. Again, granted, it is going to be somewhat unusual because, obviously, you succeed in business by offering more models, I think, you know, having more flexibility for what your customers want.

But I think it is something we will try to work up a proposal that will fit.

MS. ARMSTRONG: Yes. I am actually going to ask some questions in the room. For those of you that may use simulations now to rate the equipment, either for residential settings or for commercial settings, do you have like one, what I would

call, AEDM and multiple different modules, either technology or whatever? Is it really one AEDM or do you have like a lot of different ones? And maybe it is variable depending on industry or by manufacturer choice. But I kind of want to know what you do now.

MR. LORD: I think we have tools -- this is Dick Lord of Carrier -- we have tools for designing equipment that can predict performance over a broad range from full load to part load.

What we are talking about is probably a different tool that we use for an AEDM that is tailored to just the specific ratings that are being certified. So, it is not going to be one and the same.

We were discussing this the other day. We may have one AEDM; we may have multiple AEDMs, depending on how broad we want to do it and how many units we are going to test.

I mean, we like the flexibility of the way you have outlined it. It gives us the prerogative on how to do it.

MS. ARMSTRONG: Okay.

MR. VerSHAW: Jim VerShaw, Ingersoll Rand.

For residential products, we have a design tool that predicts performance, and it is a 2x2 heavy-duty calculation method that we have adapted with other -- I didn't write it; you know, I am still in Fortran. So, it has got other subroutines on there that will bring in the highest sales test, the sales volume combination, make the adjustments so that the curves go through that point, so we follow the ARM requirements.

And then, we also build in some adjustments for issues we find lab-to-lab. So, it brings it down a little bit, depending upon what it is.

So, it is fundamentally the same tool we use for design, but it has got other

things added onto it, so we can use it to put ratings out.

MR. KLEISS: Jeff Kleiss with Lochinvar.

This could apply to multiple different boiler manufacturers, but, typically, we would test bookends for each different product family and then do linear interpolation between the two, possibly testing an intermediate size; either that or else test each individual model within a product family.

MS. ARMSTRONG: Sure.

MR. ROBERTS: Carl from Zero Zone.

In our case, in commercial refrigeration equipment, certain terms within the AEDM change with some of the design choices. So, the answer to the question would be we have several different AEDMs.

MS. ARMSTRONG: Okay. I just have one other question. I mean, it sounds generally like maybe the majority of you may

not have all the testing that would meet this criteria done already, but you may be a good way down that pathway. Is that a fair characterization? I mean, I don't think we were writing requirements necessarily that would make you start from ground zero.

MR. VerSHAW: Well, I guess I came in thinking we had to have third-party testing for this because that is the way the ARMS is.

MS. ARMSTRONG: No third-party testing.

MR. VerSHAW: But we have a lot more testing that we are comfortable with. Our biggest issue is going to come in the next section, where we are doing verification testing and the lab-to-lab issues and all that. That is where, actually, we have more trouble than anything else.

MS. HOOTMAN: Yes, I would agree on the commercial side we have this.

MS. ARMSTRONG: Okay.

MR. LORD: This is Dick Lord,

Carrier.

The same thing for us. One question I had for you, though. If you have a product that has two metrics, I assume you will still only have to use one unit to get the two metrics? Say, for example, a heat pump that has got a cooling and a heating --

MS. ARMSTRONG: Correct.

MR. LORD: Okay.

MR. KLEISS: I will say, within the boiler industry, often there are data points that are available to substantiate things. The problem is having the appropriate documentation to say that we have properly-calibrated instruments that generated that data. That kind of support is often not going to be there.

MS. ARMSTRONG: Okay. Thank you.

MR. AMRANE: Karim Amrane, AHRI.

Well, that is a product like, for example, walk-ins, which we don't have yet --

MS. ARMSTRONG: Sure.

MR. AMRANE: -- conservation standards.

MS. ARMSTRONG: Right.

MR. AMRANE: So, there is not much data out there.

MS. ARMSTRONG: Right.

MR. AMRANE: So, don't assume that everybody is on the same level playing field.

MS. ARMSTRONG: Definitely. Definitely. No.

Yes?

MR. ROBERTS: Carl from Zero Zone.

I think it is fair to say that this proposal is written in such a way that we are partway there.

MS. ARMSTRONG: Part? Part, we will take it. We will take something.

MS. HOOTMAN: Ashley?

MS. ARMSTRONG: Sure.

MS. HOOTMAN: Jill Hootman from Trane.

One thing that I did remember, you

know, yes, we have tools, and our AEDM is fit around both air-cooled and water-cooled and water-source heat pumps. I would say that most of the other water-source heat pumps manufacturers are probably not at the same point.

MS. ARMSTRONG: Okay. Thank you.

Okay. So, any other last-minute comments on selecting units?

(No response.)

So, I will, since someone brought it up, I will go ahead and open the floor.

Do you guys want to break for lunch or do you want to keep going? It is noon now.

Well, one, two, three, four, five, six, seven more, eight more slides. Now, that being said, probably at least an hour, if I had to guess. Two? Really? Okay, maybe two hours. Two hours maybe.

Lunch? All right, we will break for lunch. We will be back here at one

o'clock. So, an hour. Is that okay?

The cafeteria is downstairs. There is a Subway all the way down. And then, if you need to go to the cafeteria, you have to go to the first floor, down, and around, is the best way I can explain.

(Whereupon, the foregoing matter went off the record for lunch at 12:01 p.m. and went back on the record at 1:07 p.m.)

1

2

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

1:07 p.m.

MS. ARMSTRONG: Okay. Welcome back. I hope everyone had a pretty good lunch here at the DOE cafeteria or Subway.

We are going to move right into the number of testing rounds. So, current regulations -- and this was something brought up earlier for motors, which require one round for substantiation and, then, subsequent rounds or even on a regular basis, multiple rounds of what we would call the verification testing over time against your AEDM.

And the Department proposed to get rid of the second round of testing for what you would call subsequent verification of the AEDM and the NOPR, and add in requirements which would, for all intents and purposes, require that the models underlying the substantiation be current. So, recognizing that that, in and of itself, would require some probably testing over time.

So, what I am going to do is open the floor to the idea of not doing subsequent rounds of verification or even an annual basis of verification testing for your AEDM on a subset of models. And instead, leaving those requirements that we talked about before we took a break on the books or weighting those two.

So, I will open it up at this point. Anybody? Do we agree with the proposal?

PARTICIPANT: We do.

(Laughter.)

MS. ARMSTRONG: Okay.

MR. GARST: Yes, Mike with Lennox. We agree. No second rounds needed.

MS. ARMSTRONG: And so, you would be more in favor of requirements which apply to the models required for substantiation, keeping those current, rather than requiring periodic review and verification of an AEDM?

I imagine there might be some differences of opinion, depending on product type. And maybe not.

Sure.

MR. HON: In a dynamic market, I don't know how you can possibly expect a simple computer model to maintain itself without some verification, with all the engineering changes that are going on in some markets. In our market, I know that is a fact. There are so many new compressors coming out, so many new fan motors coming out, so many new coils coming out, and iterations of all that, if you don't verify them, I don't know how you are going to defend your position.

MS. ARMSTRONG: Okay. So, that was Charlie from True.

MR. HON: Charlie Hon.

MS. ARMSTRONG: And I have a question, actually, a follow-up question to that, or to anyone else who wants to speak to

this. So, if we do do some type of periodic review or verification, there are two ways we could look at this. One is that we keep the tolerances intact. And obviously, the tolerances stay, and we leave it to the manufacturers' discretion how many units they may want to test and check over time. That is one way. That is the way it has been done here. There is no formal requirements, acknowledging that manufacturers will probably do some type of audits to make sure their AEDM is valid over time.

Or we could do a more formalized proposal where the Department actually has certain set of requirements that apply on an annual basis for subsequent verification and for new models that may come out or changes that will be made over time. And maybe annual is not the right number. Maybe three years is the right number, maybe five years, whatever it may be.

But I am asking for different

opinions and pros and cons and ideas for what maybe the Department should consider with respect to those.

Sure, go ahead, Frank.

MR. STANONIK: Frank Stanonik, AHRI.

I am fully aware this is not part of this rulemaking, but the question you raise leads right to that point, that if there is recognition of VICPs it changes your question a lot because, in fact, if a company is participating in a VICP, there inherently will be, I will call it, continuous validation of whatever AEDM they used because the ratings of a particular model will either be verified or not.

And so, it is difficult to answer your question right now because, according to DOE's current schedule, VICP is another rulemaking, right?

MS. ARMSTRONG: Yes, it is. It is another currently ongoing rulemaking. And as

we learned this morning, speed of light here.

But I do have a question for you. That is great for those who participate in what we would call a voluntary industry program right now. And perhaps when we go down the pathway of looking at those more specifically in our regulations, that is one thing.

Do you think that that requirement should be applicable to a manufacturer across the board? In other words, either the VICP does it or a certain percentage of models should be verified, period?

MR. STANONIK: Going out a little bit on a limb here, I think the answer is, yes, in the same way that if a manufacturer -- forget the current subject, okay. But if I am manufacturing something, and I am interested in just putting out a product that meets my design, I have my own internal QC, right? It is hard to imagine the modern-day manufacturer doesn't have some level of QC that checks

their production.

So, I would say, just taking that basic concept, I could see where it would apply to efficiency ratings and, then, the AEDM.

MS. ARMSTRONG: This is Ashley from DOE.

Just a follow-on, as Mr. Daugherty explained earlier, for motors we have something more formal where there is like this periodic verification that is required. I guess, are you advocating that that actually is a requirement? Or should it be left to the risk and discretion of the manufacturer?

MR. STANONIK: Frank Stanonik, AHRI.

I think, because, again, we are talking about a huge variety of products, I think in terms of DOE's regulation, it should be left to the manufacturer to determine what is the proper level of checking, whatever we are going to call that. Motors may be a

unique situation, which I am not very familiar with.

MS. HOOTMAN: Yes, yes. Jill Hootman, Trane.

I would agree with what you said. I think it is the risk of the manufacturer. They have to determine -- I mean, obviously, federal penalties are onerous. So, I mean, you are going to determine some way to continually upgrade and continually maintain an AEDM in order to hold that risk inside, internal to your company.

MS. ARMSTRONG: Okay. Thank you.

Sure, Charlie?

MR. HON: This is Charlie Hon, True Manufacturing.

We basically worked on a statistical maneuver here to reduce testing. You are taking it from -- for us, it would be, giving a basic idea, we would be going from 700 basic models, which would fit into 20 different categories, and right now we are

required to do two per. So, over 1400 tests which have pretty much been completed; now go back and we could come up with 20 tests, highest volume, 21 samples. From 1400 to 21 is a huge reduction in validity. And now not certify those? Not have an ongoing basis for that? I don't understand that at all. I am just totally befuddled by this whole thing.

I can understand it used on certain applications and a need for certain applications, but how can you possibly turn, unless we have arduous and very strict enforcement, so that there is constant testing of product -- without that, we have competitors who cheat every day; we know that. They are thick. They are blatant. And the Department is well aware of some of them through the Energy Star programs and through just basic testing, in California problems that have developed.

So, they know that our industry is dirty. And yet, now we are going to have,

well, industry will monitor itself. That is tough to believe because right now we are not.

MS. ARMSTRONG: Okay. Paul?

MR. DOPPEL: Paul Doppel with Mitsubishi.

I think that there probably might need to be a requirement for manufacturers, even though they are coming up with their own AEDM, if the Department is thinking that verification is needed, then the VICP should be given the highest degree of authority or support to be that verification body.

MS. ARMSTRONG: Okay. Thank you.

Sure. Go ahead.

MR. DAUGHERTY: Roger Daugherty, Baldor Electric.

I guess I would just like to give a good plug for what is going on in the motor business. We have gone to the trouble of creating a laboratory accreditation program for testing. And so, all samples that are tested for certification have to be done in an

accredited test facility or one that is recognized as participation in a third-party independent certification program.

And so, we feel that we have got very good control over the testing that is done, the results that come out of the testing, and the tolerances that went into certification. The results of that testing are used to support the AEDM.

And again, I feel that I know we are in a very different situation, that we are talking about a product that is very well-defined by the physics of the product. We are not putting together a lot of different combinations of parts that alter the efficiency and characteristics. So, we are in a very certain situation.

But I would not like to see something go into the final rule that alters away from the way we are today. It is working. We have confidence in it.

Through NEMA, they have now

created a verification program that manufacturers can participate in as an independent party. We have a CSA and a UL recognized third-party certification program that we can participate in to cover the certification of products and verifications of the AEDMs.

So, I would just caution that, as I have expressed today, there are concerns that you are trying to do one-size-fits-all type of language in Part 429. Some of those parts don't seem to really fit and apply to electric motors and small electric motors. I would like however you can consider carrying forward what is in Part 431, as you move it to Part 429.

Thank you.

MS. ARMSTRONG: Karim?

MR. AMRANE: Karim Amrane, AHRI.

I guess I would like to respond to Charlie's statement about industry being dirty and industry policing itself. I mean, I am

not sure which product you are talking about, but industry has been policing itself for more than 50 years. We have certification programs in place that are very strong certification programs. Maybe you are referring to your own product; I don't know. But that is the general statement here. Let's be clear about this.

MR. NESHAN: This is Massoud Neshan.

And I would like, kind of in support of what Karim said, I strongly disagree with the language that was used, and maybe it is inappropriate to talk about it here. But this industry is not dirty, and I personally am offended by its being said that this industry is dirty. This is uncalled for.

MR. HON: I did not say which -- I said quite clearly, if you gentlemen remember -- this is Charlie Hon again -- there have been several incidents in California which we know have happened. They are documented.

They are in the court records. We have had companies reprimanded, companies fined. That's dirty.

If you are not on the other end of that, and maybe you are not, but we still have these players in the field. The players in this room know what they are doing because they are not the ones who are going to be violating the laws, but there are others who do. The players who violate the laws don't come to these meetings.

MR. KLEISS: I would just support the comment that was made of cautioning you against the one-size-fits-all kind of a ruling here, and the comment about having, say, compressors or components that can contribute significantly to the efficiency changing over time. That just does not apply to all types of products now. So, please bear that in mind when you are making the rules.

MS. ARMSTRONG: Sure. Thank you.

MR. ROBERTS: This is Carl from

Zero Zone.

I think it is safe to say that the manufacturers who are in this room, if you give them the responsibility for making the AEDM work, they have the ability to do that.

MS. ARMSTRONG: Oh, go ahead.

MR. GARST: Mike Garst, Lennox.

I want to make sure that we are clear here because you are using the word "verification" and we have substantiation and validation and assessment testing. Is verification the assessment testing or something else?

MS. ARMSTRONG: No. So, we are not talking about assessment testing yet. This would just be a second round of testing.

I'm sorry. This is Ashley from DOE.

We are not talking about assessment testing yet. This is just currently in the regulations for AEDMs there are two rounds of what you would call

substantiation and subsequent manufacturer verification before a full use of an AEDM can occur.

And for motors, there is a periodic verification. And this is all manufacturer-initiated. So, it has nothing to do with any DOE-initiated subsequent testing.

So, we had proposed to get rid of that second round. And it sounds like from what I am hearing that the majority supports that with the exception of one for HVAC and CRE, and motors seem to be working the way they are.

Not to say what the Department may do. And we encourage you -- I guess, you know, when you write written comments, maybe there is some middle ground here and maybe there is something -- I don't know what it would be -- but maybe there are ideas. You have ideas. I strongly encourage you to submit them. I mean, if you don't want verification or if you do but you want it limited or you

have other ideas, I strongly encourage you to bring them to the table because we are open at this point. Okay?

Okay. So, we kind of talked about this earlier in terms of AEDM validation and what we proposed. We didn't propose any specific frequency that the AEDM must be updated.

There was just a requirement that, No. 1, DOE reserves the right to request documentation underlying the AEDM at any point in time. You must retain documentation describing the AEDMs, supporting the test data and anything that goes into it; obviously, the AEDM itself. If you do any subsequent verification or auditing yourself, it would be a good idea to maintain that as well, and anything else you think to support your AEDM kind of substantiation and use package, as I would say it.

And so, with that, the only frequency we had in there was regarding the

test procedures and standards being current, as we spoke to earlier.

So, I think we talked about this, but does anyone else have any comments on frequency-type things or any other proposals the Department should consider about frequency of updating or maintaining or testing?

(No response.)

No? Okay.

Oh, please.

MR. LORD: Yes, this is Dick Lord with Carrier.

At the bottom of page 32046, in the left-hand column, it says, "DOE intends to address this topic further in upcoming certification compliance/enforcement rulemaking."

MS. ARMSTRONG: Uh-huh.

MR. LORD: That is talking about the documentation. Is there going to be another -- okay.

MS. ARMSTRONG: Yes.

MR. LORD: Which is great. The more you can document it, the better.

MS. ARMSTRONG: Right.

Okay. I am guessing this is where we have comments.

Assessment testing. So, from the March certification and enforcement rulemaking, DOE made it clear that we may conduct assessment testing at any time to evaluate compliance with our standards. The test results from one unit are compared to both the standard and the rating for the product. I realize for commercial equipment -- well, see, you guys have certified ratings or AHRI rating out there, and that is what we would use in our comparisons for now.

So, I will keep going for now. So, potential outcomes of an assessment test result. So, failure to meet ratings. In other words, if we test a single unit and the results of that give rise to a potential where the rating, something looks like it is off, we

propose that manufacturers must resubstantiate their AEDM within 30 days using the test data obtained from DOE-initiated testing. In other words, we would give you that testing. If you had a substantiation -- say you had just the minimum of five; you would add it as a sixth unit, resubstantiate your AEDM for any new ratings that come out that were less efficient, you would then recertify those ratings.

We wouldn't necessarily require any new testing. It is just that we would say, hey, here are the results from our tests; incorporate it in.

MR. AMRANE: Karim Amrane.

Just a question. What did you mean by something is off? If you are not within the 5 percent, is what you mean?

MS. ARMSTRONG: There is no 5 percent in DOE's reg, Karim.

MR. AMRANE: No, no, no, no. Let's say that you are rating your product

with an AEDM. Okay? Now DOE does a test. What will be the basis for DOE to say this is a valid test or this is not a valid test? We need to know that.

MS. ARMSTRONG: Okay. So, you are asking, if we went back and we had certification data that says, yes, this rating came from an AEDM, you're right, we would look at the 5 percent. You're correct. I'm sorry. I thought you meant --

MR. AMRANE: No.

MS. ARMSTRONG: Never mind.

So, the 5 percent tolerance, yes.

MR. AMRANE: Fine.

MS. ARMSTRONG: Yes.

MR. VerSHAW: Okay. So, I guess we go back to the earlier slide, the 10 CFR 429.70(c) -- this is Jim VerShaw from Ingersoll Rand -- 429.70(c) says that, if you test something that is bigger than 5 percent of the AEDM or 5 percent of your rating --

MS. ARMSTRONG: Five percent of

your rating from the AEDM.

MR. VerSHAW: Now, you know, that could be derated from what the AEDM would give you.

And the other issue is a single test? What about some kind of defect in that particular sample or what about a test that was not set up correctly, which happens a lot? Or not charged correctly? Or I don't know.

MS. ARMSTRONG: Okay. So, just some caution here. You know, if we had a test result back that, say, it looks like the certified rating is this and it looks like our test result is 8 percent off or so, the first thing I think we would do is just contact the manufacturer and have a dialog, about the test data, about the AEDM. And before anything was required to happen, we would have that discussion and to see where things --

MR. VerSHAW: Of course, you know, the way it was written, the way we read it coming into today, it didn't include that

step.

MS. ARMSTRONG: We're not that --

(Laughter.)

MR. VerSHAW: Well, if it is not written down, it is not done that way. This is the government here, right?

(Laughter.)

MS. BARHYDT: Go ahead, Frank.

MR. STANONIK: But I guess I want to try to make sure we have the same understanding. What is on this slide says, if DOE determines that the model fails to meet its certified rating, okay? Getting to that point involves several steps and is most definitely a process, possibly starting with testing one unit, but potentially testing some more.

But for DOE to get to the point that they can say, okay, we believe your model is not rated properly is, to me, that is a defined decision, and if that is what you are meaning here, then everything else makes sense

because, in fact, you have gone through your procedures and you have done the tests that say, wait a minute, this product is not rated correctly, and it is done. The decision is done.

And if you are at that point, then, in fact, the things you have under there I say would be appropriate and correct. But some of the discussion I was hearing was, okay, you pulled in one unit, and let's just say you weren't happy with the results of the one unit, okay? That is not the same as DOE has determined the model's rating is incorrect. That the start of the process. This is the end of the process, right?

MS. ARMSTRONG: That is correct --

MR. STANONIK: Okay.

MS. ARMSTRONG: -- for the most part. There is one caveat.

MR. STANONIK: Oh, okay.

MS. ARMSTRONG: This repercussion is, once DOE has made a definitive

determination -- and, obviously, there would be some discussions at the outset. What you said is multiple tests. That is not the proposal right now.

As it stands right now, we could have one test, but we would go through a process of which that test data could be scrutinized. Plenty of discussions could be had. We would also look at other test data that the manufacturer might have, a variety of different things before a definitive determination is made. But once it is made, this is the repercussion, that is, as proposed.

Sure.

MR. LORD: So, some unit does fail, and we all agree it has failed. So, I have five units. Going through the math, let's say, of those five units, I had one that was a plus 5 percent, this one is coming in at minus 6 percent. So, I have got to take this sixth unit and add it in. Do I throw that

plus 5 percent unit out because it is too good? The math doesn't kind of work, you know, because it has got to be within plus or minus 5 percent. So, I had five units before, one of which was at a plus 5 percent, a very good unit.

So, now we are saying, well, you have got to derate your AEDM because you have got a unit that is at minus 6. That is going to throw that plus unit out of the mix then.

MS. BARHYDT: Well, the plus 5 wouldn't be the very good unit. The plus 5/minus 5 is how close did your model come to your test result. So, I am just questioning your wording a little bit there because it sounded like that was a high-performance unit, and that is not what the AEDM is supposed to be.

MR. LORD: No, no. It is just a range of the units I have, just to give an example. It means that I can't meet that plus or minus 5 percent then. So, I will have to

throw one of the other units out.

MS. ARMSTRONG: So, I don't know if that is the case. So, for example, if you have one unit that fails, a determination is made that it failed the certified rating, and that unit happens to be 6 percent off, like you said, it may mean that your simulation is just off for that specific design or that product. It doesn't necessarily mean that the ratings for all the other ones would change.

MR. LORD: Yes. No, we had that discussion internally. It was not that we may have forgotten to put in a factor for coil coolings or something.

MS. ARMSTRONG: Correct. Exactly.

MR. LORD: You know, that fixes that problem.

MS. ARMSTRONG: But if you go back and it does result in other changes, you are going to need to have a substantiation package that then meets the criteria. So, if that change results in other models falling out,

you would have to then --

MR. LORD: Do it.

MS. ARMSTRONG: Yes. Correct.

MR. DOPPEL: Paul Doppel, Mitsubishi.

All the discussion has been centered around like one unit, the whole unit. And especially like if you have a heat pump, you can have multiple metrics for each. So, if there is just one of the metrics that does not meet the requirements, does that require resubstantiation of all the others as well or just that one?

MS. ARMSTRONG: So, regardless of one metric or two, if one unit fails, it requires resubstantiation of the AEDM with that unit. Now, that being said, if you rerun your simulation and your ratings don't change for anything else in that, then it is not a big deal, right? Nothing else has changed. Just that unit has been incorporated in. You fix that unit. You fix that rating. Done

deal.

Now, if you include it in and 50 percent of your ratings change to be lower because you forgot a loss or something that is applicable to like half your product line, then you need to recertify all those ratings that would result in less efficient and more consumptive products.

Does that make sense?

MR. LEWIS: Okay. To come back to one thing that Jim said, when you get to this stage, you are notifying the manufacturer that there is an issue. And when you do the testing that Jim has mentioned here, at the prior meeting we talked that the manufacturer will be notified. We would be able to go to that lab and not supervise, but review that testing? Was that not true? Because, then, how do we know that the test was operated properly? I mean, you are talking about our livelihood. You know, innocent until proven guilty. We need to be able to watch what is

going on to just say, "Wait, you just missed a step." I mean human error.

MR. DOPPEL: And the resubstantiation, that is a tremendous amount of work.

Paul Doppel, Mitsubishi.

MR. LORD: And what you really need to probably think about is some appeal process. Like, for example, a unit may fail in a laboratory. We take it back to our laboratory and say we didn't confirm that. You know, right now, with the ITS and AHRI program, there is a way to work through that. Because labs do make mistakes. Instrumentation goes off in a lab.

MR. VerSHAW: Jim VerShaw here again.

Remember, earlier a round-robin test at a third-party lab will get you a 4 percent swing. So, you could take that unit that came in at 6 percent below or 7 percent below, put it in another room, test it the

next day, and be 2 percent low or 3 percent low. And if you hadn't done the first-day test, you wouldn't be talking to us. And we didn't do anything different.

MR. FLY: Well, and remember, that is in the same lab, too, being calibrated against each other. So, lab-to-lab, facility-to-facility, it may be higher than that. I don't think anybody in this room knows for sure that plus or minus 5 percent, or has any data that says plus or minus 5 percent is the right number. So, if the number is plus or minus 10 percent, proven through some big study with round-robin tests, you know, I can selectively go through and find the 5 percent that will meet and validate my AEDM, but the first time you test one outside of my window of tests, then I could invalidate my AEDM and I am back to ground zero again.

MS. ARMSTRONG: Let me switch to the phone because we have a couple of people who have been waiting patiently.

Jeff Bauman, do you want to speak?

MR. BAUMAN: Yes. Am I there?

MS. ARMSTRONG: Yes, you're good.

MR. BAUMAN: Okay. I just had, going back on the verification, it is a little late getting back to it, but -- from Continental Refrigerator, Jeff Bauman, hopefully one of the people who is not considered dirty in this industry. I think it is a good industry, reliable, but yet there have to be checks and balances in place to make sure that people who might not try to do things the right way are not able to do that.

One of the things that has been discussed and proposed to EPA, and possibly to DOE, as far as Energy Star, and I would like to put it out there for consideration on this side, too, is using component verification instead of actual retesting on a regular basis to verify the proper components and, basically, the products that are being built are what the manufacturer has claimed in their

original studies with their energy consumption, or whatnot.

I know some of the issues that happened in California were with the manufacturer basically claiming or saying that the product that was made, that was tested and failed was not actually the same product it was supposed to be, and it was kind of a back-and-forth there. But it certainly seemed to be a component issue there.

And I think that if there is a set of criteria that says, okay, these are the components that make up that unit, and groups such as UL inspector or an NSF-type inspector on a regular basis is doing a blind factory audit, that they be able to cover and check those things and have a more accurate and more comprehensive evaluation.

Thanks.

MS. ARMSTRONG: Thank you.

So, one more from the phone before we turn it back over to the floor here.

Craig?

MR. MESSMER: Yes, hi, Ashley.

MS. ARMSTRONG: Hi.

MR. MESSMER: This is Craig Messmer from Unico.

On your slide, you say, "It fails to meet its certified rating." Are you talking about the rating or the minimum efficiencies? Because what is DOE trying to achieve here? What is their interest level?

MS. ARMSTRONG: So, on slide 26, we actually talk about the rating. When we get to slide 28, we will be talking about standards. Okay?

Anyone? Oh, go ahead.

MR. HON: There was a question posed about validity. We have done some validity testing, taken the same unit in the same test room the next day, and started the test again, changed the legitimate conditions within the parameters of the test standard from high to low on the range of internal and

external temperatures, and found a 7 percent difference in the same piece of equipment, all within legal limits of the test standard.

It is 38 plus or minus 2. We would run one warm voltages. We would crank the opposite direction and go high to low voltages. And by changing two parameters of the test standard, which there are more than that, we changed the outcome by 7 percent.

MS. ARMSTRONG: Thank you.

Sure.

MR. DAUGHERTY: Roger Daugherty, Baldor Electric.

To follow up on the issue of where a piece of equipment may get tested, again, going back in the history of electric motors and conducting round-robin testing, in a NEMA standard the value of efficiency of any particular unit out of the basic model, out of a population, could have total losses approximately 20 percent higher than that of the NEMA nominal efficiency value.

Based on the round-robin testing and the variation that was observed in it by testing in different laboratories, then when we were working with DOE to establish the tolerance requirements for the sample testing of five units of a basic model -- I am not talking about this 10 percent thing that deals with the AEDM. But the issue here under meeting certified rating is that testing of that sample of five.

And while the round-robin testing and everything supported that 20 percent variation, when the rule was written into Part 431, DOE discounted the variation between laboratories and only accepted the variation of testing performed in the same laboratory, because the manufacturer most typically will do all of his testing of that particular size unit in the same facility rather than shipping them around. Okay?

So, the tolerances that are based upon certification of the efficiency rating

for an electric motor of a sample of five is based upon testing only being performed in a common facility by that manufacturer. So, yes, he does have the possibility that, if that unit or the five were tested by someone else in some other facility, that he could be outside of the allowable variation.

And so, DOE could make a finding and question that rating, that certified rating, while the manufacturer's test would have supported that rating. Okay?

So, yes, variation between test facilities is very important. And so, some of that process needs to be included when you are going to into enforcement.

The other concern we have with enforcement is that we have one set of criteria for approval of a sample when the manufacturer is certifying the product. And that is based upon percent of total losses over the average of the sample.

In enforcement, the rule is

written around a lower control limit of the 95 percentile of the T-distribution, a totally different concept. So, when a motor is examined to determine if it meets its certified rating under enforcement, it is a different rule that is applied than is applied when the manufacturer actually certifies the product.

And then, we have the rule against the AEDM that he may have actually used to certify that particular one that is now being tested under enforcement.

But we do realize that within the enforcement procedure there are the processes of the consultation with DOE to try to resolve any differences that were observed before it gets into a finding that you actually are in non-compliance.

MR. GLATT: Helmuth Glatt, Nidec Corporation.

I just want to expand on what Roger has been saying. It is possible, under

I think Part 431, that we already have the rule in place, that of that sample of five motors, the average of those shall be within 5 percent of the NEMA nominal efficiency. But one unit could possibly be as low as 15 percent below.

So, in that case, if you happened to pick that particular unit for this testing, you will have us requalify the entire AEDM. So, while we are okay for compliance, we would still be okay for compliance, but yet the AEDM, which already showed that the product was in compliance, would be out of compliance. So, it is confusing.

MS. ARMSTRONG: So, I do just want to make one thing clear. And maybe this is something just generally I am not sure that everyone recognizes.

If we talk about testing and we take away the AEDM for a second, if the Department were to pull a unit for tests and you had certified your rating using testing,

too, running the sampling statistics and coming up with their certified rating, then sending that to the Department, if we were to subsequently test one in a lab and we got a number that was, you know, different than your certified rating -- let's say it is 8 percent off, just for lack of a better -- we would do the same thing. This exercise would be the same regardless of whether you did testing or whether you used an AEDM.

We would come to you. We would say, "Here's the testing that we got. Let's see your test data." We would go through that same process.

So, from the Department's perspective, we didn't understand why, just because you are coming up with a simulation, or coming up with a number with a simulation, why that process should necessarily be different. And maybe it should; maybe it shouldn't.

So, I just want to make clear that

this is the same process that we use if you had tested. I don't know if that changes anyone's opinion of things. Or perhaps it changes our opinion of where we did the other thing.

MR. VerSHAW: Well, Jim VerShaw here.

So, the steps that the Department would take on getting a test that was 8 percent low, where is that written down? And if you two folks aren't here next year, God forbid, would the next folks follow the same rules and processes that you were just discussing?

MS. BARHYDT: The processes are all in Part 429, Subpart C.

MR. VerSHAW: Well, I thought in there it said, if you get a unit that falls below the -- and we are not talking about 18 -- below 13, you immediately test more units. It didn't say anywhere in there that you are going to talk to the manufacturer.

MS. BARHYDT: Well, what it says is that, if the Department has reason to believe that the product is non-compliant, that is not necessarily that it is half a percent below the standard. So, first of all, there is not an absolute cutoff there. So, if the Department has reason to believe DOE will, DOE may -- and even that is not a will; it is a may -- proceed with enforcement testing.

In order to proceed with enforcement testing, we have to contact the manufacturer. That is in the regulations. It doesn't lay out a specific we will talk to you for "X" amount of days and all kinds of things like that.

MR. VerSHAW: Well, I know that.

MS. BARHYDT: But we have to contact the manufacturer because the manufacturer has to provide the units for enforcement testing.

MR. VerSHAW: I thought you just asked us for units and be done with it.

(Laughter.)

MS. BARHYDT: No.

MR. VerSHAW: That is the way it was written. I'm sorry.

MS. ARMSTRONG: And one thing to make just one distinction here is what we are talking about here is the ratings. I realize it could be very different. I mean, something could be rated at -- I don't know; I am just going to make up a number -- 15 EER, and in that case there is no question about the EER standard. At that point, it is just a ratings thing. It has nothing to do with compliance with standards or enforcement testing. So, there is a nuance there that is different.

MR. VerSHAW: Well, yes, but -- Jim VerShaw again -- but --

MS. ARMSTRONG: But we would still talk to you.

MR. VerSHAW: Pardon me?

MS. ARMSTRONG: We would still talk to you.

MR. VerSHAW: I know, but the ramifications of missing a rating and having to redo an AEDM and changing other ratings is pretty big, regardless of whether it is at 13 or 18.

And if you think about it, if I had to -- luckily, I don't do anything over 5 tons, but if I had to do the stuff that Jill has to do, I am not sure I could get all those units built and tested in 30 days.

MS. ARMSTRONG: So, step back.

MR. VerSHAW: Yes.

MS. ARMSTRONG: Why would you need to build and test? There is no testing requirement here at all. All it says -- see at the bottom; there is no new testing.

So, all we are saying is take our test point --

MR. VerSHAW: Okay.

MS. ARMSTRONG: -- and plug it in.

MR. VerSHAW: So, you take your test point and plug it in, and, all of sudden,

it doesn't meet the 3 percent anymore.

MS. ARMSTRONG: Then, you would have to have another unit, maybe a seventh. But not like all of them. I mean, I guess that is what I am trying to understand.

MR. VerSHAW: Well, we are, too.

MS. ARMSTRONG: Where is the balance there? I mean, at some point, we require, once a determination has been made for testing purposes as it relates to the certified rating, if you were testing and came up with a rating, we require a rerate if we go through that process and make a determination. Why should this be any different?

MR. VerSHAW: Well, go ahead.

MR. AMRANE: Karim Amrane.

I guess it is a good question. Then, I would ask you, then, at least for the AEDM, it seems to be clear to me that you test the unit. You compare the rating with the AEDM. If you are not within 5 percent, you might trigger additional testing, right?

But if you had tested a unit, instead of using an AEDM, there is not such a thing written in the regulation today. It is very vague. It is up to DOE to decide what is good, what is not good enough, I guess. It doesn't say that if you are within 5 percent, it is okay; we will not do additional testing. It doesn't say anything like that.

So, let's be consistent then. Let's put the 5 percent in that part of the regulation as well, so at least it is consistent.

MS. ARMSTRONG: Thank you, Karim.

MR. FLY: You know, a lot of this could go away if we would only require one side, you know, downside tolerance on this. The plus or minus is the thing that is really -- this is Mark Fly with AAON -- that really concerns me about the whole AEDM and the testing part.

Because if we discover that the lab-to-lab tolerance, or whatever we decide

tolerances, are much bigger than 5 percent, we can knock our AEDM down 5 percent and cover everything that we need to cover. But the plus or minus, you know, my concern is not the computer program; it will give the same number with the same input every time. My concern is the testing that you have to support the computer program with.

MR. LORD: Well, I was going to maybe try to answer at least the way I was interpreting it. When you do your AEDM, you use the plus or minus 5 percent. If you conservatively rate and the testing comes in better than 5 percent, she is not going to say anything to us. She will send us a gold star.

(Laughter.)

MS. ARMSTRONG: Yes, I mean, that is exactly right. I mean, if you have rated conservatively, regardless, we are happy. That is great. The consumer is going to get that or better, right?

It is when you get to the negative

8 percent or the negative 7 percent that we are going to come knocking at your door and say, "Hey, we need to have a really friendly discussion."

MR. FLY: But at that point, you are going to get into the middle of our business about how we put the AEDM together, because at that point you are asking for all this documentation on our AEDM.

MS. ARMSTRONG: We will be asking for stuff, some stuff, correct.

Sure.

MR. LORD: We may want to talk more about the 30 days. Because even if you didn't have to test another unit, we might say, well, we question that data. We want to put it in our laboratory. We want to run tests.

MS. BARHYDT: This is after the final finding --

MR. LORD: After the final finding.

MS. BARHYDT: -- after everything, all the discussions are done.

MR. LORD: That is about three years. We've got lots of time.

(Laughter.)

MS. ARMSTRONG: It can be.

MS. BARHYDT: In all honesty, it can and does take more than 30 days. This is 30 days after the final determination.

MR. DOPPEL: Does it specifically say that in there? I don't remember seeing it, 30 after final determination.

MS. ARMSTRONG: It does. It does.

MR. DAUGHERTY: Roger Daugherty, Baldor Electric.

If I could back up to one statement that you made, you were saying that the manufacturer would not necessarily be required to do additional testing due to this particular unit not meeting certified rating, but that they were to take DOE-supplied test data from a separate laboratory and

incorporate that into their AEDM, which has been based around their testing in their facility, and does not necessarily accommodate results obtained in a different test facility.

And I don't know that manufacturers would really want to do that, to, for lack of a better word, contaminate their AEDM by using data from an unidentified and uncontrolled facility against all their other data.

MS. ARMSTRONG: Okay. Well, so that is the proposal. The unidentified uncontrollable would always be a third-party lab, like a third-party lab you guys would use for certification. So, it may be a mix. You would know what lab it is from. We would turn over our test data, and you would see everything.

You may still have the same opinion about whether it should be used or not, but just to clarify, those are some of the things that would happen.

MR. DAUGHERTY: Roger Daugherty.

Yes, I guess I would say I don't have such a problem in the motor industry. But from what I have been hearing about the other industries and the way testing is done in laboratories, I guess I was raising an issue for them and not necessarily for the motor industry.

MR. LEWIS: I'm confused. If you are going to tell us after the test where it was tested, why couldn't you tell us before the test, put a gag on us, and let us just watch the test? Then, we don't have the variation worries. I mean, what am I missing?

MS. BARHYDT: So, we have actually been actively doing enforcement testing. And I can tell you from experience that having people watch a test does not at all impact the challenges to the test. It does not seem to raise the level of comfort with the test. Honestly, it doesn't change anything.

So, from the Department's

perspective, we are confident that the test is being done in accordance with the DOE test procedures. That is not to say that every last tweak that the manufacturer may have instructed the lab when they had it certification tested was done, but we are confident that the test is being done in accordance with the DOE test procedure.

MS. ARMSTRONG: Once we make that finding.

MS. BARHYDT: Yes, and that is the other thing, is that if the test is done and we give it to the manufacturer, and the manufacturer finds something wrong with it, we redo the test. This isn't a "well, too bad, it's all over, a done deal; you're just stuck with it." I mean, it is an actual dialog. It is in our interest as well as yours to make sure that all of our decisions are based on valid test data.

MR. LORD: Dick Lord with Carrier.

One of the things that can help a

lot of times is you can allow the manufacturer to be there to commission the unit to make sure it is running properly, then ask them to leave the room during the test. Because a lot of this big commercial equipment is extremely complex, and the average person cannot set it up right.

MS. BARHYDT: This is Laura Barhydt, DOE.

A real quick follow-up question. Are these pieces of equipment that you require the setup for your own representatives to be present for setup or are these things that third parties may set up as well?

MR. LORD: Yes, this is kind of like the statement we had earlier --

MS. BARHYDT: That is why I was asking.

MR. LORD: -- that we put in our literature, factory commissioning required.

MS. BARHYDT: Okay.

MR. LORD: And we actually charge

the customer for it.

MS. BARHYDT: Okay.

MR. GARST: Mike Garst with Lennox.

I just want to make sure we understand on this. On the plus side, we talked earlier on substantiation, that we wouldn't be concerned about the plus. I think you were going to agree to do that.

But on the assessment it says that it has to be within that. So, as long as you agree on the substantiation, then we are good. I just want to make sure.

MS. ARMSTRONG: We agree and we can clarify that. We have no problem, rate conservatively all you may want.

Anybody else? Anybody else have any comments?

(No response.)

Okay. So, we had a question from the phone, but I am not sure I can answer it off the top of my head.

"But, as an example, if DOE minimums required an energy consumption that is 11 kilowatts per day, if the AEDM indicates that the CRE consumes 9 kilowatts a day, but the published rating by the manufacturer is 10 kilowatts a day, what are the implications?"

So, we compare the 9 to the 10, right. I think we are good to go. So, the rating is 10. The test data is -- so you are good on the standard because it is 9 to 11, right? So, conservatively rated. You are good and you are conservatively rated. It is fine.

Okay. Yes?

MR. HON: Would you notify the manufacturer that the rating was higher? Because that may question his validation of his system, if he is that far off on the other direction, that he didn't down-rate the product, but, actually, his model said it would be that way. He may need to know that to consider his modeling to be different.

MS. BARHYDT: In the hypothetical, there was no actual test data.

MS. ARMSTRONG: The AEDM and --

MS. BARHYDT: Oh, okay. I thought that was the standard.

MS. ARMSTRONG: Yes, they just said as a simulation and that is certified. So, there was no test data.

MS. BARHYDT: Yes, in the hypothetical there wasn't any test data.

MS. ARMSTRONG: Generally, I guess it is a question, even if we don't have a ratings issue or a compliance issue, is there general interest to know what the results of any testing the Department does is?

MR. HON: Charlie Hon.

That is the reason I asked the question, because if it is showing much better, then our models may be wrong. We may need to change our modeling technique.

MS. ARMSTRONG: Okay. So, I think, generally, the Department is working

toward making available its test data from those things that it has tested that are not subject to ongoing enforcement cases. So, there are plans in the works to make all the test data, whether it is being done for Energy Star assessment, et cetera, available.

Yes?

MS. MEYERS: So, Ashley, this is Karen Meyers with Rheem.

When you say "make the information available," is it available to the manufacturer or to the public?

MS. BARHYDT: To the public.

MS. MEYERS: This is Karen Meyers with Rheem.

I just have one other. It is not on? Yes, it is.

So, just listening to the conversations going around today, DOE seems to say rate conservatively, we like you to rate conservatively; you are not going to have any problem if you rate conservatively, where, as

a manufacturer, what I want to do is rate accurately. If the DOE regulations are so burdensome that I have to rate conservatively, then to me there is a problem with the DOE regulations. Because I think it should be the purpose in this room between manufacturers and the government to rate accurately.

I am just concerned with all of these different comments about how manufacturers are having to do their ratings to meet the burden of DOE. It seems like it is a little -- you know, at the end of the day, it is the consumer or the building owner or someone who is actually getting hurt.

And so, it is just a general observation that I think needs to be part of the public record that DOE is forcing manufacturers to rate conservatively, so that there are no issues with this process.

MS. BARHYDT: This is Laura Barhydt at DOE.

I wouldn't say that we are

encouraging conservative ratings. We certainly permit conservative ratings. It is entirely up to manufacturers how they choose to rate.

I will say that the certification statistics in the regulations are set up to cause a little bit of a conservative rating, but that has been part of the regulatory process, the whole framework, for decades.

So, beyond that little bit that is built into the certification statistics, any additional conservative rating is entirely up to a manufacturer. And we are not advocating or discouraging that practice.

MR. DOPPEL: Paul Doppel with Mitsubishi.

When you talk about releasing test information, I mean, to what extent are you going to go? Are you going to release the entire testing results? Or is it just certain criteria like where it was compared with the metric? Because, otherwise, I think some

manufacturers would object that maybe it is releasing too much information.

MS. BARHYDT: Complete test reports.

MR. DOPPEL: Complete test reports?

MS. BARHYDT: Yes.

MR. AMRANE: Karim Amrane, AHRI.

I guess, what would be the purpose of releasing the complete test report? I mean, for whom? For the consumer? Who is going to be interested in the complete test report?

MS. BARHYDT: So, obviously, there was a federal expenditure of funds for DOE testing, and this is just part of the transparency of the government providing to the public the information paid for by the American taxpayers.

MS. MEYERS: Laura, this is Karen Meyers with Rheem.

Does that requirement, though --

you know, I understand spending government funds and stuff, but why to meet that requirement does it have to include releasing the entire test report? Because I am afraid there could be some CBI information in there. And so, that would be some concern from my part.

MS. BARHYDT: The information in the test reports is all information that any party who purchased a unit and paid for testing would be able to have. There is nothing in that test report that we have obtained from the manufacturer.

So, everything in the test report is publicly accessible. And the Department has previously taken the position that test reports paid for by the Department are public and do not contain CBI.

MS. MEYERS: Where is that information publicly available today?

MS. BARHYDT: I am not exactly sure what you mean, but the test procedure is

public. And a person could buy a particular unit and they could pay a test lab to do a test, and they would get that same information. There is nothing in that test report that came from the manufacturer.

MR. DOPPEL: This is Paul Doppel with Mitsubishi.

This is an exception to that. Any manufacturer -- and it is not just VRF manufacturers, ductless manufacturers -- there are several companies that have variable-speed equipment. For like a heat pump with a variable-speed compressor, 10 tests are required, and the compressor frequency is provided by the manufacturer for each of those tests. That would be company-sensitive information.

MS. BARHYDT: So, Paul, so far, we haven't tested any VRFs.

(Laughter.)

MR. DOPPEL: Well, I know, but that is why we are concerned.

MS. ARMSTRONG: We would have to contact you. You would know beforehand.

MR. DOPPEL: Right. But, still, releasing that information is --

MS. ARMSTRONG: That's fair.

MS. BARHYDT: No, that is fair.

MR. DOPPEL: Okay.

MR. LORD: Yes, Dick Lord, Carrier.

I mean, a good engineer, if he gets his data, can sit down and reverse-engineer that unit. So, I could take a competitor's unit, look at his test data, and say, okay, this is where he runs that condensing temperature, saturated suction, get all the performance, which I really shouldn't get.

MS. ARMSTRONG: Are you really going to make me ask this question? Do you currently test your competitors' products to get that information anyway?

MR. LORD: Yes, but now I get it

free. Now I get it free from you.

(Laughter.)

MS. ARMSTRONG: Let's be honest here. You have it anyway.

MR. LORD: No, you know, I could see the key metrics that are important to the ratings, but all the test data.

MS. MEYERS: Yes, this is Karen Meyers with Rheem again.

I think having it on a public website is going to make reverse-engineering paramount. I mean, that is what everyone is going to do.

Today, if we have to go out and buy one of those units, bring it into the test, tear it down, do the analysis, it is a much more burdensome deal. So, sure, we constantly test each other's units, but it is way different than having it on a public website, where not only U.S. manufacturers, but foreign manufacturers and everyone else can reverse-engineer the unit.

So, for the record, we are going to be totally against releasing the entire test report. And I don't think that it is necessarily required.

I agree with Dick Lord; you can release key points of the test data, but the purpose of putting the whole test report out there is just lost on me.

MS. ARMSTRONG: Okay. Thank you for those comments. We will take that under advisement, but we have ranged far from the actual topic of this public meeting. So, let's get back to AEDMs.

So, we are talking about potential outcomes of assessment testing when the results of the single-unit test indicate that there may be a reason to believe that DOE should undertake an enforcement investigation.

And so, this is actually if we would go forward with enforcement testing as if, you know, the same thing, regardless of whether the unit was rated with AEDM or the

unit was tested. We would go through our sample size of four for the low-volume, built-to-order products.

And then, if the enforcement testing results definitively come out in non-compliance determination, so after all the discussion, after the testing results have been reviewed, after everything, if the definitive determination is made, these would be the repercussions of a unit that was rated with an AEDM that is found to be non-compliant.

Obviously, as with everything else, all other models within that basic model, they are deemed non-compliant. That is the same regardless of whether it is tested or an AEDM.

If the basic model was one of the ones used to substantiate the AEDM, is found non-compliant, that one can no longer be used for substantiation. It must be redone. You rerate and recertify all basic models as

necessary.

So, any questions there? Any concerns there?

Sure.

MR. LORD: Yes, Dick Lord with Carrier.

This is where the 30 days may be the issue, like if you have to get another unit. Like, for example, on large unitary, we have a 90-day lead time in the ARI program to get a second sample because it takes that long to build them.

MS. BARHYDT: So, obviously, we are proposing 30 days. If you think that that is not sufficient, we welcome those comments.

Another possibility would be to specify some normal period of time and specifically say that DOE will work with you. We have some language sort of to that effect in some of the enforcement testing provisions as well. So, we would certainly welcome comments on that.

MR. DOPPEL: Paul Doppel from Mitsubishi.

Also, if the product comes from Asia, then it will take much longer. It could be 60-plus days to get here.

MS. ARMSTRONG: Okay. So, it might be that case-specific language is better, in which case the Department would just work with the manufacturer.

MR. FLY: Mark Fly with AAON.

MS. ARMSTRONG: Yes?

MR. FLY: Now you said, basically, we are going to have to rerate everything within the basic model or the equipment class?

MS. ARMSTRONG: So, what this basically says that you would have to do is, if one of your substantiation models is found non-compliant and you bring a new model in, any of the models that were rated using that old, what I call, AEDM, as opposed to the revised AEDM, if the ratings change to be more consumptive or less efficient as a result of

any revisions made, you would need to rerate and recertify those.

MR. FLY: Okay.

MS. ARMSTRONG: Yes. Anyone else?

(No response.)

Okay. And then, this is just a general DOE proposal to disallow the use of an AEDM following multiple instances of non-compliance or if there is evidence that misrating was willful. So, this is just consistently on a regular basis, you know, the ratings are off coming out of an AEDM. DOE reserves the right to disallow the use of an AEDM altogether.

MR. LORD: It is a little open. You know, we like more specific, especially being engineers.

(Laughter.)

So, 2.5 would be good, you know, or something.

MS. ARMSTRONG: Do you have suggestions for specifics that you would like

to see?

MR. LORD: We will provide some comments. We will think about it, yes.

MS. ARMSTRONG: Okay. Thank you.

MR. VerSHAW: Yes, this is Jim VerShaw.

It is kind of hard to determine the definition of willful. It could just be bad engineering.

(Laughter.)

MS. BARHYDT: I think when we drafted willful, what we were thinking of was something more along the lines of, we look at your AEDM and it turns out that what came out of your AEDM bears no resemblance to what you actually rated it at.

MR. VerSHAW: Yes, yes.

MR. BOESENBERG: Can you provide or I guess I would like to have a dialog about the definition of multiple instances? In one of these ones where there is thousands of products being represented, you can have

multiple instances, but it is less than 1 percent or something like that.

MS. ARMSTRONG: I think that gets to his question earlier. We left it open, and if there are specific suggestions about what bounds that range or what the Department should consider, we welcome them.

MS. BARHYDT: One other thing I would note is that this is multiple instances of non-compliance, which means that we have gone through this process multiple times, which it is a very long process to get to a finding of non-compliance.

And so, if we have gone through this -- I am just throwing out numbers; I have no idea -- but three or four times over months, and possibly even years, and the manufacturer is still not producing an AEDM that can accurately rate its products, I think we would have serious doubts about the ability of that manufacturer to produce an AEDM that could accurately rate the products.

MS. ARMSTRONG: I think just an analogy there would be the same thing about doing in-house testing. If we went through multiple rounds where in-house testing has resulted in just wrong ratings over and over again, and we actually found non-compliance, not misrating, but non-compliance out of those multiple times, there may be need for a discussion of moving to third-party laboratory testing solely at that point. So, it is kind of synonymous at that point.

Okay. Moving along, I think we already hit this one for the most part. This has to do with the resubstantiation test procedure standard or if you discontinue a model that you used to substantiate your package, but I will put this up again in case anyone has any last questions or comments.

MR. AMRANE: I have a question.

MS. ARMSTRONG: Sure.

MR. AMRANE: This is Karim Amrane, AHRI.

I guess with respect to changes to the test procedure, I don't know if it was addressed before, but sometimes test procedures are amended, but then there are not substantial changes made to the test procedure. It could be, I mean, our standards that are referenced by DOE, our AHRI standards are changed all the time. And sometimes that has no impact on the energy efficiency of the product.

So, I think we need to be more specific than just say changes in the applicable test procedure. I think that should be substantive changes or changes that affect the energy efficiency of the product, or something like that.

MS. ARMSTRONG: Right. We did hit on this a little bit earlier. Well, I am actually going to turn around a question to you.

This was when the Department was told they worked at lightning speed. You

missed that part.

(Laughter.)

But I do want to ask you a question. Right now, it just says a change in the federal procedure, not the industry and not the ASHRAE test procedure, just the federal test procedure, recognizing that that usually doesn't happen more than every five to ten years.

But a question to you would be, what characteristics -- or to everyone -- what characteristics should the Department consider if it decides to further clarify what that means?

MR. AMRANE: I think I stated it.

Karim Amrane, AHRI.

Again, if it has an impact on the energy efficiency or the energy consumption of the product.

MS. ARMSTRONG: Period?

MR. AMRANE: Yes. I mean, that is what we are regulating, right?

MS. ARMSTRONG: Okay.

MR. AMRANE: Yes.

MR. DOPPEL: Paul Doppel with Mitsubishi.

Go ahead.

MR. STANONIK: Frank Stanonik, AHRI.

I think it would be something along the lines of if that change affects the ratings of the products to which the AEDM has been applied. And the reason to do that, a little more elaboration here, is I can think of two examples. Okay?

Let's say I got a waiver. Okay, I got a waiver and I have worked that into my AEDM already. All right? As we know, sometimes waivers take a long time to get into the test procedure. Okay? Well, once the waiver finally got into the test procedure -- in fact, my AEDM already adjusted for it -- it really doesn't need to be changed. Okay?

The other circumstance would be

you change the test procedure to keep up with technology. And let's talk about, again, gas products. Let's say at some point the test procedure was changed to address products that fire at multiple rates. Okay? Well, that is not all models. Okay?

If I had an AEDM that was specific to models that only fired at a single input rate, nothing has changed. So, there is going to have to be some context to explain, to qualify that. It can't just be a straightforward change whenever the test procedure changes.

MS. ARMSTRONG: So, before I open up, I just want to make one comment to you. Or maybe it is a question, and then you might want to answer this one.

What if we get an instance for which, yes, we have waivers, but in the final rule we change the method? In other words, we decide through that test procedure that the waiver method is not what we are going to use.

We are going to use some alternative.

In that case, you know, then you don't have that method in your AEDM. Should that require something like that?

MR. STANONIK: Frank Stanonik, AHRI.

Probably yes, because, again, I think what I initially suggested would be some kind of text that would say if the change affects the rating of products to which the AEDM has been applied. In the situation you have described, I would say it probably will because, otherwise, DOE wouldn't have bothered to change the waiver procedure. So, I think the answer would be yes.

MR. DOPPEL: Paul Doppel, Mitsubishi.

The wording should be very specific other than just saying it changes the test standard, because I know with a 1230 standard we are going to have some administrative changes in that that won't

affect the outcome. So, it has to be something that would be substantive within the testing procedure itself that would affect the outcome of the measured criteria.

MS. ARMSTRONG: Okay.

MR. VerSHAW: Yes, Jim VerShaw.

The upcoming change for residential air conditioning pumps, we go regional. If that were the only change, I wouldn't think that would cause a need to resubstantiate because we haven't taken any products off the market. We are still doing the same descriptors. There might be different levels for certain places. You had it in standby power or whatever we call it.

There, that wasn't done before. That portion of the AEDM would have to be adjusted and substantiated for that portion of it, but the other part shouldn't have to be touched.

MS. ARMSTRONG: Right.

MR. VerSHAW: So, you need some

kind of language that kind of spells out that type of thing.

MS. ARMSTRONG: Okay. Thank you.

Sure, Mark.

MR. FLY: Yes, Mark Fly with AAON.

Now, I mean, most of the test standards that are included in your standards by reference are changed -- Karim, help me -- if they are ANSI standards, they change every three years, I think, three or five.

MR. AMRANE: Five.

MR. FLY: Five. So, every five years, we are going to have the standard change. Now, I mean, a lot of times that standard change is just a reaffirmation or, like several people said, either we clarified something or it is a minor change in there.

How does the DOE synch up with these changes in the reference test standards?

MS. ARMSTRONG: So, for your products that you are speaking about, the ASHRAE 90.1 products, when ASHRAE 90.1 goes

through their process, DOE is, then, triggered to review it. So, we just did this back in April and brought all the test procedures and standards up for the 90.1-2010. So, we have the latest that are with 90.1-2010, but there is some lag time there.

MR. FLY: So, it is by reference then?

MS. ARMSTRONG: Parts are by reference, yes. So, yes, for the most part.

MR. GARST: Mike Garst, Lennox.

The one example I can think of in the commercial industry has been going from IPLV to IEER. And I am assuming that would be an example of one that would require that, but I can't think of anything else. That was the only thing for control, but it is still a different number that we put out there.

MR. AMRANE: This is Karim Amrane.

I have a question not really related to the discussion we are having right now, but it has to do with other descriptors.

I mean, the Department of Energy is coming up with additional requirements, let's say, for example, off-mode energy consumption. Is off-mode going to be something that the AEDM could do, for example? Or for the furnace fan, or I don't know, all those things that are coming up.

MS. ARMSTRONG: So, as proposed, the AEDM is drafted to be applicable to certain product types. So, for CACs, the answer as proposed off-mode, yes.

MR. AMRANE: Okay.

MS. ARMSTRONG: For furnace fans, it is no because there is nothing for furnace.

MR. AMRANE: There is no AEDM, yes, you're right.

MS. ARMSTRONG: There is no such thing as AEDMs for furnaces. But, yes.

MR. AMRANE: Okay.

MS. ARMSTRONG: Okay?

Yes, please.

MR. DAUGHERTY: Roger Daugherty,

Baldor Electric.

I guess it is just a request for some clarification. In the past, I think that the test standards I have heard being referred to at present are the industry test standards as to how to do the tests. In the past, when DOE has used the term "DOE test procedure," it has been in reference to how to determine the average of the sample and make that comparison against either the representative efficiency, being either the standard or against the nameplated efficiency of a motor.

Is it real clear what you are meaning here by referring to DOE test procedure?

MS. ARMSTRONG: Motors is different.

(Laughter.)

MR. DAUGHERTY: It also applies to transformers.

MS. ARMSTRONG: Right. So, we do mean the actual like, in your case, the IEEE

testing protocol and the version specifically incorporated in our regs, not necessarily the comparison. So, that is what we are referring to with respect to motors.

I understand that the term rating also has a completely different meaning for motors. I have come to appreciate that over time.

(Laughter.)

Okay. So, with that, any last questions or comments?

While you think of them, I have a question from Craig on the line. It has to do with, for independent coil manufacturers, is "current model" based on the indoor unit or the outdoor unit? And ICM only manufactures the indoor unit.

And the answer would be, while you only manufacture the indoor unit, you certify a combination. So, "current" would refer to the combinations that you have certified.

MR. VerSHAW: I'm sorry, I've got

a question. This is Jim VerShaw.

So, if a third-party coil manufacturer doesn't know how to rate appropriately, is that going to get the OEM of the outdoor unit in some kind of hot water that they shouldn't be in?

MS. BARHYDT: All of the certifications that the Department receives are certifications from a particular party. And an outdoor unit manufacturer is only responsible for the certifications that they make.

MR. VerSHAW: Okay.

MS. ARMSTRONG: Yes, please.

MR. LORD: I know it is not that we are going to discuss it today, but we still have that issue on the table that, when we add up all of our basic model groups on commercial, we have that 11-trillion-plus number. And where do we start populating a database? And is there another alternative? We have got to work that out.

MS. BARHYDT: So, one thing I did want to mention before we adjourn today, the Department is exploring the possibility of a negotiated rulemaking for certification of commercial HVAC, commercial refrigeration equipment, and I believe commercial heat --

MS. ARMSTRONG: And water heating.

MS. BARHYDT: Water heating, that is the one I forgot.

The first phase of that exploration is actually conducted by an independent third party who speaks to interested parties and gets information and then writes a report which is presented to the Department.

So, we will be having -- I think they are called the convener -- start contacting parties, hopefully, over the course of the summer. So, various people in the room may be getting a phone call. If he says he is calling about this, you will know what he is talking about.

The conversations with the convener are confidential. We only receive the summarized general gist of the views that were presented in the course of those discussions.

MR. FLY: Will the basic model group question be resolved before this goes into effect, since it is so deeply ingrained in this whole rulemaking?

MS. BARHYDT: This is Laura Barhydt with DOE.

One would hope.

(Laughter.)

MS. ARMSTRONG: Let's go up there, and then we will go down.

MR. KLEISS: Thanks. Jeff Kleiss with Lochinvar.

Going back to the number of tests that we are required to do, we do a couple of tests to validate the AEDM, and then sample within the different product classes. Each one of those basic models that is tested, is

that a single test of a single unit within the basic model or is that the rating for the basic model with statistical -- for those that are listening, they are shaking their heads no.

(Laughter.)

MS. ARMSTRONG: Okay. So, for substantiation, single model, single test, if you are rating based on testing, at least two or more.

Does that make sense?

MR. KLEISS: I'm sorry. Say it again?

MS. ARMSTRONG: So, for the AEDM substantiation, single model, single test, substantiation requirement. If you are purely basing a model's rating on testing, two or more.

MR. KLEISS: Thank you.

MS. ARMSTRONG: Sure.

Next?

MR. LORD: Yes, Dick Lord with

Carrier.

This brought up the question, which is, if we did elect to rate based on tests, commercial equipment has a 95 percent confidence level; residential has a 90 percent. It just doesn't make sense.

MS. ARMSTRONG: Thank you.

(Laughter.)

MR. LORD: Okay.

MR. DAUGHERTY: Roger Daugherty, Baldor Electric.

I have several items here that haven't been covered yet today from the NOPR. One of them deals with the definition of the AEDM that has been proposed. I have noted that you did delete the definition of AEDM for small electric motors from 431.442, but you left it in for 431.12 for electric motors.

And it is important because that definition that was in there for small electric motors and is in for electric motors makes reference to total losses as being one

of the criteria for the determination. And that is not in your present definition. So, if you are going to move to a common definition, then we would like total losses to be included in that definition.

MS. ARMSTRONG: Okay. Thank you.

MR. DAUGHERTY: The next is that, looking at the present version of Part 429 on the website, 429.41 is marked as reserved for electric motors. There is nothing in this NOPR that includes what is to go into that section, the same as there is no section reserved for small electric motors and there is no proposal in the NOPR for small electric motors.

I guess I would like to know whether it is the Department's intent to issue a separate NOPR to cover those, so that we have the opportunity to comment prior to a final rule.

MS. ARMSTRONG: Yes, sir.

MR. DAUGHERTY: Okay.

MS. ARMSTRONG: That will be in the certification, compliance, and enforcement rulemaking round two.

MR. DAUGHERTY: Even though it deals with AEDM?

MS. ARMSTRONG: The AEDM, so any provisions that relate to the AEDM should be dealt with here. Any provisions that relate to certification and enforcement will be dealt with there.

MR. DAUGHERTY: Well, what I am talking about is the --

MS. ARMSTRONG: I understand.

MR. DAUGHERTY: -- part that deals with AEDM.

MS. ARMSTRONG: Yes, sir.

MR. DAUGHERTY: Okay. And the reason I brought up the issue about new final rules is that the May 4th final rule that just came out for small electric motors revised 431.445(b), and this NOPR ends up deleting that and possibly the other parts, because

they are not included in text in this NOPR.

I wasn't clear whether you were intending to delete all of (b), not recognizing the new parts that were in the new final rule.

And the other is that that final rule expanded 431.445(c)(2) that was previously reserved, and it added a Part 3 that states the criteria for determining that the test of a sample passes requirements for certification for a basic model. That part is important not necessarily for the AEDM, but it is for certification by testing of the basic model. Yet, this NOPR deletes that.

MS. ARMSTRONG: Okay.

MR. DAUGHERTY: And so, I don't know what the Department's intent is to try to keep that somewhere.

And I believe that is all. Thank you.

MS. ARMSTRONG: Thank you.

Anyone else?

MR. NESHAN: Yes.

MS. ARMSTRONG: Yes?

MR. NESHAN: This is Massoud Neshan with Southern Store Fixtures.

I was going to, as a closing, bring up the basic model definition again and, also, on the AEDM development and the timeline. However, based on what I just heard, that there is possible negotiating approach, at least as far as the commercial refrigeration equipment is concerned, I am going to hold back until we see what is the outcome of that before we discuss this further.

Thank you.

MS. ARMSTRONG: Charlie?

MR. HON: What does that do to the reporting requirements due January 1st?

MS. ARMSTRONG: I don't know.

MS. BARHYDT: Until the Department modifies the current regulations, the current regulations stand.

MR. HON: Thank you.

MR. AMRANE: Karim Amrane, AHRI.

I guess I understand the comment, but at the same time manufacturers need some certainty. As I said in my opening statement, there is no way that the industry can be ready by January 1st, 2013, at least for the industry that AHRI represents.

So, we ask for an 18-month delay, based on the final date of this final rule. And we will, of course, put that in writing in our comments, but I would hope that the DOE would seriously consider that request.

Thank you.

MS. ARMSTRONG: Okay. And just one more on the line.

Can you unmute Aaron?

Okay, Aaron, you should be good.

MR. MEYERS: All right. Thanks, Ashley.

Two general comments regarding the AEDM. The first one is regarding the time to

resubstantiate. From our perspective, 30 days is unrealistic, and we would request something closer to like 120 days.

The reason being we are not building units specifically for testing and then throwing them away. We are needing to go into our production schedule and check what units are ordered and then build those ahead of time, so that we can put them through the specific DOE test procedures and then still satisfy our customer delivery dates. So, that is the reason for the 120 days versus the 30. And it especially becomes tough on three-phase transformers.

The second comment is regarding reducing the testing burden. And specifically, my comment here is regarding testing in the highest-loss configuration versus testing in the as-shipped configuration. So, transformer manufacturers are required by ANSI/IEEE standards to do electrical testing sort of as a quality check

before the units leave the factory.

And we have an issue because we are unable to correlate the test data that we acquire by doing this ANSI testing to the DOE's standards, and the big disconnect is really in the fact that DOE requires testing in the highest-loss configuration versus the as-shipped configuration.

All of the investigation that we have done in the past shows that it is very small, like on the order of maybe 2 or 3 percent difference between the two. And I think this topic has come up several times in the past, but it has never quite made it into one of the standards. I am hoping that this time that might be incorporating into the standard.

Thank you.

MS. ARMSTRONG: Okay. Thank you.

Yes?

MR. ROBERTS: Carl from Zero Zone.

I would agree with what Aaron said

about 120 days. We have got some components that have eight- or ten-week lead times. The tests take a long time to set up. So, if there is any retesting, physical testing required, 90 days probably isn't enough.

MS. ARMSTRONG: Okay. Any other closing remarks?

(No response.)

Anyone else on the line?

(No response.)

No?

Sure.

MR. LORD: Actually, you know, a positive thing, I think it is a much better proposal. So, I appreciate the listening before --

MS. ARMSTRONG: Sure.

MR. LORD: -- I think for a lot of us probably.

And I like the idea of a negotiated discussion. That would be a good way to get at some of these problems.

MS. ARMSTRONG: Okay. Well, with that, we thank everyone for coming today, especially on some of the short notice.

Thirty days, the comment period closes July 2nd, I believe. So, we welcome all your comments and questions up until then.

And I hope everyone has a safe trip home.

Thank you.

(Whereupon, at 2:40 p.m., the meeting was adjourned.)

A

AAON 2:8 3:12 7:6 14:2 63:1 98:6 113:8 118:8 127:9 211:18 233:10 244:5
Aaron 143:12 145:15 258:17,18 260:22
ABB 8:12
ability 60:11 61:18 88:17 180:5 236:20
able 69:1 88:17 109:17 150:8 194:16,22 197:13 198:16 226:11
absolute 144:6 207:6
Absolutely 155:10
AC 29:5
accept 136:10
acceptable 126:12
accepted 201:15
accessible 226:15
accommodate 215:3
account 18:9 22:6 88:14 90:2 141:20 141:22
accreditation 96:21 97:9 175:20
accredited 96:18 176:1
accurate 198:17
accurately 152:1 223:2,7 236:19,22
ACEEE 3:18 17:2 30:7 54:9 63:17 90:12 135:17
achieve 199:10
acknowledging 169:10
acquire 260:4
ACs 25:7 45:1
active 72:3
actively 216:16
actual 19:6 21:7 22:20,22 58:3 72:15 85:11 96:4 96:7 98:20 105:5 105:20 120:8 197:19 217:17 221:2 230:12 247:22
AC/heat 57:2
Adam 2:6 8:8
adapted 158:10
add 16:2 28:5,15 58:19 66:13 70:6 82:11 91:13 92:20 94:7 107:12 130:10 140:10,22 166:17 185:6 190:22 249:17
added 58:11,13 59:22 159:1 256:8
adding 48:21 142:3
addition 23:9
additional 17:15,18 20:9 38:1 39:21 62:7 71:12 91:13 111:1 210:22 211:7 214:19 224:12 246:2
address 183:15 241:4
addressed 11:18 16:12,20 24:1 153:19 154:6 238:3
adjourn 250:2
adjourned 262:11
adjust 119:12,13
adjusted 240:20 243:18
adjustment 93:21
adjustments 158:14,18
administrative 242:22
adopt 120:12
adopted 27:11,12 105:15
advance 15:17
advantage 42:4 109:18
advisement 230:11
advocate 41:12
advocating 34:2 83:10 172:12 224:13
AEDM 12:7,16 17:12 20:15,17,19 21:17,22 23:18,20 24:4,7 25:19 29:1 29:10 30:10 32:1 32:7,11,14,21,22 33:8,18 36:19,20 37:8,14,15 41:21 52:13,17 53:7,10 55:3 58:11,15,16 58:18,21,22 59:3 61:19 62:10,12 63:6,10 64:3,10 64:15,16 65:14 67:1 70:19 71:12 71:18 72:2,6,10 72:12 76:4,7,9 77:4,11,20 79:7 79:18 85:6 88:13 88:19 89:11,12,13 90:1 91:12,15 92:18 97:15 102:2 103:11,14,21 104:3,7 106:5,16 108:16,17 110:4 111:2 112:5 115:3 115:8,9 116:9,14 117:3 118:2 119:14 121:11 122:11,15 125:11 126:2,21 127:2,13 127:21,21 128:2 131:6,11,12,19 132:7,12 133:3,11 133:17 134:1,5,11 134:18 135:9,15 136:18 137:13 138:1,22 139:2 140:17 141:4 142:12,18,19 145:4 146:9 148:2 148:4 150:7 154:3 156:2,6 157:1,3 157:15,19 159:17 163:1 166:13,17 167:4,22 169:11 170:14 172:5 173:11 175:9 176:9 180:5 181:2 182:5,7,11,15,18 185:2,7 186:1,8 186:21 187:1,3,17 191:8,17 193:16 196:16,18 201:8 203:10 204:9,12 204:20 205:10 209:3 210:19,21 211:2,19 212:2,11 213:7,9 215:1,8 220:3 221:3 230:22 231:11,17 231:19 233:20,21 234:8,12,14 235:14,15 236:18 236:21 240:10,16 240:20 241:7 242:3,11 243:17 246:4,9,15 251:20 252:14 253:15,16 255:5,6,7,15 256:12 257:7 258:22
AEDMs 10:18 12:6 18:22 19:4 20:1 23:6 28:16,17,18 35:6,8,14 36:15 46:2 48:20 49:11 50:16 51:3,18 57:13 60:2,12 61:1,19 62:11 64:7 65:8 76:15 92:3 114:15 141:15 157:20 159:19 177:7 180:21 182:13 230:13 246:18
AEDM's 54:15
affect 14:16,17 43:14 86:22 238:15 243:1,3
affiliation 6:4 7:21 11:5
afford 15:18
afraid 226:4
agenda 3:5 10:12
aggregate 43:12
aggressive 34:12
ago 23:16 29:20 41:9,17 139:10
agree 78:15 90:8 148:11,16 160:19 167:10,16 173:5 190:17 219:9,12 219:14 230:5 260:22
ahead 11:3,9 17:1 20:12 26:17 54:8 69:6 90:21 93:3,3 94:6 140:12 141:8 163:12 170:4 175:14 180:6 188:8 199:15 210:15 240:5 259:8
AHRI 3:7 8:3,5 11:11 12:13 17:8 17:19 29:4 50:13 52:11 53:2 69:7 80:20 81:17 83:4 103:7 114:2 120:3 161:19 170:6 172:16 177:19 184:15 195:12 225:8 237:22 238:7 239:16 240:7 242:6 258:2 258:8
air 6:15 11:14 23:11 24:11 26:7 48:19 51:11 54:22 60:1,3 73:13,15 73:17 74:6 80:13 81:22 82:6 83:16

86:16 87:15 107:8 137:5 243:8
airfare 15:20
airflow 82:1 137:8
Air-Conditioning 2:2,16
air-cooled 44:10 45:5 163:2
air-source 113:14 113:17
akin 53:7
Alex 2:4 3:13 7:8 15:7
algorithm 21:9,10 22:19 54:16
algorithms 30:14 76:14
alike 154:7
allow 11:1 24:10 53:14 58:1,2,3 64:14 67:16 81:9 218:1
allowable 202:7
allowed 23:12 39:16 49:11 53:9 94:19
allows 19:4 36:20 77:5 89:11
alluded 112:14
alter 176:15
alternative 1:6 5:8 242:1 249:21
alternatives 75:4
alters 176:19
altogether 234:14
aluminum 141:22
ambient 86:4
amended 36:5 61:11 238:4
American 2:12,15 3:9 6:18 7:2 12:21 225:19
amount 41:5 80:8 87:1 93:21 195:4 207:14
amounts 151:8
Amrane 2:2 3:7 6:15,15 11:10,11 24:14,19 25:5,17 38:8,9 50:13,13 52:11,11 69:7,7 69:15 83:11,11 93:7 153:17 154:13 161:19,19 162:1,4,7 177:19 177:19 185:15,15 185:21 186:11,14 210:16,16 225:8,8 237:19,21,21 239:15,16,21 240:2 244:11 245:19,19 246:12 246:15,19 258:2,2
analogous 125:21
analogy 237:2
analysis 61:7 99:5 99:15,19 229:16
and-forth 198:9
Aniruddh 8:3
annual 53:16 142:16 167:3 169:16,18
ANSI 244:9 260:4
ANSI/IEEE 259:21
answer 26:22 29:16 31:18 51:13 66:1 66:6 67:9,14 89:2 92:12 101:12 110:18 112:6 140:5 141:12 145:17,20 159:18 170:17 171:15 212:10 219:21 241:17 242:15 246:11 248:18
answering 20:7
anybody 11:7,9 13:3 14:1 17:22 32:3 153:16 167:10 196:9 219:17,17
anymore 210:1
anyone's 121:5 206:3
anytime 95:2
anyway 20:3 228:21 229:4
apart 81:10
apologize 56:10,19 121:4
appeal 195:8
Appliance 2:6 8:9
appliances 98:16
applicability 36:20 49:8 51:2 55:13 58:7 64:17 65:3 115:8 116:6
applicable 37:9 102:19 103:21 119:5,11,12 122:12 131:19 136:17,18,19 171:10 194:5 238:13 246:9
applications 56:4 174:10,11
applied 37:9 85:7 103:11,15 148:4 203:6,6 240:11 242:11
applies 125:4 247:19
apply 58:22 60:2 102:2 108:15 124:3,8 133:15 141:13 159:5 167:19 169:15 172:4 177:12 179:18
appreciate 15:14 18:5 60:11 103:8 248:7 261:15
approach 64:2 140:17,20 257:10
appropriate 93:19 113:3 161:13 189:8
appropriately 249:4
approval 35:6 202:18
approved 29:19 35:22
approving 50:16
approximately 200:21
April 245:3
arduous 174:12
area 34:19 152:11
ARI 87:16 232:10
ARM 19:19 24:4,9 24:15 26:14 27:1 27:1 57:2,3 123:8 137:13 158:16
ARMs 19:22 23:12 24:20,21 25:3 28:19 29:6,18 33:5 35:6,9,14 42:16 48:20 160:9
Armstrong 1:15 2:2 3:2,5 4:6,9,12 4:15 5:3,5 6:11,11 7:17 9:11 12:19 13:2,22 15:6 16:6 17:1,22 18:13,20 20:6 21:2 22:12 24:18 25:1,13,21 26:9,11,17,21 28:3,6 30:17,20 32:8 33:11,22 34:2,20 36:9 37:16,22 38:19 40:4 41:11,18 42:1,11,20 43:11 44:6,12,15,17,20 45:1,5,9,12 47:21 48:4,8,17 49:2,5 50:12,17,22 52:19 52:22 54:8 55:10 59:15,20 60:5 61:2 63:11 64:11 65:18 69:5,16 71:5,7,15,20 73:4 73:9 74:22 75:15 76:19 77:1 78:10 79:1,3 80:15 83:8 83:21 84:18,22 89:1,18 90:4,9,19 91:6,17,19 92:1 93:1 94:6,22 95:5 95:11,18 96:8 98:4,14 99:10,21 101:7 104:11,16 104:19 106:6 107:1,4,14,21 108:4,11,20,22 109:6 110:7,10,13 110:16,20 111:22 112:6,12,20,22 113:6 114:4 115:4 117:6 118:14,18 119:16 121:8,19 124:5,15 125:6,17 128:8,15 129:18 129:21 130:16,22 135:16 138:2 140:12 141:7 143:1,10 145:14 145:19 148:7,10 149:5,8,12,15,21 150:2,11 154:11 154:18 156:17 158:4 159:13,20 160:10,21 161:8 161:18,22 162:3,6 162:9,16,19 163:7 166:3 167:14,18 168:17,20 170:21 172:6 173:13 175:3,13 177:18 179:21 180:6,14 183:18,22 184:3 185:19 186:5,12 186:15,22 187:10 188:2 189:16,18 189:21 192:2,15 192:18 193:3,14 196:20 197:3 198:20 199:3,11 200:10 204:15 208:5,18,21 209:11,13,20 210:2,7 211:13 212:17 213:10 214:6,13 215:11

217:9 219:14 221:3,6,11,21 228:1,5,18 229:3 230:9 233:6,11,15 234:4,21 235:4 236:3 237:1,20 238:17 239:20 240:1 241:14 243:5,21 244:3,20 245:9 246:8,13,17 246:20 247:16,21 249:14 250:7 251:14 252:7,14 252:20 253:7 254:6,21 255:1,6 255:13,16 256:15 256:21 257:2,16 257:19 258:15 260:19 261:6,17 262:1
articulate 121:20
Ashley 1:14 2:2 3:2 3:5 4:6,9,12,15 5:5 6:11 19:16 22:12 25:21 26:3 29:5 31:5 37:2,19 53:3 54:10 64:12 71:6,22 78:8,13 95:12 110:20 115:5 128:22 162:18 172:6 180:17 199:2 222:8 258:20
ASHRAE 40:14 44:9 59:22 81:18 107:9 120:3,10 239:6 244:22,22
Asia 233:4
asked 136:17 143:8 207:22 221:17
asking 21:19 30:8 38:13 52:13 74:16 89:14 91:8 110:17 114:13 169:22 186:6 213:8,10 218:18
aspect 137:20
assemble 152:22
asserts 30:13
assessment 49:19 180:11,12,15,20 184:6,9,18 219:10 222:6 230:15
Association 2:5 7:9 8:16 9:2
assume 59:6 161:4 162:7
assuming 27:10,12 28:12 35:7 59:12 128:4 245:14
as-shipped 259:19 260:8
atmospherically-... 155:14
attending 5:11
attributable 94:2
attributes 43:14
audio 15:12
audit 198:16
auditing 182:16
audits 169:11
Australia 68:11
authority 69:9 175:11
automatic 51:5
automatically 55:7
available 31:2 57:13 86:2 161:12 222:1,6,11,11 226:20
Avenue 1:13
average 59:1 89:17 91:11 92:16 94:17 96:10 127:22 202:21 204:3 218:6 247:9
aware 170:7 174:17
Awareness 2:7 8:9
A-F-T-E-R-N-O-... 166:1
a.m 1:14 5:2 75:13 75:14
A.O 42:13 48:14 147:9

B

b 2:13 72:8 256:3
back 7:18 20:15 21:7 23:15 40:19 46:16 48:15 49:6 51:1,14 63:18 75:8,10,14,16 76:5 83:22 93:7 97:21 101:2 106:3 108:13 116:21 124:13 129:1 133:8 137:5 139:7 142:13,15 163:22 164:9 166:4 174:3 186:6,17 187:12 192:18 194:10 195:10 196:19 197:5,6 198:8,22 200:16 209:11 214:16 230:13 245:2 251:18 257:12
background 20:12 23:5 97:11
back-breaking 67:3
bad 217:15 235:9
balance 35:5 55:2 63:6 86:14 210:8
balances 197:11
Baldor 2:7 4:3 8:12 20:14 45:15 58:9 69:18 84:2 96:1 104:22 131:2 141:11 146:12 175:16 200:13 214:15 247:1 253:11
bankrupt 31:13
bar 18:11
Barhydt 2:3 6:8,8 29:14,15 69:13 122:16,17 123:7 124:4 132:19,20 188:8 191:11 206:15 207:1,17 208:2 213:19 214:1,7 216:15 217:11 218:8,9,17 218:21 219:2 221:1,4,9 222:13 223:20,21 225:3,7 225:14 226:8,21 227:18 228:6 232:13 235:11 236:8 249:7 250:1 250:8 251:10,11 257:20
Barry 75:20,21,22
base 120:17 141:2 151:7
based 13:15 24:21 27:1 29:21 30:3 57:4,17 65:6 85:13 98:10 100:7 100:9 110:8 126:5 127:7 129:9 138:6 145:6 147:21 201:1,21 202:2,20 215:2 217:19 248:15 252:9 253:3 257:8 258:10
bases 151:9
basic 13:14,15,19 13:21 14:4,13 15:3,5 16:3 19:3 27:5 33:6,16 36:11,16,18,22 37:8,12,13 38:5 40:2,3 41:14 45:17,19 46:1 47:8,15,16 57:6 58:14 63:2 65:9 66:19 70:5,11,17 78:19 97:14 101:19 102:7,12 103:12,14,15 107:11 114:12 115:20 116:12,20 121:11,13,15,16 122:20 123:15 129:12,16,20 131:8 137:9 140:10 143:17 144:1,10,11,13,18 145:22 146:2,20 147:3 154:2,5,15 154:17,22 155:19 172:3 173:20,21 174:19 200:19 201:6 231:14,18 231:22 233:14 249:18 251:6,22 252:2,3 256:11,13 257:6
basically 18:22 26:14 27:7 32:6 46:12 47:9 87:19 88:2 92:10 113:10 173:17 197:21 198:5 233:12,16
basing 252:17
basis 53:16 66:17 66:20 83:15 116:1 152:15 166:11 167:3 169:16 174:6 186:2 197:19 198:15 234:11
batch 31:10
Bathrooms 10:3
Bauman 197:1,2,4 197:7
bear 179:19
bears 235:15
becoming 69:19
befuddled 174:8
behave 136:5
believe 19:8 40:11 59:21 60:20 61:17 89:14 175:2 188:19 207:3,7 230:17 250:6 256:19 262:5
Beloit 8:20
benefit 23:17 63:13
BERRY 76:22
best 137:6 164:6
better 10:22 74:7 115:17 184:2

205:7 212:14,21 215:7 221:19 233:8 261:14
beverage 51:6
beyond 39:18 72:16 88:16 136:5 224:10
big 18:6 87:22 127:12 193:20 196:13 209:4 218:5 260:5
bigger 73:21 186:20 212:1
biggest 160:14
BIL 144:5,19
Bill 9:1
bit 10:1 20:8 21:5 35:15 44:2 45:16 83:3 89:5 91:7 96:11 158:19 171:15 191:15 224:7,10 238:18
black 30:12 32:3
black-box 76:12
blatant 174:16
blind 198:15
blow 153:7
blower 80:6
board 24:6 115:9 171:11
body 175:12
Boesenberg 2:4 3:13 7:8,8 15:7,7 235:18
boiler 109:21 112:3 155:13 159:6 161:11
boilers 42:16 48:22 51:22 53:6,13,13 53:15,22 54:7 55:20,22 109:3,4 109:11,12,15,19 125:1,2 147:17 148:13,14 155:12 155:17,20
bookends 159:7
books 167:7
bothered 242:13
bottom 10:5 37:5 146:18 183:13 209:16
bought 15:22
bound 115:7 140:7
bounding 116:4
bounds 140:6 236:6
box 30:12 32:3 57:15 82:16
boxes 81:19 82:4
break 63:12 69:14 73:5 75:7 76:2 108:7 114:7 163:13,21 167:7
bridges 109:9
bridging 113:1
brief 9:17 10:12
bring 70:21 94:8 137:5 158:13 182:2 229:15 233:18 257:6
brings 158:19
broad 64:17 152:16 157:11,20
broadly-applicable 64:10,15,16
broke 46:11
brought 86:18 163:11 166:8 245:3 253:2 255:18
Brunk 2:5 9:3,3
BTP 2:2
btu's 44:10
build 158:17 209:14 232:12 259:8
building 1:3,13,15 223:13 259:5
built 41:1 77:11 116:1 153:4,14 197:21 209:10 224:11 231:2
bulb 81:21
bunch 56:7 140:21
burden 19:9 38:18 42:2,4 52:16 54:19 116:11,17 117:4 223:11 259:16
burdens 31:17
burdensome 223:3 229:17
business 156:11 175:19 213:7
buy 152:21 227:1 229:15
buying 145:7

C

C 206:16
cabinet 86:5 114:20,22
CAC 123:8
CACs 51:11 79:16 246:10
cafeteria 164:2,4 166:5
calculate 131:21
calculated 134:13
calculating 22:1 142:2
calculation 21:9 106:1 158:9
calculations 105:19 106:10,15 134:12 142:4
calibrate 88:12 90:1
calibrated 87:19 88:4 161:15 196:6
calibration 136:6
California 174:19 178:21 198:4
call 3:2 18:14 64:2 126:5 157:1 166:12,16 170:13 171:4 172:22 180:22 233:20 243:15 250:20
called 5:19 45:18 46:14 250:17
calling 250:21
capabilities 50:16
capacity 27:5,6 102:7,9,10 115:20 115:22 123:15 130:8
capacity-related 43:13
capital 151:9
care 142:18
Carl 2:14 3:19 7:12 18:3 50:7 65:4 86:19 119:1 159:14 162:12 179:22 260:21
Carrier 2:12 3:16 7:16 16:9 50:1 62:18 140:14 157:9 161:1 183:12 217:21 228:9 232:6 253:1
carrying 177:14
case 2:6 9:7,7 38:17 53:5,12,15,21 66:21 100:19 104:3 109:2 116:15,16,16 156:6 159:15 192:3 204:7 208:11 233:8 237:17 242:2 247:22
cases 66:17 74:18 114:14 120:9 129:10 222:3
case-specific 233:7
cast-iron 53:9
catalog 66:18
categories 173:22
category 38:17 39:16 125:16 152:10
cause 14:22 224:7 243:10
causes 120:15
causing 56:20 114:16
caution 177:8 187:11
cautioning 179:13
caveat 189:19
CBI 226:5,18
center 89:21
centered 193:7
central 23:11 24:11 25:7 51:11 54:22
certain 38:6,10 55:22 56:2 78:3 93:20 139:17 142:15 159:16 169:15 171:12 174:10,10 176:17 224:20 243:14 246:10
certainly 53:11 54:4 64:1 103:8 123:21 198:9 224:2 232:21
certainty 258:5
certification 11:21 12:15 31:11 36:17 125:21,22 175:22 176:3,8 177:4,6 178:3,4 183:16 184:7 186:7 201:22 215:15 217:6 224:5,11 250:4 255:2,9 256:11,13
certifications 249:8 249:9,11
certified 92:4 157:16 184:14 187:13 188:13 192:5 199:7 201:9 202:9 203:5 204:22 205:2,6 210:11 214:20 221:7 248:21
certifies 203:7
certify 19:5 28:21 174:6 203:11 248:19
certifying 52:6

202:19
cetera 33:1 222:6
CFR 100:9 186:17
challenged 31:11
challenges 216:19
challenging 115:22
chamber-to-cha... 87:17
chance 89:5
change 15:3 28:19 47:19 55:20 65:21 71:17,18 72:12 84:16 85:12 100:21 101:6 102:20,21 105:10 106:2 123:1 125:15 127:6 131:20,21,22 132:9 133:1 134:14,15 135:3,4 135:5,5,11 137:15 137:21 138:9,11 138:13,14 140:9 141:20 143:18 159:17 192:10,22 193:18 194:3 216:21 221:20 233:21 239:4 240:9 241:1,12,20 242:9,14 243:7,9 244:9,14,15,17
changed 84:11 85:9 132:6 133:2 141:2 142:14 153:12 193:20 199:20 200:9 238:8 240:21 241:4,9 244:8
changes 23:19 27:19 36:18 84:6 84:7,10,20 105:18 105:19 120:15,21 122:4 126:14 132:12 133:18 134:15 138:7 141:22 142:19,21 144:9 168:9 169:17 170:10 192:19 206:2,4 238:1,5,12,14,14 241:13 242:19,22 244:19
changing 120:6 123:19 137:20 179:17 200:7 209:3
characteristics 38:7 117:22 118:1 176:16 239:11,12
characterization 52:2 160:4
characterize 42:18
characters 14:8,8
charge 93:19 218:22
charged 93:13 187:9
CHARLES 2:10
Charlie 7:14 40:20 85:18 168:18,19 173:14,15 178:20 221:16 257:16
Charlie's 177:21
CHBs 79:16
cheat 174:15
cheated 42:8
check 60:6 169:7 198:16 259:7,22
checking 150:15,16 172:21
checks 171:22 197:11
cherry-pick 74:19
chime 9:18 138:3
choice 157:6
choices 159:18
choose 62:14 224:3
chooses 64:6
chose 103:11
Christensen 2:6 8:8,9
circumstance 103:20 155:21 240:22
circumstances 127:6
claimed 197:22
claiming 198:5
clarification 13:13 16:4 22:9 34:5 62:7 247:3
clarified 244:16
clarify 24:12 44:1 71:21 83:9 84:3 85:3 106:8 118:22 132:21 215:21 219:15 239:13
clarifying 145:18
class 16:4,5 27:4 37:11,17,21 38:4 38:6 40:16 41:13 41:15 42:14 44:3 47:4,11,13 48:3 56:9,10,14,15 61:10,10 62:22 64:4,19,20 65:11 65:12,15 70:11 101:20 102:8 107:12,16 108:18 110:4,6 114:13,18 118:11,12,15,16 122:19,22 123:4,5 123:12,13,13,16 123:18 124:17 129:13 130:3,10 130:16,17,17 136:3,13,16 233:14
classes 17:10 38:12 38:15,22 39:15,20 40:1,5 43:9,19 45:18,19 46:5,8 46:13,15,19,22 47:20 55:8 60:14 60:15,20 61:4 62:4,5,13 63:19 64:1 70:9 71:2 76:15 101:21 102:1 107:8,9 108:2,14 117:15 118:20 123:10 129:17 130:1,5 147:18 148:5,13 148:14 251:21
classification 52:2 78:20 129:20 130:14,15
classifications 40:22 78:19 129:8 129:15
classified 19:18 59:10 109:4
clause 124:10
clear 14:14 47:3 50:5 75:2,3 136:14 149:10 178:7 180:9 184:8 204:16 205:22 210:19 247:13 256:2
clearly 6:6 178:19
climb 31:12
close 86:16 128:5 191:13
closed 117:17
closely 78:11
closer 82:22 259:3
closes 262:5
closest 126:7
closing 257:5 261:7
code 31:10 32:2
codified 100:8,18
coefficients 140:19
Coffee 10:4
coil 192:13 248:14 249:2
coils 74:3 137:7 153:4 168:13
column 37:6 146:18 183:14
combination 33:7 33:16 36:21 57:5 158:14 248:20
combinations 14:10 29:2 33:21 176:15 248:21
combustion 109:13 111:7,8,10,11,16
come 20:9 29:11 36:10 61:10,18 75:8,10 82:16 86:6 99:6,8 146:8 150:17 151:18 152:5 155:2 160:14 169:17 174:3 176:6 179:11 185:8 191:13 194:10 205:11 213:2 231:5 248:7 260:13
comes 46:18 49:17 80:3 212:13 233:3
comfort 216:20
comfortable 160:13
coming 116:21 168:12,12,13 175:8 187:22 190:20 205:2,17 205:18 234:12 246:1,6 262:2
comment 23:21 38:2 48:9,11 55:11 56:22 78:14 80:12 93:10 100:4 119:3 139:6 179:13,15 241:15 254:19 258:3 259:15,17 262:4
commented 139:18
comments 4:7,10 4:13,16 10:20 11:8 35:4,21 49:7 51:16,17,21 52:12 55:15,16 58:6 62:4 74:20 84:8 84:14,22 98:21 101:14 103:4 150:22 163:9 181:16 183:4 184:5 219:18 223:9 230:10 232:15,22 235:3 237:18 248:11

258:12,21 262:6
commerce 67:21
commercial 11:20 13:10 20:3 23:7,7 38:11,14,21 40:7 40:18 44:9 45:10 51:4,8 56:3,14,15 56:18 59:8,13 60:1,2 66:15 79:15 85:21 94:10 94:21 107:8 109:3 109:3,10,19,20,22 117:11 125:4 130:18 147:17 148:14 156:21 159:15 160:20 184:13 218:5 245:13 249:19 250:5,5,6 253:4 257:10
commission 218:2
commissioning 94:15 95:2 218:20
committees 120:3,4 120:4
common 40:8 202:3 254:3
communicate 5:15
compact 74:9
companies 179:2,2 227:11
company 2:10,13 6:4 7:21 11:5 14:5 103:13 118:4 118:6 144:1 155:13,22 170:11 173:12
company-sensitive 227:16
comparable 22:21
compare 58:15 72:15 210:20 220:7
compared 80:14 155:2 184:11 224:21
compares 129:3
comparing 87:16
comparison 97:15 247:9 248:3
comparisons 184:16
competition 151:18
competitors 30:16 94:14 174:15 228:20
competitor's 228:13
complete 14:7 153:3,4 225:3,5 225:10,12
completed 12:3 151:4 174:2
completely 248:6
complex 66:2 94:10 218:6
compliance 12:14 25:2,14 27:20 29:12 30:13 50:10 65:9 120:13 131:13 135:8 184:10 204:10,11 204:13,13 208:13 221:13 231:6 234:9 255:2
compliance/enfo... 183:16
compliant 27:8 231:12
complicated 40:15
compliment 119:21
comply 11:21 12:4 25:7,11 65:17 131:15
component 63:5 197:18 198:10
componentry 152:22
components 57:17 58:2 63:3,7 134:16,17 152:20 153:5 179:16 197:20 198:13 261:1
comprehensive 198:18
compressor 74:3 82:19 137:7 153:1 227:13,14
compressors 82:16 82:17 140:4 153:2 168:11 179:16
computer 18:22 57:8,9 168:7 212:5,8
concept 131:6 172:3 203:3
concern 17:3 20:4 31:5,14 49:16 54:10 87:22 139:15 202:16 212:4,6 226:6
concerned 29:18 29:20 35:20 219:8 223:8 227:22 257:11
concerns 9:15 127:10 177:9 211:19 232:3
conclusion 146:15
condensing 77:10 77:13,19 78:1 155:17,20 228:15
condensing-gas 136:20
conditioner 54:22 73:18
conditioners 23:11 24:12 51:12 74:6 83:17
conditioning 6:16 11:15 26:7 48:19 60:1,3 73:14,15 80:14 81:22 86:17 87:15 137:5 243:8
conditions 16:14 20:19 21:15,18 39:10 67:19 76:3 114:16 143:22 199:20
conduct 184:9
conducted 96:22 97:6 250:11
conducting 200:17
confidence 18:8 88:21 128:11 176:21 253:5
confident 92:20 217:1,7
confidential 251:2
configuration 70:4 144:18,20 259:18 259:20 260:7,8
configurations 39:10
confirm 195:11
Confirmed 48:4
confirms 30:13
confused 45:17 216:9
confusing 140:15 204:14
confusion 56:20 78:17 84:4 118:19 130:21
conjunction 96:20
connected 93:16
cons 170:1
conservation 43:2 102:18 162:1
conservative 89:12 91:5,16 92:6 224:1,2,7,12
conservatively 83:5 88:11,12 89:22 212:13,19 219:16 220:11,12 222:20 222:21,22 223:3 223:18
consider 23:19 25:14 27:21 42:22 51:14 52:3,4 75:4 76:14 77:16 78:3 94:20 120:19 127:5 131:4 149:17 151:7 170:2 177:14 183:6 220:22
236:7 239:12 258:13
consideration 132:8 197:17
considered 48:21 55:14 77:7 94:3 95:3 197:9
considering 61:6
consistent 24:16 153:12,13 211:9 211:12
consistently 234:11
constant 153:9 174:13
constantly 119:6 120:5 124:12 229:18
constantly-chang... 122:9
construction 109:9
consultation 203:15
Consulting 2:5,11 2:17 8:22 9:4,6
consume 152:6
consumer 212:20 223:13 225:11
consumes 220:4
consumption 15:4 198:2 220:2 239:18 246:3
consumptive 194:8 233:22
contact 187:15 207:11,18 228:2
contacting 250:18
contain 226:18
contained 85:22
contaminate 215:7
contemplate 77:3
context 36:15 151:22 241:10
Continental 197:7
continual 142:17
continually 173:10 173:10
continuation 146:4

continue 51:8 133:10,20,22 135:2 145:4 146:9
continued 4:1,2 126:20
continuing 142:12
continuous 170:13
contrast 54:11
contribute 179:16
control 151:17 153:1,3,3,5 176:5 203:1 245:17
controllable 93:14
controls 152:20 153:6
convened 1:11
convener 250:17 251:2
convention 24:5
conventions 24:3
conversation 21:5
conversations 10:3 222:19 251:1
cooled 45:6 107:9
cooler 51:6 57:14
coolers 57:15,16 60:13 147:13
cooling 161:7
coolings 192:14
Cooperative 8:16
copper 141:21
core 141:17,19
Corey 2:17 9:5
Corporation 2:9,12 7:11 8:18 31:21 203:20
correct 26:9 30:18 37:16 38:7 44:12 44:15,16,17 45:9 59:15 91:17,20 93:1 95:18 108:19 108:20 109:6 111:22 124:5 130:17 161:8 186:9 189:8,16 192:15 193:3 213:11
correctly 107:10 108:16 147:19 187:8,9 189:4
correlate 260:3
correlation 32:6 126:7
cost 34:18
costly 67:4
Council 2:15 6:19
Counsel 2:4,6,14 6:10 9:8,10
count 108:6
countries 68:9
couple 65:7 74:4 99:22 105:1 109:16,16 121:2 137:7 196:21 251:19
coupled 143:18
course 11:11 12:7 83:4 104:16,19 187:20 250:18 251:4 258:11
court 179:1
cover 46:21 70:17 73:12 104:18 177:5 198:16 212:2,3 254:18
coverage 4:5 48:16 52:13 112:4
covered 14:20 48:20 56:12,13 70:5,18 110:2 253:13
covering 58:19
Craig 3:22 19:12 19:17 20:10 36:12 57:12 199:1,4 248:13
Craig's 24:8
crank 200:5
CRE 86:21 116:9 181:12 220:4
create 14:11 96:21 156:5
created 97:8 105:7 177:1
creating 175:20
criteria 27:2 28:13 29:11 146:22,22 147:3 160:2 192:21 198:12 202:18 224:21 243:4 254:1 256:9
critical 13:20
cross-check 59:21 61:8
CSA 177:3
curious 99:5
current 27:9,9 30:5 57:1 67:19 71:14 86:4 102:16 119:15 123:8 139:1 166:7,20 167:21 170:19 171:17 183:1 248:15,20 257:21 257:21
currently 23:5,13 28:17,18 29:18 48:18 52:8 79:8 137:10 148:12 170:22 180:21 228:20
curves 158:15
custom 55:17
customer 68:21 145:7 219:1 259:11
customers 67:5 156:14
customization 54:13
custom-built 51:18 52:1
cut 139:8
cutoff 69:3 207:6
C-O-N-T-E-N-T-S 3:1 4:1
C-1 96:4

D

daily 66:17,19 122:10
damper 81:19
Danfoss 2:18 7:5 68:17 80:11 93:5 124:7 139:14
data 10:20 28:5,9 29:21 30:14 32:7 32:10 35:10 41:20 41:21 58:15 71:13 76:15,17 89:20 98:12 102:14,15 106:14 110:5 111:16 112:2,4 119:4,10,14 127:16,18 128:6 133:3 149:10 153:11 161:11,16 162:5 182:13 185:2 186:7 187:17 190:7,9 196:11 205:13 213:16 214:22 215:8,10,17 217:20 220:9 221:2,8,10 222:1 222:5 228:11,13 229:7 230:6 260:3
database 249:21
dataset 136:6
date 11:19 12:1,5 12:14,16 18:19 25:2,3,14 27:20 120:13 258:10
dates 259:11
Daugherty 2:7 4:3 8:11,11 20:13,13 21:20,20 45:14,14 58:8,8 69:17,17 84:1,1,21 85:2 95:22,22 96:9 100:5 104:21,21 106:21 107:3 131:1,1 134:3,4 141:10,10 146:11 146:11 172:8 175:15,15 200:12 200:12 214:14,14 216:1,1 246:22,22 247:19 253:10,10 254:7,22 255:4,11 255:14,17 256:16
David 2:6 8:13 9:7
day 157:19 174:15 196:1 199:19 220:3,4,6 223:13
days 15:18 109:16 185:2 207:14 209:10 213:14 214:8,9 232:7,14 233:5 259:1,3,12 261:1,5 262:4
deal 15:5 61:12 69:1 97:10 193:20 194:1 217:16 229:17
dealing 53:15 83:2 147:17
deals 201:7 253:14 255:5,14
dealt 255:8,9
Debra 2:5 9:3
decades 224:9
decide 211:4,22 241:21
decides 239:13
decision 188:21 189:4
decisions 217:19
decrease 34:22
deemed 231:15
deeper 93:8
deeply 251:8
defect 187:6
defend 168:15
define 14:13 15:2 39:20 42:18 43:15 50:4 70:8
defined 20:20 39:14,18,22 40:1 40:7 43:13 60:16 82:4 116:20 117:15 176:13 188:21
defining 40:3 115:2
definitely 55:11

162:9,10 188:15
definition 13:12,14 13:18 14:4,14 20:15 21:6,8 32:6 33:8 36:11,16,18 37:20 42:21 45:22 46:17 47:3,15,18 60:14 110:5 116:12 235:8,20 253:14,16,20 254:2,4,5 257:6
Definitions 4:5
definitive 189:22 190:11 231:9
definitively 231:5
degree 54:12 175:11
delay 35:22 258:9
delete 253:16 256:3
deleted 19:20
deletes 58:18 256:14
deleting 255:21
delivery 259:11
Department 1:1,12 1:15 3:3,6 4:6,9 4:12,15 6:9,12 9:10 11:22 15:10 23:19 27:21 28:21 30:11 31:1,2 32:18 49:9 51:17 61:17 75:1 77:16 79:8 149:17 154:20 166:14 169:14 170:2 174:17 175:9 181:14 183:6 204:21 205:3 206:8 207:2,7 221:15,22 226:15 226:17 233:8 236:6 238:21 239:12 246:1 249:8 250:3,15 257:20
Department's 9:13 10:22 51:20 138:5 205:15 216:22 254:17 256:17
depending 14:12 44:18 82:3 157:5 157:20 158:19 168:2
depends 26:22 139:12 141:3
deploying 140:1
derate 191:8
derated 187:3
derived 19:8
described 242:12
describes 21:8 59:2
describing 182:13
descriptor 21:11
descriptors 243:13 245:22
design 66:20,21 67:17 74:9 114:18 131:12 158:8,22 159:17 171:20 192:8
designed 16:13 132:4
designers 17:7
designing 116:15 132:4 157:10
designs 47:15
details 32:18
determination 1:6 5:8 190:1,12 192:4 210:9,13 214:9,12 231:6,9 254:1
determine 22:2,7 96:22 105:21 110:4 134:12 141:18 172:20 173:7,9 203:4 235:7 247:8
determined 126:10 189:13
determines 188:12
determining 256:9
develop 25:18 60:22 151:9
developed 63:5 174:20
developing 67:1 155:17
development 257:7
device 14:20
dialog 135:18 187:16 217:17 235:19
Dick 2:12 3:16 7:16 16:8 49:22 62:18 64:1 140:13 157:9 160:22 183:11 217:21 228:8 230:5 232:5 252:22
difference 15:21 44:21 47:7 56:9 73:22 85:16 139:19 200:2 260:12
differences 152:18 168:2 203:16
different 14:12,17 22:8,19 33:13 39:6,9,10,15 41:2 43:2,3 45:2 47:10 47:14 48:5 53:20 57:18,19,20 64:2 64:4 66:17 91:8 102:5 106:11,12 108:17 109:14 111:2,21 114:16 115:16 117:13,14 117:14 120:15,16 123:8 129:2,6,7,8 129:15 130:5 133:15 138:14,15 138:19 142:2 147:18,22 148:4,5 149:17 152:8 153:17,18 154:2 157:1,4,14 159:6 159:8,19 169:22 173:22 176:11,14 190:11 196:4 201:3 203:3,6 205:5,20 208:8,15 210:14 215:4 220:22 223:9 229:19 243:14 245:18 247:17 248:6 251:21
differently 96:14
difficult 65:17 83:7 97:20 152:4 170:17
digging 80:20
dimensions 93:9
direction 18:6 38:3 200:6 220:19
dirty 174:22 177:21 178:15,17 179:3 197:9
disagree 178:13
disallow 234:7,13
disconnect 260:5
discontinue 122:13 237:15
discontinued 72:2 72:9 77:10,18,19
discontinuity 114:1
discounted 201:14
discouraging 224:14
discover 211:21
discretion 61:20 62:2,12,20 64:14 77:6 110:22 169:6 172:14
discuss 5:7 32:16 63:9 78:21 249:16 257:13
discussed 67:8 116:10 197:15
discussing 157:18 206:14
discussion 10:19 11:1 78:15 96:3 187:19 189:9 192:12 193:6 213:4 231:7 237:9 245:21 261:21
discussions 190:2,8 214:2 251:5
display 66:17
disproportionate... 54:2
disqualify 138:1
distinction 208:6
distribution 23:8 51:9 102:4 105:2 105:6 124:2 135:12 143:21
docket 85:1
document 50:3 184:2
documentation 161:14 182:11,12 183:20 213:9
documented 50:4 178:22
DOE 2:2,3,6,14 4:14 9:7 11:12 12:15 13:13,16 15:14 20:18 22:4 22:13,22 23:14 24:3 25:7,13 28:8 28:15 29:8,15 30:15 34:13,17 35:10,17 49:18 50:15 52:12 56:18 59:22 64:5 69:8,9 71:22 76:14 77:4 79:13 81:8 83:15 84:5 85:9,11 95:12 98:8 99:6 105:14 110:21 113:10 114:3 119:5,11,12 120:8 120:11 122:17 132:20 136:9 144:6 166:5 172:7 180:18 182:10 183:14 184:8 186:1,2 188:12,18 189:12,22 197:16 199:9 201:4,14 202:8 203:15 207:7,8 211:4 217:2,8 218:9

220:1 222:19 223:2,4,11,17,21 225:15 230:17 232:18 234:7,12 238:7 242:13 244:18 245:1 247:7,7,14 251:11 258:12 259:10 260:6
DOE's 21:11 23:5 170:19 172:19 185:20 260:5
DOE-initiated 181:7 185:3
DOE-supplied 214:21
doing 18:11 46:3 57:8 60:22 66:4 71:2 74:15 80:4 81:2 112:9 117:1 141:6 151:15 160:15 167:2 179:7 198:15 216:16 237:3 243:12 260:4
door 87:4 153:15 213:2
doors 57:21 87:3,4
Doppel 2:8 3:20 18:15,15 59:16,16 60:4 71:6,8,8,16 175:4,4 193:4,4 195:3,6 214:10 224:15,15 225:5 227:6,6,21 228:3 228:7 233:1,1 240:3,3 242:16,16
doubts 236:20
Doug 2:14 9:9
downside 211:16
downstairs 164:2
down-rate 220:19
draft 15:11
drafted 38:19 235:12 246:9
drift 26:20
driven 128:3
driving 34:14 35:2
drop 14:22 31:11 145:9
drops 137:22
ductless 227:10
due 15:21 120:2 214:19 257:18
duplicate 34:18
duplicative 17:14
dynamic 168:5
dynamics 154:12
D.C 1:14

E

earlier 23:10 24:8 86:18 105:16 110:9 136:17 166:9 172:9 182:5 183:2 186:17 195:18 218:16 219:7 236:4 238:18
earth 145:10
easier 10:1 155:6
easy 74:17
economizer 14:19
Economy 2:15 6:19
EER 208:10,11
EERE 2:2
effect 41:10 72:5 82:10 132:7 133:9 145:5,12 146:8 232:19 251:8
effective 11:19 12:5 12:14 18:19 84:7
effectively 133:9
efficiencies 86:13 110:1,3 199:9
efficiency 1:3,6 5:8 16:19 19:7 21:10 22:3,16 85:8,10 85:14,17 100:7,11 100:14,16,18,22 101:3 109:12,13 109:20,22 131:13 132:1,5,11 134:8 134:15,19,22 135:9,13 136:7 138:10 140:8 141:16 142:20 143:19 144:5,8,21 172:4 176:16 179:17 200:18,22 201:22 204:4 238:9,15 239:18 247:10,12
efficient 6:19 90:16 152:12 185:9 194:7 233:22
effort 17:14 42:10 66:5,22
efforts 15:14
eight 46:7 147:22 148:5 150:8 163:17 261:2
EISA 135:1
either 43:13 72:8 89:11 98:18 117:16 120:2 125:9 126:15 127:2 156:20 157:2 159:10 170:15 171:11 244:16 247:10,11
elaboration 240:12
elect 253:3
electric 2:7,8 4:3 8:12,16 20:14 22:1,2 23:9 43:5,7 45:15,20 46:6,11 46:18,19 47:1,2,4 47:5,17,17 51:5 51:10,11 58:9,10 58:20 59:4,9,10 59:17 63:19 69:18 69:22,22 70:3,7 70:10,12,13,15,15 70:22,22 71:9 74:11 84:2 85:5,5 85:12,13 96:1,5,6 96:13,13 97:16,16 100:5,6 104:22 105:4,5,8 131:2,5 131:19 136:18 141:11,14,14 142:9,10,16 146:12 175:16 177:13,13 200:13 200:16 202:1 214:15 247:1 253:11,17,18,21 253:21 254:10,13 254:14 255:20
electrical 2:4 7:9 9:2 86:3 259:22
eliminate 34:10
eliminated 59:4 135:11
eliminating 33:20 50:9
elimination 140:9
else's 57:9 151:13
Emergy 8:14
emphasized 32:4
employ 138:17
enclosures 57:14
encompass 150:8
encompassing 152:17
encourage 9:16 10:19 39:11 55:4 70:13 88:8 132:14 181:15,20 182:1
encouraging 224:1
ends 255:21
energy 1:1,3,3,12 1:15 3:3,6 4:6,9 4:12,15 6:9,12,19 9:10 11:22 14:16 14:18 15:1,3 16:15,16 18:10 19:7 39:15 43:2 43:15 68:3 80:3 102:17 104:17 152:7 174:18 197:16 198:1 220:2 222:5 238:9 238:15 239:18,18 246:1,3
Energy-Efficient 2:15
enforcement 34:12 35:1 95:20 174:13 184:7 202:15,17 202:22 203:5,12 203:14 207:9,11 207:20 208:14 216:16 222:3 230:18,20 231:4 232:20 255:2,9
engine 73:16 137:9
engineer 228:10,12
engineering 19:2 21:9 22:18 168:9 235:9
engineers 234:17
ensure 90:2
enter 67:21
entire 62:13 68:5 204:9 224:20 226:4 230:2
entirely 224:3,12
entropy 86:14
entry 31:17
EPA 197:15
EPAct 96:16 134:20
equal 53:13 129:20
equating 129:14
equation 22:18
equipment 11:16 11:16,20 13:11 19:6 23:7,8,13,16 30:11 38:21,22 39:17 40:5,16 41:13,15 44:3 45:19 51:4,9,15 51:19 52:6 56:9 56:13,15 59:8,9 59:11,14 60:2,3 61:10 62:5 65:11 65:15 66:15,20 67:11,18 71:3 73:22 78:20 79:15 79:16 83:5 85:21 86:13 88:4,12 93:11,12,15 94:3 94:10,11,13,18,21

96:17 98:13,17 113:20 117:5,12 117:15 119:8 128:5 129:8,15,22 130:3,5,10,14,17 152:22 156:20 157:10 159:16 184:13 200:2,15 218:5,11 227:12 233:14 250:6 253:4 257:11
equivalent 130:14
error 37:4,4 82:3 195:2
especially 14:5 19:22 76:12 82:18 91:2 127:11 193:8 234:16 259:13 262:3
essentially 29:8 81:6
establish 201:4
established 68:10 68:10 128:10,12 128:17
establishment 105:7
estimation 146:5
estimation-type 56:5
et 33:1 222:6
Europeans 68:9
evaluate 184:10
evaluation 198:18
evap 45:6
everybody 14:6 15:9 19:15 30:2 162:8
everyone's 30:4
evidence 234:9
evolve 17:13
evolving 155:22
exact 106:10
exactly 21:3 25:9 29:16 32:18 38:4 50:4 57:10 91:19 112:7 147:8 192:15 212:18 226:21
examined 203:4
example 14:6 16:14 43:4 54:21 63:18 68:11 69:9 94:5 101:2 105:11 111:8 117:9 118:3 118:5 125:11 136:13 138:16 143:20 147:12,12 147:16 148:19 150:7,18 155:12 161:6,21 191:21 192:3 195:9 220:1 232:9 245:12,15 246:3,5
examples 240:13
exceed 66:4 104:15
exceeds 46:20
exception 96:6 181:11 227:8
excess 41:3
exchanger 137:16
exchangers 82:6 140:3
exclude 55:7
exempt 68:13
exercise 78:16,18 205:8
existed 105:17
existence 113:16
existing 55:21 98:19 102:17 146:4
exists 44:4,5 116:13
expand 51:3 52:13 100:4 203:21
expanded 26:6 146:3 256:7
expanding 35:13 35:14 51:14
expansive 104:4
expect 168:6
expected 102:12 121:14 145:22
expended 151:8
expenditure 225:15
expense 15:19
experience 216:17
explain 65:19 164:6 241:10
explained 58:1 172:9
explanation 44:8 93:2
exploration 250:11
exploring 250:3
express 17:3
expressed 177:9
extent 78:2 106:2 224:18
external 200:1
extra 112:19
extrapolate 55:4 136:5
extrapolation 56:4 136:12 139:16,21 140:6,9 141:13 142:5
extreme 80:8
extremely 13:19 97:20 218:5

F

face 24:3 145:10 153:8
Facilitator 2:2
facilities 41:4 97:3 202:13
facility 87:11 96:19 97:4 176:1 196:7 201:19 202:3,6 215:3,4,9
facility-to-facility 81:4
fact 81:16 82:2 86:1 87:3 99:16 132:6 168:11 170:11 189:1,7 240:20 260:6
factor 92:21 97:1 192:13
factors 140:21
factory 93:12 94:15 95:2 198:15 218:20 260:1
factory-sealed 93:13
fail 190:17 195:9
failed 190:17 192:5 198:7
fails 188:12 192:4 193:15 199:6
failure 184:19
fair 160:3 162:13 228:5,6
fairly 73:19
faith 50:18
fall 52:1 88:19 114:22
falling 192:22
falls 89:20 110:6 127:18 206:18
familiar 42:17 173:1
families 147:22 150:9,13
family 74:14 109:8 148:3 149:11 159:8,12
fan 14:18,22 168:12 246:5
fans 74:4 80:6 246:13
far 55:16 65:16 77:9 81:10 83:1 98:15 141:15 151:1 152:11 197:16 220:18 227:18 230:11 257:10
fast-moving 119:18
favor 62:19 167:19
features 43:13 140:22
federal 21:1 37:5 44:4,5 71:10 102:17 109:4 173:8 225:15 239:5,7
feed 106:16
feedback 9:13 10:10
feel 9:18 14:1 39:8 58:4 92:20 147:13 176:4,10
field 31:15 93:15 95:3 102:8 162:8 179:6
field-charged 93:16 94:5
field-connected 94:4
field-topoff 93:17
Fifteen 107:14
figure 16:21 22:3 96:4
filter 14:17
final 10:22 27:12 45:20 58:12,13 61:9 69:21 84:5,9 84:13,14,15,17,19 105:13,14 106:22 120:12 131:17 176:19 213:20,21 214:9,12 241:19 254:20 255:18,19 256:5,6 258:10,10
finalized 12:9,17
finally 31:10 240:19
find 59:2 79:21 99:15 105:3 115:2 158:18 196:15
finding 202:8 203:17 213:20,22 217:10 236:13
finds 217:14
fine 28:14 31:6 104:9 138:4 186:14 220:13
fined 179:2
fine-tune 105:21
finish 26:17
fire 241:5
fired 241:8
first 33:4 61:2 73:8

75:19 77:2,5 84:4 89:7 109:1 119:16 123:12 130:1 139:9 155:18 164:5 187:14 196:17 207:5 250:10 258:22
first-day 196:2
fit 114:21 156:16 163:1 173:21 177:12
fits 152:6,9
five 27:4 39:19 43:8 47:14 64:21,22 70:16 72:6 73:19 81:20 82:8,9 91:9 92:11,14,15 97:13 101:11,19,21,22 102:1,3 103:12,13 103:16,21 107:19 107:22 108:2 127:22 129:11 132:22 141:18,19 142:2 148:1,19,22 148:22 149:1,13 150:18 154:1,2,16 155:19 156:5 163:16 169:20 185:6 186:22 190:18,19 191:4 201:6,10 202:1,5 204:2 239:8 244:10,11,12,12
fix 193:22,22
fixes 192:16
Fixtures 2:13 3:10 8:2 13:7 39:13 66:12 116:8 257:4
flexibility 140:11 156:13 158:1
floor 11:3 52:9 62:16 103:4 117:2 163:12 164:5 167:2 198:22
flow 87:8
Fly 2:8 3:11 7:6,6 14:2,2 37:2 44:1 63:1,1 87:14 89:16,19 92:8 98:2,6,6 113:8,8 118:8,8,17 127:9 127:9 128:13 196:5 211:14,18 213:5 233:10,10 233:12 234:3 244:5,5,12 245:7 251:6
folks 206:11,12
follow 47:22 134:4 143:2 146:17 147:7 158:16 200:14 206:12
followed 122:12
following 14:3 234:8
followup 65:19
follow-on 150:12 172:8
follow-up 168:21 218:10
footing 30:2
forbid 206:12
force 140:8
forcing 223:17
foregoing 75:12 164:7
foreign 229:21
foresaw 43:20
forget 171:17
forgot 194:4 250:9
forgotten 192:13
formal 169:9 172:10
formalized 169:13
Forrestal 1:12
forth 89:8
Fortran 158:11
forum 10:18 11:1
forward 15:11 126:21 177:15 230:20
found 81:17 82:2 85:3 86:16 135:18 200:1 231:11,19 233:17 237:6
foundation 116:21
four 12:10 46:13 80:4 96:10 129:16 163:16 231:2 236:16
framework 224:9
Frank 2:16 8:4 29:3 53:1 55:19 103:5,6 112:13 125:8,18 150:3 170:4,5 172:15 188:8 240:6 242:5
free 9:18 14:1 39:8 229:1,1
freely 5:21 39:9
freezer 51:7
freezers 57:17 60:13
frequency 182:7,22 183:6 227:14
frequency-type 183:5
frequently 123:1
fresh 93:8
friendly 213:3
front 12:8
fuel 43:14
full 6:3 140:18 157:11 181:2
fully 89:6 170:7
full-load 100:11
fundamentally 30:10 137:14 158:21
funds 225:15 226:2
furnace 246:5,13 246:14
furnaces 246:18
further 44:8 183:15 239:13 257:14

G

gag 216:12
game 41:8
gap 109:9
gaps 113:2
Garst 2:9 3:14 6:13 6:13 16:2 49:14 49:15 90:22,22 167:15 180:7,7 219:3,3 245:11,11
Gary 8:19
gas 43:6,7 63:20 74:11 241:2
gather 9:13
general 2:3,6,14 6:10 9:8,10 21:8 49:12,13 78:14 79:4 178:7 221:14 223:15 234:7 251:3 258:21
generally 21:6 35:6 118:19 159:22 204:17 221:11,22
generate 15:4 112:2,4
generated 161:15
generator 31:9
gentlemen 178:19
getting 26:20 35:5 35:10,22 45:16 75:15 88:6 110:11 115:12 188:13 197:6 206:9 223:14 250:20
gist 251:3
give 16:14 43:4 66:8 96:11 117:8 143:20 175:17 180:4 184:21 185:4 187:3 191:20 212:5 217:13
given 66:22 123:4 132:8 138:18 146:22 175:11
gives 42:4 158:2
giving 15:17 17:15 173:20
glad 54:13
glass 87:2,3,4 152:10
Glatt 2:9 7:10,10 31:20,20 203:19 203:19
go 6:2 10:3 11:2,6,9 13:4 17:1 20:12 26:17 27:10 28:18 31:12 33:8 39:17 40:17,19 49:5 54:8 69:6 72:9 74:5,14 75:19 76:20 77:9 83:21 84:14 85:1 88:21 90:5,21 93:3,3 94:6 97:20 106:18 108:7 125:8 126:21 129:1 138:4 139:7 140:12 141:8,9 142:13,14 143:2 149:13 150:19,19 158:15 163:12 164:4,5 170:4 171:5 174:2 175:14 176:19 180:6 186:17 188:8 190:6 192:18 194:16 196:15 199:15 200:6 205:13 210:12,15 211:15 220:8 224:19 229:14 230:20 231:1 240:5 243:8 251:14,15 254:11 259:6
God 124:13 206:11
goes 15:12 48:15 66:22 72:5 97:11 106:8 108:13 125:12,13 137:10 142:5 144:9 145:5 145:11 182:14 195:15 244:22 251:7
going 5:13 6:1 9:22 11:2 12:11 15:2,4 16:18 25:10 26:15

27:16 32:9 35:16 37:13 38:13,18 40:6,18 42:9 46:10 49:3 63:3,9 64:18 65:1,16,18 67:11 75:6,7,19 76:5,20 77:2 79:6 80:12 82:6 88:1 89:2,2 90:6,7 92:11,20 94:8 99:13 101:2,17 106:3 109:1 110:12 116:14,17 117:3,8 125:14,15 127:12,20 131:4 138:1,11,13,17 139:22 140:21 141:4,8 143:2 145:19,20 147:11 151:12,16,21 154:19 155:8,19 156:10,18 157:17 157:21 160:14 161:16 163:14 166:6 167:1 168:9 168:15 171:14 172:22 173:9,20 174:22 175:18 179:8 183:20 184:17 190:18 191:9 192:20 195:1 197:5 200:16 202:15 206:22 208:10 212:9,14,20 213:2 213:6 216:10 219:9 222:19,21 224:19,19 225:12 228:19 229:11,13 230:1 233:13 238:19 241:9,22 242:1,21 244:13 245:13 246:4 249:4,16 251:18 254:3 257:5,12

gold 212:15

good 5:3 16:14 19:14 27:10 37:18 37:20 45:22 50:9 53:17 65:22 94:9 104:20 106:7 118:6 126:11 143:6 152:2 154:11 160:2 166:4 175:18 176:5 182:17 191:2,6,12 197:3 197:10 210:17 211:5,5 219:12 220:8,10,12 228:10 234:19 258:18 261:21

Goodman 8:14

gotten 53:4 62:3 142:8

government 151:17 188:6 223:7 225:17 226:1

grandfathered 29:13

grandfathering 29:8

granted 29:19 156:10

great 28:7 97:10 120:2 171:3 184:1 212:20

greater 31:17 100:12

ground 10:7 160:6 181:17 196:19

grounds 90:14

group 8:12 44:3 86:12,12 105:11 251:7

grouped 113:10

groups 34:14 78:20 148:6 198:13 249:18

guess 21:21 24:14 38:10 42:15 51:19 66:8 69:8 83:12 95:15 96:9 108:14 114:13 123:20 138:5 148:22 154:18 155:5 160:7 163:19 172:12 175:17 177:20 181:15 186:16 188:9 210:4,17 211:5 216:2,6 221:11 225:9 235:19 238:1 247:2 254:16 258:3

guessing 184:4

guilty 194:22

guy 94:17

guys 10:19 52:5 62:9 87:15 141:4 163:13 184:14 215:14

H

H 2:7

half 73:19 153:20 194:5 207:4

hand 5:18 54:15

Handbook 97:8

handle 16:22

Hang 121:1

happen 83:2 88:15 150:15 187:18 215:22 239:8

happened 178:22 198:4 204:7

happens 187:8 192:6

happy 21:4 189:11 212:19

hard 87:6,8 127:20 171:21 235:7

hardest 74:9

Harmon 2:12 3:8 7:2 12:20

Harvey 2:15 3:17 6:18 17:2,18 30:7 31:4 54:8,9 63:16 63:17 90:12 135:16,17 138:2 139:7

head 108:6 111:10 117:7 118:10 219:22

heads 252:4

hear 13:16 25:15 43:20 51:21 78:9 78:10

heard 119:17 247:4 257:9

hearing 136:1,9 144:16 181:10 189:9 216:4

heat 14:20 23:12 24:12 26:7 45:2 48:3,19 51:12 73:14,17 74:11,11 82:6 87:4 113:14 113:14,17 137:16 140:2,18 161:6 163:3,4 193:8 227:12 250:6

Heatcraft 2:17 8:7 60:10

heater 136:19

heaters 42:16 43:5 43:9 48:22 51:22 53:19 63:20,20 64:9

heating 2:2,16 6:16 11:15,15 23:8 44:18 51:9 60:1,3 73:14 161:7 250:7 250:8

heavy-duty 158:9

Hello 121:9

Helmuth 2:9 7:10 31:20 203:19

help 10:21 17:15 23:3 65:20 116:14 131:3 132:17 217:22 244:8

helpful 25:15 52:17 88:22 137:1

hey 78:13 185:13 213:3

hi 75:21 78:8 121:8 128:22 143:7 199:2,3

high 113:13 136:7 199:22 200:6

higher 115:14 131:15 134:8 196:8 200:21 220:16

higher-efficiency 145:8

highest 27:6 33:7 33:15,21 57:4 102:8,11,13 107:16,17 118:15 118:16 121:18 122:2,3,18,22 123:2,11,14,17 124:10,17,19 125:2,14 131:8 134:10 137:12 143:22 144:22 145:1 146:1,6 148:20 158:13 174:4 175:11

highest-loss 259:18 260:7

highest-volume 121:11,13,15 123:5 143:16 144:13 148:3

highly 32:4

highly-customized 66:16

high-performance 191:16

high-side 91:4

hinted 16:11

history 29:12 97:21 200:16

hit 237:13 238:17

hold 10:2 173:11 257:12

hole 31:12

Holt 8:15,15

home 262:8

homework 42:5

Hon 2:10 7:14,14 40:20,20 41:16,22

42:3 85:18,18 150:21 168:5,19 168:19 173:15,15 178:18,20 199:16 220:15 221:16,16 257:17 258:1
honest 229:3
Honestly 12:2 216:21
honesty 214:7
Hootman 2:10 6:22 6:22 44:7,7,13,16 44:19,22 45:3,7 45:11,13 90:7,10 107:6,6,19 108:3 108:9 114:10 160:19 162:18,20 162:20 173:3,4
hope 37:4 136:22 166:4 251:12 258:12 262:7
hopefully 75:3 197:8 250:18
hoping 37:10 260:15
horsepower 47:7,8 47:13
hot 148:14 249:5
hotels 15:20
hour 153:21 163:18 164:1
hours 82:21 163:20 163:20
house 55:1
household 98:16
Hoyt 9:1,1
huge 151:8 172:18 174:5
human 195:2
humidity 87:9
hundreds 151:4,8
hurt 223:14
HVAC 23:7 44:9 51:8 79:15 80:2 98:13 107:8 113:9 181:11 250:5
HVAC-type 86:13
hypothetical 221:1 221:10

I

icemakers 51:5
ICM 19:18 57:3 76:6,10 77:11,15 248:16
ICMs 20:1 36:12 57:3 76:2,16 77:9 78:4 91:2
idea 30:1 37:15 55:17 61:16 69:4 70:10 103:8 115:11,18 133:16 141:13 143:2 152:5 167:2 173:20 182:17 236:16 261:20
ideas 39:5 170:1 181:19,20 182:1
IEC 120:4
IEEE 22:7 97:7 105:11 247:22
IEER 245:14
imagine 108:5 168:1 171:21
immediately 206:20
impact 216:18 238:9 239:17
impacts 148:15
implement 22:18
implementation 18:19
implication 71:17
implications 220:6
implicitly 136:9
imply 72:11
import 68:12
important 11:14 14:4 54:13 91:2 114:8 146:14 202:13 229:6 253:19 256:12
impose 14:21
imposed 147:2,7
imposing 31:16
improved 81:14
improvement 124:21 140:8
inadequacies 81:18
inappropriate 178:14
inches 141:17,19
incidents 178:21
include 26:6 187:22 194:2 226:3
included 59:19 136:7 202:14 244:7 254:5 256:1
includes 51:4 254:11
including 23:20 51:10 55:12 101:19 129:12
inconceivable 70:12
incorporate 185:14 215:1
incorporated 7:7 193:21 248:2
incorporating 260:16
incorrect 189:14
increase 15:1 34:21 35:17 42:2,3
Independence 1:13
independent 113:17 176:3 177:3 248:14 250:12
indicate 90:16 154:20 230:16
indicates 220:3
individual 79:14,17 89:3 105:22 159:11
indoor 248:15,17 248:19
induction 47:6 136:3,15
industrial 59:10,13
industries 31:8 216:5
industry 34:14 152:3 157:5 161:11 171:4 174:21 175:1 177:21,22 178:2 178:15,17 197:9 197:10 216:3,8 239:5 245:13 247:5 258:6,8
inference 30:9
infers 37:12
inform 10:22
information 17:4,6 17:9,16 23:15 31:1,3 35:18 38:3 58:19 60:19 61:3 70:21 91:3 96:12 97:22 98:3,8,10 111:1 123:22 151:9 222:10 224:18 225:2,18 226:5,8,9,20 227:4,17 228:4,21 250:13
informed 98:18
Ingersoll 2:18 6:21 7:1 33:3 50:20 73:13 79:22 80:19 95:7 137:3 158:6 186:19
ingrained 251:8
inherent 56:1,4 80:13
inherently 126:19 170:12
initially 155:18 242:8
initiative 17:8
innocent 194:21
innovation 54:19 55:5 67:5
input 212:6 241:8
inside 20:16 86:5 173:11
inspector 198:14 198:14
instance 100:10 114:19 146:19 241:18
instances 234:8 235:20 236:1,9
instantaneous 43:7 43:8
Institute 2:3,16 6:17
instructed 217:5
instructive 135:20
instrumentation 81:13 195:15
instruments 161:15
insulated 55:1
intact 56:6 169:4
intended 22:10
intending 256:3
intends 183:14
intent 20:21 71:19 85:11 254:17 256:17
intention 34:21 38:20 60:8 120:22
intents 106:9 166:18
interest 64:6 199:10 217:18 221:14
interested 27:19 62:6 171:18 225:12 250:13
interesting 79:22 85:4
intermediate 159:10
internal 171:20 173:12 199:22
internally 192:12
International 2:9 3:15 6:14
interoffice 154:12
interpolation 55:21 159:9
interpreting 212:11

interval 18:8
introduce 7:20
introduced 46:13 146:2
introductions 3:4 6:2
invalidate 196:18
investigation 230:18 260:9
involved 108:18 142:5
involves 188:14
in-house 237:3,4
IPLV 245:14
ISO 86:12 88:2
issue 11:17 16:3 40:2 60:13 74:12 80:21 114:18 135:10,14 142:18 160:14 187:5 194:13 198:10 200:14 201:8 216:7 221:13,13 232:8 249:17 254:17 255:18 260:2
issued 23:14 51:16
issues 9:15 23:22 38:1 69:2 83:1 86:18 120:12 158:18 160:16 198:3 223:19
issuing 11:12
item 105:9 119:4
items 10:17 105:1 147:8 253:12
iterations 168:13

J

JAMES 2:18
January 12:2,11 60:17 257:18 258:7
Jeff 2:11 42:12 48:13 147:9 159:3 197:1,7 251:16
Jeff's 155:12
Jill 2:10 6:22 44:7 107:5,6 114:9 162:20 173:3 209:8
Jim 6:20 33:2 73:12 79:22 80:18 86:9 95:6 137:2 158:5 186:18 194:11,14 195:16 206:6 208:17 235:5 243:6 249:1
John 8:15
judgmentally 30:8
July 58:12 262:5
jump 128:18
JUNE 1:9
justification 126:5

K

Kapoor 101:9 143:4,7
Karen 2:13 26:3 99:1,2 222:9,14 225:20 229:8
Karim 2:2 3:7 6:15 11:9,10 26:13 38:8 50:13 52:11 69:6,7 83:11 93:7 150:20 161:19 177:18,19 178:12 185:15,20 210:16 211:13 225:8 237:21 239:16 244:8 245:19 258:2
Karim's 18:17 27:18
keep 18:7 86:6 89:2 90:6 92:11 103:9 109:1 112:14,16 116:20 163:14 169:3 184:17 241:1 256:18
keeping 167:21
kept 150:14
key 10:17 81:22 229:6 230:6
kicked 133:19
kilowatts 220:3,4,6
kind 14:17 16:11 26:12 28:20 31:8 31:22 35:5 37:2 37:12,14 43:20 48:1 53:4 54:6 55:5 67:4 71:16 77:4 86:17 104:6 109:9 113:12 117:4 122:8 125:20 139:8 141:5 149:22 155:21 156:2,8 157:6 161:16 178:11 179:14 182:4,19 187:6 191:2 198:8 218:15 235:7 237:10 242:9 244:1,1 249:5
kinds 10:20 69:2 124:9 207:14
Kleiss 2:11 42:12 42:12 43:10 48:13 48:13,18 49:4 108:13,21 109:2,7 110:8,11,15,19 111:20 112:1,11 112:17,21 113:1 124:22 147:9,9 148:9 149:4,7,9 149:14,19 150:1 159:3,3 161:10 179:12 251:16,16 252:12,19
knock 212:2
knocking 213:2
know 10:6 12:1,6 13:18 20:10 31:18 35:7 39:8,8,17 40:9 51:15 66:7 67:8,14 73:10,13 73:18 74:7,18 77:13 84:12 87:14 88:4 94:13,16,19 99:5,7,17 111:9 112:8,15 117:7 118:5 120:11 127:1 131:3 137:4 137:6 138:9,10,12 138:16 141:4,15 145:16,17 147:12 151:17 152:14 155:9 156:12 157:6 158:11 163:1 168:6,10,15 174:15,21 176:10 178:6,22 179:7 181:16,18 186:4 187:2,9,11,20 191:3 192:2,16 194:19,21 195:12 196:14 198:3 205:5 206:2 207:16 208:9 209:1 211:14,16 212:4 215:5,16 220:21 221:14 223:12 226:1 227:21 228:2 229:5 230:21 234:11,16,19 238:2 240:16 242:2,20 246:6 249:3,15 250:21 254:16 256:17 257:19 261:13
knowing 27:20 55:3 62:6
knows 196:9
Kunal 101:9 143:4
kV 144:5,19
kVA 144:3,18,19

L

L 2:8
lab 80:8,13,21 81:1 87:7,17,20 88:14 93:17,22 194:17 195:15,19 196:6 205:4 215:14,14 215:16 217:5 227:2
laboratories 201:3 201:15 216:6
laboratory 95:4 175:20 195:10,11 201:16 213:17 214:22 237:9
labs 88:1 113:16 195:14
lab-to-lab 90:3 98:12 158:18 160:16 196:7 211:22
lack 42:9 205:7 215:7
lag 245:6
language 177:11 178:13 232:19 233:7 244:1
large 41:5 53:18 54:12,17 62:21 66:3 94:21 109:5 109:12,21 127:17 136:3 147:20 232:9
larger 111:14
largest 102:7,9,10 107:11 114:12,17 115:1,3,20,20,21 118:11,13 123:15 130:8
large-scale 55:9
last-minute 163:8
late 41:7 145:3 197:6
latest 245:5
Laughter 17:21 25:20 26:18 48:12 50:19 63:14 73:6 90:17 92:13 95:17 119:19 125:5 139:11 149:18 154:8 167:13 188:3,7 208:1 212:16 214:5 227:20 229:2 234:18 235:10 239:2 247:18

248:9 251:13 252:6 253:8
Laura 2:3 6:8 8:17 29:14 122:16 132:19 135:19 218:8 223:20 225:20 251:10
laws 179:9,10
lay 207:13
lead 31:15 232:10 261:2
leading 17:14
leads 170:9
learned 171:1
leave 62:20 169:5 218:4 260:1
leaving 62:11 167:5
left 10:4 58:20 62:2 146:18 172:13,20 236:4 253:18
left-hand 183:14
legal 200:3
Legett 2:11 8:21,21
legislation 69:12
legitimate 31:6 199:20
Lennox 2:9 3:15 6:13 49:15 90:22 167:15 180:7 219:4 245:11
letter 29:10
let's 54:4 73:4 82:14 104:4 108:9 110:17 112:9 126:5,12,19 132:22 150:19 154:3 155:11,12 155:22 178:7 185:22 189:10 190:19 205:6,12 211:9,10 229:3 230:13 240:14 241:2,3 246:2 251:14
level 30:2 31:15 39:15 48:5 131:14 131:16 132:5 134:15 138:10,18 144:5,8,21 162:8 171:22 172:21 199:10 216:20 253:5
levels 18:10 43:12 88:21 97:11 131:18 134:22 135:13,14 243:14
Lewis 2:12 3:8 7:2 7:2 12:20,20 194:10 216:9
lieu 76:16
life 10:1 68:5
light 76:12 171:1
lightning 238:22
limb 171:15
limit 67:10,13 69:10,10 128:11 203:1
limited 91:3 181:22
limits 69:4 114:3 136:11 147:2 200:3
line 5:14,17,20 36:10 118:13 125:14 126:17 143:5 155:17 156:1,7 194:5 248:13 258:16 261:9
linear 55:21 159:8
lines 11:7 88:20 117:8 235:13 240:9
lineup 71:18
listed 93:11 113:10 114:3 147:2
listening 222:18 252:4 261:15
listing 113:12
literature 218:20
little 10:1 16:18 20:8 23:15 36:17 40:15 44:2 45:16 50:17 91:7 96:11 104:2 124:9 140:11 152:8 158:19 171:14 191:15 197:5 223:12 224:7,10 234:15 238:18 240:12
livelihood 194:21
LLC 2:11
load 157:11,12
Lochinvar 2:11 42:13 48:14 147:10 159:4 251:17
long 29:11,19 49:20 122:11 139:10 219:11 232:11 236:12 240:17 261:3
longer 33:9 57:7 72:7,13 121:15 231:20 233:4
long-established 31:6
look 38:16 43:1,18 47:4 68:8 73:11 78:19 80:22 88:10 93:8,8 112:7 114:6 123:10 125:20 129:10 132:16 136:12 145:1 148:13 169:3 186:8 190:9 228:13 235:13
looked 70:1 98:8
looking 15:11 33:5 34:17 70:5 85:20 86:12 88:9,18 98:2,7 114:19 136:2 171:6 254:8
looks 184:22 187:12,13
loophole 31:9
Lord 2:12 3:16 7:16,16 16:8,8 26:12,19 27:22 28:4 37:19 47:22 48:6,10 49:22,22 62:18,18 91:7,18 91:21 92:7,10 94:7 104:13,17,20 125:10 140:13,13 157:8,9 160:22,22 161:9 183:11,11 183:19 184:1 190:16 191:19 192:11,16 193:2 195:7 212:9 213:13,21 214:3 217:21,21 218:15 218:19,22 228:8,8 228:22 229:5 230:5 232:5,5 234:15 235:2 249:15 252:22,22 253:9 261:13,18
Lord's 64:1
lose 150:5
loss 194:4
losses 22:1,7 43:3 85:8,14 97:19 100:7,10,12,15 101:1 105:22 131:22 134:13 141:18 142:2 200:20 202:20 253:22 254:4
lost 53:4 230:8
lot 16:20 34:10,13 62:3 76:20 80:21 88:6 94:14 114:14 120:1,21 137:11 140:15,16 141:3 145:12 151:1 154:14 157:3 160:12 170:11 176:14 187:8 211:14 218:1,4 244:14 261:18
lots 83:1 214:4
love 32:1
low 196:1,2 199:22 200:6 204:5 206:10
lower 16:19 90:1 100:15 115:13 135:13 194:3 203:1
lowest 27:5 107:17 118:15 148:21
low-volume 51:18 55:17 231:2
luck 145:7
luckily 209:7
lumped 70:1 122:5
lunch 163:14,21,22 164:8 166:4

M

machine 142:3
machines 51:6
machining 80:6
made-to-order 52:1
magnitude 26:1 53:22 80:16
maintain 28:10 32:15,20 168:7 173:10 182:17
maintained 30:22
maintaining 35:10 183:7
major 27:19 80:22
majority 35:3 55:15 159:22 181:10
making 74:20 155:13 156:7 179:20 180:4 222:1
maneuver 173:18
manufacture 13:10 66:16 67:2,17,22 68:1 117:13 248:19
manufacturer 30:13 54:20 64:6 64:8,14 66:2,14 67:17 76:3,16 77:12 93:14,20 95:14,16 116:14 117:12 131:11

135:7 138:17 146:20 150:6 152:19,20 154:4,5 154:15 157:5 171:10,16,21 172:14,20 173:6 181:1 187:16 190:10 194:12,15 197:22 198:5 201:17 202:3,19 203:7 206:22 207:12,18,19 214:18 217:4,13 217:14 218:1 220:5,16 222:12 223:1 224:13 226:13 227:5,9,15 233:9 236:18,21 249:3,10
manufacturers 2:5 7:9 9:2 11:14,20 12:4,5,11 19:4 22:14 23:11 24:20 25:11 29:6 31:7 31:16 35:7,19 38:13,20 41:19 52:15,18 60:19 61:18 65:17 66:9 76:6,8 77:6 82:18 90:14 91:4 95:9 98:22 113:18,19 138:15 159:6 163:5 169:6,10 175:7 177:2 180:3 185:1 215:6 223:6 223:10,18 224:3 225:1 227:10,10 229:20,21 248:14 258:4 259:20
manufacturer's 68:20 76:13 202:10
manufacturer-in... 181:6
manufactures 248:16
manufacturing 2:10,13 7:15 40:21 41:4 66:5 68:4 85:19 87:2 88:15 99:3 116:15 171:18 173:16
March 184:7
Mark 2:8 3:11 7:6 14:2 63:1 98:6 113:7,8 118:8 127:9 211:18 233:10 244:4,5
marked 254:9
market 49:17,20 53:15,21 54:21 56:17,18 151:2 168:5,10 243:12
marketplace 68:6
markets 168:10
market-at-large 68:22
marry 24:4
mass 87:7
Massoud 2:13 3:10 8:1 13:6 39:12 66:11 116:7 178:9 257:3
matched 57:4,6
material 132:1 141:17
materiality 68:19 68:19,21 69:2
materials 85:22
math 59:21 190:18 191:2
mathematical 19:1
mathematically-... 48:7
matter 26:1 31:19 60:19 75:12 112:18 164:7
mature 82:17
ma'am 45:12
McDermott 8:14
mean 21:18 22:9 27:10 30:20 32:10 35:12 36:14 38:15 55:10,20 57:14 62:19 65:20 68:3 72:17 74:22 81:9 83:14 89:17 92:2 93:2 99:8,12,17 106:6,9 115:11 120:19 124:15 128:10,16 149:15 150:9 154:18 155:3,8 158:1 159:21 160:4 173:7,8 177:22 181:21 185:17,18 192:7,9 194:20 195:2 208:8 210:4 210:8 212:17,18 216:14 217:17 224:18 225:11 226:22 228:10 229:12 238:6 239:21 244:6,14 246:1 247:22
meaning 20:22 188:22 247:14 248:6
meanings 56:16
means 36:2 42:18 72:4 84:16 89:19 130:1 151:6 152:11 191:21 236:10 239:14
meant 22:15,20 120:18 186:10
measure 87:6 109:13
measured 21:11 110:3 243:4
measuring 81:13 81:21 82:1 109:11
mechanical 70:4
meet 25:3 36:5 41:9 72:7 102:17 104:14 117:21 118:1 119:5,11 132:1 133:13,21 138:8,18 160:1 184:19 188:12 191:21 193:11 196:16 199:7 210:1 223:11 226:2
meeting 1:5,11 5:7 5:22 9:12 10:16 11:8 13:9 15:10 29:10 78:18 105:12 194:15 201:9 214:20 230:12 262:11
meetings 179:11
meets 27:2 126:11 171:19 192:21 203:4
member 8:12
mention 18:7 250:2
mentioned 59:19 194:14
Messmer 3:22 19:12,14,17 36:13 199:2,4,5
met 28:13 62:15 106:17 133:4 145:2
meter 87:20
method 21:22 22:7 23:1 57:15,17 158:9 241:20,22 242:3
methodology 13:17 30:4 109:14 111:21 114:11,13
methods 1:6 5:8 24:6,11 29:9 34:9 56:5 76:13
metric 111:6,7 193:15 224:22
metrics 111:3 161:4,6 193:9,10 229:6
Meyers 2:13 26:3 26:10 99:2,3,12 143:12,13 145:16 222:8,9,14,14 225:20,21 226:19 229:8,9 258:19
microchannel 137:16 140:2
microchannels 138:18
microphone 6:6 10:9 52:20
microphones 7:19 10:10
microprocessors 94:11
middle 181:17 213:6
migrate 144:21
migrated 124:16
migration 138:19
Mike 2:9,17 3:14 6:13 8:6 49:14 60:9 90:22 167:15 180:7 219:3 245:11
million 53:21
millions 14:11
million-dollar 87:7
mind 18:7 74:14 179:19 186:12
minimizes 10:9
minimum 28:12 44:4,5 64:21 69:10 101:19 112:13 129:11 144:6 154:1 185:6 199:8
minimums 126:15 220:2
minor 14:18 27:15 27:16,17 244:17
minorly 14:16
minus 81:3 87:5 88:18 89:17 92:16 92:17 96:2 100:20 100:22 101:12 190:21 191:4,9,22 196:10,11,13 200:4 211:17 212:4,12
minute 151:14 156:4 189:3
mislead 90:14

misrating 234:10 237:7
missed 129:5 195:1 239:1
missing 209:2 216:14
mistakes 195:14
misunderstanding 136:22
misunderstood 129:4
Mitsubishi 2:8 3:21 18:16 59:17 71:9 175:5 193:5 195:6 224:16 227:7 233:2 240:4 242:17
mix 191:10 215:15
mixed 36:12,17 76:11
mixed/matched 57:1
Mixer 82:4
mixers 81:19
mixing 56:11
mode 246:4
model 13:14,15,19 14:4,7,13 15:3 16:3 19:10 33:6 33:16 36:11,16,18 36:22 37:8,12,13 38:6 40:2,3 41:14 46:1 47:16,16 54:5 57:6 67:3 70:11 71:18 72:3 72:16 77:18 78:19 97:14 102:10,12 114:12 115:20 116:12,20 121:12 121:13,15,16 122:14,20 124:19 125:22 128:5 129:20 132:7 136:4 137:22 140:18 143:17 144:1,10,11,13 145:22 146:10 148:5 150:9,13 152:4 159:11 168:7 170:15 188:12,19 191:13 200:19 201:6 220:20 231:15,18 233:14,18 237:16 248:15 249:18 251:6 252:2,3,8 252:15 256:11,14 257:6
modelers 17:7
modeling 13:21 19:1 76:10 151:15 220:22 221:20
models 13:21 14:12 15:5 19:4 27:5 31:12 36:3 39:3,7 41:3,8 45:17,20 53:18 54:2 58:14 63:5 64:4,21,22 65:9,11 66:19 70:5,17 71:14 72:1,15 74:8 101:19 102:7,21 103:12,14,15,22 104:6,8,9,14 107:11 117:13,14 120:17 123:10,15 126:6,22 127:1 129:2,6,7,12,16 129:22 130:6 131:8 132:22 142:15 146:2,21 147:3,22 149:11 151:4,7 152:2,3,6 152:13 154:2,2,5 154:16,17 155:1 155:19 156:12 166:19 167:5,20 169:17 171:12 173:21 192:22 221:19 231:14,22 233:17,19 241:6,8 251:22
model's 189:13 252:17
moderator 9:21
modern-day 171:21
modifies 257:21
modify 105:12
modifying 97:7
modules 64:2 157:1
monitor 122:10 175:1
month 84:10
monthly 122:10
months 12:10,10 12:16 18:18 144:11 236:17
morning 5:3 19:14 171:1
motion 13:1
motor 2:9 7:11 22:5 31:21 46:18 47:12 82:15 100:6 100:6 131:9 132:3 133:4 152:19,20 175:18 202:1 203:3 216:3,8 247:12
motors 22:1,2 23:9 45:20 46:6,7,11 46:20 47:2,2,5,5,6 47:17,17 51:5,10 51:11 58:11,20 59:4,9,10 69:22 69:22 70:3,7,10 70:12,13,15,15,22 70:22 80:1,4,14 83:10,16 85:5,5 85:12,13 96:5,6 96:13,14 97:4,16 97:16 105:4,5,8 131:5,12,14,19 133:5,12 134:7,19 134:21 135:9,12 136:3,7,13,15,16 138:20 141:14,14 142:9,10,17 166:9 168:12 172:9,22 177:13,13 181:4 181:12 200:16 204:3 247:16 248:4,7 253:17,18 253:21,21 254:10 254:13,15 255:20
mouthful 145:17
move 16:7 18:5 49:8 79:5 166:6 177:15 254:3
moving 18:21 119:7,8 120:9,10 124:19 237:9,12
multiple 61:19 62:1 62:11 118:20 123:10 157:1,20 159:5 166:11 190:3 193:9 234:8 235:20 236:1,9,11 237:4,8 241:5

N

name 5:5 6:3 7:20 11:4,10 98:4,5 121:5
nameplated 247:12
naming 24:3,5
National 2:4 7:9 8:15 9:1
nature 76:12 117:10 153:8
Navigant 2:5,11,17 8:22 9:3,6
NAVLAP 97:8
near 54:4 113:13
necessarily 33:15 72:11 98:17 104:5 106:14 132:10 133:19 136:19 138:12 153:2 156:4 160:5 185:11 192:9 205:19 207:4 214:18 215:3 216:7 230:4 248:2 256:12
necessary 25:15,18 50:10 58:5 65:13 70:20 74:17 155:4 232:1
need 10:2 14:14 16:4 27:15,16 28:13 34:10,16 38:4,16 42:22 43:20,21 51:17 57:7 64:10 65:3 67:11,18 69:11 71:21 72:3,9,12 72:14,18 74:5,13 77:22 83:12,13 94:20 97:20 103:1 117:20,21 118:1 118:22 120:17 122:21 130:2 150:16 154:13 164:4 174:10 175:7 186:4 192:20 194:6,22 195:8 209:13 212:3 213:3 220:21 221:20 234:1 237:8 238:11 240:21 243:10,22 258:4
needed 32:16 62:7 138:8 167:17 175:10
needing 259:6
needs 17:15 32:3 55:14 146:2 202:14 223:16
negate 37:15
negative 88:22 90:5 90:8,18 91:1 150:22 212:22 213:1
negotiated 250:4 261:21
negotiating 257:9
NEMA 3:13 15:8 96:19 176:22 200:17,22 204:4
Neshan 2:13 3:10 8:1,1 13:6,7 39:12 39:12 66:11,11 116:7,7 178:9,10

257:1,3,4
net 55:13
never 47:3 72:21 125:15 186:12 260:14
new 5:13 17:3 25:2 25:12,18 26:16 36:4,5 49:17 55:7 66:20 68:11 72:4 78:1 102:15,22 120:12,13 122:21 132:1 133:4,6,7,8 133:12 137:17 144:21 145:2,4,11 156:2,6 168:11,12 168:13 169:17 185:7,12 209:16 233:18 255:18 256:4,4
newcomer 50:5
newly 146:1,3
Nidec 2:9 7:10 31:20 203:19
NIST/NAVLAP 96:20
Noe 8:19,19
nominal 100:11 101:3 200:22 204:4
non 231:5,11 234:8
non-compliance 203:18 236:10,13 237:6,7
non-compliant 144:11,14 146:10 207:3 231:15,20 233:18
non-complying 31:12
non-regulating 111:6
non-tested 19:3
noon 163:15
NOPR 11:18 12:8 20:16 22:11 53:5 58:3,17 59:7 84:9 84:11,15,17 85:9 96:4 100:21 153:22 166:17 253:13 254:11,14 254:18 255:21 256:1,14
NOPRs 69:21
normal 143:22 232:17
note 17:18 59:6 236:9
noted 23:10 62:6 253:15
notice 1:5 5:10 10:17,21 15:16,22 20:16 75:2 89:4 262:3
noticed 19:19
notification 28:20
notified 194:16
notify 220:15
notifying 194:12
notion 155:5
nozzles 82:3
NSF-type 198:14
nuance 208:15
nuances 41:1
number 4:11 26:2 53:18 54:2,5 64:21 86:22 87:5 87:16 128:14 142:15 148:19 151:19 166:7 169:19,20 196:12 196:12 205:5,18 208:10 212:5 245:18 249:20 251:18
numbers 83:6 99:8 106:11 107:15 127:14,14 236:15
numerical 105:19

O

object 225:1
objection 90:13
observation 68:18 137:1 223:16
observed 201:2 203:16
obstacles 147:6
obtained 71:13 185:3 215:4 226:13
obvious 40:12 69:19
obviously 22:19 44:11 55:22 102:14 108:1 156:11 169:4 173:7 182:14 190:1 225:14 231:13 232:13
occur 36:3 126:21 138:10 181:3
OEM 77:15 78:2 249:4
offended 178:16
offer 155:8
offering 19:10 61:21 62:14 155:18 156:12
offerings 117:8
Office 2:3,6,14 6:10 9:7
officially 12:13
offline 21:5
off-mode 246:3,11
oh 73:9,12 95:15 96:9 98:6 101:9 110:7 124:13 143:10 154:7 180:6 183:10 189:20 199:15 221:4
oil 43:6
okay 10:15 13:22 20:6 21:2 23:3,4 24:13,19 25:5 26:21 34:1 36:9 40:4 42:11 43:10 43:21 45:11 47:21 49:2,4 50:22 51:1 56:7,21 59:20 60:4 61:15 64:13 69:16 72:19 75:15 76:19 77:1 78:5,7 78:13 79:3 83:9 84:21 85:2 90:5,9 92:22 94:6,22 95:5 96:8 99:21 100:3 101:7,14,17 104:11,15,20 107:7 108:9,11,13 108:21 109:1,2 110:10,15,19 112:11 113:7 114:4 117:6 118:7 118:17 123:7 124:4 125:6,6,17 126:3,8,11 130:13 130:20,21 135:16 139:4 141:7 143:1 143:6,10 144:20 145:14 148:7,9 149:4,7,14 150:2 150:9,21 154:7 155:12,15,18 156:2 158:4 159:20 160:21 161:9,18 163:7,8 163:19 164:1 166:3 167:14 168:17 171:17 173:13 175:3,13 182:3,4 183:9,21 184:4 186:1,5,16 187:10 188:13,19 189:10,12,17,20 194:10 197:4 198:12 199:14 201:20 202:11 204:10,11 209:19 211:7 215:11 218:21 219:2,20 220:14 221:4,21 228:7,14 230:9 233:6 234:3,6 235:4 237:12 240:1,13,14,18,21 241:5,6 243:5 244:3 246:12,19 246:20 248:10 249:13 252:7 253:9 254:6,22 255:17 256:15 258:15,18 260:19 261:6 262:1
old 24:15 233:20
once 19:6 33:18 70:2 92:3 126:9 126:10 128:6 131:10 145:4,11 149:12 189:22 190:12 210:9 217:9 240:18
onerous 173:8
ones 27:8 39:21 40:6,8,11 62:1 74:8 111:14,18 134:9 137:14 157:4 179:8 192:10 231:19 235:21
one-by-one 76:20
one-size-fits-all 177:10 179:14
one-tailed 18:8
one-time 127:5,6
ongoing 34:11,16 61:5 153:9 170:22 174:6 222:3
open 5:14 10:13 11:7 21:4 52:9 55:18 62:16 74:10 74:13 75:1 103:3 115:8,17 116:3 120:20,21 151:16 154:21 163:12 167:1,9 182:2 234:15 236:4 241:14
opened 117:17
opening 3:5 4:2 11:4 13:3 18:1 116:5 151:10 153:15 258:5
operated 194:19
operating 143:22

opinion 168:2 206:3,4 215:20
opinions 170:1
opportunity 54:18 254:19
opposed 233:20
opposite 31:22 200:6
option 53:14 144:15,17
options 14:9,11,15
order 3:2 54:3 55:18 65:8 93:21 109:17 112:1,4 147:1 173:11 207:10 260:11
ordered 259:8
original 198:1
other's 229:18
outcome 106:13 200:9 243:1,4 257:13
outcomes 184:18 230:15
outdoor 248:16 249:5,10
outliers 114:15 115:2
outlined 129:3 158:2
output 32:7
outset 11:8 190:2
outside 10:3 34:13 110:3,6 112:3 127:19 139:16 196:17 202:7
overall 76:11 77:4
overcome 147:6
overdue 11:13
overlooked 146:13
oversight 59:7
Overview 4:4
overwrite 84:19
owner 223:13
o'clock 164:1

P

package 122:6 182:19 192:20 237:17
packaged 48:2 125:11
page 20:22 71:10 78:15 129:3,10 146:16 183:13
paid 225:18 226:10 226:17
pair 76:8
panel 2:12 3:9 7:3 12:21 57:18
paragraph 71:11 146:14
parameters 199:21 200:7
paramount 229:12
Pardon 208:20
pare 39:4
part 30:1,21 32:9 46:3 58:11,18,19 59:5,11,11 66:4 70:6,14,21 73:2 89:8,9 97:14,17 100:9 115:7 118:21 128:16 142:7,9,9 156:7 157:12 162:16,16 170:7 177:11,15 177:16 189:19 201:13 204:1 206:16 211:10,20 223:16 224:8 225:16 226:7 237:13 239:1 243:19 245:10 254:8 255:14 256:8,11
PARTICIPANT 167:12
participate 5:22 171:3 177:2,5
participating 170:12
participation 9:16 176:2

particular 38:17 65:14 100:19 114:21 122:20 124:3 136:1 170:15 187:7 200:19 201:18 203:11 204:8 214:20 227:1 249:9
parties 218:14 250:13,18
parts 84:7 176:15 177:12 245:9 255:22 256:4
partway 162:15
party 81:1 87:11 95:13 177:3 226:10 249:9 250:12
pass 66:9 74:17
passes 256:10
pathway 160:3 171:6
patiently 121:3 196:22
Paul 2:8 3:20 18:15 59:16 71:8 175:3 175:4 193:4 195:6 224:15 227:6,18 233:1 240:3 242:16
pay 227:2
payback 42:9
penalties 173:8
people 5:15 7:18 15:20 78:17 88:3 121:2 139:17 140:16 196:21 197:8,12 216:18 244:16 250:19
percent 15:21 18:8 27:6 72:17,18 79:11,11,12,17,18 80:1,2,3,5 81:3 82:10,12,12,15,20 82:22 83:3,7,9,10 83:14,15,16,16 85:7 86:7,15,16 87:5,11,12,12,13 87:18 89:17,21 91:10,11,14,14 92:9,15,16,17,21 96:3 99:6,7,7 100:11,12,14,15 100:16,20,22 101:3,5,5,11 102:9 114:5 115:19 127:19 128:11 130:8 140:7 150:16 151:19 185:18,20 186:9,13,20,21,22 187:14 190:20,21 191:1,4,5,22 192:6 194:3 195:20,21,21 196:1,1,10,11,13 196:15 200:1,9,21 201:7,12 202:20 204:4,6 205:6 206:10 207:5 210:1,21 211:6,10 212:1,2,12,14 213:1,1 236:2 253:4,6 260:12
percentage 86:22 171:12
percentages 83:14 99:16,20
percentile 203:2
performance 17:6 19:3,5 30:11 43:15 60:16 81:6 82:17,20 139:16 157:11 158:8 228:16
performed 201:16 202:2
period 64:22 171:13 232:17 239:20 262:4
periodic 167:22 169:1 172:11 181:5
permit 23:6 224:2
permutation 66:9
permutations 14:10 63:22
person 5:10 218:6 227:1
personally 178:16
perspective 51:20 138:6 139:12 205:16 217:1 259:1
pertaining 76:1
Petrosino 121:4,7,9 122:7 123:2 124:1
phase 250:10 259:14
PhD 2:2,6,7,15
phone 5:12 75:18 78:12 99:22 101:9 121:2 128:19 141:9 143:3 196:21 198:21 219:21 250:20
physical 71:13 261:4
physics 137:15 142:4 152:15 176:13
physics-based 140:18
pick 204:8
picking 83:15 114:11
picture 67:21 122:9
piece 67:18 94:11 94:18 200:2,15
pieces 67:10 218:11
piston 80:5
pit 125:1
place 13:17 84:13 88:3 132:15 178:4 197:11 204:2
places 243:14
plan 10:13 34:12
planning 34:11
plans 222:4
plausible 106:12

play 17:5
players 179:6,6,10
playing 31:15 162:8
please 5:17 6:3 7:22 10:3 11:4 14:1 39:8,11 42:18 58:7 75:10 95:21 108:12 143:5 179:19 183:10 246:21 249:14
Plenty 190:8
plug 175:18 209:20 209:22
plus 81:3 87:5 88:18 89:17 92:16 92:17 96:2 100:19 100:22 101:11 107:20,21 190:20 191:1,3,5,10,11 191:12,21 196:10 196:11,12 200:4 211:17 212:4,12 219:6,8
point 16:18 19:13 24:8 27:18 32:4 37:3 40:5 41:18 52:10 53:3 55:19 58:7 63:10 68:20 68:22 72:19 75:1 75:6 77:7 85:15 92:8 93:6 94:9 103:3 104:6,9 106:7,8 111:16 112:2,4 115:8,12 119:22 132:21 136:22 137:19 140:11 155:16 158:15 163:6 167:10 170:9 182:3,11 188:14 188:18 189:6 208:12 209:18,22 210:8 213:5,8 237:10,11 241:3
pointed 101:6
pointing 61:13
points 161:12 230:6
policing 177:22 178:2
policy 90:13
polyphase 47:5 136:2,15
popular 126:6 144:2,10
populating 249:20
population 200:20
portion 243:17,18
posed 199:17
position 168:16 226:16
positive 261:14
possibility 66:8 202:4 232:16 250:3
possible 146:20 203:22 257:9
possibly 26:22 156:1 159:9 168:6 174:11 188:15 197:15 204:5 236:17 255:22
postponed 12:15
potential 54:21 90:11 124:22 184:18,21 230:14
potentially 95:20 188:16
power 46:7 243:15
practical 50:11 65:9 68:14
practice 224:14
preapproval 28:8 28:16 34:15 49:9 49:12,13,16 50:2 50:9,21
preapprove 35:16 49:10
preclude 21:19
preconceived 155:5
predict 19:3 22:16 157:10
predictability 126:13
predicts 21:10 158:8
preliminary 61:7
premise 61:16 148:11,17 149:2
premium 134:21 135:8,13
preparing 84:8 85:8
prequalify/preap... 34:8
prerogative 158:3
present 2:1 9:22 10:16 46:9 47:14 70:6 85:4 105:13 218:13 247:5 254:2,8
presentation 9:18 13:5 16:7 23:10
presented 250:14 251:4
presenter 9:21
presently 70:14 100:8,18 105:12 105:15
presiding 1:16
pressure 14:22
pretty 43:12 55:5 78:11 166:4 174:2 209:4
previous 100:4 102:11 144:14
previously 127:18 226:16 256:8
price 15:22
primarily 20:2
primary 144:3
prior 194:15 254:19
priority 147:1
probably 53:16 56:11 82:21 94:9 157:14 163:5,18 166:22 169:10 175:6 195:8 242:7 242:12 261:5,19
problem 19:21 25:6 47:1 49:21 58:17 66:7 112:9 114:1 142:7 161:13 192:17 216:3 219:15 222:22 223:4
problems 174:19 261:22
procedural 23:18
procedurally 29:7
procedure 21:14 30:6 55:21 56:1 58:13 85:4 86:1,2 102:19,20 105:20 119:6,7,11,13,15 120:13,16 203:14 217:8 226:22 237:15 238:2,6,13 239:5,6,7 240:18 240:19 241:1,4,13 241:21 242:14 243:3 247:7,15
procedures 16:20 27:9 36:4 98:19 120:2 126:15 183:1 189:2 217:3 238:4 245:3 259:10
proceed 207:9,10
process 28:16 46:3 46:6 67:3,4,12 116:17 147:15 188:15 189:14,15 190:7 195:9 202:14 205:14,19 206:1 210:13 223:19 224:9 236:11,12 245:1
processes 43:17 203:14 206:13,15
produce 236:21
producing 236:18
product 16:3,5 17:9 27:3 37:17 37:21 38:4,6,12 38:15 42:14 43:3 43:8,19 44:3 45:17 46:5,8,13 46:14,19,21 47:4 47:11,13,20 48:3 56:10,12,14 60:14 60:15,20 61:4,10 61:21 62:4,13,14 62:21,21 63:5,19 63:22 64:4,19,20 65:11 70:9,11 71:1 73:11 74:14 78:19 79:12 89:3 89:15 101:20,21 102:1,8 107:8,12 107:16 108:2,14 108:17 109:8 110:3,5,6 114:12 114:18 117:7 118:13 122:19,22 123:4,5,10,12,12 123:13,16,18 124:17 126:16 129:13,17 130:15 130:16,17 133:15 145:2 147:18 148:3,5,12,14 151:13 152:17 156:1,7 159:8,12 161:4,20 168:2 171:19 174:14 176:12,13 178:1,6 184:13 185:22 189:3 192:9 194:5 198:6,7 202:19 203:8 204:12 207:3 220:20 233:3 238:10,15 239:19 246:10 251:21
production 54:18 55:9 69:10 126:1 135:12 138:1 143:17 145:11 172:1 259:7
production-line 54:11

products 2:17 16:12 19:22 20:2 28:22 38:11 40:13 52:14 53:6 54:11 55:7 56:13,14 61:22 63:4 70:2 79:8 90:15 96:15 113:9,11,15 132:18 147:17 151:1 155:14 158:7 172:18 177:6 179:19 194:8 197:21 228:20 231:3 235:22 236:19,22 240:10 241:3,4 242:10 243:12 244:21,22
product-by-prod... 38:16
program 1:3,16 83:4 96:21 97:9 113:13 119:18 126:22 153:12,13 171:5 175:20 176:3 177:1,4 195:13 212:5,8 232:10
programs 17:5,13 34:18 174:18 178:3,5
prohibit 139:20 140:6
prohibits 29:8 67:4
project 2:7 8:10 150:22
promulgated 57:16
prop 80:6
proper 127:3 172:21 197:20
properly 70:16 119:12 161:14 188:20 194:20 218:3
proposal 9:14 10:17 24:2 30:18 30:21 50:10 57:7 62:1,17 77:3 89:15 103:17 133:14 156:16 162:14 167:11 169:14 190:4 215:12 234:7 254:14 261:15
proposals 35:2 183:5
propose 182:6 185:1
proposed 1:5 5:7 10:21 11:12 24:1 24:17,22 25:9 27:13 36:1 51:2 55:12 84:19 100:20 166:14 181:8 182:6 190:14 197:15 246:8,11 253:15
proposing 24:4,7,9 24:10 28:8,15 123:9 149:16 232:14
pros 170:1
protest 151:13
protests 153:14
protocol 248:1
proven 194:21 196:13
proves 91:11
provide 10:18 25:10 48:10 149:10 207:19 235:2,18
provided 227:15
providing 67:5 76:14 154:21 225:17
provision 69:3
provisions 25:2,4 37:10 123:8 155:3 232:20 255:7,8
psychrometers 81:19
public 1:5,11 5:6 9:12 10:19 30:15 90:15 222:12,13 223:17 225:18 226:17 227:1 229:10,19 230:12
publication 21:1
publicly 226:15,20
publish 91:15 92:19
published 45:21 84:6 220:5
pull 204:21
pulled 189:10
pump 26:7 48:19 57:2 73:17 113:17 161:7 193:8 227:12
pumps 23:12 24:12 45:2 51:12 73:14 113:14,15 163:3,4 243:8
purchased 226:10
purely 252:16
purpose 9:12 10:15 13:20 223:6 225:9 230:7
purposes 76:17 106:9 166:18 210:10
pushed 35:5
pushing 74:8 82:22 86:15
put 10:8 13:17 16:15 37:20 63:7 66:5 69:10 82:14 112:9 127:13 132:1 134:16 135:1 137:15,16 140:6,21 141:16 141:17,21 142:1 145:22 146:15 159:1 192:13 195:22 197:17 211:10 213:7,17 216:12 218:19 237:17 245:18 258:11 259:9
puts 69:3 150:5
putting 171:19 176:14 230:7
P-R-O-C-E-E-D-... 5:1
p.m 164:8,9 166:2 262:10

Q

QC 171:20,22
qualifications 88:19
qualified 26:15
qualify 241:11
quality 259:22
question 20:4 24:15 29:17 31:19 34:7 36:10 41:12 51:13 55:6 56:8 56:22 57:12 64:5 66:1,1 67:13 69:8 73:8 76:1 78:5 84:5 99:4 101:8 101:10 110:12,14 116:13,18 121:10 123:3 124:6 143:8 143:14,15 144:12 151:11 153:18,19 154:10,19 159:18 159:21 161:3 168:21,21 170:8 170:10,18 171:2 185:16 199:16 202:9 208:11 210:17 213:16 218:10 219:20 220:17 221:12,18 228:19 236:4 237:19 238:19 239:4,10 241:16 245:20 248:13 249:1 251:7 253:2
questioning 191:14
questions 4:7,10,13 4:16 9:15 20:9 33:4 34:19 56:8 58:6 75:17 76:21 79:4 99:22 103:4 143:9 145:18 156:18 232:2 237:18 248:11 262:6
quick 119:3 138:3 218:10
quicker 35:6
quickly 48:1
quite 21:3 33:12 35:15,17 83:3 115:22 148:8 178:19 260:14
quote 152:9

R

raise 5:17 11:17 170:8 216:20
raised 131:18
raises 34:19 135:14
raising 18:11 216:6
ramifications 209:2
ran 129:2
Rand 2:18 6:21 7:1 33:3 50:20 73:13 79:22 80:19 95:7 137:3 158:6 186:19
random 145:7
randomly 147:4
randomly-selected 127:1
range 61:20 62:13 86:3 87:18 90:5,8 93:11 94:1 101:4 112:3 115:7,13,14 116:4,5 118:21 127:19 139:17 157:11 191:20 199:22 236:6
ranged 230:11
Ransom 8:13,13
rare 103:20 104:3
rate 16:17 19:5 23:12 29:1 51:18 65:8 81:9 83:5 88:11 89:22

113:13 130:12 156:20 212:13 219:15 222:20,20 222:22 223:1,3,7 223:18 224:4 236:19,22 241:9 249:3 253:3
rated 32:21 82:20 152:1 188:20 189:3 208:9 212:18 220:11,12 230:22 231:10 233:19 235:16
rates 241:5
rating 16:13,17 39:9 52:6 57:2,4,5 92:2,2 114:2 137:13 184:12,15 184:22 185:22 186:7,21 187:1,13 188:13 189:13 192:5 193:22 199:7,8,12 201:9 201:22 202:9,10 202:11 203:5 204:22 205:2,6 209:2 210:11,12 210:20 214:20 220:5,9,16 224:7 224:12 242:10 248:5 252:2,9,17
ratings 30:3,5 46:7 52:7 70:17 76:17 87:19 90:16 91:15 92:4 120:15 140:21 157:16 159:2 170:14 172:4 184:14,19 185:8,10 192:10 193:18 194:3,6 208:7,12 209:3 221:13 223:10 224:1,2 229:7 233:21 234:12 237:5 240:10
Rawald 2:14 9:9,9
read 77:17,21 89:6 147:5 153:22 187:21
reading 107:10
ready 12:11 136:10 258:6
reaffirmation 244:15
real 54:11 132:9 138:3 218:10 247:13
reality 65:7,10 128:6
realize 36:15 96:12 115:21 118:18 120:1 131:10 184:13 203:13 208:7
really 9:13,15 10:16 14:20 16:11 16:12,19 19:20 41:5 62:1 74:16 81:20 82:12 91:2 97:21 113:19,20 128:3,14 132:6,8 139:18 141:6 143:15 145:12 155:1,7,9 157:2 163:19 177:12 195:7 211:17,18 213:3 215:6 228:16,18 240:21 245:20 260:6
Reamer 8:17,17
reason 31:3 49:1 122:14 207:2,7 221:17 230:17 240:11 255:18 259:4,12
reasonable 27:20 39:6 63:8
reasonably-equi... 87:10
reasons 124:16 145:21
Rebecca 2:11 8:21
receive 251:2
received 51:16 55:16 98:21
receives 249:8
recently-announ... 17:8
recertify 185:9 194:6 231:22 234:2
recognition 170:10
recognized 176:2 177:4
recognizes 204:18
recognizing 166:20 239:7 256:4
reconfirm 26:13
reconsider 70:14 97:17
record 6:4 7:21 11:5 75:13,14 164:8,9 223:17 230:1
records 28:10 30:22 32:5,14,17 179:1
recovery 14:20 16:15
redefining 41:7
redesigned 72:8
redo 124:14 126:16 209:3 217:15
redone 231:21
reduce 19:8 34:16 116:11,17 117:4 122:21 173:18
reduces 54:19
reducing 52:16 259:16
reduction 174:5
refer 59:8 248:20
reference 244:8,19 245:7,10 247:8 253:22
referenced 238:7
references 59:12
referred 20:17 247:4
referring 21:3 59:13 95:19 178:5 247:14 248:3
reflected 54:14
refrigerant 93:19
refrigerated 13:11
refrigeration 2:3 2:16,17 6:16 8:7 11:16 38:11,14,21 40:8,18 51:4,7 57:20 58:4 60:10 60:12 66:15 85:21 117:12 159:16 250:5 257:11
refrigeration-type 79:15
Refrigerator 197:7
reg 60:6 185:20
Regal 8:19
Regal-Beloit 8:18
regard 58:10 86:21 96:2
regarding 57:13 182:22 258:21,22 259:15,17
regardless 193:14 205:9 209:4 212:19 230:21 231:16
regional 243:9
Register 21:1 37:5 71:10 109:4
regs 120:8 128:10 149:6 248:2
regular 116:1 166:11 197:19 198:15 234:11
regulate 87:9
regulated 151:2
regulating 111:6 239:22
regulation 21:12 172:19 211:3,11
regulations 19:20 23:6,18,20 28:18 35:9 103:1 120:14 166:8 171:7 180:21 207:12 223:2,5 224:6 257:21,22
regulatory 21:7,13 119:17 224:8
reiterate 93:6
relate 10:18 38:5 78:21 255:7,8
related 37:3 124:2 143:15 153:18 245:21
relates 121:10 143:16 210:10
relating 22:4
relative 126:14
relatively 73:18
release 17:8 224:19 230:6
releasing 224:17 225:2,10 226:3 228:4 230:2
reliable 197:10
relying 153:10
remain 56:6
remains 123:18
remarks 3:5 4:2 11:4 13:4 18:1 261:7
remember 162:22 178:19 195:18 196:5 214:11
remote 117:18
removed 20:1
RENEWABLE 1:3
reoccurring 36:2 72:20
repair 15:15
repeat 122:14 154:9
repeatability 80:22 81:11
repeatable 88:6
repeating 106:4
repercussion 189:21 190:13
repercussions 231:10
replace 72:3 77:22 121:17 133:12

replaced 84:17
replaces 84:15
report 225:10,13 226:4,12,14 227:5 230:3,7 250:14
reported 42:7
reporting 42:6 257:18
reports 12:15 225:4,6 226:9,17
represent 66:3 119:14
representation 118:6
representative 46:14 89:8,10 247:10
representatives 218:12
represented 129:7 235:22
represents 42:19 258:8
reprimanded 179:2
requalify 204:9
request 12:14 23:14 30:22 31:3 35:11 182:10 247:2 258:13 259:2
require 27:17,19 28:20 64:17 67:6 94:15 106:3 156:1 166:9,19,21 185:11 193:11 210:9,12 211:15 218:11 242:4 245:15
required 95:2 96:17 144:6 145:8 148:1 167:20 172:11 174:1 187:18 214:19 218:20 220:2 227:14 230:4 251:19 259:21 261:5
requirement 33:20 47:14 62:15 102:6 121:11 122:8 124:3 126:19 130:1 171:9 172:13 175:7 182:9 209:15 225:22 226:3 252:16
requirements 4:8 11:22 12:7 24:16 25:8 41:13 42:7 58:22 68:13 75:9 75:17 77:14 79:5 95:13 97:13 104:14,15 106:17 112:13 126:12 150:17 158:16 160:5 166:17 167:6,19 169:9,15 193:11 201:5 246:2 256:10 257:18
requires 193:16 260:6
requiring 24:15 167:21
rerate 210:12 231:22 233:13 234:1
rerated 72:8
rerun 72:13 106:15 193:17
resemblance 235:15
reserved 254:9,13 256:8
reserves 182:10 234:13
residential 6:21 25:6 26:7 29:5 33:5 45:10 48:19 48:21,22 51:15,21 51:22 52:14 53:5 53:12 54:7 56:13 56:15,17 73:15 79:16 98:16 125:4 130:19 156:21 158:7 243:8 253:5
resistance 63:20 136:18
resolve 203:15
resolved 251:7
resonated 155:11
resources 155:1
respect 36:19 46:11 105:1 135:15 170:3 238:1 248:4
respond 54:20 69:13 177:20
response 13:16 35:4 98:21 101:16 163:10 183:8 219:19 234:5 261:8,10
responsibility 35:8 76:6,10 150:6,13 180:4
responsible 249:11
rest 5:21 130:12 135:21 150:12
restate 28:1
restrictions 93:18
restructured 89:4
resubstantiate 72:10 76:4,7,9 132:12 185:1,7 243:11 259:1
resubstantiated 36:7
resubstantiation 193:12,16 195:4 237:14
result 97:5 184:19 187:12,14 191:14 192:19 194:7 233:22
resulted 237:5
results 19:7 22:21 36:21 72:13 76:10 79:19 87:20 88:6 98:11 176:6,8 184:11,21 185:13 189:11 192:22 215:4 221:14 224:20 230:16 231:5,7
retain 34:3 182:12
retained 102:5
retaining 41:12
retest 26:16 72:14 106:14 121:17 142:15
retested 103:2 120:17
retesting 197:19 261:4
revalidate 24:21 25:18
revalidation 142:10,17
revealed 60:17
reverse 228:11
reverse-engineer 229:22
reverse-engineer... 229:11
review 3:5 10:12 49:10 83:20 167:22 169:2 194:17 245:2
reviewed 231:8
reviewing 35:18
revised 233:21 255:20
revision 120:5
revisions 234:1
revisit 83:13 154:14
revisited 83:18
rewriting 119:6
RFI 35:4 51:16 98:22
Rheem 2:13 26:4 99:3 222:9,15 225:21 229:9
rid 24:9 166:15 181:8
right 9:11 17:19 18:6,21 24:2 33:12 36:8 44:19 44:22 45:3 46:10 48:5 61:9 71:15 77:2,5,16 91:16 93:2 99:16 101:13 106:19 107:21 108:3,9 111:20,20 115:4 117:19 118:21 125:10 128:8,10,14 142:16 149:1,3 162:3,6 163:21 166:6 169:19,20 170:9,18,20 171:5 171:20 173:22 175:2 182:10 184:3 186:8 188:6 189:15 190:4,5 193:20 195:12 196:12 197:13 210:22 212:18,21 218:7 220:8,11 228:3 234:13 238:17 239:4,22 240:16 243:21 245:21 246:16 247:21 258:19
rise 184:21
risk 172:14 173:6 173:11
Robert 2:18 7:4 68:16 75:20,22 80:10 93:4 124:6 139:13
Roberts 2:14 3:19 7:12,12 18:3,3 50:7,7 65:4,22 86:19 119:1 159:14 162:12 179:22 260:21
robin 97:2,7 98:15
robins 81:1
robust 34:12 54:16 150:7
Roger 2:7 4:3 8:11 20:13 21:20 45:14 58:8 69:17 84:1 95:22 100:4 101:6

104:21 131:1 134:3 135:19 136:2 141:10 146:11 175:15 200:12 203:22 214:14 216:1 246:22 253:10
Ron 78:6,7 128:19 128:20 143:7
rooftop 16:16
rooftops 48:1 125:12
room 1:12 5:16,21 6:2 10:11 11:6 14:6 22:15 81:7,8 81:11,11 86:4 88:5 121:22 153:20 156:19 179:7 180:3 195:22 196:9 199:19 218:4 223:6 250:19
rotor 142:1
roughly 46:19
round 81:1 97:2,6 97:6 98:14 166:9 166:15 180:16 181:9 255:3
rounds 4:11 166:7 166:11,12 167:3 167:16 180:22 237:4
round-robin 96:22 98:9,12 195:18 196:14 200:17 201:1,11
Roy 8:3,3
Ruffing 100:1,3
rule 5:7 10:22 11:13 12:9 24:1 24:17,22 25:9 26:6 45:21 53:8 56:6 58:12,13 59:22 84:6,9,13 84:14,15,17,20 95:1 99:14 103:10 105:13,14 106:20 106:22 120:12 131:7,17 176:19 201:13 202:22 203:6,9 204:2 241:20 254:20 255:19 256:5,7 258:10
rulemaking 1:5 4:4 10:21 12:17 40:10 43:16 46:5,10,18 61:5 79:13 170:8 170:20,22 183:17 184:8 250:4 251:9 255:3
rules 10:7 57:2 69:21 81:9 105:5 179:20 206:13 255:19
ruling 110:2 179:14
run 16:13 82:21 98:15 148:1 200:5 213:17
running 88:3 98:9 205:1 218:3
runs 228:14
Rural 8:16

S

S 2:12
Sachs 2:15 3:17 6:18,18 17:2,2,19 30:7,7,19 31:4,4 54:9,9 63:17,17 73:1 90:12,12 135:17,17
safe 180:2 262:7
safety 92:21
sale 134:10
sales 33:7,15,21 54:1,5 57:5 102:11,13 107:17 118:16 122:3,3,18 122:22 123:11,14 123:17 124:17,19 125:2,14 137:12 146:1,6 148:20 158:13,13
sample 82:5,6 97:13 187:7 201:5 201:10 202:1,18 202:21 204:2 231:2 232:11 247:9 251:20 256:10
samples 174:4 175:21
sampling 58:13 98:19 205:1
satisfy 259:11
saturated 228:15
save 16:16 68:5
saying 17:19 26:8 29:9 44:2 92:22 112:18 121:5 123:4 129:16,19 136:4 191:7 198:5 203:22 209:17 214:17 242:19
says 57:11 88:2 96:5 124:10 129:11 154:1 183:14 186:7,19 188:11 196:11 198:12 207:1 209:15 219:10 233:16 239:4 250:20
scenario 129:1
schedule 170:19 259:7
schedules 15:19
science 152:15
scope 4:5 26:6 35:14 48:15 49:8 55:12 86:3 116:5
scroll 80:5 82:18
scrutinized 190:8
second 12:22 34:7 40:4 49:3 68:4 83:22 89:9 97:6 121:1 123:12 144:17 166:15 167:16 180:16 181:9 204:20 232:11 259:15
secondary 41:1 144:4
section 59:2 146:15 160:15 254:12,12
sectionals 53:9
sections 89:4
see 15:12 32:19 34:9 38:17,18 47:19 54:14 73:22 88:16 97:2,3 110:18 120:21 141:1 145:20 172:3 176:18 184:14 187:19 205:13 209:15 215:17 229:6 235:1 257:12
seeing 214:11
seek 63:12
seemingly 19:19
seen 30:15 31:8 98:11
SEER 137:8,9 139:19,20,22 140:1
segue 28:7
select 58:14 70:16 123:14 131:7 146:20
selected 147:3
selecting 101:18 163:9
selection 104:13
selectively 196:15
self 85:21
self-contained 93:12 94:4 117:18
sell 66:21 67:10,17 67:22 126:7 127:8
selling 90:15 116:16 136:8
semi-vertical 117:16
send 212:15
sending 205:3
sense 23:2 68:2,7 103:19 104:10 111:19 116:4 119:9 126:4 134:2 154:15 156:3 188:22 194:9 252:11 253:6
separate 77:14 214:22 254:18
serious 55:6 150:22 236:20
seriously 258:13
set 12:2 18:10 20:11 23:4 28:12 67:10 94:16,17 99:13 109:21 112:13 134:11 153:13 169:15 187:8 198:11 202:17 218:6,14 224:6 261:3
sets 69:3 89:8,10
setting 13:8 34:11 109:15,18 113:4
settings 156:21,22
settled 116:22
setup 34:8 95:16 218:12,13
seven 163:17
seventh 210:3
shady 31:10
shaking 252:4
share 32:2
Shebik 78:6,8,13 79:2 128:22 129:19 130:13,20 143:7
shift 124:12
shifted 124:13
shipping 201:19
shop 10:4
short 5:10 15:16,22 87:6 262:3
show 16:18 28:4,9 115:19 127:2 149:5 151:18
showed 133:4

204:12
showing 221:18
shows 260:10
shrink 111:16
side 32:1 73:15 88:10,22 160:20 197:18 211:16 219:6
sidebar 10:2
sides 7:19
sight 150:5
significant 16:16 150:6
significantly 179:17
similar 23:17 30:3 39:3 63:4 99:4
simple 67:8 84:5 103:9 112:14,15 112:16 168:7
simplistic 140:20
simulate 20:18 21:17 33:10,11 57:3 74:2
simulated 19:7
simulating 36:21
simulation 24:6,11 30:10 34:9 36:1 57:8,9 58:1,3 61:22 72:14,16 76:13 79:18 111:17 136:4,14 155:2 192:7 193:18 205:17,18 221:7
simulations 19:1,2 73:16 79:9 134:12 156:20
single 24:5 61:19 62:10,12 64:3,19 70:4 81:1 184:20 187:5 241:8 252:1 252:1,8,8,15,15
single-phase 45:8 144:3
single-unit 230:16
sir 254:21 255:16
sit 228:11
sitting 85:20 88:5
situation 32:16 54:6 106:12 139:1 156:3,9 173:1 176:11,17 242:11
six 12:10 39:20 103:21 108:1 141:17,19 148:19 148:20 163:17
sixth 185:6 190:22
size 47:10 114:20 114:22 134:16 159:10 201:18 231:2
slide 28:7 30:9 35:13 119:4 146:16 186:17 188:11 199:6,11 199:13
slides 163:17
slower 120:10
small 22:2 46:6,18 47:2,17 51:5,10 54:22 58:10,19 59:3,9 62:21 65:17 66:2,9,14 67:16 69:22 70:7 70:9,12,15,22 85:5,13 96:5,13 97:16 100:6 105:4 109:5,10,10,19 111:10 116:13 141:14 142:10 147:20 154:4,4 177:13 253:17,20 254:13,14 255:20 260:11
smallest 102:6 107:11 114:11,17 115:1,3 118:11,13 123:15 130:7
smart 88:3
Smith 42:13 48:14 147:10
smooth 136:12
sold 68:6
solely 237:10
solution 67:7,15
solve 66:7
Somebody 140:19
someplace 37:21
somewhat 50:3 156:10
sorry 19:15 37:17 63:16 125:3 129:1 130:19 149:1 153:19 154:7 180:17 186:9 208:4 248:22 252:12
sort 131:4 232:19 259:22
sought 23:21 38:1 55:11
sound 54:16
sounded 191:16
sounds 159:21 181:9
source 32:2
Southern 2:13 3:10 8:2 13:7 39:13 66:12 116:8 257:4
span 117:14 118:20 129:22
speak 5:20 6:5,6 10:7 22:15 39:9 39:11 80:15 168:22 197:1
speaking 10:8 244:21
speaks 43:19 61:7 250:12
specific 19:22 34:21 39:5 42:21 43:2 53:3 54:5 78:4 103:17 106:19,22 157:15 182:7 192:8 207:13 234:16 236:5 238:12 241:7 242:19 259:10
specifically 21:12 21:14 40:14 53:8 59:18 77:10,14 101:15 116:19 121:20 171:7 214:10 232:18 248:1 259:5,17
specification 86:6
specifics 234:22
specifies 93:20
specify 153:2 232:17
speed 171:1 238:22
spells 244:1
spending 34:17 226:1
split 57:2
spoke 183:2
squirrel-cage 47:6
stage 20:11 23:4 194:12
stand 257:22
standard 14:21 16:13,17 18:10 40:9 41:9 42:8 44:4,5 66:18 72:5 72:7 76:15 86:1 88:2 92:6 97:8 102:21 105:13 106:3 131:14 132:10 133:2,5,6 133:7,13,18,18,21 135:5 137:10 138:18 142:14 143:19 145:3,4,9 145:11 184:12 199:21 200:3,8,18 207:5 208:12 220:10 221:5 237:15 242:20,21 244:13,15 247:11 260:17
standardized 151:3
standards 2:6 8:9 27:9 30:6 36:6 40:7 43:1,3,16,18 60:16 61:6,11 70:6,18 81:18 102:18 105:9,10 105:14 114:2 117:15 120:11 132:2,6,11,13 133:1,8 134:20 135:3,11 137:22 138:6,8 142:20,20 142:21 146:8 162:2 183:1 184:10 199:14 208:14 238:6,7 244:7,7,9,19 245:4 247:4,5 259:21 260:5,15
standby 243:15
stands 190:5
Stanonik 2:16 8:4,4 29:3,3 52:21 53:1 53:1 103:6,6 125:19 150:4 155:10 170:5,5 171:14 172:15,15 188:9 189:17,20 240:6,6 242:5,5
star 104:18 174:18 197:16 212:15 222:6
start 6:1 77:2 87:22 151:14 160:6 189:14 249:20 250:17
started 116:10 151:22 199:19
starting 188:15
startup 66:3
state 28:22 98:4,5
stated 20:16 22:10 37:7 50:3 60:15 66:14 239:15
statement 177:21 178:7 214:17 218:16 258:5
states 1:1 256:9
static 14:22
statistical 99:15 173:18 252:3
statistics 205:1

224:6,11
stay 122:15 169:5
step 18:6 76:5 188:1 195:2 209:11
stepping 93:7
steps 188:14 206:8
Steve 100:1
stick 87:20
stop 152:1
storage 43:6,6,6
Store 2:13 3:10 8:2 13:7 39:13 66:12 116:8 257:4
straightforward 73:20 241:12
Straub 2:17 8:6,6 60:9,9
stretch 82:13
strict 174:12
string 14:7
strong 178:4
strongly 88:8 178:12 181:20 182:1
stuck 217:16
studies 198:1
study 196:14
stuff 32:19 146:17 209:8 213:11,11 226:2
subcategory 104:2
subclass 53:6
subcommittee 81:17
subject 171:17 222:3
submit 10:20 35:19 52:12 181:20
submitting 60:19
Subpart 206:16
subroutines 158:12
subsequent 32:11 166:10,16 167:2 169:16 181:1,7 182:15
subsequently 122:13 205:4
subset 19:9 33:13 167:5
substantial 82:2 85:16 101:6 238:5
substantiate 32:11 32:22 33:18 36:3 46:2 58:14,16 59:3 72:2,6 77:20 99:19 106:4 111:2 133:10,22 134:5 141:1 144:12 148:2 154:3 156:5 161:12 231:19 237:16
substantiated 33:19 92:4 126:2 131:11 134:6,18 139:2 243:18
substantiates 92:18
substantiating 85:6 114:15
substantiation 4:8 62:15 70:19 71:1 73:2 75:8,16 76:18 79:5 101:18 102:16 106:17 119:5,10 122:2,5 126:10,20 127:4 127:11 150:17 166:10,20 167:20 180:10 181:1 182:19 185:5 192:20 219:7,12 231:21 233:17 252:8,15,16
substantive 238:14 243:2
subsystems 81:15
Subway 164:3 166:5
succeed 156:11
suction 228:15
sudden 209:22
suddenly 142:14 153:7
sufficient 232:15
suggest 53:11 97:15 125:20
suggested 242:8
suggestion 18:18 65:20 121:21 122:1,7
suggestions 75:5 78:3 234:22 236:5
suggests 61:3
summarized 251:3
summer 250:19
supervise 194:17
super-insulated 64:9
supplemental 17:9
supply 82:18
support 18:17 49:12,13,15 50:2 50:14,21 62:22 63:2 90:18 91:1 149:21 161:16 175:12 176:9 178:12 179:12 182:18 212:7
supported 71:13 201:12 202:11
supporting 182:13
supports 32:13 86:18 97:21 181:10
supposed 37:10 60:17 191:17 198:8
sure 11:9 12:19 13:5 15:6 16:7 18:2,14 21:3 25:13 30:4 35:8 43:22 50:15 57:10 60:5,7 61:6 63:15 66:6 69:6,15 72:10 73:9 76:22 78:11 79:1 88:13 90:19,19 91:6 95:21 103:5 104:12 106:16 107:4,5 108:11 113:2,6,6 114:5,9 115:15 123:3 124:15,20 129:13 137:21 138:22 140:12 148:10,16 150:14 159:13 161:22 162:19 168:4 169:11 170:4 173:14 175:14 178:1 179:21 180:8 188:10 190:15 196:10 197:12 200:11 204:17 209:9 213:12 217:19 218:3 219:5,13,21 226:22 229:17 232:4 237:20 244:4 252:20 261:12,17
surface 152:11
surprising 87:1
surrounded 55:17
SW 1:13
swap 111:18
swing 195:20
switch 46:4 111:5 196:20
synch 244:18
synonymous 56:16 130:18 237:11
system 57:2,6,20 58:4 76:11 153:6 153:10 220:18
systems 26:8 36:12 51:7 59:18 60:12 76:18 94:20
system's 57:4
S-E-S-S-I-O-N 166:1

T

table 40:14 44:9 49:3 114:6 182:2 249:17
tables 43:1,19
tailored 157:15
take 21:5 22:6 64:1 73:5 75:7 86:1 91:8 109:16 125:11 140:19 142:18 144:18 162:17,17 190:21 195:10,20 204:20 206:9 209:17,21 214:8,21 228:12 230:10 233:4 240:17 261:3
taken 18:9 41:6 199:18 226:16 243:11
takes 80:2 232:11
talk 5:17 10:14 21:12,14 32:17 53:19 75:8 78:11 101:17 120:1 178:14 199:12 204:19 206:22 207:13 208:19,22 213:13 224:17 241:2
talked 61:15 76:2 127:17 167:6 182:4 183:3 194:15 219:7
talking 13:17 39:21 40:12,13 52:16 53:20 112:8 116:11 117:1 120:7 157:13 172:18 176:12 178:1 180:15,19 183:19 194:20 196:3 199:8,13 201:7 206:19 208:7 230:14 250:22 255:12
tank 63:21 64:9 136:18
tankless 63:21 136:20
target 119:7,8,18 120:9,10 124:19 151:19

taxpayers 225:19
tear 229:16
technically 134:6
technique 221:20
technologies 140:2
technology 1:3,16 131:20 132:9 134:14 135:4 137:17,21 138:7,9 138:13,14 140:10 156:6 157:2 241:2
tell 9:20 13:13 35:12 85:22 216:10,11,17
telling 47:12
temperature 86:5 228:15
temperatures 86:4 200:1
ten 127:22 239:9
tend 82:16
ten-week 261:2
term 24:7,9 42:14 42:17 45:18 247:7 248:5
terminology 56:19
terms 24:4 32:21 34:22 56:11,16 62:5 74:1 81:12 122:18 125:1 135:21 145:10 159:16 172:19 182:5
test 20:18 21:14 22:7,22 27:9 28:11 29:21 30:6 30:14 32:7,10 33:21 36:4 37:7 37:13 38:14 39:1 41:13,14 46:20 47:12,14 52:8,15 55:21 56:1 57:15 57:17,18,19,21 58:15 67:19,20 68:1 71:12,13 78:1 81:3,7,8 86:2 87:11 89:20 91:9 91:22 95:8 96:18 97:3,7,12 98:9,12 98:20 101:19,22 102:2,6,10,14,15 102:19,20 103:13 103:16,22 104:5,8 104:8 105:10,12 105:14,20 106:3 106:10,14 109:14 109:20,22 111:4 111:21 113:16,20 115:12,15 117:20 118:3,10,12,14 119:4,6,10,14,15 120:2,13,16 121:12 122:21 126:15 127:16,18 128:3,6,9 129:10 130:2,4,7,11 132:10 133:3,11 135:5 142:21 144:20 149:10 152:4 154:1,16 155:6 156:5 157:22 158:13 159:7,11 169:7 176:1 182:13 183:1 184:11,18 184:20 185:2 186:1,3,3,20 187:6,7,11,14,16 190:6,7,9 191:14 194:19 195:19,22 196:3,17 199:19 199:20,21 200:3,8 202:10,12 205:4 205:13 206:9,20 209:14,18,22 210:19 213:15 214:21 215:4,17 216:10,12,13,18 216:19,20 217:1,2 217:7,8,12,15,20 218:4 220:9 221:2 221:8,10 222:1,5 224:17 225:3,5,10 225:12 226:4,9,12 226:14,16,22 227:2,3,4 228:13 228:20 229:7,16 229:18 230:3,6,7 230:16 237:14 238:2,3,5,13 239:6,7 240:18,19 241:1,3,12,21 242:20 244:6,19 245:3 247:4,5,7 247:14 252:1,8,15 256:10 259:10 260:3
tested 19:11 22:5 27:3,4,8 28:2 33:21 36:4 41:9 57:5,7 64:20 79:17 96:18 102:18,22 123:6 126:22 132:22 133:7 134:7 143:18 175:22 198:6 200:15 202:5 203:12 206:2 209:10 211:1 216:11 217:6 222:2 227:19 231:1,16 251:22
testing 4:11 13:20 14:21 19:6,9 20:18 22:17,20 29:12 33:1,6,9,13 33:14,18 34:10,13 34:16,22,22 36:2 36:16 37:1 38:5 41:5 42:2,4 46:21 49:19 52:5,17 60:22 65:10 66:1 67:1 70:10 72:15 82:11 87:15 88:20 89:9 95:8,13 96:22 97:1,4,13 98:20 105:2,16 106:4 112:19 113:3 116:12,18 117:4 119:11,13 121:12 129:11 134:19 146:21 151:3 152:14 153:9 155:3 159:10 160:1,8,11 160:13,16 166:7 166:13,15,22 167:4 173:18 174:13,19 175:21 176:5,7,8 180:11 180:12,15,16,20 181:7 183:7 184:6 184:9 185:3,4,12 188:16,16 194:14 194:18 199:18 200:17 201:1,3,5 201:9,11,16,18 202:2 204:8,19,22 205:9,12 207:9,11 207:20 208:14 209:14,16 210:10 210:11,22 211:7 211:20 212:7,13 214:19 215:2 216:5,16 221:15 224:20 225:16 226:11 230:15,20 231:5,7 232:20 237:3,4,10 243:3 248:1 252:9,17 256:13 259:5,16 259:18,19,22 260:4,6 261:4
tests 71:14 74:16 87:18 92:11,14,15 95:8,9,10,14 107:12 109:17 127:22 133:9,17 148:1 152:16 174:1,3 185:13 189:2 190:3 196:14,18 204:21 213:18 227:13,16 247:6 251:18,20 253:4 261:3
text 21:7,13 60:6 96:7 242:9 256:1
thank 11:12 12:18 13:2,8,22 15:10 15:12,17 16:1 17:17 18:12,20 19:15 20:5,6 23:3 30:19 37:17 42:11 50:22 60:4 61:13 68:15 69:5 71:4,5 79:1 90:20 98:1 101:7 104:11 107:3,4 119:20 125:7,17 130:21 130:22 141:7 142:22 143:10 149:14,20 150:2 161:18 163:7 173:13 175:13 177:17 179:21 198:20 200:10 211:13 230:9 235:4 244:3 252:19 253:7 254:6 256:19,21 257:15 258:1,14 260:18,19 262:2,9
Thanks 17:20 45:13 52:22 79:2 143:13 145:14 198:19 251:16 258:19
theirs 151:20
theoretical 117:9 147:12
theory 118:7
thermal 109:11,20 109:22 111:8,12 111:15
thick 174:16
thing 31:8 40:1 56:19 72:20 74:10 77:5 94:15 96:13 99:11 116:22 127:5,6 128:11 137:18 150:10 161:2 162:22 171:8 174:8 187:15 194:11

201:7 204:16 205:8 206:5 208:5 208:13 211:3,17 217:12 230:21 236:8 237:2 244:2 245:17 246:18 250:1 261:14
things 16:10 36:7 40:15 54:12,17 71:2 80:7 81:14 81:20 82:9,9,13 83:17 84:10 86:22 87:2,6,8 120:6,20 124:9 126:7 127:7 143:3 159:1 161:13 183:5 187:19 189:7 190:11 197:13,14 198:17 206:3 207:14 215:22 217:22 218:13 222:2 246:6
think 14:5 16:4 20:7 25:22 26:13 30:19 31:7,18 32:16 34:20 35:3 35:21 36:14,18 37:3 38:15 42:20 49:15 50:14 54:17 55:5,8,15 66:10 69:19 73:10 74:13 74:15 78:16 80:16 81:2 83:6,12,17 83:19 84:3,4 87:11,12 94:14 95:18 99:13 104:9 105:3 106:7 110:17 112:6 113:22 114:8 115:6 122:11,15 124:16,18 125:10 126:18 127:4,10 127:12 128:9 135:22 136:21 137:4,19 139:15 139:17 140:17 144:15 146:6 149:2 153:22 154:7,13 156:12 156:15 157:8 160:4 162:13 171:9,15 172:17 172:19 173:6 175:6 180:2 182:18 183:3 187:15 195:8 196:9 197:9 198:11 204:1 209:6 219:8 220:8 221:22 223:5,16 224:22 229:10 230:3 232:14 235:3,11 236:3,19 237:1,12 238:11 238:13 239:15 240:8,12 242:8,14 243:10 244:10 245:12,16 247:3 248:12 250:16 260:13 261:14,18
thinking 17:12 120:6 125:3 156:9 160:8 175:9 235:12
third 80:22 87:10 95:12 123:13 218:14 250:12
third-party 95:10 160:8,10 176:2 177:4 195:19 215:13,14 237:9 249:2
Thirty 262:4
thirty-five 44:13
thought 20:1 34:5 62:10 147:14 186:10 206:17 207:21 221:4
thousand 67:2
thousands 14:11 235:21
three 28:1,11 72:5 79:10 80:3 103:22 124:11 133:5,11 133:12 163:16 169:19 214:3 236:16 244:10,10 259:13
three-phase 45:8
thresholds 69:4
throw 190:22 191:10 192:1
throwing 236:15 259:6
ticket 15:22
tied 122:19
tight 87:12
tightening 97:19
tightly 152:21
time 5:14 6:5 11:2 13:4 15:18,18 18:1,9 25:10,11 25:17 29:20 36:5 46:20 49:20 71:17 82:21 83:4,19 103:18 119:17 122:2,4,12 127:15 134:9 142:12 143:9 166:13,22 169:7,12,18 179:18 182:12 184:9 196:17 212:6 214:4 232:10,17 238:8 240:17 245:6 248:8 258:4,22 259:9 260:16 261:3
timeframe 25:16
timeline 257:8
times 218:1 236:11 236:16 237:8 244:14 260:13 261:2
timing 143:16
timing-wise 138:14
title 59:11 96:4
today 9:21 10:14 15:11,21 24:20 25:7,8 26:15 27:2 33:5 38:12 52:15 86:2 87:21 102:6 151:2 176:20 177:9 187:22 211:3 222:19 226:20 229:14 249:16 250:2 253:13 262:2
today's 10:15 121:17
told 26:13 238:22
tolerance 80:1 83:3 85:6,10,12,16 87:3 97:1,18 100:6,9,17,21 101:4 124:8 127:13,17 128:2,3 128:9 186:13 201:5 211:16,22
tolerances 23:20 27:11 59:1,1 63:10 76:11 79:7 79:10,14 83:13 88:9,10,14,15 96:10 97:12 98:20 101:15 150:14 169:4,5 176:7 201:21 212:1
Tom 121:4
tomorrow 12:3
tons 44:14 73:19 113:11 209:8
tool 126:3,11,14 157:14 158:8,22
tools 19:1 157:8,10 163:1
top 82:14 108:6 111:9 117:7 219:22
topic 51:1 183:15 230:12 260:13
topics 23:22
total 85:7,14 97:18 100:7,9 101:1 135:8 200:20 202:20 253:22 254:4
totally 22:8 41:2 53:20 126:16 174:8 203:2 230:2
touched 139:3,5 243:20
tough 175:2 259:13
to-facility 196:8
to-order 231:3
traditional 114:2
traditionally 113:11 155:14
trained 94:17
Trane 2:10 6:21,22 44:7 107:6 162:21 173:4
transfer 140:19
transformer 143:21 259:20
transformers 23:8 51:10 102:4 105:3 105:6 124:2 247:20 259:14
translate 135:20
transparency 225:17
treat 30:12
treated 96:14
treating 32:3
trees 82:5
tremendous 195:4
tried 57:22 64:13 112:14,15
trigger 210:22
triggered 245:1
trillions 14:12
trip 262:8
trivial 150:10
trouble 15:13 160:18 175:19
true 2:10 7:14 40:20 85:18 105:4 168:18 173:16 194:18
try 5:13 82:5 85:2 103:9 110:18 135:20 145:19 156:16 188:10 197:12 203:15

212:10 256:17
trying 15:13 21:21 22:3,8 34:4 73:12 105:21 112:18 115:1,6 116:3 118:9 131:7 138:21 147:7 177:10 199:9 210:5
Tucker 2:17 9:5,5
TUESDAY 1:8
tune 127:21
turn 11:3 52:19 63:18 154:19 174:11 198:22 215:16 238:19
turns 235:14
tweak 111:12 217:4
tweaking 93:18
tweaks 27:15,16,17
twenty 127:22
twice 152:7,10
two 28:5,11 33:4 67:10,20 68:1 74:3 75:17 79:10 107:20 130:9 133:6,9 143:3 147:18 148:2,12 148:18 149:3 154:5,15,16,22 155:7 159:9 161:4 161:6 163:16,19 163:19,20 167:8 169:2 174:1 180:22 193:15 200:7 206:11 240:13 252:9,17 255:3 258:21 260:12
two-tenths 48:2
type 20:19 21:8 38:2 44:18 46:17 51:19 52:2 59:9 59:22 73:11 74:10 79:12 94:2 98:17 99:15,18 138:19 168:3 169:1,11 177:11 244:2
types 23:16 36:7 43:14 51:3,15 55:22 56:3,3 133:15 179:18 246:10
typically 55:8 159:7 201:17
T-distribution 203:2
T-value 18:8

U

Uh-huh 28:3 48:17 183:18
UL 177:3 198:14
unable 260:3
unbelievable 151:11
uncalled 178:17
uncertainty 86:15 145:13
unclear 123:6
uncontrollable 215:13
uncontrolled 215:9
underlying 30:14 32:5 33:1 54:16 102:16 133:17 166:19 182:11
undermining 104:7
underneath 14:9
understand 9:14 21:22 25:22 26:5 89:18 110:13 114:5,7 123:3 128:15 129:14 139:15 147:14,19 174:7,9 205:16 210:5 219:6 226:1 248:5 255:13 258:3
understanding 108:15 112:22 136:11 138:7 188:11
understood 91:9 147:14
undertake 230:18
Unfortunately 40:22
Unico 3:22 19:17 75:22 199:5
unidentified 215:8 215:12
unique 44:5 54:6 66:16,21 173:1
unit 27:3 37:7,11 67:21 68:4,5 77:10,13,19,22 78:1 79:17 81:2,5 86:8 115:11 121:17 123:5 139:19,20 140:10 145:8 152:7,14 161:5 184:11,20 185:7 188:16 189:10,12 190:16 190:22 191:1,6,9 191:10,12,16 192:4,6 193:7,7 193:15,17,21,22 195:9,20 198:13 199:18 200:19 201:19 202:5 204:5,8,21 206:18 210:3,20 211:1 213:15 214:20 218:2 226:10 227:2 228:12,13 229:22 230:22 231:1,10 232:9 248:15,16,17,19 249:5,10 252:1
unitary 80:13 232:9
UNITED 1:1
units 26:16,16 28:1 28:5 48:2,19 53:21 67:20 68:12 71:12 72:6 91:9 101:18 104:15 105:2 111:3 113:4 130:9 154:16 157:21 163:9 169:6 190:18,19 191:4,20 192:1 201:6 206:20 207:19,22 209:10 229:15,18 259:5,8 260:1
unit-to-unit 86:7
unmute 5:20 128:19 143:5 258:17
unmuted 100:2 128:20
unrealistic 259:2
untested 29:1 65:8
unusual 152:3 156:10
upcoming 183:15 243:7
updated 182:8
updating 183:7
upfront 74:16
upgrade 173:10
upside 90:11 113:22
upwards 38:22
up-to-date 42:6 142:19
use 17:6,16 19:4,7 21:17 23:6,12,17 24:5,7,10 25:3 28:2 29:19 41:20 49:11 51:3,8 54:18 56:12 61:20 62:10,12 64:18 65:8,13 72:1,6 76:16 89:11 92:3 97:18 104:17 110:2,5,22 111:11 111:12,15,21 112:3 115:9 116:9 118:2 133:20 134:8 155:11 156:19 157:14 158:22 159:1 161:5 181:2 182:19 184:16 206:1 212:12 215:14 234:7,13 241:22 242:1
useful 78:16,18
uses 109:8
usually 43:12,15 114:14 134:7 239:8
utilize 60:12
U.S 6:9 229:20

V

vague 211:4
valid 72:13 121:16 126:3,13 169:12 186:3,3 217:20
validate 37:14 108:17 112:5 127:20 142:12 196:16 251:20
validates 91:21
validating 92:1 108:16
validation 4:14 170:13 180:11 182:5 220:17
validity 29:21 174:5 199:17,18
value 89:8,10,13,13 200:18,22
values 85:17
variability 81:12 87:1 94:2
variable 157:4
variables 153:7,11
variable-speed 140:3 227:11,13
variation 80:9,13 82:10,15 86:7 201:2,13,14,15 202:7,12 216:14
variations 80:7
variety 21:18 23:21 172:18 190:10
various 69:21 76:15 97:11 250:19

vary 79:12
vast 152:17
vending 51:6
vendors 87:4
verification 32:12 35:1 95:19 125:22 126:1,20 153:13 160:15 166:12,16 167:3,4,22 168:8 169:2,16 172:11 175:10,12 177:1 180:10,12 181:2,5 181:21 182:16 197:5,18
verifications 177:6
verified 170:15 171:13
verify 168:14 197:20
VerSHAW 2:18 6:20,20 33:2,2,17 34:1,4 36:8 50:20 73:7,10,12 79:21 79:22 80:18,18 86:9,10 95:6,6,15 137:2,2 139:9 158:5,5 160:7,12 186:16,18 187:2 187:20 188:4 195:16,16 206:6,6 206:17 207:16,21 208:3,16,17,20 209:1,12,19,21 210:6,15 235:5,6 235:17 243:6,6,22 248:22 249:1,13
version 105:15,16 120:8 248:1 254:8
versus 35:7 39:7 43:6,6,7,7 55:4 94:4 125:21,22 259:12,19 260:7
vertical 117:17
VICP 170:12,19 171:11 175:10
VICPs 170:10
view 41:19 68:20 68:22
views 251:3
violate 179:10
violating 179:9
voltage 87:9 144:4
voltages 200:5,7
volts 81:13 144:4 144:19
volume 33:7,15,21 57:5 102:8,11,13 107:17 118:16 121:18 122:3,4,19 122:22 123:11,14 123:18 124:10,17 124:19 125:2 131:8 134:10 137:12 145:1,2,11 146:1,6 148:20 158:14 174:4
volumes 54:18
voluntary 171:4
VRF 59:18 94:20 227:9
VRFs 59:22 227:19

W

wait 5:19 60:21 73:3 156:4 189:3 195:1
waiting 13:11 121:3 196:22
waiver 240:14,15 240:19 241:22 242:14
waivers 240:17 241:19
walk 57:14
walk-in 51:6 57:14 57:16 60:13
walk-ins 161:21
want 5:17 10:6 13:3 15:9 18:17 32:2 39:17 44:1 62:20 63:15 73:1 73:3 74:18 89:22 91:14 102:1 111:1 112:2,18 113:19 113:20 119:22 123:5 126:4,6 129:13 132:21 139:7 141:1,16 145:17 150:4 154:9 156:14 157:6,20 163:13 163:14 169:7 180:8 181:21,22 188:9 197:1 203:21 204:15 205:22 213:13,16 213:17 215:6 219:5,13,16 223:1 239:3 241:15,17 250:2
wanted 14:13 18:7 32:19 100:3 108:7 111:4,12,15 129:1 143:8
wanting 55:4 113:2
wants 11:7 153:16 168:22
warm 200:5
Washington 1:14
wasn't 18:9 139:10 221:10 243:16 256:2
waste 68:3
watch 194:22 216:13,18
water 11:15 23:7 42:16 43:5,9 45:5 48:21 51:9,22 53:19 63:20,20 64:9 136:19 249:5 250:7,8
water-cooled 45:4 163:2
water-source 113:14 163:3,4
water/steam 148:15
way 5:18 7:19 10:4 10:9 12:3,10 14:18 22:4,10 34:6 35:1 39:3,4 39:14 41:7 49:18 64:6 70:9 77:21 78:1 89:13 91:9 92:6 101:12 106:8 112:10 115:16,17 121:20 132:16 141:5 153:3 158:2 160:3,9 162:14 164:3,6 169:8,8 171:16 173:9 176:20 181:12 187:21,21 188:5 195:13 197:13 208:3 212:10 216:5 220:21 229:19 258:6 261:22
ways 75:5 124:21 140:16 169:2
webinar 5:11,14,19 10:11 11:7 15:12
website 98:3,8 229:11,20 254:9
weeks 109:16
weighting 167:7
welcome 5:6,9 11:3 55:14 61:3 75:5 78:4 166:3 232:15 232:21 236:7 262:5
well-defined 46:2 82:7 142:4
well-known 42:15
went 46:16 75:13 75:13 164:8,9 176:7 186:6 237:3
weren't 102:21 189:11
wet 81:21
We're 125:6 188:2
We've 214:4
whatnot 198:2
wheel 16:15
wheels 80:6
whichever 88:11 123:13
wide 21:17 61:20 62:12 93:10 94:1 116:5
widen 101:4
wider 36:20 55:13
wide-range 65:3
Wilkins 2:18 7:4,4 68:16,16 80:10,10 93:4,4 95:1 124:6 124:7 139:13,13
willful 234:10 235:8,12
window 196:17
wire 141:21
wise 57:8
wish 18:1 22:15 90:14
wondered 62:9
wondering 19:21 76:5
word 97:18 180:9 215:7
wording 191:15 242:18
words 64:16 72:4 104:2 119:13 171:11 184:20 185:4 241:20
work 80:19 81:16 86:11,17 118:4,7 120:3 135:3 136:15 156:16 180:5 191:2 195:5 195:13 232:18 233:9 249:22
workable 45:22 47:18
worked 134:21 173:17 238:22 240:15
working 39:19 65:6 69:21 86:12 105:11 132:15,17 135:1 176:21 181:12 201:4 221:22
works 31:6 65:15 110:18 222:4

world 143:21
worms 151:10,16
worried 35:21
worries 216:14
worth 155:1
worthwhile 17:11
wouldn't 61:10 111:21 133:19 185:11 191:12 196:3 219:8 223:22 242:13 243:10
Wow 26:10
write 158:10 181:16
writes 250:14
writing 160:5 258:11
written 25:4 27:2 30:18 101:13 149:22 162:14 181:16 187:21 188:5 201:13 203:1 206:10 208:4 211:3
wrong 121:5 217:14 221:19 237:5
wrote 75:2

X

X 124:11 140:7 207:14
X-1 95:9

Y

year 13:12 23:15 41:9 53:17 60:18 66:22 67:11 68:12 102:11 116:10 121:13,14,14 123:20,20 144:14 146:7 206:11
yearly 122:11
years 29:7 39:20 41:17 46:21 65:7 69:20 81:14 83:19 87:16 124:11,11 169:19,20 178:3 214:4 236:17 239:9 244:10,13
yield 17:5

Z

Zealand 68:11
zero 2:14 3:19 7:12 18:3 50:7 65:4 86:20 119:2 159:14 160:6 162:12 180:1 196:19 260:21
Zone 2:14 3:19 7:13 18:4 50:8 65:5 86:20 119:2 159:14 162:12 180:1 260:21

1

1 47:7,12 79:11 100:20 116:18 165:1 182:10 236:1
1st 12:2,12 257:18 258:7
1.02 81:8
1.5 82:10
1:07 164:9 166:2
10 3:5 29:6 46:14 67:13 79:12 80:1 82:15 83:15,16 85:7 86:15 87:5 87:12 99:7 100:8 100:12,15,22 186:17 196:13 201:7 220:5,7,9 227:13
10th 117:2
10-year 153:11
10:13 75:13
10:30 75:10
10:34 75:14
100 14:7 41:3 82:22 114:5 117:13,13 117:20 129:2,6,6 129:22 130:5,11
1000 1:13
101 4:8 101:5
103 4:10
11 3:7 220:3,10
11-trillion-plus 249:19
112 22:7 97:7 105:11
12 3:8 30:9 144:10
12:01 164:8
120 259:3,12 261:1
122/40 144:4,19
1230 242:20
13 3:10 137:8,10 139:19,22 206:20 209:4
13s 137:11
135 44:10 125:13
14 3:11 137:10 139:19
1400 174:1,4
15 3:13 29:6 82:11 107:12 204:5 208:10
15-minute 75:7
15-ton 74:1
150-10 97:9
16 3:14,16 78:15
165 4:11
17 3:17
18 3:19,20 12:16 18:18 140:1 206:19 209:5
18-month 258:9
181 4:14
182 4:16
183 4:14
184 4:16
185 46:20
19 3:22
1950 139:2,9
1990s 96:19
1992 96:16 134:20
1999 45:21 131:5 132:5,16 135:2

2

2 44:20 81:3 87:18 91:13 92:21 165:2 196:1 200:4 260:11
2nd 262:5
2x2 158:9
2.5 234:19
2:40 262:10
20 4:3 29:6 38:12 67:13 108:5 111:4 117:14,18,21,21 119:4 129:3,7,11 129:14,22 130:3,4 173:21 174:3 200:21 201:12
200,000s 53:17
2004 105:15
2007 135:1
2009 58:12 121:12
2012 1:9
2013 12:2,12 258:7
2015 145:3,9
2016 144:9,22
21 117:22 118:1 129:10 130:11 174:4,4
22 137:8
229 4:14
23 4:4
231 4:16
233 4:15,17
236 4:15,17
24 4:7
24,000 70:5
24,014 46:19
240 44:14,14
25 14:9 27:6 102:9 105:2 115:19 130:8 144:3,18
25-ton 74:1
250 15:21
26 199:11
28 4:4 199:13
29 4:7

3

3 72:17 82:10 83:7 87:12 89:16,20 91:11 92:8,17 96:3 99:7 130:7 196:1 210:1 256:8 260:11
30 15:17 38:22 39:7 108:6 185:2 209:10 213:14 214:8,9,12 232:7 232:14 259:1,12
30-some 40:10
300 39:7
300,000 53:18
32041 20:22
32046 183:13
32055 37:5
32056 71:11 146:17
38 200:4

4

4 195:19
4th 84:9 255:19
41 21:4
429 58:19 70:21 89:3 177:11,16 206:16 254:8
429.41 254:9
429.7(C)(2) 37:6
429.70 58:22
429.70(c) 186:18,19
429.75 146:17
429.75(i) 96:7
431 46:3 58:12,18 59:5,12 70:6,14 97:14,17 100:9 142:9 177:15 201:14 204:1
431.12 253:18
431.442 253:17
431.445(b) 255:21
431.445(c)(2) 256:7

5

5 1:9 3:2 71:11 72:17 79:11,16,18 80:4 82:12 83:3,9 83:10,14,16 87:11 87:13 91:10,14 92:15,16 99:6

101:12 127:19
150:16 151:19
185:18,19 186:9
186:13,20,21
190:20 191:1,4,5
191:11,13,22
196:10,11,15
204:3 209:7
210:21 211:6,10
212:1,2,12,14
5/minus 191:13
50 67:14 68:12
103:15 111:4
178:3 194:2
500 47:8,13 66:19
51 4:4
52 4:7

6

6 3:4 190:21 191:9
192:6 195:21
6-ton 115:10
60-plus 233:5
63 44:14 113:11
63-ton 113:16
65 44:10 125:12,13
125:13,13
65,000 44:10 45:7
69-ton 115:10

7

7 86:16 195:21
200:1,9 213:1
7th 58:12
700 173:21
72 46:8
7200 144:4,19
75 82:21
760,000 125:12,13
79 4:8,10 118:2
130:12

8

8 86:7 187:14 205:6
206:9 213:1
8E-089 1:12

9

9 220:4,7,10
9-10 53:21
9:00 1:14
9:01 5:2
90 253:5 261:5
90-day 232:10
90.1 244:22,22
90.1-2010 245:4,5
90.9 100:14 101:4
91.7 100:11 101:3
92.4 100:16
95 18:7 80:2 82:19
128:11 144:4,19
203:1 253:4
97 82:20
98 81:7
98.91 144:7
99 80:2 82:22 144:9

C E R T I F I C A T E

This is to certify that the foregoing transcript

In the matter of: Alternate Efficiency Determination Methods

Before: US DOE

Date: 06-05-12

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