WORKSHOP

BEFORE THE

CALIFORNIA ENERGY RESOURCES CONSERVATION

AND DEVELOPMENT COMMISSION

In the Matter of:)
) Docket No.
2008 CALIFORNIA BUILDING ENERGY)
EFFICIENCY STANDARDS)
___________________________________)

CALIFORNIA ENERGY COMMISSION

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Reported by:
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P R O C E E D I N G S

10:09 a.m.

MS. HEBERT: Good morning, everyone, and welcome to the Energy Commission and another in our series of workshops on the 2008 California building energy efficiency standards.

My name is Elaine Hebert. I'm one of the energy efficiency staff here at the Energy Commission, and deeply involved in this project. I'd like to make some other introductions. Commissioner Art Rosenfeld is here; our Project Manager Bill Pennington, to my immediate right; one of our technical staff, Gary Flamm, over here; he's one of our lighting experts. And we'll have other staff in and out as the day goes on.

There are agendas for this workshop out on the table out in the entryway there, and sign-in sheets if you aren't already on our mailing lists.

I'm going to give a few words of introduction here by way of what we're doing. For those who are not familiar with our process, we held out first workshop on the 2008 standards in October. We are still in the initial phase of development for the 2008 standards.

During this phase we hold what we call staff workshops, public workshops, to present the results of energy efficiency research sponsored by the Energy Commission, electric and gas utilities and other entities. And we also propose modifications to the building standards to reflect that research and to create more energy savings for Californians in our buildings, both residential and nonresidential.

As you know from the agendas for these workshops we invite feedback on our proposals and other suggestions for the standards from our stakeholders and the general public, you folks out there.

We have a lifecycle cost analysis methodology to help evaluate proposed modifications to the standards, and that methodology is posted on our website.

We expect this phase of staff workshops to be over approximately midyear this year. The second phase will include more public workshops at which we will propose formal language in draft form that reflects the proposals feedback and public input from the first phase.

We usually put forth several drafts of

that language over time and hold several workshops to gather further feedback and refine the language. We expect that phase to take place in the latter half of this year.

The third phase is the formal adoption process for the 2008 standards, which we expect in the first half of 2007. In our ideal world the Commissioners would adopt the new standards in the middle of 2007, with an effective date approximately November 2008.

The last phase before that November effective date is the development of software and interpretive manuals to support the new standards. And that, of course, takes a good amount of time.

So, back to today. We are being broadcast over the internet and we are being recorded. So if you wish to speak, please step up to a microphone, introduce yourself and your affiliation. Our recorder here may ask you for a business card to get the spelling of your name or company correct for the transcript. And the transcripts from this workshop will be posted to the website within approximately three weeks or so.

There is one change to the agenda for

tomorrow. There is a topic in the afternoon we were planning to cover which will now be covered in a future workshop, and that's overall envelope approach.

We do have another set of meetings in this proceeding. The dates have not been firmed up yet. We had picked some tentative dates. We're encountering some conflicts, so we haven't completely resolved that, but we're hoping to have a workshop in March to talk about some of the modeling issues; and another workshop in May.

Here's how it will go today approximately. We've got Martyn Dodd, who will be the main presenter today. He's going to talk about the evaluations he's done of some new technologies and he'll focus on lighting in the morning and mechanical in the afternoon. And he'll do a presentation on one topic and then there'll be time for discussion, and then another topic and discussion.

So I think that's all. Do any of my colleagues have anything to add? My colleague, Mazi Shirakh, who's the technical lead for the 2008 standards has arrived. So, he's here now, as well.

So, I think we'll get the lights turned down, Serge, if you would help. And Martyn Dodd is stepping to the microphone. Welcome, Martyn.

MR. DODD: Thanks, Elaine. Okay, so I'm going to present today a series of change proposals here in the morning which relate to changes in the lighting standards for the 2008. And then in the afternoon I'm going to cover a series of changes to the mechanical.

So a little bit of background on what I'm going to be presenting today. This is all research that has been done by the PIER group here at the Energy Commission.

For those of you that do not know what PIER means, it stands for Public Interest Energy Research. And basically it is research which is done by the Commission, using outside contractors, and it is funded by your utility taxes on your utility bills.

So, just as Caltrans has a sign above the freeway that says "your tax dollars at work", the PIER group has a big sign up there that says, "your energy tax dollars at work."

So what I'm going to present is the results of these research projects. And we're going to take a look at some change proposals which we feel can be fit into the 2008 standards change cycle.

So there's two portions of the PIER that I looked at, and that was the lighting research program, the LRP; and the second was the high performance commercial building systems program. And both of these are fairly comprehensive research programs that looked into all aspects of lighting and mechanical systems with an eye towards determining what we can do as far as the most energy efficiency technologies.

One thing I need to point out, I did not do any of this research, okay. So the PIER group hired me to come take a look at all of the research that was done and to evaluate that, and to determine how we can make changes to the standards.

So when I present the proposals today, I do have other folks here in the audience from the PIER group who are also able to answer technical questions. I've done a fairly good amount of study of the research that was done. There are thousands and thousands of pages of work that's available here.

Each of the measure templates that I have presented here today is available off the Energy Commission's website if you do not already have a copy. And each measure template includes at the end of that template a hyperlink which will take you to the specific PIER research report which references all the background material and research that was done in support of these change recommendations. So I encourage you definitely to take a good solid look at that report, or those reports.

Just to bound what are we talking about today, I will be limiting my change proposals to the nonresidential/high-rise residential/hotel-motel standards.

So nothing I'm going to present today will have any implications on the low-rise residential standards. We have somebody else doing research or doing measure templates for the PIER group who will be presenting those at a later workshop for consideration in the residential standards.

So, what I will be going through today, or this morning, anyway, will be five different measure templates. We've got one related to LED exterior lighting. We'll be looking at a new load shedding ballast technology. The implications of using LED night lighting in bathrooms.

We've got a very very nice integrated classroom lighting system that was developed with PIER research money. And then we'll take a look at bi-level stairwell lighting.

So what I will do is I will go through now and I will present a template; and then I will go through the general idea of what the PIER research was all about. I'll talk about the energy saving aspect of the measure. I will then cover the change proposals. And then open it up to folks for comment.

Okay, so the first one, LED exterior lighting. So what we're describing here is basically a hybrid fixture which consists of a conventional lamp, either incandescent or fluorescent, that operates at night during normal operation. And then during periods of non-occupancy only the LED operates.

So the idea here is that most of the time, if we take a look at certain areas of commercial space in the exterior, we will have periods of non-occupancy. And so this fixture will reduce its lighting level down so that only the LED will be operating.

Common features in this fixture. It will use a conventional incandescent or fluorescent lamp. You could possibly consider other technologies as far as the primary source of illumination, but probably the best fit right now for the technology is going to be incandescent or fluorescent.

It uses LED, and obviously this provides the low-level illumination when nobody's present. It includes a photosensor control; important feature here in that the fixture basically will be able to detect if there's daylight available, and will automatically shut itself off.

So that's actually an important feature of this fixture because one of the problems that we do see consistently in the exterior lighting is exterior lighting that is operating during the daytime, even though the standards do dictate that you either use a photocell or you use a astronomical time clock.

Obviously the conventional lamp will be activated by an occupancy sensor. And the most important feature of this system is that it's a completely integrated system. So we're not talking about assembling a series of photocell controls and occupancy sensors that control an exterior lighting system. We're talking about a completely integrated system. It's completely plug-and-play. And that eliminates a lot of the issues related to initial commissioning of the system, making sure it's all working, et cetera, et cetera.

Energy saving benefits we can see here. Obviously by switching on the incandescent or fluorescent lamp only when motion is detected, fairly obvious benefit.

We see that the fixtures will also provide an ambient LED background lighting. So rather than just completely turning off the outdoor lighting source, which is probably not going to be acceptable in many exterior lighting applications, we'll end up with a small illumination from the LED.

If the primary lamp burns out we have still the ability that the LED will provide some functional light from the fixture. And, of course, the LED is going to last considerably longer than the conventional lamp in the fixture.

The use of the incandescent and fluorescent lamps will eliminate the need for using a higher lumen output, more expensive LED array. What was determined during the study was that you could do the entire fixture with LED.

However, the cost of producing 75 watts, 60 watt LED lamps for the entire fixture is going to be considerably higher. And you're not going to get the energy savings payback that you'd expect. Because the motion sensor is only going to have the incandescent lamp operating for a certain number of hours a night.

And, in addition, the use of colored LEDs provide a color changing feature as an added security benefit.

So, we have an LED that uses 5 watts continuously all night long. We end up with for a typical incandescent fixture, 87 percent savings documented in the report. Although Gary's brought to my attention recently that that 87 percent savings claimed is probably more predicated upon use in residential applications.

They did look into the possibility of using a compact fluorescent lamp in there. What they determined was the payback on the overall fixture increases to five years with the use of the compact fluorescent. So it didn't seem to justify the additional cost, although it's a possibility. And obviously that would depend on the fixture manufacturer and with time it's going to get to the point where compact fluorescents are going to be commonplace in these type of fixtures anyway.

And one more thing is it's been in the marketplace since 2004. So this is not something that was just developed recently, it has been commercialized. It is there.

The proposed change that I'm suggesting here is to add a new power adjustment factor table into the outdoor lighting in section 147. So if we take a look at the section 147 of the standards this covers the exterior lighting requirements. This is a brand new section that was implemented for 2005. And up till now the Energy Commission hasn't significantly regulated the outdoor lighting of the building, other than a few mandatory measures.

We now have the actual lighting power density regulated in the standards. And what we do not have is any power adjustment factors which give credit for use of types of controls. We do have those in the section 146 of the standards for indoor lighting applications, but not outdoor lighting applications.

The recommendation is to include a 50 percent power adjustment factor for the hybrid fixture. And while it's not my area to make recommendations in the residential, strongly suggest that this be investigated for use in residential applications. Particularly because in the residential applications, we're seeing a lot of resistance to the requirements in the new standards for the high efficacy lighting in residential, particularly in the single family sector.

A sample savings calculation that I did here. I compared the hybrid based LED incandescent combination back to a compact fluorescent design. And the idea here was I had ten lamps in a series of compact fluorescent fixtures that were mounted outside. And we end up with 150 watts. Assuming 12 hours of operation, that lighting system would use 657 kilowatt hours per year.

If I were to take that exact same

configuration and in each of those fixtures I were to substitute the LED incandescent hybrid, I would end up with the following.

The ten lamps at 60 watts, plus the ten lamps at 5 watts would give me a total of 650 watts. By applying the power adjustment factor I would end up with an effective adjusted lighting of 325 watts.

So I've now got a lighting system which is twice what the compact fluorescent design is from a code point of view. So that means that that lighting system, if I were to maximize the amount of light that I could put in, I'm only allowed to put in half as much as an equivalent compact fluorescent design.

However, if I take a look at the energy savings I end up with only 342 kilowatt hours per year. So I'm allowed to put in half the lighting, yet I get double the lighting savings. And that's using the 50 percent power adjustment factor.

If I were to make that power adjustment factor .75, both designs would have an equivalency under Title 24, and yet the hybrid is still using half the power using those estimates.

Eligibility criteria here for having

this as a credit in the standards. The primary light source would be controlled by an occupancy sensor. The secondary light source would be an LED. The secondary light source would be always on. And we feel the always on is probably important, because if it turns the fixture entirely off it probably is going to be less prone to acceptance in the marketplace.

the entire system is integrated with a photosensor, so integral design here; we're not talking about assembling something from pieces and taking credit with this clause in the standards.

And we had discussed feedback from staff limiting this to pedestrian area applications. If we limit it to pedestrian area applications, my original measure template had recommended changes in section 132. And that's no longer needed because section 132 does not regulate a 50 percent switching requirement on pedestrian areas. That would only apply to parking lots.

So originally we're going down the avenue of recommending this also for parking lots. The change proposal now is just doing pedestrian areas. If the Commission decided to allow in parking lots, then we would need to add an exemption in section 132 that said that if you got the LED function it does not need to be turned off because the LED function stays on all the time, then that violates the minimum 50 percent switching, or switching of the lights requirement.

Okay. Questions? Mazi.

MR. SHIRAKH: When you say the LED stays always on, does that mean during daylight hours, too, or just the --

MR. DODD: No, the entire system's controlled by a photosensor, so it shuts everything off during daylight. The LED would just be on continuously at night.

Gary.

MR. FLAMM: Gary Flamm, Energy Commission. I do believe that section 132 just says that 50 percent switching applies to hardscape, which -- and it says, including parking lots, et cetera. I do not believe that pedestrian hardscape is specifically excluded from section 132 15 percent switching requirement.

Therefore, part of this switching might be complying with a mandatory measure. So that's one issue I wanted to bring up.

The other issue is that it's my

understanding of the study that it was based on more of a rural environment. And with the outdoor lighting, we have four zones, lighting zone one through four. And lighting zone four is really an urban, high entertainment type of area.

And what is not known is how much activity would occur in that case. Therefore, 50 percent appears very high for lighting zone four. I think this has a lot of potential.

Another issue is that in lighting zone three and lighting zone four I would expect the baseline design to be an HID light of about 90 lumens per watt, instead of a 50 lumen per watt compact fluorescent.

So, therefore one would not be able to go for a one-to-one comparison with the hybrid light compared to a baseline design.

So I would propose evaluating different power adjustment factors for the various lighting zones. For example, lighting zone one through four could be 50, 40, 30 and 20 percent power adjustment factors. Specifically because we really don't understand how much activity there will be in those lighting zone four applications.

MR. DODD: That's a good observation,

particularly lighting zone four where they're getting tons of light anyway.

MR. PENNINGTON: I have a few questions, Martyn. My understanding is that this device was -- at least my thought, anyway, was that this device was designed for kind of porchlight situation, or on the facade entry lighting. And that that's been how it's been designed so far.

And I wasn't aware that this was designed or contemplated to be a multifunctional device that would be applied in any outdoor lighting application for commercial buildings such as a parking lot.

So I thought where we were with the design so far was kind of an entry kind of a device. So I'm sort of surprised that we're talking about this in a much broader scope than that. That's one comment.

We also have requirements in the commercial standards, the nonresidential standards about timer control. And I guess you're using a basecase here of fluorescent in comparing this LED hybrid to fluorescent is how you're doing it.

Another possible basecase is to consider incandescent or nonfluorescent controlled by a timer as compared to having this LED control. Or controlled by a photocell, which is an alternative in 132, right, instead of the LED.

So I'm wondering how this device compares to that basecase, also.

MR. DODD: I double checked that -- do you have the standards with you? Because after you told me that I went back and looked at it. And I'd almost swear that it didn't cover the pedestrian areas. Has anybody got the standards here?

I've got them on my laptop.

MR. PENNINGTON: So maybe it only applies to entry lighting, was that correct? We all didn't bring our standards, so that's--

MR. DODD: I've got it there --

MR. FLAMM: I believe what the standard says, section 132, is that hardscape lighting, and then there's a subset including parking lots, et cetera, there's a string of inclusions. And then it goes on, shall be, you know, switched.

There's two issues, the bi-level switching, which is 132(c)(2), I believe; and then the astronomical time clock or the photocontrol is 132(c)(1). But i believe it's kind of broad in the statement. I don't believe it says that pedestrian hardscape is excluded.

MR. DODD: Excuse me a second, I'll pull it up. Other comments while I look that one up?

MR. PENNINGTON: I had one other comment, too. There is a possibility if you're switching from fluorescent to incandescent with this control that you'll have some daytime operation of the lighting device.

And so you would have actually more energy use during daytime instead of having, you know, if it was fluorescent instead and you were getting some daytime use of the exterior light, then the LED would not be on in that situation.

And so you'd have a negative energy savings associated with this device for that situation.

MR. DODD: I think the entire fixture is controlled by the photosensor, so that you basically can't turn it on unless you've got -- that's my understanding. It doesn't just control the LED.

MR. PENNINGTON: Okay.

MR. DODD: Okay, let me give you 132 here. Okay, so here's what it says, Gary: For lighting of building facade, parking lots, garages, sales and nonsales canopies and all outdoor sales areas where two or more luminaires are used in automatic time switch shall be installed, turns off lighting, yada yada, 50 percent, not exceeding 80 percent.

It doesn't cover pedestrian.

MR. FLAMM: You are correct.

MR. TOLEN: Tom Tolen, lighting designer. Two points. First of all, I think this is an excellent product for the residential market.

Secondly, I'm concerned about using this in commercial. I mean, as a designer, I can't think of any instances, other than landscape lighting, where I would use incandescent in a nonresidential project.

Do we need this? I mean would this potentially encourage people to use incandescent because now they have a way of getting around it in a nonresidential space.

MR. DODD: Other questions?

MR. SHIRAKH: I remember some conversations with manufacturers. In the past they were concerned about the false ons by motion sensors in outdoor situations where it could be triggered by, you know, animals, raccoons and so forth.

Now if you're using this in the pedestrian areas and all that, how does that handle this type of situation where you may have, you know, false triggers by the motion sensor?

MR. DODD: I'm not too sure. Did anybody from CLTC show up today? They were going to come and possibly give some input into the process. I'm not sure I can answer that one, Mazi.

COMMISSIONER ROSENFELD: Mazi, do you really think the raccoon density is that high?

(Laughter.)

MR. SHIRAKH: It could be dogs, cats, I mean --

COMMISSIONER ROSENFELD: But as I understand it, it's been tried, it's in use, according to Martyn, since 2004 in residential where there's a fair density of pets. And people haven't complained.

MR. SHIRAKH: In the residential, the way it's used I think it's at the porch it's mounted at a higher --

COMMISSIONER ROSENFELD: It's higher.

MR. SHIRAKH: But my concern is the pedestrian areas where it could be on a 40-inch high pole, and then anything, a raccoon chasing the squirrel could trigger it, certainly.

COMMISSIONER ROSENFELD: Doesn't seem so bad to me.

(Laughter.)

COMMISSIONER ROSENFELD: -- while I'm talking, I have a slightly different question. But you had this throw-away line at the bottom of one of your slides which said you could have colored LEDs and that would enhance security. And I didn't understand what the heck that was all about. I don't think it matter, but --

MR. DODD: Yeah, the use of colored LEDs provide a color changing features and add security benefit.

I pulled that out of the PIER report and I didn't really research what they were referencing, so I apologize.

COMMISSIONER ROSENFELD: Okay, both of us don't have a clue, right?

MR. DODD: Yeah. Yeah. Other comments?

Okay, let's move on to the next one

which is load shedding ballasts.

So this is a technology which is really aimed more at demand reduction than it is at energy savings. And what we're describing here is going to be a ballast which is capable of receiving a signal from a load control panel in the building which will then reduce the lighting energy usage in the building. So basically there'll be an external signal provided by the utility that will have the lighting automatically dim on receipt of that signal.

And I know there is a lot of discussion going on right now about these type of things, particularly the programmable thermostats capable of receiving the signals.

So, this system, which was actually tested by the PIER group consisted of a ballast which include a switch capacitor circuit. Upon receiving a signal the lamp current is reduced by 35 percent. This ends up producing a 33 percent reduction in actual lamp input power.

The system uses a power line carrier signaling method to receive the signal. $9 incremental cost per ballast. Shows a payback in less than three years, so fairly good technology.

The proposed changes here would be to add a new entry in table 146-A of the standards. We currently have an indoor lighting power adjustment factor table that gives credits in the standards for various types of control systems.

Currently there's one that covers what we call an automatic load control with dimming system. And that credit is given to a set of luminaires which include an automatic load control panel in the building that receives a signal from the outside utility and will automatically dim the lights in the building.

Credit is currently given in the standards, in the power adjustment factor table, of 25 percent.

What we're suggesting here for the load shedding ballast is a control credit of 15 percent. The reason for the reduced credit is the system does not have any user-controlled dimming available. Unlike the entry where the 25 percent credit is given, there is a certain amount of energy savings associated with the fact that the users are able to dim their individual lighting in the building. This system will not have that capability.

Eligibility criteria recommended for this would be a minimum ballast efficacy factor of 1.48. It must have a control system that is ready to respond to a signal from the utility. All lights that receive the control credit must be controlled. Every light that qualifies for this credit must be equipped with a load shedding ballast that is able to respond to that signal.

And each luminaire that is receiving a signal must provide a minimum 30 percent reduction in the lighting input power upon receiving the signal.

COMMISSIONER ROSENFELD: This is Art Rosenfeld. Can I interrupt you for a second? You keep talking about a signal from the utility. And I'm puzzled.

Several different things are envisioned under what's coming, which is critical peak pricing. But there's going to be higher prices every afternoon during the summer, that's time-of-use pricing from 10:00, noon, till probably 6:00 p.m. And then maybe ten days a year there'll be a critical peak day with very high prices.

So, when you talk about savings of 25 percent on a signal from the utility or whatever,

I don't have a clue as to what sort of schedule
you're talking about.

MR. DODD: The 25 percent savings, power adjustment factor savings, that's been in there, that was put into the 2005 standards. And I think in discussing this with staff there is no measurable energy savings that we can necessarily associate with that 25 percent. So that's a credit that's already there.

But, what we're associating is a benefit to the state by the reduction of the lighting power during these critical periods.

So what we're recommending is a similar type of credit here for the load shedding ballasts, only a lesser value because it does not have the obvious energy savings potential of dimming.

And the other thing is I keep saying signal from the utility, there is no reason why the signal could not initiate internally from inside the building, as well.

MR. PENNINGTON: To follow on with Art's comment, we are evaluating different technologies for demand response. And we're dealing with a relatively limited number of events during a year, and a relatively limited amount of time per event.

So, the percentage of total time where you would have the demand response would be on the order of 1 percent or less of the total operating hours of the building. So it doesn't really translate directly to a, you know, energy savings approach. It's valued for its demand response.

MR. DODD: Yeah, I agree.

MR. PENNINGTON: So if this is primarily a demand response kind of technique here, then I think we need to reconsider the justification for it in a similar way that we're evaluating other demand response technologies.

MR. DODD: Fully agree. Fully agree. Yeah, one of the problems with the 25 percent that's in there, you can't associate that with really 25 percent savings when it's only operating at 1 percent of the time. Agreed.

Questions from folks on the load shedding ballasts, comments? Tom.

MR. TOLEN: I think Bill's comments are quite valid. I'm curious as to how you got a three-year payback on a $9 ballast adder. What your methodology was to determine that.

Secondly, dimming the power by 33

percent, what is the effect on light output to do that? Is it 10 percent? Is it more than that? How low can you dim it and not affect productivity in the building.

Third, why 1.48 on the BEF? Just curious on that.

MR. DODD: Okay. So, answers to those questions, if you take a look in the PIER study they actually have the economics in there on the load shedding ballast. They found a, I believe, a payback on the product in New York. And then they also did a payback on the product here in California.

Now, the payback that I mentioned was the payback based upon an IOU. They found the payback was higher if you went to the munis. Okay.

To answer the BEF question, I'll point that to Mazi.

MR. SHIRAKH: The number came from Francis Rubenstein from LBNL. Basically the problem is a lot of the dimming ballasts, and whether it's step dimming or continuous dimming, they require a heater to the cathode. And they stay on in most ballasts, even at full power above

75 percent of full output.

And when that happens there's about 20, 25 percent energy penalty. So -- which poses a problem. And we just heard that for load shedding, you know, it's probably 100 hours out of the year or less. For the rest of the year these ballasts are drawing 25 percent more energy than they should.

So we're interested in promoting dimming ballasts that can dim, but also that are more efficient; and the ideal thing would be to have a ballast that will cut out the heater above 75 percent.

A few manufacturers are making that type of a ballast. More are probably on the way. And Francis' research showed that of the ones that are available right now, 1.48 is the right number for now. And, you know, we can monitor what's going on with the new ballast, and perhaps adjust it. But his recommendation was to set it at 1.48.

MR. DODD: To answer your other question, Tom, if you take a look in the PIER research report you'll find that they actually went out and did studies on what was the acceptable amount of light reduction that folks would accept in a dimming situation like this.

And they found that this level was acceptable for anywhere from two to three hours to users. So that was part of the research.

MR. SHIRAKH: If I may add, Tom, if you have more information on this ballast factor that we can use, we'd be more than happy to look at any information that you may have.

MR. TOLEN: I was just curious about it. Sounds like you're talking about a new product all together that acts like an --

MR. SHIRAKH: You need to come to the podium -- can't hear you.

MR. TOLEN: I'm just not aware of this product that acts like an instant start ballast above 75 percent, and really rapid start below that. And we know from experience that to dim effectively and not kill the lamp you got to keep the cathodes heated.

So, you know, I wasn't aware of this product, didn't hear about it.

MR. SHIRAKH: Yeah, this is a new product. I think Sylvania is making it. And it is available.

MR. DODD: If you take a look at the

PIER research report you'll find all those issues were considered in the study. What would the impact be on lamp life; what would be the, you know, acceptable reduction that users would tolerate for a short period.

This obviously was not intended to be a system that would be used, you know, on a weekly basis. It was intended to be a system that would be used only in critical times. And that was all researched fairly heavily.

Other questions or comments?

COMMISSIONER ROSENFELD: I just want to get it straight after Tom's question. When the dimming was, I think you said 30 percent in load -- you had a slide -- yeah.

Okay, two comments on that slide. First of all, if you reduce the lamp current by 35 percent you keep the voltage the same, then why doesn't the power just reduce by 35 percent? I mean I know it's silly to get upset about a 2 percent change, but I just don't understand.

MR. DODD: I didn't, either. But I took that directly out of the PIER research report, and they were very specific on that.

COMMISSIONER ROSENFELD: Okay, power

factor change?

MR. TOLEN: That happens because you are heating the cathodes. So it's not a strictly linear relationship between voltage and current.

COMMISSIONER ROSENFELD: Okay. But what's really important was Tom's question. That is, if this is going to go into justification somewhere you've got to say what that does to the lumen output. And you don't say, and I'm trying to get it straight.

I think you said only 10 percent? That's too good to be true.

MR. DODD: No, no, no, no, I didn't say 10 percent.

COMMISSIONER ROSENFELD: What did you say?

MR. DODD: I didn't. I didn't.

COMMISSIONER ROSENFELD: Oh, you didn't, okay.

MR. DODD: What I said was that they had studied that issue in the report and they determined what an acceptable reduction was. That was part of all the background on choosing the 35 percent reduction.

COMMISSIONER ROSENFELD: Okay, thanks.

MR. PENNINGTON: Also on this slide, Art, do we have any concern about the power line carrier signal expectation?

COMMISSIONER ROSENFELD: You have a good point, I was sleeping through that, I guess. That's only going to be one method in which the information is going to get done. So if you take that as a feature, I guess it's okay. But it's only one of many possible signals.

And my guess is Francis Rubenstein would say, oh, it's all going to be radio frequency.

MR. PENNINGTON: So do we need to make sure that this device is multi-capable? Mr. DR expert, here? Are there going to be other ways to communicate with this device that could be considered?

MR. SHIRAKH: There's always other ways.

(Laughter.)

COMMISSIONER ROSENFELD: Bill, I think you have a very good point. We ought to talk to the PIER Staff about that.

MR. PENNINGTON: Okay, thank you.

MR. DODD: Okay, so the next PIER product that I'll talk about, LED night lighting in bathrooms.

And what we're describing here is a bathroom fixture primarily designed for hotels, although I could see applications of this in high rise residential. There's been a big surge in high rise residential, particularly in the larger cities. They're not that different from hotels as far as the configuration of the rooms and the bathrooms.

So, what we're describing here is a conventional luminaire. And it includes an occupancy sensor and also includes a low power LED. And the low power LED is going to be less than 1 watt in this fixture that was developed.

They also developed, if you read the PIER report, a night lighting switch which is basically everything you see here, except for the eventual luminaire, for applications in hotels. That was mainly designed for retrofit applications. And what I'm describing here is primarily designed for new construction. Although it certainly would have applicability in retrofits.

Benefits they determined in the study. The occupancy sensor reduces the lights left on. Big problem in hotel bathrooms would be lights being left on all the time.

Additional benefits, the LED serves as a night light function. Staying in a lot of hotels, myself, I do see a lot of hotels now that are using night lights. That's a very common thing that the hotel operators are providing for their guests.

The LED can also be used as a safety light during power outages, so it does have the ability to be controlled by emergency power. They determined 50 to 75 percent energy savings thanks to the use of the occupancy sensor, and determined that there was a two to six year simple payback on this product.

Now, section 150 of the standards which regulates bathroom lighting considers this LED as being a low efficacy light source. What it says is low efficacy light sources in bathrooms must be on an occupancy sensor. So that would imply that the entire fixture, including the LED, would need to be on an occupancy sensor, which completely defeats the LED night lighting feature of the product.

So, technically speaking, I could not install this new technology in any hotel bathrooms, or high rise residential bathrooms, for that matter, currently in California because of that regulation 150.

So the change proposal that I'm recommending here is that we modify the table 150-C; that's in section 150. And that we include an entry that permits the use of the lower efficacy LEDs for low wattage applications. So specifically we're targeting the low wattage applications. Obviously, we're not trying to open the doors here to the use of the low efficacy LEDs and the higher wattage applications.

This will still exclude the use of incandescents if we make this change. So what we're suggesting here is that we add an additional entry line onto table 150-C at the bottom or the top that permits 5 watts or less lamps to be 30 lumens per watt.

And I think that's the proposal. Comments?

MR. MAEDA: Bruce Maeda, California Energy Commission Staff. If you have the, especially the 5 watts or less per lamp, what is the lamp for the LED? Is it just the individual little LED, in which case you could have such an unlimited amount of low efficacy stuff running around, unless you also limit it by fixture, as well.

MR. DODD: That's a good observation. Unfortunately, the way the table's written, it's written around lamps. But maybe the table needs to be a little bit more specific. Gary.

MR. FLAMM: Gary Flamm, Energy Commission. There is some other work that we're looking at for the 2008 standards on how to determine wattage to address some of the LED issues.

And the tables 150-C does not say that LED is not high efficacy. There's a performance formula. So the industry is claiming they're very close to reaching that efficacy of the 40 lumens per watt. And some are claiming even higher than that.

And some of the language proposed for changes in section 130(c) on how to determine wattage are some additional performance parameters for LEDs to say that you shall include all power supply transformer losses, et cetera.

So I have some draft language that I'm proposing to address that issue. So I would rather not add another line to the bottom of table 150-C because the industry is indicating that they're close to reaching that, anyway.

And we don't want to send a message for them to stop, to give up that effort to reach that high efficacy. And it would be appropriate for them to compete with compact fluorescent efficacy anyway.

So, I think there's another way to deal with that. One thing we could do is to treat bathrooms in hotels/motels as an exclusion, and treat them, you know, to allow this. Or we could say that lamps less than 5 watts or something; or LEDs less than 5 watts are an exclusion.

So I think there are other ways to get around this without lowering the performance target for LEDs.

MR. DODD: Other comments?

MR. HOGAN: John Hogan, City of Seattle. I know this is based on the PIER research and it focuses on this particular application, but it starts to beg the question about the whole issue of lights left on in hotel/motel guestrooms. You know, would it be better to have some general sort of occupancy sensor of all the lights, you know, once the people leave the space. Or something more like you see in Asian or European motels where you need some sort of power -- you put the card in and you get power. And you take the card out when you leave and the power is gone.

So, this seems narrowly focused. Maybe there should be some broader thought about how to address all the lights.

MR. PENNINGTON: Gary, do you want to spend a minute on that thought?

MR. FLAMM: Sure. We have been in dialogue with Michael Siminovitch from Lighting Technology Center and Jim Abrams from the California Hotel/Motel Association.

And there are efforts to look at this hotel key card issue. And to do some studies, some field studies on this application. So, we're aware of that and we are trying to get some studies to establish the feasibility of having those controls, those key card controls in hotels.

But going back to the other issue that John raised about LEDs should be turned off at night, as everything else. Dr. Siminovitch has done some studies and has worked with hotel/motels. And people are using the bathroom light as night lights. And maintenance, or custodial staff are leaving lights on.

So there is significant energy savings that has been documented by using this hotel night light scenario.

So I hear what John Hogan is saying, but I do think that the study indicates that there is a savings achieved through this night light, LED night light of bathrooms.

COMMISSIONER ROSENFELD: This is Art Rosenfeld. I'd like to make a comment to John, too.

John Hogan and I have both spent a fair amount of time in Chinese hotels where they do have key cards, so, bless you. But, I want to go along with Mazi and Gary. I think they're two different issues. Yes, we should have the key cards, and we're doing some tests on that. But that doesn't solve the night light problem at night. Can we convince you that they should both be done?

MR. HOGAN: John Hogan. Sure, I think Gary's comment about having exemption for maybe lamps or bulbs, whatever we're going to call this, less than 5 watts. Maybe that allows the LED to skip out of this.

But seems you also got lights maybe left on, you know, in the living area, the bedroom area and things like that, too. So maybe if it's, you know, 5 watts, and no matter where it is, if it's less than 5 watts you don't care. But otherwise generally it seems you want them to be swept off.

MR. FLAMM: Right. Gary Flamm. One of the reasons I'm reluctant to just say 5 watts is exempt is we have these little xenon lamps that are, I think they're 5.5 watts, but they may be 3 watts, also, which is an incandescent lamp.

And we don't want to encourage the xenon technology. We really would prefer encouraging the LED technology. So I think we need to be careful how we craft such language if we do so.

MR. PENNINGTON: I guess I'm not absolutely clear why we need this proposal. If bathroom lighting is currently required to be controlled by an occupancy sensor, and LEDs are close to being high efficacy, I'm not sure what we're accomplishing with this.

MR. DODD: Well, I guess if they do achieve the high efficacy, then you're absolutely right.

MR. FLAMM: Gary Flamm. Well, if they put in fluorescent lighting in the bathroom, let's say a hotel bathroom, the guests could leave that fluorescent bath bar on under the current scenario and still leave that light burn all night.

So this would allow a specific application, which hotel/motel bathrooms, for example, to, even if they have a high efficacy luminaire, to allow a night light.

COMMISSIONER ROSENFELD: Well, I mean, now that Bill is -- well, no, I want to go a little further now that you've jolted me awake again.

I'm with Gary, this is a real problem. I travel, I keep a night light in my suitcase just because I like having a night light and I don't like to leave the bathroom light on all night.

What we've done is to permit, but not really to encourage, night lights in hotels. And I'm wondering if we're clever enough to figure out some way to actually encourage them.

This only permits them, as I understand it.

But I'm not smart enough to figure out what to do about that. And I'm asking for help.

MR. PENNINGTON: So you're proposing a mandatory requirement that requires this technology?

COMMISSIONER ROSENFELD: I'd like to at least talk about it for 35 seconds.

I mean we seem to have a very good idea here, and -- well, I just said it, I don't know what to do.

Elaine, or somebody.

MR. DODD: Jon.

COMMISSIONER ROSENFELD: Jon.

MR. McHUGH: Jon McHugh, Heschong Mahone Group. There may be a way to kind of satisfy what Art's looking for, and that might be to require occupancy sensors in bathrooms, and to exempt less than 5 watts or some sort of minimal amount of power that could be left on.

So it would get to the night lighting issue, and it would also turn off, if you had fluorescent lights in there.

The other issue around the lamp efficacy for less than 5 watts is to consider what is the spectral quality of the light. Over the last five years or so there's been quite a bit of research pointing out that light of the blue spectrum, so, you know, if we're trying to get LEDs that are white LEDs, that might actually be the wrong thing for a bathroom.

Indeed, what you might want to be looking for is the amber or red kind of colors that allows people to see, and yet at the same time, doesn't have undue effect on people's circadian rhythms.

MR. SHIRAKH: Art, are you -- your night light concern, is it just related to the bathrooms, or the room in general?

COMMISSIONER ROSENFELD: The room, in general. I mean I think most of us just like enough light to be able to get up and get to the bathroom.

MR. SHIRAKH: I agree.

COMMISSIONER ROSENFELD: I wouldn't say where it was to be put, but I would like to encourage hotels to have some sort of night lighting.

MR. SHIRAKH: And I do agree with Jon McHugh's comment about the light of the LED.

COMMISSIONER ROSENFELD: But presumably we wouldn't put any constraints on the color of the light, so.

MR. SHIRAKH: In the energy standards
you couldn't.

COMMISSIONER ROSENFELD: Right.

MR. FLAMM: Gary Flamm. Again, I wanted to restate about when we talk in terms of less than a threshold wattage, we could be including candelabra-based Christmas tree light bulbs, which come in a range of wattages.

So, you know, we could be encouraging little Christmas tree light bulb night lights, and I don't think we want to do that. I think we would prefer phrasing any language that we adopt to push more efficacious technologies. And LED is a very promising technology.

So I think we need to have some kind of efficacy threshold on that night light, in addition to a wattage threshold.

COMMISSIONER ROSENFELD: Agreed.

MR. DODD: Other public comments?

Okay, the next one I'm going to talk about is a integrated classroom lighting system that was developed through the PIER research.

And this is quite a sophisticated lighting system that was applied in various classrooms throughout California.

It basically is a high performance lighting system, and it uses products that are currently in the marketplace. So we're not really talking about any extraordinarily new technology here.

A combination of direct/indirect luminaires used in the technology. And one of the important things was the use of the 96 percent reflective material in those applications.

MR. PENNINGTON: Could I ask you about that, Martyn?

MR. DODD: Yes.

MR. PENNINGTON: Are you talking about the ceiling material, the reflectance of the ceiling?

MR. DODD: Well, actually Michael had me correct that slide, because I originally said 96 percent reflective material in luminaire. And he pointed out to me that it wasn't necessarily the luminaire, but it also could use reflective surfaces on the ceiling, as well. So it could be either.

COMMISSIONER ROSENFELD: But surely you don't get 96 percent reflection from a ceiling, do you?

MR. DODD: No, no, I -- no, no.

MR. PENNINGTON: So I'm unclear what that means, what is meant by material.

MR. DODD: My reading of the slide, or of the PIER report, was that they were using a 96 percent reflective coated reflector in the luminaire, itself. Okay, so --

MR. MAEDA: It's hard to get 96 percent even in --

MR. DODD: Yeah. Well, apparently from what the PIER report said, they developed specifically for this product this coating that was achieving the 96 percent reflective material.

But I want to caution you, that's not really part of the proposed change that I'm making here anyway. That's really just to describe the lighting system that they put into place.

So, the system, itself, quite innovative, included a lot of features giving the teachers a lot of control features. This would include switches that would allow them to switch between a general lighting mode, as well as an A/V mode. And on the A/V mode they have the ability to do dimming.

It also optionally included the use of

occupancy sensors. And one of the most important things about it was it had a plug-and-play configuration, so this was actually a lighting system, as opposed to being a bunch of off-the-shelf components that were simply strung together in the field by somebody who would just connect point A to point B. So that was an important feature of it.

They installed this system into six schools in California; 19 different classrooms. So they did both north and south on the studies.

The system was achieving 40 to 70 footcandles on the student desks. So that's a very adequate lighting level. The resulting LPD, lighting power density, of the system was .95 watts per square foot. That was the peak wattage of the system. The system actually was running at lower wattages many times during the dimming. However, we're just looking at the peak in Title 24.

If I were to take the same system and also incorporate occupancy sensors, Title 24 allows me to take that peak wattage of .95 watts per square foot and to reduce it down to .76. This has got nothing to do with the amount of actual overall energy savings that might occur. It is rather a power adjustment factor currently in the standards that says that if I combine occupancy sensors in a classroom, then I can take a .2 power adjustment factor.

So that means this design, which was a peak wattage of .95, from a code compliance point of view, would be .76 watts per square foot.

The current Title 24 says that on that classroom I am allowed 1.2 watts per square foot. So these designs meet the current Title 24, the 2005 code, by 36 percent. Based upon the actual installations they were replacing they were actually beating the existing installations by 50 percent, because the existing installations had up around 1.35 watts per square foot. So, very considerable achievement here on this lighting system.

In addition, they got a lot of positive responses from the teachers on the quality of light. Most of the teachers preferred the quality of light from the direct/indirect lighting system to a conventional trougher-based system.

There's a higher cost associated with this type of system per fixture. Direct/indirect fixtures do cost more money. However, overall, they achieve a lower installed system cost due to the use of the high quality luminaires, a reduced number of fixtures, as well as the plug-and-play design. These fixtures are typically put on 14 to 16 foot centers in the classrooms, so you've got considerably less installation costs associated with that.

Installation costs on these systems range between $3.31 a square foot to $4.31 a square foot. And that depends on the sophistication of the controls that they chose to install into those classrooms.

COMMISSIONER ROSENFELD: I'm sorry, I'm not familiar with these figures. Go back. The last line, -- turned myself off -- you said the installation cost. You mean the installed cost or the --

MR. DODD: The overall installed cost fell between 3.31 and 4.31. And that just depended on how many different teacher control units and occupancy sensors and whatnot they chose to add to the system.

So, the change proposal that I've got here is based around the allowed lighting power density tables. If we take a look in the 2005 standards, we have table 146-B which provides a complete building method allowed lighting power density. And we have table 146-C which is the area category method. And these both give me allowances of watts per square foot that I can install into these spaces.

If we take a look at table 146-B, it is currently allowing me to put in 1.2 watts per square foot into a school. Okay. The recommendation here, or suggestion, is that we reduce that down to 1.1 watt per square foot. So a modest reduction.

The second recommendation relates to classrooms in the table 146-C; and once again, a similar reduction. The reason for the recommendations of these reductions is that it's been demonstrated with a cost effective design that has a lower installed first cost than a trougher system, that I can beat the current Title 24 by a mile.

If I made a recommendation here to reduce it to 1 watt per square foot, which I think should be considered, then I can still beat Title 24 with a classroom design by installing occupancy sensors, I can still beat it by 24 percent.

So, Title 24, as it stands right now, is not a very significant bar when it comes to achieving an efficient classroom lighting design. And I'm suggesting that we make revisions to the allowed LPDs so that we can funnel the direction of designs here to use the more efficient lighting designs.

Questions?

MR. PENNINGTON: I have some questions. In the last round of standards we changed the LPD for classrooms from 1.4 to 1.2 thinking that that was, you know, the appropriate change relative to the newest technologies.

And now we're getting some additional slack that's proposed here, and I'm curious to know where that slack comes from. Are these fixtures more widely spaced, and so you're getting a watts per square foot improvement due to the spacing?

Are they more reflective and so you're getting a better utilization? Is there something about the hardware that's more efficient? I'm not sure where this slack is coming from.

Or was the 1.2 just overly generous? So

that's -- and I'm not asking just you, I'm asking the other folks that might have --

MR. DODD: I can answer most of it. I can answer most of it. The lighting design that they're using here, which uses the indirect/direct system has fixture spacing of anywhere from 14 to possibly 16 feet apart.

So that's a considerable difference. In fact, if we go back to the first slide here, this really does show what's going on here. And you'll see that they have a considerable reduction in the number of fixtures that end up going into the space.

What the manufacturers are doing here is they're investing a lot of their expense into a much more efficient fixture. Where we've got typically a T8, super T8 applied here, although it can be done with a T5. The T5 does drive up the cost, though; and T5s tend to be unpopular from a maintenance and lamp replacement point of view. But, it is also being done with T5s.

By putting a lot of expense into the fixture and achieving much higher lighting out on the fixture, they end up with much more overall efficacy on the system. In addition, the indirect system, as you can see, utilizes the ceiling, as well. And ends up with being considerably better than what Title 24 currently requires.

I will say this. I do a lot of work with lighting designers down in San Diego. And on a regular basis they are coming into the savings by design programs with their school designs; and they're getting very significant incentives for these efficient lighting designs using these technologies.

Now, I'm not saying they shouldn't get the incentives, but what I am saying is that it's very commonplace to see these type of things.

Demonstrated examples of lighting designs achieving even into the .6 watts per square foot using daylighting controls. Now, I'm not recommending here daylighting controls because it's probably something that might have some resistance from the schools.

But what I am suggesting is that this system has a lower overall first cost, and a 36 percent lower lighting power density than the code, and it's clearly something to consider.

MR. PENNINGTON: So in that compliance documentation that you're seeing, Martyn, are you saying the hardware, itself, having LPDs below 1, or the controlled --

MR. DODD: Typically the hardware will have LPDs in the .9 range. And then the controls will typically drive that down into the .6 range, if they go to the daylighting controls. Occupancy sensors, absolutely commonplace, used in schools in the designs I'm seeing.

MR. SHIRAKH: I'd like to ask Tom Tolen to comment. I've been to some of his classes and he's showed that you can do this with about 1 watt per square foot or less. So, I wonder what he thinks.

MR. TOLEN: Well, I want to temper that a bit. I'm really at issue with this. If we assume, taking Bill's point, that 1.2 is the current baseline, and that's effective, and it's a good reduction in what we did in the past, then there has not been a technological innovation in lamp ballasts system efficacy, per se, that justifies another reduction.

Secondly, I've done a lot of classrooms in the numbers that you're talking about, but when you really consider classroom lighting and how this number applies to every kind of classroom out there, it doesn't take into consideration a number of things.

One of those is who uses the classroom. Okay. If it's a bunch of teenagers, no problem. But if you've got, for instance, adult school going on there, and they're performing paper tasks, not computer tasks like you're assuming, you know, a typical forty-year-old gets about a third of the retinal illumination that a 15 year old would. So you have to adjust for that.

Secondly, the visual tasks that you're assuming are all computer tasks. There's still a lot of classrooms that do art work, despite what Proposition 13 did to us. There's a lot of classrooms that still do manual drafting. How do we address that with this system?

Third, IES, Illuminating Engineering Society. Really only two of the 14 factors that go into lighting design for classrooms are addressed here, and that's horizontal,vertical illumination. What about uniformity? When you hang fixtures 14 foot on center with T-8 lamps, you exceed the recommendations of IES by a considerable factor. I've done a lot of modeling on this.

Another concern I have is to my knowledge this is really limited to one manufacturer right now. It's two manufacturers, one control manufacturer, one luminaire manufacturer, who have joined together and provided some excellent marketing material and a very good product, I might add. But it's limited to them, as far as I know.

What do we do in situations where we have eight-foot ceilings or low ceilings, other than a typical ten-foot? I'm concerned about that, also.

So, just being my curmudgeonly self, I have some concerns about your proposal.

MR. DODD: Tom, on the eight-foot ceiling, I originally also had brought that up as a comment for the PIER folks. And they pointed out to me that the system was designed and implemented using eight-foot ceilings.

MR. TOLEN: I've seen that layout and it doesn't work. Sorry.

MR. DODD: And they, according to the report they were achieving up to 70 footcandles at the desks. So that's a pretty good illumination level.

COMMISSIONER ROSENFELD: But you don't mean, for the present discussion you don't mean up to 70, you mean at least 70, I hope, because that's Tom's whole point.

MR. DODD: They were achieving between 40 and 70 footcandles in the final designs.

MR. MAEDA: Bruce Maeda, California Energy Commission Staff. I have several questions. First of all, were these new classrooms in new buildings, or existing classrooms? That's question number one.

Secondly, actually -- well, I have this concern about I didn't see any vertical lights in the particular applications that were shown, or the application that was shown here. So vertical lighting is a very different thing, especially when you're using direct/indirect luminaires.

Direct/indirect luminaires are very good actually for lighting quality because the SI footcandles are fairly good because, well, we studied that issue a while back. So they do actually give more uniformity, especially compared to parabolics, trials and things. So I think there probably is more uniformity because they are using the indirect technology. Of course, that very highly depends upon the quality of the ceiling and the reflectivity of the ceiling, too.

I am concerned because they are using 96 percent reflectivity, what about aging and dust accumulation and cleaning of these fixtures in particular.

So, those are my concerns.

MR. DODD: Just to answer the one question, it was retrofit applications.

MR. MAEDA: Yeah, I was concerned about that because I think newer schools have different characteristics since the earthquake standards and things. So, at any rate, I'd be concerned.

MR. SHIRAKH: So I have a question from Tom, again. I've been to some of your classes -- if you want to come up to the podium to answer -- and you've shown LPDs in the range of .9 or so for --

MR. TOLEN: Office space.

MR. SHIRAKH: Office space. Well, his proposal is to reduce it only by a tenth of a point, .1 watt per square foot from 1.2 to 1.1, which is a modest reduction. Is that significant enough to cause all the angst that you're having about --

MR. TOLEN: Yeah. I think we're at a point where we're at diminishing returns right now. And the last time we went through this for 2005 we set the number at 1.2 and we realized we could do a good lighting design at 1.2.

I haven't seen a lamp ballast system improvement that allows us to go any lower than that and maintain good lighting quality.

As to the uniformity issue, by the way, I'm talking about the ceiling uniformity. That's what I'm concerned about.

MR. SHIRAKH: Do you worry about hot spots on the ceiling and dark spots?

MR. TOLEN: Yeah, yeah.

MR. SHIRAKH: Not necessarily on the task?

MR. TOLEN: Well, it could happen on a task, but that's not my primary concern. I mean that's one of the IES concerns is uniformity of the work plane. But also ceiling uniformity --

MR. SHIRAKH: The measured footcandle is from 40 to 70, so that would be the variation.

MR. TOLEN: Right. But, if I'm --

MR. SHIRAKH: And I think that is within IES recommendations.

MR. TOLEN: No, it depends on the application. That's fine if you're doing typical classroom tasks. But what if you have an art classroom where you need much higher illumination levels. Minimum IES recommendation there is an average 70. Well, we might hit 70 at our peak with this system, but we're not getting an average of that by a long shot.

MR. FLAMM: Before you go, Tom, -- this is Gary Flamm -- do you think it appropriate that we have just one classroom lighting power density? Or might it be appropriate to consider two, or, you know, use the --

MR. TOLEN: Based on ceiling height?

MR. FLAMM: Or based on whether it's an elementary school, a middle school, a high school and the continuing education. Whether it's an industrial arts type classroom.

MR. TOLEN: I'm not sure you can make that call, because most schools are selling spaces for whatever they can. And you know me, I'm all about simplifying the code, not making it more complex. So I'd say no to that.

MR. FLAMM: Thank you.

MR. DODD: On the art room example, if

you were to get an additional 30 percent lighting there, would you get your footcandle levels?

MR. TOLEN: Thirty percent power?

MR. DODD: If I gave you additional -- yeah, power.

MR. TOLEN: I'd have to model it to tell you. The thing is, Martyn, is that I would -- we're talking about two rows of luminaires in a 30-by-30 classroom for this system. I would probably go to three rows in a classroom that I knew was going to have higher illuminance requirements. And that's -- is that 30 percent more? It's 33 percent more, 50 percent more.

MR. DODD: Fifty percent.

COMMISSIONER ROSENFELD: It's 50 percent more.

MR. TOLEN: Yeah, 50 percent more. But that's kind of what my options are if I'm going to hang fixtures, as opposed to putting troughers in, not that I recommend using troughers. Make sense?

MR. DODD: Yeah. The reason I'm asking that is if we reduce it down to the 1.1 that I suggested you still get 20 percent additional lighting that can be added by the use of occupancy sensors in there.

So you can go from 1.1 up to -- what does that work out to be? About 1.3-something.

MR. TOLEN: But what you're doing is you're applying an adjustment factor. I'm looking at the base lumens without any control systems whatsoever, what I need to get my footcandles in the space, --

MR. DODD: Right.

MR. TOLEN: -- what I need to get my uniformity. I don't care about the occupancy sensor.

MR. DODD: No, but Title 24 is going to give you the ability to put in that additional lighting that you're asking for by the use of occupancy sensors.

MR. TOLEN: Gives it to me now, too.

MR. DODD: Exactly.

MR. TOLEN: Yeah. I don't see an additional technology innovation that would allow for further reduction, though, from this system. It's just an occupant sensor and a suspended luminaire.

MR. FLAMM: This is Gary Flamm. So, Tom, do you think that the 1.2 where we are now doesn't meet all the need, and the occupant sensor

credit power adjustment factor we now have is
really needed to meet the appropriate light
levels?

MR. TOLEN: I'm not sure I understand
your question, Gary.

MR. FLAMM: As Martyn was alluding, we
have a power adjustment factor credit available
now. So, is that being used to --

MR. TOLEN: Absolutely.

MR. FLAMM: So then the 1.2 is really on
the low end, is that what you're saying? And we
do need that power adjustment factor for
appropriate lighting?

MR. TOLEN: It's on the low end for
difficult visual tasks, yeah. For standard
classroom use for elementary school, and usually
when you got a lot of daylight it's during the
daytime, it's fine. It's at the upper end then.

It's those other circumstances that
concern me. You know, we have to light for an
aging population here.

MR. PENNINGTON: So it seems to me part
of the rationale for this proposal is the
conclusion that occupant sensors are a valid
device and a useful device in classrooms pretty

much universally. And instead of having a substantial credit for that device, we want to be pushing that device --

MR. TOLEN: Yeah.

MR. PENNINGTON: -- in those spaces.

MR. TOLEN: I'd agree with that, yeah.

MR. PENNINGTON: And so one way to do that would be to lower the LPD. And if you could get by with just the efficient hardware, then fine. Or you --

MR. TOLEN: Well, I think if --

MR. PENNINGTON: -- would be driven to an occupant sensor more frequently than you are currently?

MR. TOLEN: If you want people to use occupant sensors, require them to use them. Make it mandatory in classrooms. There's still some guys out there that put it on the time clock, you know. What do you do in those cases? You're going to allow them to have less lighting because they're not using a sensor? I'm not sure if that's really fair or not.

MR. DODD: John.

MR. HOGAN: John Hogan, City of Seattle. I'd like to support the previous comments here. I think let's not complicate things by saying the actual watts you're installing in the space aren't really the actual watts, you know, we've got these multipliers and other things like that.

I think it's simpler for designers, for electrical inspectors, for everybody else to say, here's the watts and this is what's being installed.

And both IES standard 90.1-2004 and the IECC 2006 specify 1.2 watts a square foot for school spaces. And don't give any credits for occupancy sensors or things like that.

So, I think if the goal is to get at some of the controls, let's require that the controls be mandatory and not give credits for them. Take those credits out.

MR. SHIRAKH: I'm wondering what Tom's reaction is to this proposal to keep it at 1.2 but not give any power adjustment factor credits and require -- and if we do require occupant sensors, then by definition there would be no power credits.

MR. TOLEN: Understood. I think in 90 percent of the classrooms that works. I think there's quite a few that will fall through the cracks that way. I like the thought, though.

But my concern is you don't reduce that 1.2 any further. That's my primary concern.

MR. DODD: Other comments? Okay, next one we'll talk about is bi-level stairwell lighting. And this was a research project that was conducted by LBNL.

And basically they went out and did some surveys on the use of lighting in stairwells, and in most cases we're going to find stairwells are lit 24/7 basically because of egress requirements.

Studies showed a very low occupancy level in those stairwells, anywhere from .7 to 3.3 percent documented in that study. The bi-level stairwell lighting system is a system that would reduce the lighting level in the stairwell to code minimum when it is unoccupied. Once occupancy is detected the lighting system then returns back up to 100 percent.

And basically the system uses about one-third or less of the power of the normal system most of the time. So there's a lot of opportunities here with the stairwells.

They looked at studies that were done by previous researchers, done at the LRC. And these guys looked at high rise residential applications as well as high rise office applications in the study.

And they demonstrated anywhere from 53 to 60 percent savings by the use of a bi-level stairwell system. And resulted in a 2.5 year payback. That's based upon utility rates in New York City.

The LBNL study which was funded by PIER took a look at three office buildings in California. Took a look at a university building. And they demonstrated there 40 to 60 percent energy savings through the installation of the systems in the stairwells. And that demonstrated a five-year payback or less.

So, the proposed changes that I'm suggesting here relate to the table 146-A which is the power adjustment factor table for indoor lighting.

So once again we have control credits in the standards that give us power adjustment factors based upon the use of controls. We currently have entries in that table which cover the use of bi-level lighting in applications such as hallways of hotel/motels, in commercial and industrial storage stack areas, as well as in library stack areas.

So those were put into the 2005 code a new credits. But what are not given credit are the use of bi-level lighting systems in stairwells. So the recommendation here is that we apply a 25 percent power adjustment factor to the numbers in that table. This would be the exact same number as we have for hallways.

Eligibility criteria suggested here. It would be applicable only to stairwells. It would need to be controlled by an occupant-sensing device. Now, in the LBNL study they actually developed a fixture that included integral to it the occupant-sensing device. However, as part of this recommendation we're not saying must be integral with the actual fixture.

We're saying you control the lights in a bi-level fashion. If you want to use conventional lighting technology that's already out there, that's fine, as long as it's controlled by an occupant sensing device.

It'll produce either a dimming system or a multi-level switch, and it needs to reduce the power by at least 50 percent during periods of non-occupancy.

And then Mazi had suggested we also include a minimum ballast efficacy factor to this technology of 1.48.

Any questions on that?

MR. PENNINGTON: Did you consider safety issues related to this proposal?

MR. DODD: Absolutely, yes. That was one of the big issues there. And you'll notice that what we say here is that it reduces the light level to code minimums when it's unoccupied. And that's not very hard to achieve. I believe the code minimum for a stairwell right now is -- is it 2 footcandles? One. Okay. So, it's 1 footcandle. So that's not very hard to achieve.

What's probably happening right now is a lot of the stairwells are lit to a much higher level, you know, closer to 10 footcandles. So there's a considerable potential for savings here.

Tom.

MR. TOLEN: First off, I'd like to say I do support this proposal with a couple of modifications. I'd recommend that you require an integral sensor on the fixture, itself. My observation has been that those systems perform a lot better and save a lot more energy than if you just kind of scatter sensors willy-nilly. They also provide more safety, less likely to have problems that way.

There's an ANSI standard out now that's requiring 10 footcandles. That's going to be a problem with this unless you adjust the language about code minimum.

COMMISSIONER ROSENFELD: Just say the word again, adjust the language about?

MR. TOLEN: About the code minimum. It requires the -- it reduces light level to code minimums when unoccupied.

MR. DODD: Tom, in the eligibility criteria that I list here, what we say is that you basically control the lighting with an occupant sensing device. And you reduce it by at least 50 percent.

What I mentioned here was that in the LBNL study that they did, the lighting system there was reducing lighting level down to code minimums. But I didn't suggest that as a eligibility criteria.

MR. TOLEN: I understand. Okay. Okay. Yeah, because that'll be problematic if that is the case.

MR. PENNINGTON: So, Tom, could you tell us what ANSI standard that is? Not necessarily off the top, but --

MR. TOLEN: I don't know off the top of my head what the number is.

MR. DODD: Isn't it NFPA?

MR. TOLEN: It will be. It's ANSI now.

MR. DODD: Will be, yeah. It's documented in my report. I don't have a copy of it, but in the measure template it's in there.

MR. TOLEN: But basically this is in response to 9/11 and people not being able to get out of stairwells. So they raised the minimum egress lighting from 1 to 10 footcandles in stairwells.

MR. FLAMM: This is Gary Flamm. Tom, I have a question. The current standard allows .6 watts per square foot in these hallways.

MR. TOLEN: I'm concerned about that. That's where I was going.

MR. FLAMM: So, at 50 percent that would be .3 watts per square foot. Would not .3 watts per square foot provide over 10 footcandles?

MR. TOLEN: I highly doubt it.

MR. FLAMM: So what level do you think would be needed for 10 footcandles?

MR. TOLEN: I'd have to look at it real closely, Gary. I don't think -- that was actually where I was leading with this, was once that comes in, this is another concern. But I think we need to take a hard look at stairwells.

MR. SHIRAKH: Our models are based on 15 footcandles, although --

MR. TOLEN: I didn't know that.

MR. SHIRAKH: -- they may not be robust enough to account for all the different configuration of stairways, so.

MR. TOLEN: Right.

MR. FLAMM: This is Gary Flamm. I have another issue that I think needs to be addressed. And that is on the outdoor lighting standards we exempt stairwell lighting. And what I have discovered since those standards have been adopted is there's some ambiguity between outdoor stairs and indoor stairs, because now we have stairs that are kind of an appendage to a building, and they're semi-open.

And I think what we need help with is to define that ambiguity, whether those stairs are regulated unconditioned stairs, or whether they're outdoor stairs. So I just want to bring attention to the stakeholders that I think that's something we need to address.

MR. DODD: Well, a good example of that would be a parking garage. So -- a parking garage as indoor lighting, the stairwell on the parking garage.

MR. ANDIS: Yes, Gary Andis with Testing, Adjusting, Balancing Bureau. On the stairway we have a big deal with stairway pressurization. Especially when we have fires within a building. And there's still four different codes since 1989 for stairway pressurization.

So, this lighting, is this for just new buildings, or could it be for retrofit buildings?

MR. DODD: Well, actually what we're suggesting here is not a requirement that somebody put in bi-level lighting in a stairwell. I want to emphasize that.

What we're suggesting here is that if somebody chooses to put in bi-level lighting, then they would receive an adjustment credit to the amount of lighting that they can put in. Very important, it's not a requirement.

MR. ANDIS: Okay, the only thing that concerns me is during a fire that lighting should be as bright as possible. And if you don't have some way to bring that lighting up to 100 percent during the stairway pressurization that would concern me.

MR. SHIRAKH: To follow up on that comment, can the motion sensor be activated through smoke and fire and all that?

MR. DODD: I think it's strictly activated by occupancy detection.

MR. SHIRAKH: So I mean if there is smoke in the corridor and somebody enters, I wonder if the motion sensor can actually pick up the occupancy through all the smoke.

MR. FLAMM: This is Gary Flamm. The question I have is a motion sensor on -- an occupant sensor on a fluorescent system is immediate. There's no delay. And I would anticipate most stairwells to be illuminated with fluorescent lighting.

Does not that immediate 100 percent activation meet the fire requirements? The gentleman who just came up.

MR. ANDIS: It would if it sensed it. Now, the smoke is a big issue. And plus, on multi-levels, are you bringing all the lighting up on a 40-story building when it senses on the third floor? Or are you just bringing the lighting on the third floor?

MR. FLAMM: It's my understanding that this would be luminaire by luminaire. Each would have its own control. So, the answer would be no. So I think we have some homework to do --

MR. ANDIS: I agree.

MR. FLAMM: -- to answer some of these questions.

MR. MAEDA: Bruce Maeda, Energy Commission Staff. I suspect that the infra-red sensors would actually be set off by moving smoke or heat and come on. Of course, they may not last long. But any way, so -- but just pressure, itself, I'm not sure, so.

MR. SHIRAKH: We don't know that, though. I mean we need to investigate.

MR. PENNINGTON: That's only infrared, too, so.

MR. DODD: Other comments? Okay, that's the last of my change proposals. It looks like we finished up a little bit early on that.

MS. HEBERT: Are there any other comments on any of the topics Martyn talked about today?

MR. FLAMM: This is Gary Flamm. I have one more comment I want to bring up about the stair -- I'm not done with the stairwell lighting.

If we allow .6 and then we offer a 25 percent power adjustment factor, what we're really allowing is a .8 connected load. And then half of .8 would be .4. So I think we need to keep that in mind.

You know, I was talking to Tom earlier, we're not talking about .3, we're talking about .4 watts per square foot, if my math is correct. So will .4 give us that 10 footcandles?

So I don't think we have to answer that now, but I just wanted to bring that up.

MR. GATES: Steve Gates with Hirsch and Associates. I missed half of an earlier presentation where you were talking about outdoor lighting that was a combination of LED with another type of lighting that would then be controlled based on a motion detector.

The one question I had was are these

motion detectors capable -- someone mentioned, you know, an issue like raccoons chasing across the field. Can these motion detectors isolate the effects of wind blowing branches and other foliage?

My personal experience just in my neighborhood is that a couple of the neighbors have motion detectors on their lights, and the things go off all night long every time the breeze blows. But I imagine that's also a very cheap detection technology that those devices are using.

But I did want to at least raise the question as to whether other things besides animals might set off these lights and have them illuminating all night long.

MR. DODD: I didn't actually glean that from the study, so I -- you might take a look at the study that's there and see what they have to say about that.

MS. HEBERT: I have a question about the classroom lighting. This would be more to the designers in the room. Do you try to design every classroom so that it's ultimately flexible so that it can accommodate children, well, whose eyes have more skill, but do you also design so that the lighting can be adjusted for adults who, as you say, the retinas are not quite as sharp. And, as well, for being able to turn the lights off for watching films.

I mean is every classroom, do you want every classroom to be adjusted -- and then the situation, you know, where the children are doing art so you need greater lighting.

Is there flexibility inherent in the system so that you can adjust for all those? And should we aim for that? So lower levels when lower levels are called for; higher levels when higher levels are called for.

MR. SHIRAKH: Tom, you're the only lighting designer, here, so.

MR. TOLEN: But speaks volumes. Good question, Elaine. I think ultimately we strive for that flexibility but we do it with controls.

I, for one, don't just settle for bi-level control in a classroom. If you're using a three-lamp system, then you can get, essentially with off you get four levels of control if you do it right.

So that's how we do it. And we do try and -- speaking for myself, I do try and make it as flexible as possible and for as many different applications as possible.

MS. HEBERT: So are there fixtures that maybe have two bulbs or lamps in them, and you can turn one off, you know. Like we do that here in the Energy Commission sometimes. We de-lamp or we turn half of them off when there's no one in the room or something like that.

MR. TOLEN: Well, it's all in the circuiting. And you can specify how it's circuited so that you can handle that.

MS. HEBERT: And so even in a retrofit situation?

MR. TOLEN: It's a little more difficult in a retrofit just because it adds cost. And typically they're going to say no, it costs too much to put that extra wire whip in there. But, yeah, you can't do it easily and cheaply.

MS. HEBERT: Thanks, Tom.

MR. TOLEN: Um-hum.

MS. HEBERT: Anyone else?

All right, so we're a little bit ahead of schedule. We get a little bit longer lunch break.

I think we'll still reconvene at 1:15,

but please be prompt. That gives us almost an hour and a half for lunch, so, thank you.

(Whereupon, at 11:50 a.m., the workshop was adjourned, to reconvene at 1:15 p.m., this same day.)

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AFTERNOON SESSION

1:25 p.m.

MS. HEBERT: This afternoon we are back with Martyn Dodd who is going to discuss a number of heating, ventilation and air conditioning issues much as he did lighting issues this morning.

Charles Eley has come in. He's sitting over here next to Mazi. And Charles is leading the team of contractors and subcontractors who are doing a lot of the research and writing on the 2008 standards. So, welcome, Charles.

And, Martyn, you may take the floor.

MR. DODD: Thanks, Elaine. Okay, I'm Martyn Dodd with EnergySoft, and for those of you who are just new here this afternoon, we're going to go through the change proposals that I have prepared.

These have appeared as measure templates on the Energy Commission's website. So hopefully if you have an interest you've taken a look at those measure templates.

The basis of the preparation of these measure templates has been the research done by the PIER group here at the California Energy

Commission. And PIER stands for Public Interest Energy Research.

So what I've been asked to do is evaluate the research that was done and to take a look at potential changes that we can make into the Title 24 standards for the 2008 code cycle and make recommendations here.

So, what I will do is go through the different measures that we have here; and we have six to talk about today. Please understand that I did not participate in any of the research that was done here. This was all done by outside contractors that worked for the PIER group. However, I have evaluated the research that's being prepared and sort of boiled it down into these measure templates.

So I do have some folks here from the PIER group, as well as some of their contractors, who are also going to assist me today and answer some of the questions and concerns that you may have on these proposals.

So, we're going to talk today about the fault detection and diagnostics. And you're going to see me using a lot of jargon here today, so this one we're going to fall FDD. So there's a new term to learn. And we'll talk about that one in relationship to both rooftop air conditioning units, as well as air handling units and variable air volume boxes.

We'll talk about displacement ventilation systems; common to refer to these as thermal displacement ventilation systems. I chose not to use the term TDV in any of my presentations. TDV has been adopted by the California Energy Commission as a completely different term referencing time-dependent valuation. So I'll refer to this in my presentations as DV, displacement ventilation systems.

We have the underfloor air distribution systems, UFAD systems. We'll talk about natural ventilation for cooling. And then we'll tie up with some research that's being done by LBNL on building performance monitoring.

I'll go through and present each of the templates and present all the different ideas, and then I'll go ahead and solicit any comments from everybody on what I've presented.

So, let's dig into the FDD for rooftop air conditioners. This is quite a clever batch of research that's being done, and development on rooftop air conditioning systems that are actually able to automatically determine any type of problems that they have and apply diagnostics to those.

So what's important about this is it is more than just a fault detection system, but it also includes diagnostics to determine the severity of the fault. And I know that a lot of manufacturers do have smart systems these days in which they will determine if systems are performing correctly, et cetera, et cetera. But what distinguishes this system is its ability to self diagnose.

One of the reasons for taking a look at this is that 54 percent of the systems installed in California happen to be rooftop air conditioning units. There is very poor maintenance practices that are associated with those rooftop air conditioners.

A study done by the New Buildings Institute looked at 503 rooftops. And that study determined that on those systems 64 percent of the economizers were faulty; 42 percent of these systems had improper air flow; 20 percent had failed sensors, and 72 percent had improper refrigerant charge.

This is consistent with a lot of the information that's being determined by similar studies on residential related to things like refrigerant charge. So you see that the standards do reflect that in the 2001 and the 2005 code changes related to refrigerant charge.

The key concepts behind this system. We have sensors that will monitor conditions at various points in the cooling cycle. So we use data that includes things like the ambient dry bulb temperature, dry bulb and wet bulb temperatures, including the return, mixed and supply air. It will detect the evaporator temperature, the suction super-heat condenser temperature, condenser sub-cooling, and compressor hot gas temperatures.

Based upon this it will look at the differences in that and your condenser and evaporator temperatures and calculate what the expected temperatures would be, and compare that to the actual monitored temperature.

That becomes, then, the basis of determining if we have any problem with the system. And if any types of maintenance, et cetera, will be needed on it.

The first cost, $300. Now, this first cost, we had a discussion on this this morning, is probably predicated upon a mature marketplace. That marketplace obviously is not mature right now because this is technology which is just now being introduced. So we can expect that probably the first cost right now could be as high as $500. Okay.

They've done field testing of the systems. So they actually went out to sites and they chose sites in climate zones 3, 8, 10 and 12, so we have a good sprinkling of both your coastal climates as well as your inland and your valley climates.

During the testing they looked at schools, retail buildings and restaurants. What they found in the test samples is that 71 percent of the systems had faults that were detected by the FDD.

Projected savings from utilizing the FDD was somewhere between $400 and $1000 per year. So even if we take my first cost of $300 and we say, okay, it's $500 because it's not a mature marketplace, we still have somewhere approaching a one-year payback on the use of the FDD.

The change proposal. Based upon a one-year payback you're probably looking at me saying why isn't this a mandatory measure. And that's a very good question. Maybe it's worth discussing. I did not develop a change proposal based upon making it a mandatory measure.

I developed a proposal basing it on a compliance option. A compliance option is going to be an optional modeling capability with the performance method.

So to make sure this is clear, this is not a requirement that you would have to put this onto your rooftop air conditioners. This would be an optional credit if the manufacturer chose to incorporate this into their system.

And basically what we're suggesting here is that we adjust the operation of standard rooftop units in the energy modeling under the performance method so that we reduce the cooling efficiency down to 90 percent of normal. The assumption being that we have, in typical applications, a degraded performance when we do not have the FDD installed.

Similar situation for the economizers. The economizers are not functioning to their full capacity on a system that does not include the FDD. So the economizer capability would be operating at 90 percent.

For a system which chose to include the FDD, we would increase the cooling efficiency up to 96 percent. This is similar to the adjustment that's made in the residential standards for the basis of the TXVs. So those numbers were not just chosen arbitrarily. The economizer capability restored back to 100 percent, fully functional.

We would incorporate verification of the installation of this into the acceptance requirements. So the 2005 standards require that a certificate of acceptance be filled out for your rooftop units; and part of those certificate of acceptance requirements for this proposal would include additional information related to the FDD.

Eligibility criteria in order to take this credit. We would limit this to packaged systems. The reason for limiting this to packaged systems is that most manufactures are not going to be too kind if you start adding sensor points into their split systems. So we need to get something here that comes from the factory, from the manufacturer, with the controls and the sensors integrated.

If a system has an economizer then it will qualify for the economizer credit. Otherwise there will be no credit for that feature.

And it will include controls from the manufacturer that allow for self-detection, as well as diagnostic, of the faults. One of the key things here that was developed in this research was the intelligence of the system to be able to detect or to be able to diagnose the actual fault, as opposed to simply just detecting the presence of it.

And, in fact, one of the major pluses for the FDD on the rooftop air conditioning units was the ability to communicate information on potential maintenance back into the system. So that an owner could actually extend maintenance intervals based upon the FDD detecting levels of operation and necessary maintenance.

We see this type of thing on a lot of modern vehicles. My car, for instance, will tell me that my oil change is not due for 15,000 miles. My friend gets his oil changed every 3750 miles.

The manufacturer says that. Newer cars are coming out with a lot of systems that will detect how severe the conditions are, et cetera, et cetera, and actually ends up producing energy savings or cost savings from lower maintenance. We've got the same concept here that has been applied with the FDD.

Okay. Questions and comments on that? Charles.

MR. ELEY: How do you, when you say the economizers work at 90 percent efficient, 90 percent of -- what does that mean? Is that --

MR. DODD: Yeah, it would be nice to apply some sort of logic to say, well, the economizers --

MR. ELEY: I mean which 10 percent does it not work, you know.

MR. DODD: Yeah. What the recommendation there was, was to set the economizer control so that it would never achieve more than 90 percent operation. In other words, it's never fully opened, as opposed to the default that we assume right now, with an economizer is that it runs full outside air 100 percent.

MR. ELEY: Oh, I see. So it's like

there's restrictions in the damper or something. Okay.

MR. DODD: Right, exactly. It never fully opens.

MR. ELEY: And then for the cooling side of things, is that just the compressor or the fan or both?

MR. DODD: What I suggested in the template there is that we take basically the cooling EER and we adjust it similar to the way we do the --

MR. ELEY: Oh, okay, --

MR. DODD: -- the adjustments on the TXVs.

MR. ELEY: -- so it would be both then.

MR. DODD: Yeah.

MR. ELEY: Okay.

MR. HOGAN: John Hogan, City of Seattle. I just want to raise a question about the whole concept here, the notion that manufacturers supplying equipment that's not expected to operate the way you think it's going to operate when you buy it or something, and so you're going to give a credit for then actually installing features to make sure it does operate the correct way. I wonder if that's really the right way to go, to take that approach.

But, secondly, I also wanted to talk about the size issue here. So your slide says rooftop air conditioners. You were using the term package units before. I'm not sure how large of equipment is this meant to apply to.

And I would say I can see that there might be some problems with a five-ton unit that maybe people in a retail space wouldn't know that they should be looking at their rooftop units not working correctly.

But if you've got a 20-ton unit or a 50-ton package unit, a large package unit, it seems more likely that somebody's paying attention to it. And so maybe they shouldn't get the same credits.

MR. DODD: The PIER study looked at, I believe, rooftops between six and 20 tons in their analysis. And I think the other thing is that the NBI study looked at a very wide range of sizes on the rooftops and determined a lot of systems not functioning properly.

MR. HOGAN: John Hogan here. Yeah, I think if you look at that NBI data, it does vary by system size. That the ones at the smaller end, I think, had more problems than the ones at the larger size.

MR. MULLEN: Jim Mullen with Lennox. A couple three questions, I guess. I'm not sure, in reading the information that was on the website I couldn't determine if there's -- what the performance requirements are for the diagnostic system.

Is there a specification coming that would tell a manufacturer what it needs to do? Or is it -- I saw a link to a Honeywell website. Are we supposed to go to Honeywell and get this?

MR. DODD: Well, that's a very good question. I was a little bit hesitant to write very specific language in there related to the actual -- obviously we want full detection and diagnostic related to the actual diagnostic.

I did not write specific language in the measure template. That certainly is something that probably needs to get refined with the standards language.

MR. MULLEN: From a manufacturer's viewpoint I would certainly encourage the Commission Staff to start thinking about what the requirements would be and try and give us a performance requirement, if you can. Let manufacturers use their creativity to try and come up with the best way to get there.

The other, the $300 or $500 or whatever it costs, was that -- what unit was that based on? Was that a single-compressor unit, or a four-compressor unit, or --

MR. DODD: I didn't look closely enough to -- there were at least four references to the $300 in the report. I did not look at the specific unit sizes in reference to the control costs.

MR. MULLEN: Okay. As you analyze it, as you probably recall, in today's market a five-ton unit probably has one compressor. And as you get to 20 tons you may find as many as four compressors, or four separate refrigeration systems in a unit.

So, as you look at trying to do diagnostics on a system, the cost may go up with multiple compressors, which have other advantages.

Thank you.

MR. DODD: One thing to keep in mind about the proposal here is in no way, shape or form are we suggesting that manufacturers would need to do this. We're suggesting this would be an optional carrot in which the systems would receive credit.

The baseline system that we're suggesting in Title 24 would be the system without the FDD. So we're assuming that your system is broken because it does not have the FDD. And also the Title 24 baseline system is broken.

So actually what we're looking at here is additional incentive for somebody to specify and add this onto their mechanical systems and achieve the compliance benefit.

MS. HEBERT: Please introduce yourself when you get there.

MR. PHILLIPS: Tom Phillips, Air Resources Board. I may have missed it, but did you factor in the possible incentives for reduced maintenance costs and equipment lifetime and so on?

MR. DODD: Yes. The numbers that we have here, the $400 to $1000 annual savings, part of that was reductions in maintenance for the unnecessary maintenance calls that would occur. So they did take that into account.

MR. PHILLIPS: Thanks.

MR. ANDIS: Gary Andis with TABB. Where is this information being fed back to? Is it a central system, or would the service technician or the maintenance person be able to pick this up at the unit?

MR. DODD: It can be picked up at the unit. It can be picked up on the internet.

MR. ANDIS: Okay, so it would be tied into a central system?

MR. DODD: Um-hum.

MR. ANDIS: Would there be any special equipment to verify? In other words, is there laptops where a technician can plug in and receive this information?

MR. DODD: Web-based interface that would give you the information.

MR. ANDIS: Okay.

MR. DODD: This would be web-based.

MR. ANDIS: And what kind of training would be used to operate this type of system? Is that included in this $300 price?

MR. DODD: No. We're just looking at the cost. I would assume that if a manufacturer were to implement this on a product line, that the manufacturers would probably provide the training to the service technicians to diagnose the systems. That's normally the way the manufacturers handle this.

MR. ANDIS: Well, the only thing that concerns me is if you pick it up at the piece of equipment, and if it doesn't have to be verified or sent to a central data system, that system can sit there until the next routine maintenance or whatever with a fault and never be fixed.

So how are you getting the energy system just because some system is telling you that something's wrong, air flow or filters. So I guess I'm looking to see if there's some type of mandate on this thing that it has to feed to some central system. And has to be fixed within a certain time period or something.

I mean, to me, that's what you're trying to do, is have savings.

MR. DODD: Yeah. The system is designed to provide notification when there are faults detected. Now, the problem, Gary, is how do we insure that somebody actually fixes the problem. And there's no way to guarantee that.

It's no different than if your fixengine light comes in your car. It's up to you if you're going to take it down to the dealer and get it fixed, or if you're going to drive the next 30,000 miles and see what happens.

So, we're sort of assuming that somebody's going to do the right thing once they've got the information that they need to make a correction to the mechanical system.

From what I've been told by Chris, the building owners that were surveyed on these systems had a very very high interest in being able to have this information available to them. So there's a lot of interest in being able to get this information.

MR. PIO: Henry Pio, City of San Diego. I see climate zone 10 here; and we have two climate zones, 7 and 10. Ten could be very mild, and the area that's bordering climate zone 7, like in San Marcos, California, or if you go down west of the Rancho Bernardo area, you could have mild weather. So on what basis you've chose 10?

The other thing is we go back to the issue of maintenance. If you are having any kind of alarm systems electronically controlled, it needs maintenance, it needs staff, and possibly needs a remote reporting, whether you go through a telephone or you do need a communication system. So is this cost included with that? Or you just including the devices in the equipment?

MR. DODD: Well, to answer your first question, the climate zones that they chose here, climate zone 3, pretty similar to San Diego climate zone 7. I mean it tends to be a cooler climate, coastally dominated -- I mean obviously not the same as 7, but a good coastal choice anyway.

Climate zone 8, inland L.A. area. Climate zone 10 was chosen because that tends to be a much warmer climate. And you might take a look and see that quite a large percentage of construction in the state occurs in climate zone 10, particularly out in the Riverside area.

Climate zone 12, we're in climate zone 12, so basically your inland valley climates.

So they chose a sprinkling of different climate zones so that we would get a whole diversity of different types of buildings and different type of climates to quantify the savings.

So, the system, itself, $300 is what

you're going to spend, or $500, whatever it ends up being, on the system to get this as an option added in from the factory. Okay.

Then that system will provide notification to you. And you can choose how that system is, you know, provides the notification, provides it to you, it provides it to your service company, et cetera. So that way -- maybe you have a property management company and it provides the information to them.

So there's lots of choices; and probably the manufacturer, when they implement these, may choose to implement them differently. So we weren't specific on how that would be implemented in there because everybody does it a little bit differently.

MR. PIO: How can we enforce it? I mean, we're already have extensive list of things with the involvement of equipment and HERS and so many things like cool roofs and all that stuff. So how we going to enforce this, just by saying in the calculation they have this and --

MR. DODD: Well, what we do here is --

MR. PIO: -- it's -- concern.

MR. DODD: -- we're empowering people so

that they can make the right choices. But can we force them to do these things? Well, maybe in ten years we do like the smog folks here in California, and require that you pass some sort of test to get your car recertified. Maybe your HVAC system has to do the same thing.

But right now we don't have regulations that cover what you with the a building after that building is built, so how you operate it and maintain it.

DR. AMRANE: Karim Amrane, ARI. You assume in your baseline that the economizer is 10 percent efficient. But it is my understanding that the 2005 version of Title 24 has some requirements for economizer to avoid failures in the field, things like that.

So you are basing your analysis on a study that was probably done way before the new issue of Title 24. Will there be need for you to reassess your baseline a little bit here?

MR. DODD: The assumption on the economizer is that right now on a broken system the economizer is running at 90 percent functionality in the proposal. We're suggesting that with an FDD the economizer would run at its full 100 percent functionality.

So we're doing a very minor degradation here. Based upon the numbers that were put out in the NBI study, the energy savings alone from just repairing broken economizers was, I believe, up to 25 percent energy savings.

So I've definitely derated the impact from the FDD, basically the system being broken, in these numbers already.

So, yes, the new Title 24 does include a acceptance requirement that requires that the economizer, when it is initially installed into the building, is tested and is working. And it has to pass functional tests.

But, probably a large percentage of buildings do not undergo any testing or recalibration or whatever on the economizers after they've been in service. And that's really where the problem starts to lie. As we move away from that initial commissioning of the system, performance starts to degrade on the systems.

And the FDD would give us the ability to keep track of that and to act on that data.

DR. AMRANE: Right, but the FDD will tell you that the economizer is not functioning, but there's no guarantee that it will be fixed.

MR. DODD: Correct. Correct. Once again, we can only give people the information to do the right thing, but we don't have the ability to force the right thing.

MR. MAEDA: Bruce Maeda, Energy Commission Staff. We make the sort of tacit assumption on the residential side that package units have their charge set right and properly at the factory.

Was the NBI study done primarily upon package units? Do we need to re-examine our assumptions about whether their charge has been done properly on package units or not?

Also, is there any difference in the NBI study in particular between single-phase and three-phase units, and do we have any issues with that?

And so those are the main concerns.

MR. DODD: I didn't look at the single-phase, three-phase issue, Bruce, on the NBI study. But 72 percent with improper refrigerant charge does raise concerns about the refrigerant charges on those systems, and the need for TXVs. So that's also, that's a sort of a sidebar issue, but perhaps something that does need to get discussed.

MR. PENNINGTON: So, Martyn, do you know what the age of these rooftop units were in the NBI study? I mean were they, you know, were they old enough that there had been more than one round of maintenance on them? Or are these brand new systems, you know, --

MR. DODD: I believe the system ages were between two and five years, unless anybody remembers -- yeah, two to five years.

Jon.

MR. McHUGH: I'd just like to mention we've got somebody in the audience -- researcher in the NBI study; he's right there, Pete Jacobs.

MR. SHIRAKH: He is suggesting that perhaps Mr. Pete Jacobs, who did the NBI study, should come up to the podium.

(Laughter.)

MR. JACOBS: I mean I'd be happy to if you want --

MR. DODD: Please, I'd actually -- audience participation, yeah.

MR. JACOBS: I'm Pete Jacobs with Architectural Energy Corporation. I think the answer to that one question about the three-phase, Bruce -- versus single phase units, we didn't really track it that way. Although we could go back and find those data, because we took full make and model numbers to look at how they broke out. But, for the most part, you know, they were -- well, I can't say actually whether they were three-phase or single-phase.

The majority of the units were five tons nominally. Our study really focused on units between -- up to ten tons, although we wound up pulling some units as high as 20 tons into the study. But the primary focus was 10 tons and smaller. And units that were, I believe, four years old or newer.

So, clearly, all of these units have been through some service. And we don't have the data necessarily to support it because we didn't really, you know, follow these things throughout their full service history.

But our suspicion is that a lot of the issues with improper charge, with, you know, single packaged units, hermetically sealed, charged at the factory, why are we seeing these problems is that it was probably due to inadvertent adjustments done during service that messed up something that was probably okay to begin with.

Is there any other questions?

MR. PENNINGTON: Pete, yeah, question. Did your study try to estimate energy savings potential from having this kind of FDD?

MR. JACOBS: We went through and estimated energy savings from correcting faults. So the extent to which the faults map into types of things that FDD would take care of, then, you know, you could derive that from our study.

And my -- I'm not totally familiar with the FDD capabilities, but my guess is it's going to map pretty well into the types of things we looked at.

MR. PENNINGTON: I'm sort of wondering about the global assumptions that Martyn made in trying to estimate the, you know, compliance credit or the degradation that would be assumed for modeling purposes.

I'm wondering if there might be information in your reports that would allow for maybe a more specific correction to be modeled of the equipment instead of a, you know, 10 percent effect on outdoor air, or 10 percent efficiency correction. Do you understand my question?

MR. JACOBS: Yeah, and we looked at savings more in terms of statewide kilowatt hours and statewide demand savings. Not so much expressed in terms of changes in average efficiency. Although I suppose one could use those data to back up some of those efficiency corrections.

MR. PENNINGTON: So how did you determine, you know, to get the statewide --

MR. JACOBS: Um-hum.

MR. PENNINGTON: -- you need to have some way of estimating the impact on a particular building, and then you can, you know, extrapolate that to a population of buildings.

MR. JACOBS: Right.

MR. PENNINGTON: So how did you do it for the individual building?

MR. JACOBS: So run a fault-by-fault basis for economizers we really looked at a couple different issues, whether the economizer was working correctly or not. As well as whether the setting was correct.

So we used the different key words within DOEII to simulate the economizer either working or not working. And also simulating the change-over points relative to what was observed in the field, relative to what's actually in Title 24 now for change-over points.

For corrections to refrigerant charge, we did make efficiency adjustments, and our report has some curves that show efficiency adjustments as a function of charge deviation. Same thing with air flow, change in efficiency with respect to change in air flow deviation from nominal.

MR. DODD: You did have some predictions in there, as far as percentage savings on the different fixes, as well.

MR. JACOBS: Um-hum.

MR. DODD: Because I remember seeing 25 percent on the economizers. I believe I put that into the measure template.

MR. JACOBS: I did this awhile ago, so you may be more familiar than I am.

(Laughter.)

MR. PENNINGTON: Thanks, Pete.

MR. JACOBS: Okay. Anything else?

MR. MULLEN: Yes, there always has to be one more.

MR. DODD: Okay.

MR. MULLEN: Jim Mullen with Lennox. Just looking at that slide, when you look at it, it says 72 percent had improper refrigerant charge. You always assume that that was a big deviation from standard, and that it resulted in a lot of energy loss.

What is really the definition of improper? Is it 2 percent or 5 percent or --

MR. JACOBS: That's a great question. We were using computerized system to analyze whether the charge needed to be adjusted. And there were criteria that that system used, I believe, that's within 5 degrees of the target superheat for a non-TXV system, and within 5 degrees of the target subcooling for units with TXV.

So those would basically raise a flag and say, you need to do something. So these were 72 percent of the units basically raised a flag and said we have to do something within those violated those target criteria.

Now, once that criterion was reached in terms of being more than 5 degrees off on superheater subcooling then there's a continuum in terms of how much adjustment actually was made to the charge to bring it back within those values.

So, some of that 72 percent required a very small amount of adjustment; some required quite a bit of adjustment. But the actual energy savings numbers within our report reflected the distribution of charge adjustments that was needed according to the field work.

MR. PENNINGTON: The work that underlies the residential, you know, treatment of refrigerant charge found that the energy implications was much more severe for undercharging than it was for overcharging.

MR. JACOBS: Um-hum.

MR. PENNINGTON: In fact, it was quite limited for overcharging. So the savings, you know, is -- the average savings is really weighted heavily by the portion that are undercharged --

MR. JACOBS: Um-hum.

MR. PENNINGTON: -- in the analysis that was done for residential.

MR. JACOBS: And we took a similar approach. I mean we used savings as a function of charge where that function showed a stronger impact on the undercharged side, and projected that across our observed distribution of charge and balance.

Anybody else?

MR. DODD: Other comments?

MR. PENNINGTON: That was a good suggestion, John, so, good job.

MR. DODD: The next measure template we'll be discussing a similar technology which is applied to air handling units and variable air volume boxes.

Similar proposal to the FDD in terms of the change. What we're talking about in this case are expert rules that are applied to the air handling unit operation. And as part of the PIER development effort, they developed the APAR, the air handler unit performance assessment rules.

And basically this uses control signals and occupancy information to identify the mode of operation of the air handling unit. And to determine what the correct parameters should be for that operation.

So it applies basic rules based on conservation of mass and energy, along with the sensor information that is typically available for the air handling units.

In addition, there is the VAV box

performance assessment control charts, VBACC. And this uses a small number of control charts to assess the performance of VAV boxes.

They did field testing of this system or the systems in office buildings, restaurants, community colleges, university campuses. They did both constant volume systems as well as variable air volume systems.

So, the change proposal, once again to emphasize, this is a compliance option proposal. We're not requiring that you install these controls or this FDD system onto your mechanical system. We're suggesting to offer it as an optional performance credit.

So, we're suggesting that once again to reflect the improper operation of the economizers on the air handling units that we adjust the capability to 90 percent. And that we adjust the operation of the standard VAV boxes by 10 percent.

Now, I want to qualify 10 percent there, because I'm not talking about changing it from 30 percent to 40 percent. I'm talking about the VAV box which would be at 30 percent would be increased by a very small amount up to 33 percent. So not a significant number there, although significant enough.

For the system that has the FDD installed, the economizer capability would be restored back to 100 percent of normal. And the VAV box minimum flow would be restored down to the normal specified in the modeling.

And, once again, we would incorporate verification into the acceptance requirements.

Eligibility criteria for this FDD proposal, it would only be applied to built-up systems, as opposed to the DX systems which were suggested earlier. That would be systems that included chilled water coils.

Once again, to quality for the economizer credit, it would need to have an economizer. And if the system has VAV boxes then it would qualify for the VAV credit. Now, of course, not all of the systems are going to be necessarily VAV systems, so it is possible to take credit on a air handling unit that was a constant volume system. Once again, the controls would allow for self-detection and diagnostic of the faults.

Questions on this one? Steve.

MR. PENNINGTON: I'm wondering if you

evaluated what would be the extended compliance credit for either of these proposals.

MR. DODD: No, I have not, but I should have. I thought that question was going to come up. The 10 percent economizer credit, I'm guessing, is going to be very minimal because the economizer already is able to run up to 90 percent. So that extra 10 percent's probably not going to make that much difference.

The 3 percent on the VAV boxes, very small credit there. So I tried to keep the credits not too exorbitant to, you know, reflect the fact that you've got systems out there where people may not respond, and do something about it and fix them. So we sort of need to, you know, water down the change.

Steve, you had a question?

MR. GATES: Yes. Steve Gates with Hirsh and Associates. This is actually not a question, it's more a comment or actually an identification of an area that might be worthwhile doing some additional research in.

When you mentioned the minimum box flow's around 35 percent; and you know, tweaking that number by a few percentage points to develop a credit.

I ten years ago -- actually ten-plus years ago I was actually a controls engineer; worked for one of the major controls companies in the United States.

And I had looked at their VAV boxes at the time. And asking the question, given the error in the measurement at the little transducer that was on the VAV box, translating that error from what they published at the full rated air flow down to this minimum air flow ratio and also recognizing that static pressure -- velocity of pressures go as the square of air flow, my conclusion at the time was if you actually turn a box down to about 30 percent minimum flow, the measuring precision at that air flow is on the order of plus or minus a 50 percent error.

And so I basically concluded at the time, you know, if you turn a box way down you really are fairly clueless as to what air flow you're actually getting out of the thing.

And I just wanted to flag that for the Commission as a potential area to be addressed. Are there differences now in transducers; does it make sense to actually look at this imprecision at low air flows so that you're aware of how bad the errors are in terms of the actual amount of air you're getting out of a box.

Second comment, related to the first, is there are -- at the time at least, there were -- in fact, the company I worked for, their VAV box, once you went into the heating mode, even if you turned it down to 35 percent minimum air flow, it would, by default, jump up to 50 percent airflow whenever it attempted reheat.

The logic being when you put air into a space at 30 percent air flow, the velocity that you're introducing that warm air can be so low that you don't actually get effect of mixing in the space anymore. You actually wind up floating a lot of warm air on the ceiling where it stays until it's drawn back out through the returns.

And I don't know if the Commission has ever actually addressed the practicality of going down to the minimum air flow they specify, and whether in reality VAV boxes actually comply with that.

I know at the time there were boxes that were commonly installed in the state that did not comply with that, because they were actually -- at

50 percent airflow.

So, again, this isn't a question as much as simply an identification of an area that might be worth further investigation.

MR. MAEDA: Bruce Maeda, Energy Commission Staff. You mentioned occupancy detection. How is occupancy detected as part of the criteria to control the system? Is it CO2 or something else?

MR. DODD: You're talking about -- okay, what they're doing there is they're determining what the different occupancy mode of the building is. In other words, is it during the occupied hours? Is it during non-occupied hours? They have five different modes in their rules here that they --

MR. MAEDA: So it's just by timing then, or basically --

MR. DODD: Yeah, yeah. Other comments? Okay. What I'm going to do now is I'm going to present a displacement ventilation system or thermal displacement ventilation, if you want to call it that, measure template proposal.

I'm going to then follow that with a UFAD, underfloor air distribution system proposal.

And then I'm going to have some folks from the Center for the Built Environment come up; and they're going to talk a little bit about some additional enhancement features that they are recommending to the proposal that I've made.

So, we'll have a little bit of a -- and then we'll have a discussion on both the -- and comments on both the displacement ventilation and the underfloor air distribution together.

So, displacement ventilation systems, not really a new technology. Been in use in Europe since the '70s. The basic concept is that we're going to be supplying a higher supply air temperature, somewhere between 63 and 68 degrees.

One of the benefits of this higher supply air temperature is going to be a greater number of hours of economizer operation.

And I was looking at a chart that showed the energy savings difference between the outside temperature and the supply air temperature setpoint, and this is a considerable area of energy savings, is the economizer operation.

This system results in less reheat energy. We're using a supply temperature which is considerably higher than the 55 degrees which is normally supplied on the mechanical system. Hence, when we need to reheat that air, we're going to provide less heat into the system.

We're talking about supplying very large volumes of air at very low velocities. What characterizes this system is we do not mix the air around. So your typical overhead systems, you're mixing up all the air into the space, and you're providing your conditioning.

So, energy savings resulting on these systems results calculated in the range of 30 to 50 percent actual systems installed in California.

The change proposal is as a compliance option. And we're suggesting that optional credit be assigned in the performance method for the use of this system.

We're suggesting that the modeling language, which is currently written in the ACM manual, which describes modeling of underfloor air distribution systems be enhanced and we provide more precise language which will also cover the DV systems. So there is language in the ACM manual right now that says, as of the 2005 standards I'm able to model under the performance approach and take credit for underfloor air distribution systems. However, DV systems are not covered in there.

The language that we're proposing here, we're going to provide enough latitude in the ACM manual language that will permit the simulation by the major energy simulation programs in the marketplace and in use in California. That would include DOEII.1E, DOEII.2 and while EnergyPlus is not yet become a certified ACM tool for use with the standards, it certainly has been used quite extensively for a lot of research purposes. And a lot of enhancements have been done to the EnergyPlus software to model things like the displacement ventilation systems.

One of the things that the PIER study did was to enhance EnergyPlus so that we have modeling tools now that can give us better approximation of the energy savings by these types of systems. That's something that the CBE folks will talk about.

So, the original proposal here, which we're going to talk about, is a variation that CBE will present, is to assign a portion of the loads to the return air plenum. And if any of you took a look at the documents that I referenced in this measure template, we looked at two different documents. One done by the PIER folks, and another done by the EDR folks, the Energy Design Resources. So that's basically the conglomeration of the statewide utilities, their research projects.

And what we're proposing here is that a certain portion of the load that appears in the building will actually be placed into the return air plenum as opposed to appearing as load in the space.

What characterizes a displacement ventilation system is that by providing very low volumes -- excuse me, velocities of air into the space we don't take all of the heat and mix it all up. Rather we end up with a stratification effect, so that we have a much higher temperature at the stratified layer as we do down here where we've got this 63 to 68 degree air coming across.

As a result a lot of the loads will not appear directly as space loads. We're suggesting that 33 percent of the load from people will actually end up in the return air plenum. Fifty percent of the lights, 50 percent of the equipment loads would actually be modeled in the modeling tools in the plenum.

Now, I want to emphasize that the numbers that I'm suggesting here are based upon the EDR work that was done by the utilities. And that CBE is going to provide a more robust recommendation for refinement on these numbers.

Verification via the certificate of acceptance. In particular we need to make sure that the economizer is verified. We're getting a lot of energy savings out of these systems by the fact that it's able to run in economizer mode a lot more hours of the year.

Eligibility criteria. We could restrict it to chill water systems. I didn't write that in specifically because the manufacturers are now starting to introduce a lot of DX system lines that have multiple compressors, specifically targeted towards these higher supply temperature systems that are becoming popular.

So, the displacement ventilation systems, they're being done. We've already got them out there in the marketplace. We've got test cases where people are putting them into buildings. What we're suggesting here is we need the ability to model these and take them into account in the ACMs.

We're suggesting that the ACMs would automatically default the assignment of loads to the plenums. Right now the way the ACM is written, it basically says assign some portion of the loads to the plenums for the UFAd systems. It's completely vague on that topic and does not give us any specific modeling rules. I'm suggesting tightening up those modeling rules and accommodating the DV systems.

We would have special features messages on the PERF-1 when these systems are used so that it's made very clear that credit's being taken for this special type of mechanical system.

Underfloor air distribution systems. Similar type of system, slightly different concept. Commonly referred to as access floor systems. So, we'll basically have an entire area under the floor where we've got access to put all that data cable, all that communications, all that electrical. And in addition, we utilize that space as the supply air plenum for the mechanical system.

Big surge in popularity in recent years. Take a look on the CBE website and you'll see many

many systems have been installed in the United States. And in looking at their website, there's many many more they don't know about that are being installed. So there's lots of these systems out there.

The underfloor air distribution systems obviously have other benefits besides energy. There's flexibility in space configurations. Obviously there are energy efficiency benefits with using these higher supply temperatures. There are occupant comfort benefits. Indoor air quality, we're not taking and mixing up all the air into the space. So basically we are using a stratification effect. And indoor air pollutants will tend to move up in the stratification.

This is still being studied by PIER. This is an ongoing project. This is not a completed study project. And CBE.

So in the case of the UFAD system, slightly different. We've got a higher supply air temperature than a conventional system, somewhere between 60 and 68, although the UFAD system does tend to have a little bit more mixing than a displacement ventilation system.

Once again, we've got the benefit from

the number of economizer hours. Benefits in less reheat energy due to higher supplier temperatures.

So the change proposal is similar to what I suggested for the displacement ventilation systems. We assign an optional credit for use of the system in the performance method. Now, let me emphasize that currently the performance method allows me to model a UFAD system, it's in there.

What I'm suggesting here is more precise language that governs the way we model these systems, okay. The language that we're suggesting here is structured so we have latitude once again to use the current tools, DOEII.1E, DOEII.2, and also to segue into the up and coming EnergyPlus.

Little bit of background on that. The EnergyPlus software is not being used for the development directly of the 2008 standards, although it is being used for a lot of looking at a lot of things that we're not able to necessarily quantify with the older simulation tools like DOEII.1E and DOEII.2.

And, in fact, you'll find that CBE's proposal is actually predicated upon work they did with EnergyPlus. So, once again, the PIER group had the development of EnergyPlus enhanced to include the underfloor air distribution systems.

So here's the original proposal that appeared in the measure template that was posted onto the website. And once again we're looking at assigning a portion of the loads to the return air plenum, according to this table, slightly lower percentages being assigned to the return air plenum because the underfloor air distributions systems do tend to mix up the air a little bit more than the DV systems.

Once again, verification via the certificate of acceptance; and in particular, important verification item is going to be the economizer.

Okay, now I'm going to turn it over to the folks from CBE.

MR. WEBSTER: I'm Tom Webster from CBE, Center for the Built Environment at UC Berkeley. And I'm going to talk about this method and how we propose to or are suggesting that it be modified and expanded to be more comprehensive.

So, you see here a list of our recommendations, so this is kind of the bottomline of what we're recommending.

These first two items are kind of key to this whole issue. Defining and expanding this load split method, and I'll talk about that in a moment. Also to account for temperature gain in the supply plenum for UFAD systems. A key element that really doesn't seem to appear in the work to date on this.

Also there, in our view, should be allowance for lower fan static pressures, and I'll talk about that in a minute, as well. And there seems to be some limitations on being able to control humidity in the DOEII programs that would operate with these kinds of systems, so that probably should be addressed, although that might be less of a problem in California.

Heating systems, we'll talk about that in a moment. They should reflect more accurately the actual operation and configuration of these systems.

And then we're also suggesting that we expand and revise some of the discussions in the template and in other materials to be more accurate, more thermodynamically correct, and also provide some additional guidance that would be really helpful, I think, for people that are simulating these systems.

And then possibly where there are limitations and capabilities with DOEII, we might be able to work up some correction factors, you know, that would allow you to get some, you know, more accuracy and credit for some of these issues.

So, this slide is just to summarize where we're coming from on this in our suggestions in here. And basically it appears that the general approach of dividing these loads between the return plenum and the spaces is a pretty good one, and we would support moving ahead with that concept, although developing it further and allowing it to be broader.

One other issue that comes up when you try to apply this method is the issue of outside air. If you try to apply it in the way that Martyn was just talking about, using these -- just putting the loads, as you saw on that list there, up into the plenum.

So when you put people loads up there, then you have an issue with the outside air requirements being correct. And so you have to make some adjustment for that by possibly fixing the outside air requirements.

Then the crux of what we're suggesting,

though, is to base these methods really on a thorough understanding of both the stratification issues and the heat transfer to the plenum for UFAD systems. These are real key in developing the energy savings out of these systems.

Then finally, to be able to differentiate these splits for different kinds of operation, for example the big one is that there isn't any allowance for differences between interior spaces and perimeter spaces. And that's an obvious one.

But also between DB and UFAD and numbers of diffusers and those kinds of things. The degree of stratification is a secondary consideration.

So, and Martyn kind of made this point earlier, but I want to drive it home, and I will continue to drive it home because this is really the name of the game for these systems in the modeling, it's really important that we get accurate about predicting the fan energy and economizer performance. Because that's where the savings potential is for these systems.

So, I'm going to just show a couple of slides here to kind of illustrate what we're talking about in these particular areas. And stratification here, you see a slide which is a normalized temperature distribution of temperature versus height. You can see there. And showing a couple of three different curves there.

So it's kind of a continuum. You can think about this as a continuum from fully mixed condition to UFAD to DV, say. But realize also that there's a lot of variability in the UFAD and the DV actually. So it's really kind of a band there, really, a gray band fairly wide where they tend to look like one another, actually, in terms of their stratification performance.

And then this one which few people may be aware of, and this is the result of a study that we've just published, or is being published in the ASHRAE Transactions right now. This is not done from EnergyPlus, by the way. This is done by an independent simplified model that we developed to just try to get a handle on where's the energy distribution in these systems.

And as you can see, there's a fair amount of heat transfer through the floor, chiefly by radiation from the ceiling, as well as up through the floor due to -- thank you -- great --

down through the floor primarily radiation, as I said. And then up through the floor through conduction through the slab from the warm return plenum there.

And when you add those all up, it adds up to a fairly large amount in this particular example of like 35 percent. So you really have, all of a sudden you've got a split already just with this heat transfer through the plenum idea for UFAD systems.

So when you combine that with the stratification issues, then you really need to, you know, hone in. You need to understand those principles very well to develop the methods of doing these splits. Okay.

So now we turn to the perimeter load situation, which really isn't well developed because there's just one set of figures in that template now. And those are really only referencing the internal loads. So obviously we have solar load to worry about, but we think that it's, you know, potentially possible that we could develop similar methods that would apply to perimeter zones where we do load splits, as well, but incorporate in that the solar gains.

And the first point here, I go back to that, I forgot to mention this, right now the way it's proposed is there's kind of a cluge approach that would compromise the daylighting performance if you wanted to do daylighting. Well, we think it's important to kind of preserve that. And so our methods would, by doing these load splits properly, and allowing for perimeter load conditions that we could probably not have to have that compromise.

But the other thing that's important with these perimeter systems is there's some limits on the stratification. So you could build in a lot of stratification, but you might, in actuality, be beyond what the comfort standards allow. And so you have to be mindful of that when we develop these load splits, that we're not creating a situation that's really unachievable in a real building.

And then DV systems typically have a difficult time with high loads. So if you have a high load condition in a perimeter zone, it may not be appropriate to use that because of the stratification problem.

And then there's also an issue here of

some variation in these splits due to stratification and air flow requirements, if you go back to that diagram and look at the splits in the UFAD system, when you vary the air flow through the plenum and stratification, you get actually different numbers for those splits, and you can see that actually in the paper that we're publishing.

And finally, these splits need to consider the fact that there are different diffuser types out there, some of which don't allow very much stratification and others that do. And, as well as what happens when the blinds are closed. Well, we've done a lot of laboratory studies actually and shown that when you close the blinds you dramatically increase the strength of the thermal plume at the window. So the stratification just really takes off at that point. And consequently your air flow requirements are reduced pretty significantly. So that's a benefit that ought to be handled in some way here.

So this is just an example of a kind of a table that we would propose that we think about including in here where we have a set of, instead of trying to get too detailed about separating the load components out, if we can just basically use one number on the total internal gain as a split to the space versus the plenum. But you include all these types of variations in it for different system types and different configurations of the system. Blinds open and blinds closed, and that sort of thing. So that you have a, you know, a wider range of possibilities so you can be more comprehensive in simulation of various zone solutions.

And heating operating, you really don't want to do this load split method. You don't want to be throwing away that heat. You want to keep it in there. So our recommendation is simply go back to current models that are used for heating anytime you're in heating mode. And I don't know exactly how you would implement that in DOEII, but potentially you could switch it in some way, or have parallel simulations or what. But that's one of the things we could talk about.

Also, these systems need to have the ability to have a separate heating system. DV systems really aren't heating systems, they're really cooling-only systems, or ventilation-only systems. And in the case of UFAD we need to be able to have optional baseboard solutions for heating as well as some of these systems have heating only through fan coils that are not used for the cooling operation. So it would have to be a fan coil that's dedicated to heating only.

And now the economizer again, just to emphasize this point, it is very sensitive to the supply air temperature, and obviously the local climate. And so for example, if you look at Oakland, which is a very very benign climate, and you look at the total operating hours. We built a little simple model to do this. You can show savings at 65 degree supply air temperature of about 83 percent. But when you go down to 60 degree supply temperature it drops down to 31 percent.

So that sensitivity there is really important to capture. And the decay that occurs in the plenum that drives that supply air temperature requirement depends on air flow and plenum configuration. We need to provide guidance about this. And one of the papers that we're publishing in the Transactions addresses this issue.

And now the energy, the fan energy, central fan energy here, obviously depends on air flow and static pressure. So obviously we've got to get the zone air flows right, but we also want to be able to lower the static pressure requirements because typically these systems, UFAD systems, in any event, use about 25 percent less static pressure than an overhead system. So you want to be able to, in your comparisons, allow the UFAD system to operate at less static pressure. And hopefully with static pressure reset.

This is just a chart here that we did a long time ago, but it kind of shows what the potential is. This is a chart of fan savings relative to overhead versus percent of design load. So this is like a diversity factor on the load here.

And this is for two cases. One that has 90 percent of the flow of an overhead system, but 75 percent of its static pressure. And another one that's 120 percent of air flow and 75 percent of static pressure. And so you get this band of performance here that you can see -- having trouble with this pointer here. I think it's running out of battery, Elaine. Sorry.

All right, thank you. So in any event, you know, there's a band here obviously. And so, you know, if you look at some annual load diversity, say around 65, 70 percent, then you're in the 40 percent energy savings range. So it's a significant potential that we want to be able to capture.

And finally, this slide is here just to emphasize the point that we need to do this kind of system component matchup, you know, with look at what kind of system components are available in DOEII, and match those with the kinds of things that actually occur in these systems.

So, for example, a series fan powered box is probably fine to simulate a typical fan coil unit in an underfloor system. And maybe cooling-only boxes are fine to simulate a modulating diffuser type solution that is pretty popular out there.

DV, VAV for DV, I'm not exactly sure how we'd approach that, but that's an area we could explore.

So I think that's it. Yeah. So is there any questions? Do you want to finish, Martyn? Yeah, okay, that's fine.

MR. DODD: Okay, I'll just go real quickly through the eligibility criteria. Same issues as the DV systems we described. We could restrict this to chilled water systems, although once again we are seeing manufacturers introducing DX systems that have multiple compressors specifically designed for higher supply air temperatures.

We're suggesting that the language that we develop here, the ACMs, would default the assignment of the loads based upon the tables that we come up with. And special features messages on the PERF-1.

So, once again to emphasize, the UFAD systems are encompassed by the ACM language. However, it is very generalized and we're suggesting much more precise language here. And also take into account a lot of the effects that Tom has mentioned.

So, questions?

MR. PENNINGTON: I have a couple of questions. Go ahead, it's all yours.

MR. MAEDA: Bruce Maeda, California Energy Commission Staff. First of all you mentioned on reheat savings, you mentioned a delta

T reheat savings, but you also have a large volume of air coming through and possibly a larger volume of outside air, so I'm not sure what the balance is between the fact you have to reheat a lot more air compared to the temperature difference that you have to bring it up to on the heating side.

I'm sure on the cooling side you get extra savings, but on the heating side it's not exactly clear what you're going to save, or whether you're going to save much.

On general simulation things, simulation things are fine for accurately predicting what you're trying to achieve. However, for compliance simulation purposes, many of these things -- the more complicated you get, while it may make it more accurate, doesn't make it any easier for us to check and verify, or for building officials or whoever we're going to have checking this, be able to figure out what's going on in these systems.

So we have to have relatively simple rules for compliance simulation; they are totally different between the goal and trying to accurately predict what's going on. So we need to consider the balance between how we model them for compliance versus how we model them for predicting what they're actually going to do.

MR. DODD: In regards to the reheat question, really the air flow requirements shouldn't be any different for heating for UFAD systems than overhead system. And there's also a variant of these systems out there that actually have ducted return from the space that completely eliminates the reheat problem.

So, it's like to be significantly less, actually.

MR. PENNINGTON: I have a couple of questions. You're saying that the performance of these systems is really dependent on high quality performance of the economizer. And, you know, juxtaposed with that is the findings that economizers often have failures in the field.

I'm wondering about the field experience that you've had with these systems, or that you observed researchers have, whomever, are they finding problems with these systems resulting from economizer problems? That's part of my question.

Another part of my question is what can we do about that? Is there some further specification we might make relative to economizers to try to better insure quality performance of these systems?

MR. WEBSTER: -- in terms of that last part, but the -- you know, the components that go in these systems, other than the diffusers, are really no different than what is used today.

So economizer problems that exist will certainly, you know, be there for UFAD systems, as well, so, you know, I think it argues for good maintenance, good commissioning, good maintenance, you know, procedures and continuing those kind of activities.

But you're right, it's really important. It's probably more important for these systems.

MR. DODD: Well, I guess to address the second part of Bill's question, the certificate of acceptance gets us an economizer that works when the building first starts off.

But we just finished talking about FDD and all the broken economizers that exist in California. So, it's actually a very valid point that, you know, perhaps in the modeling assumptions that we make here, perhaps we need to also apply the same degradation that we discussed for the -- and then somebody choose to do an FDD in conjunction with this system, then perhaps we restore the operation back to 100 percent.

MR. ELEY: This is Charles Eley. I have a couple of questions. On the economizer issue, I think it's important to note that the air handlers that are used for underfloor and DV systems are not package systems. So the data that we saw earlier I don't think applies to the class of air handlers that we're talking about here.

That's not to say we're not going to get failures, but I don't think we're going to see the failure rate that we saw with the packages.

I had a question. You mentioned a couple of times that these systems require that more air be delivered. I want to get clarification of that because it's my experience that if you achieve the stratification so that the delta T between the supply and the return is still say 15 degrees, that you don't have to supply more air; that you can deliver the same volume of air in the low 60s as you would with a conventional system.

MR. WEBSTER: Yeah, that's exactly right. I'm glad you brought that up because that is a misstatement, I think, and misconception on a lot of people's part because it is the stratification that is offsetting that air flow requirement at higher temperature. And that's certainly the case. And how much stratification you can stand keeps lowering that volume, you know; you go to very very high stratifications and you can get even less air flow than an overhead system.

Which is another point that I might just mention is this, you know, the ASHRAE 55 standard regulates stratification to 5 degrees Fahrenheit in the occupied zone. We've just finished a study at CBE with a new comfort model that's developed in our group where we did a study of stratification on a more detailed basis, you know, for thermal comfort. And found that, in fact, stratification could go much higher than what the standard allows potentially and still be comfortable.

So that's something that's going to be winding its way through the standards process probably, you know, in the next few years.

MR. ELEY: Okay. One other question which relates to the way that you're proposing to offer credit for these systems is by assigning the heat from occupants and lights and so forth to the plenum.

Are you talking about a real plenum or virtual plenum. For instance, if there's a tall space with no actual plenum, can you still apply this modeling technique?

MR. MOORE: Timothy Moore with the Center for the Built Environment. Yes, just, you know, the methodology in DOEII is basically to say there is a return air plenum as a zone, and you're assigning loads to it, or some fraction of loads to it. And the important thing is how you do that assignment so you don't get in trouble in the process of doing it. But it can be a virtual space to represent that stratified upper zone which is unoccupied, and therefore not seen by the thermostat.

MR. ELEY: Okay.

MR. PENNINGTON: I have another question. You were saying that the design of the system can be very important in terms of how well this stratification works, down to the diffuser selection being important.

Should we have eligibility criteria that focuses in on getting these systems designed well?

MR. WEBSTER: Well, yeah, that's a good

idea. In fact, we're working on a project right now to develop design tools for UFAD systems, an extension of our PIER energy work. And that's the idea is to provide the tools and techniques and guidance to be able to design them properly, so they perform well.

MR. PENNINGTON: So if we could boil down a design guideline into a series of specifications that you would expect, could be performance specifications or they could be prescriptive, you know, to have this kind of a diffuser or could be some sort of performance criteria, that would be very helpful, I think.

MR. WEBSTER: Yeah, yeah, right. There's a lot of tradeoffs here that, you know, you have to consider. That's what we hope to be doing with EnergyPlus once we get the models finished and are able to really simulate these systems, is to look at all of these kinds of issues and see what are the logical or best practices tradeoffs to make.

MR. DODD: Steve.

MR. GATES: Steve Gates with Hirsh and Associates. I'm curious with the UFAD studies today, you're talking about stratification. How much typically are you seeing in spaces?

For example, in the conventional VAV system I know I can get at least 20 degrees. I can put air in at 55; I can easily take it out at 75, maybe closer to 80, you know, by the time you take account of lights and the plenum and that kind of thing. So typical system I would expect I can get between 20 and 25 degrees easily.

Are you actually seeing that in the UFAD systems? For example, if you're putting air in at 65 and floating that on the floor, are you actually taking air out at 85 at the ceiling?

MR. WEBSTER: Well, that's a good question. In the lab we can create just about anything you want. And if you take the case that I mentioned earlier about blinds, yeah, you can get 20 degrees when the blinds are closed.

Typically though, what we're hearing and we haven't done enough of these studies in real buildings to really understand what's going on, if there's a lot of anecdotal talk around the industry about oh, stratification's not happening, UFAD doesn't work, what-have-you.

I think it's really critical to do a proper study on these systems to find out why that's the case, because we know we can do it in the lab, we know we can do it in some buildings. You get, you know, stratification of, you know, 65 to 78 to 80 degrees return temperatures.

So, you know, the issue is finding out how these systems were designed. There aren't any design tools out there right now, you know. So people are really doing it by the seat of their pants and engineering judgment, you know, putting these systems together.

Also the way they're operated is a problem, you know. A lot of operators don't really understand this technology and they're just using the same principles that they did with overhead systems. And a lot of times if you set the thermostat too low, you know, you're going to end up driving the air flows up and destroying the stratification that way. And also probably over cooling.

MR. GATES: Okay, because the -- yeah, because I've heard this similar anecdotal type stories where I've talked to engineers who've designed UFAD systems, and you know, the feedback that I've been hearing is that the stratification typically isn't 20 degrees.

And, in fact, if I do hand calcs, just looking at radiant exchange between an 85 degree ceiling and a 65 degree floor, it turns out that's a huge heat flux in terms of the overall energy transfer in the space. And my calcs actually suggest that it could be extremely difficult to get a 20 degree stratification, you know.

And your comment about well, if you close blinds then you can. I mean, maybe that's where you really do get it. But I've also heard, you know, with a lot of UFAD systems they're applied to the interior spaces of a building because the perimeters do need heat and heating with a UFAD is problematic.

So, I guess I'm a little -- I wonder if -- well, actually I have a couple other questions I'd like to ask first.

You mentioned that you could possibly save as much as an inch in the static pressure on the fan system. I would assume that's primarily from eliminating the VAV box?

MR. WEBSTER: Yeah, the branch duct work, yeah, in the VAV boxes, right.

MR. GATES: Okay. Yeah, because I used to design HVAC systems professionally and I typically allocated three-quarters of an inch for the box, itself, as well as all downstream duct work. That was very common.

If I didn't want as much measurement accuracy on the velocity sensor in the box, I could go with a larger size box for a given air flow, and then get down to a half-inch static pressure from the box on down.

It seems to me that the UFAD systems are eliminating -- the way they're getting this is by eliminating the velocity pressure loss that occurs in the VAV box, itself. That's associated with getting the air through the nozzle fast enough so that you can actually do a reasonable job of measuring air flow.

This ties into the comment I made earlier about, you know, if you take a VAV box and you take it down to 35 percent of that air flow, your error in measurement may be plus or minus 50 percent or so. That was the impression that I developed 10-plus years ago looking at the current technology in those boxes.

I guess I question are you actually comparing apples to apples. I mean if I want to design a conventional VAV system without a pressure independent box, in other words if I don't care about measuring that velocity into the space, I can go with a very low pressure system.

But the reason engineers haven't done that in the past is because they ran into control problems. You know, you can now no longer adequately control the air flow into a given space, and that then causes -- you can then get imbalances in the building that, particularly during peak air flow periods, some spaces may be starved while others are hogging all the air.

And the whole logic about going to a more expensive VAV box that actually measured air flow, in other words, there are pressure dependent VAV boxes that do not measure air flow. They simply respond to a thermostat and open and close a damper, which is what a UFAD system is doing, is my impression.

And then there are pressure independent VAV boxes that actually use a higher inlet velocity on the box. They have an air flow sensor in the box so that you actually know what the air flow is, so that you can actually insure that each space in a building is getting the air flow that the designer wants.

And so I think people need to be aware that if you go to this type of technology that you're not necessarily getting the same controllability and the same guarantee that you're getting the air flow into each space that those spaces need.

And so, anyway, I think there at least needs to be a little bit more restriction to this question about where is the static pressure savings coming from, and can you actually get it in a conventional VAV system if you simply throw away some of the controllability that engineers have relied on for the last 30 years.

MR. WEBSTER: Well, certainly you could, you know, if you designed the Cadillac overhead system and larger duct work, it will, you know, minimize the losses. I don't argue with that a bit, you know. And people should do that. But people don't generally.

MR. GATES: Yeah. One of the problems I had as a designer was always fighting with the architect in terms of the amount of space I actually had above the ceiling to run duct work.

MR. WEBSTER: Yeah.

MR. GATES: It was always tight.

Oftentimes with buildings that I designed I would work with the structural engineer so that near the air shaft he would actually go to a shorter beam, wider flange, more expensive beam, but at least that way it gave me more height near the air shaft so that I could get large ducts out with a reasonable aspect ratio so that I wasn't encountering large pressure losses.

I find I'm kind of surprised all of a sudden that, you know, here I was arguing over six inches of space, but now all of a sudden there's this 18 inches under the floor that's become available. I'm surprised.

MR. WEBSTER: Yeah, it's completely unfettered in a way in terms of air flow anyway. But, yeah, I mean generally we say half-inch to an inch, you know, depending on where you want to draw the line and what kind of system you're comparing to.

But you are eliminating, largely eliminating all the duct work downstream of the mains; all the branch duct work, VAV boxes, what-have-you, you know, in an open plenum design.

Some cases you do have duct work under the floor and you don't get as much air highways and other types of distribution systems.

Going back a minute to your heating question, the heating really, like I said before, isn't any different really, you know, than what you might do in a -- you could have a baseboard system just like you do in an overhead system. You're not heating from overhead, but you still are heating without any problem. The equipment handles it nicely either through a fan coil unit or baseboards, or what-have-you.

So, you know, they're well designed to handle that.

MR. GATES: Yeah. I guess the one question I have in my mind, really, or the comment is whether this technology is actually ready and been well enough studied for the next set of standards.

You know, as you mentioned, there hasn't been a lot of studies done on actual buildings and, you know, addressing these questions of, you know, what kind of stratification are you actually getting.

I certainly think in terms of the standards that they should not be prohibited. But as to whether there's any kind of special credit given or that type of thing, I wonder if it's a little premature to actually conclude that these systems save energy compared to a conventional system that's well designed.

MR. WEBSTER: Well, that's why we're developing EnergyPlus, you know, with this modeling capabilities in it to answer that question, in fact. And under what conditions, you know, and what design requirements do you need to achieve in order to get the potential out of it.

I will mention also we are doing this study actually right here in Sacramento of real buildings at the East End project here, where we're comparing a underfloor building with an overhead building right next door.

So that's the most definitive study we know that's being done in terms of actually looking at a real system.

We have done a few case studies that we report on our website. We would like to do more of them. This is an important area. I think we need to get out in real buildings and understand them better. But you really have to do the right study. You can't just go in there and do a walk-through and do an anecdotal appraisal of it. You have to really understand how it was designed and how it's operated and all that.

MR. GATES: Yes, I agree. Yeah. Just as a very quick aside there, I work with the DOEII program and we've actually developed a version of that that can model supply plenums. It hasn't been released out to the general public at this point, we're still playing with it.

But similar to EnergyPlus, the idea is to, yeah, you got to model those, the energy transfer between supply plenums immediately adjacent to a hot return plenum, recognizing that there's very little insulation between them. Do you want to use fan powered boxes on those so you can actually provide some sort of heat. That type of thing.

So, it's an interesting area, but there's -- in my mind there's this, you know, based on the runs I've done so far I've got as many questions in my mind as answers.

(Laughter.)

MR. SHIRAKH: So, Steve, your questions are related to both UFAD and displacement ventilation, both technologies, correct?

MR. GATES: Well, they're very similar

technologies, you know. Actually I think one of the more intriguing possibilities is where you go with a displacement ventilation system within some sort of whether you call it radiant cooling or convective cooling in the space, so that you're not using the main system to deliver all your heating and cooling as much as air flow.

I think that's a very intriguing technology that I'd be interested in seeing more work and more studies done on that.

MR. WEBSTER: There's some of the reports that we'll be releasing over the next few months will document the work that we've done in a real full-scale testing in our development program where we've actually tested what we call a DV diffuser that simply is a swirl defuser in the floor that has a very low throw. And it performs very similar to a DV system, but yet it's an underfloor system.

MR. BOURASSA: Norman Bourassa, PIER CEC Staff. A couple things here. I wanted to first of all, while I don't want to cut off discussion, I want to be mindful of time here. We have two more templates to discuss and I don't want to short-change them.

And I just wanted to get up here and mention the PIER thinking on this, especially, Steve, you had a real good segue in on this. It was implied earlier, but we'll make it more explicit, the real motivation from our perspective is that these systems are going in anyway. And standards needs to start implementing more rigor in terms of how it's handling it. We need to get more rigorous language in there.

Yes, we need to learn more. We need to learn more about how the buildings occupy. But we certainly have enough knowledge about how these systems are operating, especially in a lab situation, and now beginning moreso in actual situations, to get a beginning of good language in the standards.

This is about laying down a framework that's extensible and that we can grow into in future standards, and we shouldn't lose track of that. Because these systems are going in. There are non-energy benefits that are driving that, as well.

From our perspective, of course, we're most interested in the energy benefits. But we need to be mindful of the mainstream market at large.

MR. DODD: I'll do you next, Gary.

MR. HOGAN: John Hogan, City of Seattle. I guess I wanted to build on Steve and Bruce Maeda's comments. Seems there's some difference between what you would allow for tradeoffs versus this notion of what a green building is or the next step forward.

ASHRAE90.1 has these differences between chapter 11 ECB, which has a fairly tight set of tradeoff criteria versus appendix G, which is used as the basis for lead.

So, for example, you cannot get credit for controls, lighting controls within chapter 11; but within appendix G you can. You can say here's the baseline, I'm so much better.

I think the concern here, maybe as Steve mentioned, if these are good systems you want to make sure you're not tripping them up somehow. So, to allow them to go through the process. But if you can get 83 percent savings, you know, we're not talking about encouraging a new technology. What we're talking about is some zero-sum gain. So, what's going to be different? How much is the lighting levels, the watts per square foot going to go up, how much is he glazing area going to increase, or the U factor increase, or the SHDC increase?

So, I think I would be very cautious about putting in this monster system that suddenly wiped out the whole rest of the standard here that you can pretty much do whatever you wanted.

And when I hear things about shifting between 65 degrees and 60 degrees, going from 83 percent to 31 percent savings, there's not any building officials or inspectors that are going to be checking for those sorts of things.

I appreciate all the detail, you know, trying to model this accurately, and I think that's a very valuable thing to do. For code compliance I would pick the worst case. I'd pick simple, single values. Don't make it complex. And know that those are always going to work. So that if you're trying something away, you're giving people more windows and stuff, you know you're really getting that savings no matter how badly they mangle the system when they put it in.

MR. WIMER: Hello; I'm John Wimer with the National Center for Energy Management and Building Technologies, and we do research. And it seems at every professional organization I go to where there's a discussion on UFAD it's kind of like dueling UFAD.

And I'd simply like to say that I have heard today -- I was really here to hear, listen and see where this was going, but I've heard, I think Martyn say it, that this is an ongoing study; it's a work in progress I've heard several times.

I think there's some real concerns with does it save energy, is the complexity worth it. And I think the California Energy Commission is looking at it from that vein. And that's really my intent is to hear that.

We are doing research on underfloor air distribution, talking about some of the anecdotal discussions there two ways. But I think you need to really verify. And I think some of that research is coming out.

And I talked to Tom about perhaps our working together on some of these things. May be able to pull it together quicker instead of debating it on the public floor here.

So, with that, thank you.

MR. PENNINGTON: So, John, you said --

MR. WIMER: A question, Bill?

MR. PENNINGTON: Yeah, a question. You said that the debate's going two ways, both ways. The implication of that is that there are people who are concerned about the reliability of these systems, or the performance of these systems, is that correct?

MR. WIMER: I'm going to stay focused on the energy piece. I think there's some debates there yet to be proven. And that's all I'll address here because that's all you're concerned about.

We can go into the softer side of this whole thing if you'd like. But I don't know that this is the venue for it.

I think --

MR. PENNINGTON: Well, if there's evidence about concerns about the system, we'd like to know about that, also.

MR. WIMER: Okay. I don't think this is the right place to do that. I think we can do that, and I think -- I'd be glad to do it with Tom or CBE. I think we really ought to sit down with you folks and talk about some of the issues.

That would be my recommendation. We

could volunteer the time. Tom, would that be good?

MR. TOLEN: Sure, yeah --

MR. WIMER: Good. I think we're all after the same thing, we really are. Okay.

MR. PENNINGTON: Okay, thanks.

MR. DODD: Gary.

MR. ANDIS: I'm Gary Andis with TABB. I think the gentleman before me pretty much said it all. But, the 80 percent savings, as everything I read, and everybody knows a lot going on with underfloor air, where has it been validated on an existing building.

And as Martyn has already, in his previous presentation, especially with PIER, he showed us where they had six school classes lighting done. This done; that done. All I've heard here today is about modeling. And I don't think modeling is going to tell us whether the savings are there or not.

And I would like to see some actual buildings verified before you even, you know, before you consider this.

There's some other things that I'm going to throw out there. Indoor air quality; National

Fire Protection Agency. We've all been told with fire, hit the floor and roll. Are you doing to do that on underfloor air distribution? It's been brought to the floor of the National Fire Protection Agency. And they don't know how to answer it.

So, all I'm asking is you look at all aspects.

MR. WEBSTER: Let's be clear about this 83 percent. I'm just showing that as an example, and in an extreme case it turns out that Oakland has a large, almost virtually all their operating hours below 65, if you can believe that.

And that was just to illustrate the kind of savings you can achieve. And I was really trying to get at the point that there's this variability, depending on the supply air temperature.

I'm not saying that you're going to deliver that kind of performance on an annual basis consistently.

So, again, the simulations, the modeling that we're doing is extremely important to nail down just these kinds of issues. And certainly there's room for energy studies on real buildings which is exactly what we're doing on the East End buildings here. These are expensive studies to do; we would love to do more of them, but it's a matter of funding primarily.

But, yes, we would support that a hundred percent. We should do more monitoring of these buildings and understand their energy use. But, again, I want to emphasize that the point there of doing these kinds of studies is also to find out if they're not performing well, why aren't they performing well.

We think a lot of it has to do with how the systems have been designed and are being operated. Not that it's not possible to do these kinds of things. We have done these kinds of things in the lab, you know, every day.

So, there's issues there, certainly. But we're on the path. And, you know, this is kind of an interesting junction because we're just at the tail-end of this project, just finishing up, trying to get these models working and document all this work we've been doing for three years now.

So it's kind of interesting that this whole process is coming right at this particular time, before we've had a chance to actually disseminate all the stuff that we've learned in three years. But it's all coming out, trust me.

MR. PENNINGTON: I have a question related to the comment about maybe NFPA concerns. Are you aware of any reason why this system might have fire safety concerns?

MR. WEBSTER: There's a whole list of issues like that that the SMACNA people have brought up in a number of venues here. We've put together a response to the comments that they've made online to the template that I think pretty much addresses all of these issues.

Fire, I don't think, is actually in there. I'm not that familiar with the fire issues, so I'm not really one to comment on it. But there's a whole lot of other issues that we feel are a bit overblown, frankly. And we've tried to address those in the comments that we left with Elaine.

MR. DODD: Make it quick, Bruce; we've got more to do.

MR. MAEDA: Yeah. Bruce Maeda. One quick question about why the plenum splits are the same for lighting and equipment. I would expect that lighting being at the ceiling would be sort of a more stagnant producer of warmth at the ceiling compared to equipment which is lower, which probably -- convection cells. So I'm just wondering why they're the same.

MR. DODD: Yeah, that's based upon the EDR recommendations and work that they did. But I think CBE doesn't agree with those numbers. So we started it with those as a starting point for discussion, but I think CBE thinks that they need to change.

MR. SHIRAKH: I suggest we move on to the next topic area, and then hold questions for the very end.

MR. DODD: Okay. Here's something that hopefully will be a little less contentious. Natural ventilation does actually save energy if we don't have a cooling system. Hopefully nobody disagrees with that.

So, we're going to have a research work here done by PIER into natural ventilation used for cooling. We've got no fan energy. The standards right now are not configured to give any credit to systems that use no cooling energy. This has been a traditional direction of the standards is that if a building does not have any type of space conditioning system for cooling in it, that we automatically assume a cooling system, and assume all the energy associated with the cooling system.

This builds upon PIER work that's being done to enhance EnergyPlus to model natural ventilation in buildings. One of the problems we have is that the current model DOEII is clearly unable to model the cooling benefits of natural ventilation.

So I'm not going to stand up here and present a change template to you that suggests that we provide any type of cooling benefit for the use of natural ventilation.

I'm merely suggesting with this change that we make a modeling refinement to the rules in the ACM manual. The standard design fan power would be assumed to be .4 watts per cfm for a system that utilizes natural ventilation for cooling.

So right now what will happen in the modeling rules is the fan power will track the fan power in the proposed building all the way down to zero. Thus, if I do put in modeling for a building that had natural ventilation for cooling I would see absolutely no benefit or savings from either the cooling or the fan power.

So we're suggesting that we hold a floor of .4 watts per cfm. For those of you that date back to the 1992 ACM manual, that .4 will look familiar. That .4 was actually in the original '92 through '95 ACM manual as being the lower threshold of fan power.

The proposed building which does have natural ventilation will allow the fan to be modeled down to zero. Thus we'll see the energy benefits and savings from utilizing the natural ventilation in the fan energy. But no credit is being proposed in this template for cooling energy savings.

Eligibility criteria for the natural ventilation. Climate zones 1, 3, 5 through 7, and 16. These are climates which are coastal. And you'll see by this map here we start up with 1, up the far northern coast, Arcata, up there.

We come down to the Bay Area, climate zone 3; climate zone 5 down in San Luis Obispo; 6 down Santa Barbara; 7 down near San Diego. And, of course, climate zone 16, benefit there to do the natural ventilation.

Questions, should 8 and 9 be included? Eight and 9 are sort of marginal. In the standards they're sort of lumped in as being coastal climates. That's the L.A. region down there. Climate zone 8, Anaheim; climate zone 9 would be Los Angeles.

Right now the way I wrote it, the change proposal strictly focused on the coastal climate zones. So that's a topic for discussion.

Only office and school occupancies would qualify, the way I've written the change proposal. It's not realistic to expect that people are going to put in natural ventilation as their source of cooling in high density occupancies. So all these things over here, auditoriums, convention centers, banks, et cetera, are not included.

I excluded occupancies that don't normally get air conditioning. Obviously it would be a give-away if we said, okay, if you're going to naturally ventilate your warehouse, then you're going to get energy efficiency credit in the standards. Well, if somebody's not air conditioning a warehouse they shouldn't get any credit for it. Because that's probably the normal thing they're going to do.

We can possibly discuss other occupancies that folks think should be included here. Those are the first two that came to mind as being eligible for the credit, but we can discuss if that needs to be expanded.

Plans and specifications would need to show minimum ventilation requirements have been met for standard section 121. We would need to have no supply air fans or exhaust fans, other than regular bathroom exhaust fans, used for any type of cooling or ventilation to take this credit.

The ACM, when it prints out the certificate of compliance, would note any spaces that utilize natural ventilation in the special features and modeling assumptions section of the PERF-1.

Questions, concerns on the natural ventilation? John.

MR. HOGAN: John Hogan, City of Seattle. Big picture philosophy concern; I guess it's similar to the previous one, so why would the CEC want to give something away for this? Is this as dependable as what you're giving away for? So are you giving people more glass, or less insulation, or more lighting?

In the Northwest we often have people come through with buildings and they say, well, we don't want to insulate them because, you know, we won't heat them, you know, they won't be -- spaces.

And we've got to the point where we say no, we're presuming there's going to be heat and you have to insulate those spaces. And we have some distinction between semi-heat in other spaces, but basically we're saying we know it will be heated eventually.

I think the challenge here is how do you know that these spaces won't be cooled eventually. So, sure they don't come through in the first, you know, with the other mechanical system, or they don't come through in the first six months or a year, but are these less comfortable spaces, are they going to end up being cooled later on so you've given something away, and you've sort of lost something overall.

I understand the desire for high performance buildings to move towards this natural ventilation. I wonder whether you really need to give credit for that, though, in something which is, again, the minimum standards.

MR. PIO: Yeah. I'm Henry Pio with the City of San Diego. The answer to his question is we currently issue permits for shell buildings, and they do not insulate them. And when they want to upgrade them and condition those buildings, we issue the permits. So it's the responsibility of the building owner to come back and get a permit.

So, if his intention in the beginning is to have natural ventilation, in my opinion, we should encourage that. And they could do a lot of things inside the building without us knowing, unless they come and report to us that they're doing that activity and they'll obtain the permit.

And non-energy issues, and anything. Even they can do bearing walls. If we don't know about that we cannot check structurally that building.

But a good example, answer to the gentleman from Seattle, is shell buildings. We do issue permits for shell buildings that are non-conditioned. And the responsibility of the tenant when they come back for TI to do the permit and insulate that space.

We get some little problems with it, but it's been working for many many years. Thank you.

MR. HOGAN: I'm not sure what the dialogue here is, or the protocol. But to quickly respond to that, it's one thing to have a shell building where there's no insulation and conceivably the walls aren't finished or whatever, and so you can come back and do that.

But what if, in this case, people decide, well, with this credit for natural ventilation I won't put in any low SHGC windows. I'll just put in clear glass in the building.

I think it becomes a much more expensive proposition if somebody's coming back in to install mechanical cooling to say, now you need to change out all your windows and put in ones that meet the SHGC requirements.

MR. DODD: The credit that we're suggesting here is the differential between the .4 watts per cfm and the zero that exists in the actual design.

So, it's very very unrealistic to expect that somebody could move their SHGC from the Title 24 requirement up to clear. It's not that significant of a credit that we're suggesting here. And there's no credit being suggested on the cooling side of the equation.

The other thing is we specifically chose eligibility criteria here based upon occupancy for occupancies where we can expect some persistence. If the buildings are designed up front, particularly schools are good examples where there are opportunities for natural ventilation. And some offices.

There's a lot of high performance office buildings being done in the state. Lead examples in which natural ventilation is the buzz word. And right now Title 24 is basically saying natural ventilation is completely unrecognized in the code.

So, it's also a matter of a message. Natural ventilation is a good strategy and certainly can work quite well in the coastal climate zones.

MR. GATES: Yeah, you mentioned that schools would be one candidate category for natural ventilation. It seems as though if you allowed exhaust fans that could be a way of insuring that the natural ventilation actually works.

You know, if you've got a classroom with 30 kids in there, that's a fairly dense, you know, that's a fairly dense source of heat gains, and if you actually had exhaust fans that insure that on a calm but cool day that you're still getting the air in through the windows, I think that part of it might want to be some consideration given to allowing low static pressure exhaust fans to be part of the natural ventilation system.

MR. DODD: I agree; that would be a good refinement to the measure template.

MR. RAZAVI: Kaveh Razavi with County of Los Angeles. In case of change of occupancy, when the building is already approved for Title 24, they don't have to do the envelope calculations anymore. And all they have to do, they provide calculations for mechanical equipment.

And the building might not meet the requirement of Title 24 envelope portion of it if they change occupancy.

MR. DODD: The occupancies that we've restricted this to, schools, I think you'll agree, don't change occupancy, so that's not worthy of discussion.

But on the offices, probably you're

going to find most of your office occupancies are not going to change over to occupancies such as retail or any of the higher density occupancies.

MR. RAZAVI: Well, we see that happens every day.

MR. DODD: But not a very big percentage.

MR. RAZAVI: Not big percentage, but it happens.

MR. DODD: Well, admittedly at that point they'd put air conditioning on the building.

MR. RAZAVI: Correct, but the credit they get here, as this gentleman mentioned, they may get credit because of envelope deficiencies. And by changing the occupancy, the building does not qualify anymore.

MR. DODD: It's a valid point.

MR. PENNINGTON: I would just say for the 2005 standards, we got quite a bit of comment from CalOSHA about concerns with encouraging natural ventilation in schools. And, you know, basically concerned about the inadequacy of, you know, opening windows and providing ventilation for schools.

I would suspect we would hear again from them.

MR. DODD: Yeah, good point, too. Jon.

MR. McHUGH: Jon McHugh, HMG. This issue brings up I think kind of a larger question. I think that John had mentioned earlier where we're looking at some things where we want to give credit for building so that they can comply with lead credits or with CHPS credits, Collaborative for High Performance Schools.

There may be some kind of side calculation for compliance, or not compliance credit, but credit, green credits or some other kinds of credits where you can use these involuntary programs, use some involuntary rating programs. But you don't actually use this for changing your compliance of your building to codes.

And I think this is one of those things that I'd recommend that we look at those kinds of things so that there's some things that if we're using natural ventilation, in general we're not trying to increase the loads in the building, increase the lighting, increase the solar gains, et cetera.

But we want to give credit; we want to

give them sort of the gold-star for having natural ventilation. And so I think that there might be this other path that we look at similar to what ASHRAE has done where they, rather than 90.1, which is a code, they have this other appendix for giving people credit for lead buildings.

MR. DODD: Other comments? Okay, running a little late here, sorry.

Let's do the building performance monitoring template. Basically there's been quite a considerable amount of work done by LBNL in the area of developing a building performance monitoring specification.

So we're going to present -- or the measure template presents the results of that performance monitoring specification. And this template proposes to assign credit for buildings that choose to utilize the building monitoring performance specification outlined.

So, basically the monitoring would allow the building to track things like plant power energy usage; keep track of things like chiller efficiencies; allow the system to identify more efficient ways to operate the central plant.

Enables us to detect any degradations in system performance. This is kind of similar to the FDD, but not quite as much on the diagnostic end, but really on the detection end of things.

Includes things like high quality weather station that provides for reliable measurement of outside air temperature, which allows for the most effective use of economizers, minimizing the chiller usage.

Their specification includes reliable measurement of outside temperatures, wet bulb, which will allow us to optimize cooling tower operation.

The change proposal here, based upon the performance monitoring specification that LBNL has produced, which is in drop format, I might add, is similar to the FDD. We provided optional credit under the performance method.

So, once again, we're not suggesting that the building performance monitoring must be implemented in the building. Rather we are suggesting this as an optional compliance credit.

Once again, we would use the same concepts as the FDD, where the DX cooling system performance is degraded for systems that do not have the performance monitoring. We'd adjust the operation of the air handling units, as discussed earlier. Reduce the economizer capability to 90 percent. And also adjust the operation of the VAV boxes.

And for a system that utilizes the performance monitoring, we would increase the DX cooling efficiency up to 93 percent. Didn't increase it up to 96 percent because the building performance monitoring specification doesn't actually include in it any type of diagnostic, but rather detection capabilities.

Economizer capability restored to 100 percent; VAV minimum box, flow restored to normal. And then we would incorporate verification into the acceptance requirements.

Eligibility criteria for this credit. The building would include controls that monitor system and building performance. There are two classifications in the specification produced by LBNL. There's basic monitoring which would be applied to a single building with DX cooling systems. And then there's intermediate class 2 monitoring which would be applied to conventional buildings with built up systems, which include built up air handlers, boilers and chill water plants.

And this table here outlines the performance monitoring requirements. Now, it's important to note here that this table not only includes measurements of the basic systems in the building, but also includes two aspects of visualization of the data, so that the operator of the building is able to visualize what the operation of the building looks like, and where the problems might be, et cetera.

And, in addition, we're recommending that data archiving be included here, so that we have a history of the building energy performance of the building. And we've got two different classifications given here, basic and intermediate.

And questions and comments on that? Charles.

MR. ELEY: Just a clarification. Would this be -- I assume you wouldn't combine this with FDD?

MR. DODD: No, this would be FDD or this. Yes, it would be the suggestion. Yes. So FDD obviously giving you more benefit.

MR. MAEDA: Bruce Maeda, Energy

Commission Staff. On your weather station measurements how are those -- what are the specifications on the sensors in particular outside air temperature? Because we have some data from on a comp-up where it's clear they are using shielded air temperature sensors. I was just curious.

MR. DODD: Rob Hitchcock with LBNL. Got some answers?

MR. HITCHCOCK: Rob Hitchcock, LBNL. Actually off the top of my head I won't give you the details, but I will refer you to, I guess we didn't include the URL for the set of specifications. But those are downloadable on the web. And so that access to those specs is open to folks now. And all of the details are in that for not only the weather station, but all of the installed sensors in the building and systems.

MR. DODD: The URL was in the measure template.

MR. HITCHCOCK: Oh, it is? Okay, yeah, that URL is in the measure template.

MR. DODD: Other comments?

MS. HEBERT: All right, I think we're going to move on. Thank you so much, Martyn.

Good thing you have experience teaching all the classes for the endurance that you had to have today.

We're going to bring up Pete Jacobs next, a little change of pace here. And he's going to talk about the utilities' work on refrigerated warehouses.

MR. JACOBS: Thank you. I'd like to go through our presentation on code change proposals for refrigerated warehouses. As Elaine mentioned, this is funded by PG&E through their codes and standards enhancement project. So they're responsible for bringing this forward.

So, to give you a general idea of how we conducted the study. Did some background research, and just to mention quickly, the refrigerated warehouses have not traditionally been covered by Title 24, so this is looking at expanding the scope of the standards to include refrigerated warehouses.

To conduct this research we did a literature review; and I just listed on the slide some of the more important documents that came out of our literature review. And these are also in our report that's available on the web.

Besides going through literature review, we also did a series of telephone interviews with contractors and designers of refrigerated warehouses. And then from that information we developed a series of DOEII simulations to do the actual measure analysis.

The analytical work that we did for this project used the DOEII.2 R simulation model. For those of you who are not familiar with that, it's a new version of DOEII.2 that's designed specifically to model refrigeration systems.

Our prototype refrigerated warehouse was an ammonia-based system with screw compressors and evaporative condensers, roughly 90,000 square feet, that included a combination of freezer, cooler and shipping dock space. The specific makeup of our prototype model is described in our report.

We looked at several areas of design within a refrigerated warehouse. The evaporators inside the conditioned space; condensers; the compressor systems; lighting; shell insulation; the use of underfloor heat which you see in freezer spaces and control the defrost systems.

The first measure that I want to discuss is the use of variable speed drives on evaporator fans. To analyze this measure we looked at energy savings, or we valued energy savings using the time-dependent valuation methodology which looks at the 15-year net present value of the value of energy savings on an hourly basis. So it's more heavily weighted towards peak demand than off-peak periods.

We also looked at the impact of over-sizing of refrigeration systems on measure savings and cost effectiveness. We relied pretty heavily on some work that's been done in the Pacific Northwest through the Northwest Energy Efficiency Alliance on VSDs applied to evaporator fans. And pulled some data from their study in terms of costing the measure, as well as to inform some of our work.

They certainly, in their -- the Alliance is promoting this technology pretty heavily through demonstrated energy savings, through some case studies that they've done, and also looking at some of the non-energy benefits, including reduced mass loss in fruit in the Pacific Northwest.

So, the data that's in our report I have graphed on the next slide. But I think the main take-away here is that the tremendous energy savings available through this technology, which is -- and it's extremely cost effective.

This particular graph, the right-hand axis -- somebody have a laser I could borrow for a second -- shows benefit/cost ratios. Left side shows energy savings in kilowatt hours per square foot. Showing strong energy savings over a wide range of over-sizing of the evaporators.

We also looked at a couple different scenarios where the fans run continuously versus where they run cycle intermittently on load. And strong energy savings under both scenarios; strong benefit/cost ratios. The worst one we saw was 10-to-1; so we feel this measure is highly cost effective.

On the compressor plant side, we looked at applying variable speed drives to compressors in order to better match the load in the building to the operating efficiency of the compressor.

In this particular analysis we used a 15-year net present value analysis using the TDV methodology. And we looked at a couple different scenarios. We looked at applying VSDs to one compressor in a bank of three compressors that are of equal size, parallel equal situation.

We also looked at applying a VSD to the smallest compressor in a three-compressor parallel unequal line. So, looking at a range of options for VSDs on compressors. We also used the -- measure cost study to evaluate the first cost of the VSDs.

In this situation when you apply a VSD to the smallest compressor in a parallel but unequal line, the energy savings are fairly modest, but the cost effectiveness is still almost benefit/cost ratio of two.

When you apply it to one compressor in a parallel-equal line, energy savings are much more substantial with a very high benefit/cost ratio. So the takeaway here is that you get more -- certainly get more savings from a parallel-equal situation; however, on applying VSDs regardless of the makeup of the screw compressor line, is cost effective.

On the condenser side we looked at both condenser sizing and floating head pressure measures. Again, we used the 15-year TDV to value the energy cost savings. We looked at a range of approach temperatures where the approach temperature is defined as the difference between the condensing temperature inside the evaporative condenser, and the wet bulb temperature, so the closer the approach temperature the larger the condenser.

We also looked at improvements to the specific fan and pump power in the condenser from common practice condition of 330 Btus per hour per watt of fan and pump power to increasing that to 400.

And we also looked at the impact of dropping the minimum condensing temperature from a nominal value of 85 to a value of 70, which people would generally relate to floating head pressure.

We looked at a couple different control strategies. One where we just fixed the condensing temperature at that lower value of 70 degrees. And another where we tracked the wet bulb temperature with the control system to maintain a 9 degree offset. And then used a variable frequency drive on the condenser fan to draw a nice tradeoff between lower condensing temperature and lower compressor energy with also minimizing the condenser fan energy.

We relied on the 2005 measure cost study to price these measures for the cost effectiveness analysis.

What we learned in doing these simulations was that over-sizing the condensers had a fairly modest impact on energy savings. And, in fact, we didn't see much difference in the energy savings changing the approach temperature from 21 degrees down to 13. So we wound up changing our thinking on that, and not including that in the standards.

However, we do see some substantial energy savings from floating head pressure down to 70 degrees. And an increment in controlling the condensers to maintain a 9 degree wet bulb offset with a variable frequency drive.

In all cases these measures are cost effective with benefit/cost ratios of two or more.

We also looked at insulating the shell of the structure. We kind of started with that and realized that that wasn't the ballgame. But in any case, we looked at that, both on the floors of freezers and on walls and ceilings of freezers and coolers.

For that particular analysis we used a

30-year TDV because it's a shell measure. And we used incremental insulation costs primarily from means. And the cost assumptions are in the report.

We compared different insulation levels to common practices to the recommendations that are in the ASHRAE guidelines for designing refrigerated warehouses. And I think struck what we feel is a pretty reasonable balance between what's being commonly done in the industry, what ASHRAE is recommending, while trying to maintain cost effectiveness across the state.

So, the only situation where our recommended value is not cost effective is in the cooler walls in coastal climates. And at this point we'd like to move forward with that just for simplicity in the standards.

MR. PENNINGTON: So, Pete, I have a question.

MR. JACOBS: Sure.

MR. PENNINGTON: What was your basecase for this?

MR. JACOBS: We started with common practice and then we added insulation above common practice approaching our recommendations and --

MR. PENNINGTON: So I'm having a little trouble with your freezer floor example. Common practice is R-30; the recommendation is R-30; and there's a benefit/cost ratio of 4.8.

MR. JACOBS: We started, actually the common practice, we started with the common practice that's used in the utility program. And for this slide I actually modified that based on what was suggested by some of the designers. But the actual cost effectiveness was based on the common practice as --

MR. PENNINGTON: Okay, so you're not showing the basecase here --

MR. JACOBS: Exactly. But that's in the report.

We also looked at underfloor heat in freezer spaces. And based on our analysis we're showing roughly about .6 watts a square foot of energy requirement.

In most cases, common practice dictates that most people use glycol systems run off of waste heat from the condenser systems. However, in some cases people will specify electric underfloor heat.

And the issue there is that we'd like to move people towards glycol systems, away from resistance underfloor heat, although the way that the proposal is worded now is that if people really do want to use electric underfloor heat, they need to control it off during onpeak periods.

The benefit/cost ratio moving from electric to a glycol-based system is extremely cost effective. The savings is on the order of $15 per square foot net present value. And the incremental cost to go from electric system to a glycol system is marginal. So, it's highly cost effective to go with a glycol system.

There were some reservations expressed by some of the folks that we interviewed regarding, you know, potential for leakage and so forth that might drive someone away from that. So our proposal at this time is to say that if you really want to do electric you need to be willing to control it off during onpeak periods.

We also looked at defrost controls. Common practice in controlling defrost cycles in refrigerated warehouses is to use a time-on, time-terminate type of control strategy where the defrost comes on at ceratin set periods and runs for certain set periods throughout the day.

That particular strategy doesn't necessarily take into account the fact that within a particular location within the facility the defrost needs vary. In other words, defrost needs are much higher by dock entrances and so forth where you have more humid air coming in and out of the space. Less so in the middle of the facility.

So, our code change proposal at this point is to look at a time-on temperature terminate strategy that allows the systems to terminate their defrost cycles based on the actual frost load. And therefore adapt to the variability throughout the facility.

It's fairly minor addition to the system. You just have to add an additional temperature sensor at the evaporator to implement that control strategy. But it's a fairly quick payback.

Looking at how these packages of measures stack up in terms of savings throughout the building, our base building simulated at about 28 kilowatt hours per square foot.

The biggest bang that we got was putting the VSDs on the evaporators. Incrementally we put the VSDs on the compressor and then beyond that, VSDs on the evaporative condenser. And then finally implemented the shell measures.

So clearly the biggest bang is on the evaporator side, which surprised us.

MR. PENNINGTON: Could I ask you a question about that chart?

MR. JACOBS: Sure, Bill.

MR. PENNINGTON: If you had proposed glycol underfloor system, where would that have appeared in this chart?

MR. JACOBS: Our base building actually had the glycol underfloor system in it, so if you were to take an electric system, you'd basically add, what was it, about 5, I think, kilowatt hours per square foot to each of these bars.

And then when you got to the removing that electric underfloor system then you pull essentially 5 kilowatt hours, I believe. Yeah, 5.2 kilowatt hours per square foot per year.

But our basecase system assumed that it was a glycol underfloor system.

So, we're predicting energy savings on the order of about 12 kilowatt hours per square foot and noncoincident demand savings on the order of about 1.5 watt per square foot. Highly cost effective. We feel like this is a really ripe opportunity for energy savings.

Just to amplify what that bar chart showed previously, virtually half of the savings is on the evaporator fans. So that's the measure we're most interested in pursuing.

Compressor energy savings in the parallel/equal system, which is our basecase, you know, accounts for another third of the energy savings. Condenser savings about 10 percent; the shell's pretty minor.

So, our proposal is that we put provisions in the standards to make certain measures mandatory. We went the mandatory route largely because there's a lack of an ACM that will work well in predicting energy performance of refrigerated warehouses. So the mandatory approach is the approach we took.

We've proposed some code language in our report; add a new section to the standards, section 120, mandatory requirements for refrigerated warehouses.

And in order to make a distinction between refrigerated warehouses which are proposed to be handled under Title 24, and walk-in coolers and freezers, which are currently covered under the Title 20 appliance standards, we had this apply to freezers and coolers greater than 3000 square feet. We went back and mined some data from some new construction onsite surveys that had been done for the utilities, and looked at the size of walk-in coolers and so forth in grocery stores and restaurants and institutional buildings and so forth. And found that 3000 square foot seemed to be a pretty good breakpoint between what's in the -- what would be covered under the appliance standards and what should be covered here.

So, our proposed provisions for the code would be to, on the evaporator side, require VSDs on evaporator fan motors. Limit evaporator motor fan power to essentially .15 watts per cfm based on some requirements from the old refrigerated warehouse program from the utilities. And scanning the selections in the catalogues, it seems like a pretty good value to get a rein on the evaporator motor fan power.

We want to limit use of electric defrost. And there's an exception that's based on system size. But for the most part we want to limit the use of electric defrost. And we want to require temperature termination on the defrost controls.

On the compressor side, we want to require a VSD on at least one compressor per section group. And we want to also require that compressors and accessories that are supplied by manufacturers are capable of operating at the lower condensing temperature. So that any of that equipment that supply has the ability to implement those lower condensing temperature control strategies.

On the lighting side, we're basically referring to the lighting provisions that are already in the standards and just including refrigerated warehouses. Maximum lighting power of .6 watts per square foot and bi-level lighting controls required in storage spaces are the same as for nonrefrigerated warehouses. And that would also apply to refrigerated warehouses.

We were also proposing use of evaporative condensers on all ammonia-based systems. And limit our approach temperature to something reasonable, 20 degrees at design conditions. We weren't -- didn't feel strongly that we wanted to push it much further than that.

We want to put a limit on condenser fan and pump power of 400 Btus per watt consistent with the current values that are used in the utility efficiency programs.

Require the ability to float head pressure down to 70 degrees, and also to put VSDs on evaporative condenser fans that are responsive to the, either the load on the system or the ambient conditions.

On the insulation levels we've got some minimum R values. R-40 for walls; R-49 for ceilings; R-30 for floors, for freezers. R-25 for walls; R-35 for ceilings, for coolers. And we want to again limit electric resistance underfloor heating. With some exceptions based on the size of the facility and also on allowing resistance heat during -- with the proviso that it be controlled off during onpeak periods.

So, that's our proposal. Questions?

MR. RAZAVI: Kaveh Razavi, L.A. County. What constitutes a refrigerated warehouse? Is it the temperature setting, or how do we determine if it's a refrigerated warehouse or just a process area?

MR. JACOBS: Currently the standards don't apply to spaces conditioned below 55 degrees, is that right?

UNIDENTIFIED SPEAKER: Correct.

MR. JACOBS: so, traditionally refrigerated warehouses have been excluded from the standards because they're conditioned to lower temperatures.

So the idea here is to incorporate into the standards facilities that are conditioned at temperatures lower than 55 degrees.

The exclusion in the standards on the high end still exists. But this would drop that exclusion on the low end. And we've got some code language in our report.

MR. RAZAVI: And my second question is what entity is going to inspect these requirements? Certainly inspectors are not equipped to measure all these temperature settings in all these installations. How do you expect a local jurisdiction to inspect these?

MR. JACOBS: You know, I think there would be, you know, similar to the way that compliance is done now, a mechanical engineer would have to fill out a compliance report and stamp it. And that that compliance report would be reviewed by the jurisdiction.

DR. AKBARI: Hashem Akbari, Lawrence Berkeley National Lab. First of all, I would like to wholeheartedly support this measure. I've been thinking about it, and somehow on and off working about it. And I'm glad that somebody has picked up the baton and moving forward.

Having said that, I would like to bring in a little bit of experience that we have and show a little bit of a disappointment why that experience is not being utilized.

In a study that was sponsored by California Energy Commission, we installed cool roofs on a refrigerated warehouse, and to our greatest surprise we saved energy in excess of 20 percent, and peak demand in excess of 20 percent.

And once we tried to understand the data, we find out that out of that 20 percent 5 percent of it was because of the load reduction directly from the roofs. And then the other 15 percent was because of the better operation of the system. The operators have noted that now that the cool roof is cooler, they can increase the suction pressure of the evaporator; as a result of that the compressors operate more efficiently.

So, particularly these cool roofs were installed at the time that they needed to have a new roof. So practically it was zero incremental cost and great savings.

We further investigated this thing; we find out that based on our calculation, our estimate, when the roof of that refrigerated warehouse was in its hot initial condition and its temperature approaching 190 degrees Fahrenheit, the apparent daily insulation value of the roof, which were installed as an R-30, was only about R-17.

When we installed the cool roof that apparent estimated insulation R value increased to about R-24. So that was yet another great effect that basically led from the cool roofs.

Then going on the second topic, I was very surprised that the sizing of the condenser fan did not have much of an impact on the performance of the system. I'm wondering whether the system was allowed to be subcooling the refrigerant so the performance would get best.

Based on simple thermodynamic analysis the two first measures that would have the greatest effect on the cycle would be the evaporator fan, as you have correctly identified, and the condenser fan. So I was very surprised on that one.

And then the third comment that I would like to mention is that clearly the floating head control is one way to go, but a real time optimal control of the compressor system and constantly controlling the suction and discharge pressure and adjusting it based on the load, should be an integral part of any design.

Once we include all these factors chances are that it would save a minimum of 50 percent of the peak, and perhaps the same amount or more on the energy.

MR. JACOBS: Okay. Thank you.

MR. PENNINGTON: Do you have any response to those comments, Pete?

MR. JACOBS: I do. I think the first one, in terms of the cool roof, we actually did look at cool roofs and ran some analysis on that. Found them to be cost effective. However, that analysis didn't make it into the report. But I definitely hear you comment on cool roofs, and will take that into consideration.

As far as the evaporative -- or the condenser sizing, the behavior that we observed in the simulations is consistent with the observations of the designers and also of the folks that have been operating the refrigerated warehouse efficiency programs.

They've really over the years have backed away from the oversize condensers. They weren't really seeing the savings there in that there's fairly steep first costs associated with doing highly oversized condensers.

So the utilities have backed away from that as a measure. We didn't really see it in our simulations. Whether our simulations are picking up as much of the subcooling effect a more detailed analysis might show. We could certainly investigate that.

Based on our interviews with the designers, as well as the utility program administrators, we feel like our analysis is consistent with their experience.

And I guess the other comment was on the optimal control of the system. I certainly agree that you could go further in terms of optimizing the floating -- combination of condensing pressure, suction pressure, staging equipment on and off. We're looking for a set of proposals that would give us good savings, I think, and also be something that was reasonably straightforward to implement in a standards framework.

Yes, sir.

DR. AMRANE: Karim Amrane with the Air Conditioning and Refrigeration Institute. If I understand you correctly, you defined -- those requirements apply to refrigerated warehouses in excess of 3000 square feet, because you wanted to exclude the walk-ins that are covered under Title 20?

MR. JACOBS: Correct.

DR. AMRANE: But, if that's the case, then if I have a walk-in that is exactly 3000 square feet, then I will have to comply with Title 20 and Title 24?

MR. JACOBS: Well, I think what we learned was that the definition or the division between where Title 20 applies and where Title 24 applies is not clear at this time. So we're making a proposal that Title 24 pick up at 3000 square feet.

DR. AMRANE: Then I would recommend that

you add an exclusion excluding walk-in as defined in Title 20. That would be a thing that will resolve the issue.

MR. JACOBS: Okay.

DR. AMRANE: However, I have a more general comments about this proposal. I think this prescription approach if the wrong approach. I think -- I've testified many times in front of the Commission -- I think the performance approach would be more preferable in general.

And I understand that you did not follow that path because there's no ACM calculation method available?

MR. JACOBS: That's correct.

DR. AMRANE: But you still use DOEII to simulate all those watts, I mean you've done all those ones with DOEII. So there is tools available to simulate energy consumption of those warehouses, right?

MR. JACOBS: Correct.

DR. AMRANE: So we can develop an ACM metric?

MR. JACOBS: Well, I think the issue is that particular version of DOEII has not been certified by the Commission as an ACM.

DR. AMRANE: But it can be done? I guess I'm asking you question. Because if that's the case then I think it will be desirable that simply we specify energy consumption to watts per square foot, and then let designer design to that instead of prescribing exactly how the system should be designed, how your walls should be, how your compressor should be.

I mean that would be, I think, a preferable option. You will achieve what you want in terms of energy savings, and then you have the flexibility what you design the way they want to design the system.

MR. JACOBS: Thank you.

MR. BOYCE: Bill Boyce with SMUD. Not with regards to Pete's analysis, but something I wanted to bring up that's generally related with regards to this new discussion on refrigerated warehouses.

In the draft State Climate Action Team report they were recommending possible truck refrigeration unit electrification, which would basically have electrical outlets out at the loading docks to trucks could turn off their diesel generator refrigeration systems and basically plug into the grid to reduce greenhouse gas emissions and that.

One of the things I wanted to bring up is, you know, that is going to be additional load if that occurs. What sort of provisions could we develop to reduce peak energy usage for that application?

It's an overall benefit, I think, to the state and the communities, but something we're going to have to, you know, be concerned with in the future.

MR. PENNINGTON: We need to figure out some way to define those as a building.

MR. BOYCE: It's really, you know, it gets built into the building as part of the overall design structure of the building. You know, what I kind of see coming down is if it's more or less built in as a requirement.

A, you know, any sort of refrigerated warehouse could have this required; therefore, you'd have to take it into account more on the building code side.

MR. MULLEN: Jim Mullen, Lennox -- Craft. A couple questions. You said there's a report available. Is that available on the Title

24 website?

MR. JACOBS: You bet.

MR. MULLEN: Okay. We need to dig into that and understand the details a little better.

I think a lot of the equipment that's used in walk-ins, whether you set the line at 3000 square feet, or 9000 square feet, or 6662 square feet is going to be the same equipment. And from a manufacturer's standpoint, it would be nice if we could build a piece of equipment the same way and put it in inventory. And then you decide whether to use it in a walk-in or a refrigerated warehouse.

And that probably goes specifically to the motor control strategy; and we're at PSCs today and ECMs pretty soon, and which I think is a pretty good solution in terms of energy efficiency.

And there are some adaptations in there to handle poly-phase motors and other things. It would be nice to preserve that if possible.

MR. JACOBS: Okay.

MR. MULLEN: You specified variable speed drives on the evaporator. And I assume there's some control strategy that goes with that

that you want to implement also. Is that in the report or --

MR. JACOBS: Yes, it is.

MR. MULLEN: And is there adequate evidence that that preserves all the food safety requirements and things?

MR. JACOBS: We did quite a bit of background research on that, and I would refer you to the work that's been done in the Pacific Northwest, where they looked at that issue in detail.

And not only were the requirements -- or not only were the food preservation conditions maintained, but they were actually enhanced through reduced mass loss in the stored fruit and so forth.

So quite to our surprise there really weren't any negative issues, and as a matter of fact, there were some positive benefits.

MR. MULLEN: Okay, that's in the Northwest report?

MR. JACOBS: Correct.

MR. MULLEN: All right, what kind of life assumptions were made about the variable speed drives in terms of cost effectiveness?

MR. JACOBS: Fifteen years.

MR. MULLEN: Is there some data on that?

MR. JACOBS: Not that we've investigated.

MR. MULLEN: Okay. And then one last question. On the proposed limitations on electric defrost, could you thumbnail sketch what those limitations are?

MR. JACOBS: Just for smaller systems they'd be allowed. But for -- and I believe what we put, just that same 3500 square foot limitation that's in the --

MR. MULLEN: Up to the size limitation you could use electric defrost?

MR. JACOBS: Right.

MR. MULLEN: Okay, thank you.

MR. PENNINGTON: So, Jim, I have a question for you. Are you concerned about the useful life being less than 15 years for the VSDs?

MR. MULLEN: Yes, because they are an expensive item. Whether it be life or maintenance costs, both could enter into the equation.

MR. PENNINGTON: So do you have some evidence that you could provide us?

MR. MULLEN: I'm going to go back and

check, and that's why I was just looking to find out what the database is.

MR. PENNINGTON: Okay.

MR. FLAMM: Gary Flamm, Energy Commission Staff. In your lighting assumption you assumed that that would be the same as a regular warehouse, and that may be true, but I would be more comfortable if some models were run. Because I do not believe the models were run under the thermal conditions that may occur in a refrigerated warehouse or a freezer.

And I also -- it's my assumption that there are some active areas of this refrigerated warehouse. There are assembly areas, there are loading docks. I'm thinking more of the way we have the structure of high-bay/low-bay, precision industrial.

I think it would be more prudent to start with a blank slate. It's my understanding, I just looked at John -- I forgot your last name - - John Hogan's ASHRAE IES standards and ASHRAE IES does not have a recommended power level for refrigerated warehouses, either.

So I don't think it prudent just to assume that those levels are appropriate.

MR. PENNINGTON: So, one question I have, Pete, is you were recommending that the underfloor, if it's electric floor -- electric underfloor system, that it be controlled off during peak periods.

Any sense of whether that creates some issue with the functioning of the refrigerated warehouse to control the off, how long you're talking about controlling it off?

MR. JACOBS: We assumed that it would be controlled off during the onpeak period which would be essentially a few hours a day during the summertime.

The thermal mass associated with the soil and the concrete slab and so forth is such that controlling it off for a few hours won't affect its ability to prevent frost --

MR. PENNINGTON: Okay, thanks.

MR. JACOBS: Anything else?

MS. HEBERT: Well, seeing no other hands or people approaching the podium it is time for the long-awaited moment for the public to have their suggestions heard by us.

So, how many people have something they want to say? Please raise your hand. I'm not seeing that many, so it's Mr. Blum, is that right? Would you please approach our podium and talk to us? Please identify yourself.

MR. BLUM: Helmut Blum, and I have a company who manufactures exterior shading device, as rolling shading sunscreens retractable awnings. I'm clear, understood? Yeah.

Since years I try to find out what to do to get some sort of official recommendations of my products. In particular, there is a strong demand from my customers. You can say 90 percent of my customer complain and say why did we not know earlier about you. We have customers there who complain. We put air conditioning in with your shutters air conditioning became obsolete.

I learn today and other occasion that basically you have tied in your hands or whatever that my products are basically too much loaded by the human factor that people might not use it. As they can be taken off or whatever.

I requested once something three years ago, and obviously, Mr. Rosenfeld, we did not quite understand. You wrote me back that it's hard to change the standards, and that it's hard, you do not know if American people want the product.

I never intended that. My request was that people who want it, that nobody stops them in doing this. And that's in particular 60, 70 percent of our houses controlled by homeowners association. And there's usually the board follows the CC&Rs. And they basically prohibit that something will be put out which is exterior attached.

I know that Arizona and Nevada, they have changed. I do not exactly know how they did it, but I know like Nevada did it through civil court, as there was a homeowner association and somebody the shutters up. And they went to court to put it down. And then they had some sort of a get-together and it was decided to change the code, you know, like with solar panels. The code was also changed. And there was Conacero, Bruce Conacero, who set something up.

You can find it in your publication in 2003 under page 12. I have it with me. Where he proposed that basically these things should be somehow limited, or put a lock in front of it.

I just had it happen to me, this is usually which I do not touch, I'm more on the residential side, but there is a big company who now wants to improve. They bought from Heidelberg a printing company, a bit printing outfit. And job was over 20,000. And I proposed, that's basically what I do, the shading has to go on the outside. They want screens. And I thought we had them in bed, and then naturally the owner of the building says no, nothing on the outside. So, I lost the job. I didn't want to do anything on the inside.

Here's another thing. I was looking all these years. How can I explain what is the difference between interior and exterior shading? I did a substantial investigation. I have a report here about all this.

But roughly what I think it's very simple. When you look at a house; a house has usually a temperature of 50 degrees when people live in there, winter and summer. But the max in a house is max heat 90 degrees, even if you have 120, 130 degrees.

So we looking here at an increase of 40 degrees what the weather, the sun or whatever will bring in. We also know, and this is a number which Livermore Berkeley Lab said when they proposed double glass, 40 percent of energy goes through windows and doors.

I know from Europe that they even go to 50 percent. When you consider we have a heat up of 40 degrees and we split it, 50 coming through the envelope, roof, walls; 50 through the windows. Hey, take the 50 off, that means 20 degrees. You have there 50 plus 20, 70 degrees. It's very simple, you know.

But that's how I get it confirmed by the jobs we do. I just take care of south-southwest, problem resolved.

You know, so another thing what I like to pass on is I was here in Stutgardt there's every three years a window treatment show. This time I miss the American one. Also the Israeli flag wasn't there. They always were there and there was always you know that would increase. It has increased. There were people there like the president from the WCPA, you know, I belong to that association. He was here and a couple of other people.

So there is more interest coming. Every three year we have this. You can size of a football field, 550 exhibitors, 50,000 people were there in five days, and not only Germany, all over Europe. They come from anywhere, anywhere in the country, -- like Olympic Games, and Stutgardt for the window thing, you know.

But I saw there what was new to me when I talk about exterior shading. We can do sunscreens, you can wonderful look through, and it keeps 85, 90 percent of the sun energy out. That's a fact.

Then I have this other that's the rolling shutters. They are starting from 1.5 height; have like a holds, like (inaudible) in between. You can slide them apart, then position, close them together, pitch dark.

Then there is a new industrial thing which is stainless steel. You can roll it up and down; however, you cannot make it pitch dark. And this is now the new thing. They developed a new sled, which is a rolled form, I think aluminum. And it's only like 9 mm high, and then it has a chain of holes which the size of a couple of inches. It allows it 40 percent of the daylight can come in. And you have a good view. You can fairly clearly see what's going on. And have the benefit. You can roll it down and then it's pitch dark again. That is new and will probably be available in a year or so.

So that concludes my speech, and I thank you.

MS. HEBERT: Are there any comments regarding what Mr. Blum had to say? Bruce.

MR. MAEDA: A quick comment. Bruce Maeda, California Energy Commission Staff. If we do decide to have some sort of credit for exterior shading in the standards, you might want to re-examine the operational assumptions we already have for interior shading devices.

We now have it such that they sort of automatically close when there's 30 Btus per hour per square foot on the windows of sunlight. So I mean there is some sunlight on the windows, the interior shades close automatically. This is a pretty efficient assumption. But it does only shade to 20 percent.

Second thing about exterior shading in particular, especially the sort of hardware-based systems, we have been concerned about reliability of these systems in the long run. A lot of buildings, including at least a couple in Sacramento, the SMUD building for example, and our building, that ability of the exterior devices has been disabled. And so they're not really operable any longer. And we believe there's a problem associated with that.

MR. BLUM: You want me to go on through the roof or what? Exterior shading, I have it on my house in Europe, I have it here on my house. They built that they last as long as your house exists. And you can make it pitch dark. And when you have the shutters, you know, where you have the holes, then it's usually actually in the summertime.

I should not even say this, the box which you unfortunately have to have on the outside is built after the fact, the sun is up to 90 degrees, that box shades the window so much that the result is that people say once they have my shutters it's always a concern, you know, I have my Venetian blinds closed, I have not a good view. If I put your shutters up then I don't see nothing anymore.

The result is that they come and say now I have an excellent view and the sun, I keep out to any extent, I can close it, shut it completely, or just put it in vent position.

The holes are built in a way that when the sun is on an angle that basically upper shades the holes that so no solar energy comes through the slit.

And that new product, what I told you, that has a little drawback. The sun has to raise up like 20 degrees then it cannot get in anymore. And the configuration of the design of the slit is that always they shade each other so the holes, they are free there, and light can come through, but no sun energy.

See, also to the sun energy, you know, you all know this, I do not say anything new there. We looking when it comes to the energy, we look at the UV light, the infrared light, the visible light. And there is something, you know, what we know, depending on the wave lengths, the majority of the UV light, some visible light, as well as -- light.

You go to your car, you can test it any day. You go and touch, your windshield is warm or hot. You open the door, it's surely hot. That happens only if you put your car in the sun.

What happens, there are waves which cannot enter the glass, but they heat the glass.

Then you open the door, all these waves which could enter, heated up the interior, convert into heat, become now waves which the sun stops. That's a similar situation; that's a greenhouse effect. And that's what happens to our houses.

You know, and I cannot help it, whenever you tell me here, I have -- I left proofs of -- 4000 customers, and why do they all say, why did we not know about you earlier. You guys are the best kept secret in the whole Santa Clara Valley.

I had a company coming over here and he said where's your competitor. I say I have none. Area he looked on the map, which I had on the wall. He said, like this in Europe would mean about 500 companies at least.

And that's basically like you look here at companies who make the fixed awnings or produce the windows, these type of companies they also have in Europe the exterior shading devices. And that's what I try to get growing, you know.

An industry which is 5 billion gross, and there are about 500,000 people employed just in the center of Europe. And when you look at their retractable awnings every year 200- to 500,000 are sold in Europe. And we just came now up to 70,000 in he whole United States.

You know, and so, why?

MR. ELEY: Mr. Blum, maybe we can get some clarification. The performance standards actually offer credit already for exterior shading devices. Do you not think the credit is adequate or correct or --

MR. BLUM: No, you see, here's --

MR. ELEY: -- what? I don't understand what the issue is here. The standards certainly don't prohibit exterior shading devices. In fact, for residences there's credits that are offered for them. Tables 3-7 of the residential ACM offers the credits.

MR. BLUM: Are you from SMUD?

MR. ELEY: No, I'm not from --

MR. BLUM: I know SMUD does it, and I never applied for it.

MR. ELEY: Well, this is not a hearing for SMUD. This is the California Energy Commission.

MR. BLUM: Okay. I heard from they that they do it, and I tried it. It was PG&E 18 years ago. And they said, well, we subsidize now double glass even if it does not justify a return of investment is not within the limits. But they said, well, we support it. It will, on the long, it will, the window will come down. And when we then go. And also support to retrofit all the homes. Then come back and talk to us again.

But again, that you understand what I want, is basically I'm not shooting here that I want a rebate. I just want that when I go in these association that the board cannot refuse when the customer wants it. The customer pays for it, doesn't expect rebate. He wants just the permission to put these things up.

MR. SHIRAKH: Well, this is the California Energy Commission. We're not SMUD, we're not PG&E. In our regulations --

MR. BLUM: I know.

MR. SHIRAKH: -- we do not prohibit --

MR. BLUM: If I'm wrong here, I apologize and I was wrong, whatever I said.

MR. SHIRAKH: We do not prohibit the installation of exterior shading devices. As Mr. Eley just pointed out, we even provide credits in our performance standards for the shading devices.

MR. BLUM: Okay, okay, I'm only looking what I just said.

MR. SHIRAKH: Now, what local CC&Rs do--

MR. BLUM: You know, if that cannot be done here, --

MR. SHIRAKH: -- that's really not within the realm of our authority. So I don't know what it is that you want us to do.

MR. BLUM: Well, I do not know. You see, I was told, I was in Washington, you know, looking for help and they said okay, I have here to go back, is the California Energy Commission. I did it, and Mr. Rosenfeld knows it. Maybe I did it all wrong, approached the wrong people, I have no idea.

I do not know where else to go that I think it cannot be when you call PG&E, they tell you something about white velcro on the windows and stuff, you know. But nobody ever mentioned exterior shading.

See, that's my point. That it is not recognized, and that there is nobody when somebody goes to the official site and says, okay, how about that, who says, yeah, this is the way.

You see, I was involved. I gave to Livermore Berkeley Lab rolling shutters and sunscreens, and they investigated. I have a picture; they came out. There's a difference of 7 degrees C, and they said if we could start all over again, we would recommend single glass with good exterior shading. The job was done.

Okay, sorry if I said something which offends you.

MR. PENNINGTON: You didn't say anything that offended us. And we thank you for your comment.

MR. BLUM: Okay, thank you.

MS. HEBERT: Thank you. Is there anyone else that wishes to address us at this time? On any other topic related to the 2008 standards?

MR. WIMER: Just very quickly, if I could.

MS. HEBERT: Okay, Mr. Wimer.

MR. WIMER: I'm John Wimer with the National Center for Energy Management and Building Technologies. And I probably pose this more as a question because I think it's already taken care of.

Test and balancing, you know, Bill, if I can address this to you, was really not in the standards. I think it was an omission of some sort. You know we feel very strongly about the importance of test and balancing as part of your guideline. And I'm just here to, I guess, remind you that it needs to go into 2008.

I don't know that we need any discussion at all. I just wanted to publicly say that.

MR. PENNINGTON: You have already put that in writing, haven't you?

MR. WIMER: I think it's been put in writing. If it's not, and you need it in that template form that you use here, Elaine, is that what we should do? Except it was in before.

MS. HEBERT: I'd like some clarification as to whether our commissioning stuff includes testing and balancing.

MR. PENNINGTON: It does not explicitly.

MR. WIMER: It's in the guideline, as I recall. Bill, we did catch it and it was put into the guideline as a recommendation. Again, we're talking commercial and industrial.

MR. PENNINGTON: Yeah, I don't recall that, whether that's correct or not correct.

MR. WIMER: Okay.

MR. PENNINGTON: We can check on that.

MR. WIMER: Anyhow, I'd just like it to be in --

MS. HEBERT: I can't remember if I received something from you in writing or not, because I'm getting stuff all the --

MR. WIMER: Not recently.

MS. HEBERT: -- time. And so you may want to take a look at the template, the template to be filled in is on our website, and there are a number of questions that we ask that you fill in and --

MR. WIMER: Right, I've seen it. And I don't think test and balancing really needs defended. It's just I wanted to tickle your memory here. Thank you.

MS. HEBERT: Thank you. Anyone else? Going once; going twice. All right, then let's call this day closed.

We will start again tomorrow at 10:00 a.m. Thank you, everyone. And I did forget to say that the PowerPoint presentations you've seen today and will see tomorrow will be on our website as soon as we can get them there, so, thank you.

(Whereupon, at 4:35 p.m., the workshop was adjourned, to reconvene at 10:00 a.m., Tuesday, February 23, 2006, at this same location.)

CERTIFICATE OF REPORTER

I, PETER PETTY, an Electronic Reporter, do hereby certify that I am a disinterested person herein; that I recorded the foregoing California Energy Commission Workshop; that it was thereafter transcribed into typewriting.

I further certify that I am not of counsel or attorney for any of the parties to said workshop, nor in any way interested in outcome of said workshop.

IN WITNESS WHEREOF, I have hereunto set my hand this 6th day of March, 2006.