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Pam Cole: Welcome, everyone. I am Pam Cole, of the Pacific Northwest National Laboratory, and I'd like to welcome you to today's Energy Code Commentator Webinar. It's on ASHRAE 90.1-2013 and the IECC 2015: A Review of Lighting Requirements. We do the webinar the second Thursday of every month at the same time. So, keep watch out on the building energy code training webpage as topics get added. If you have any topic suggestions you'd like us to consider, please e-mail them to us using the e-mail in your webinar reminder messages.

Our speaker today is Eric Richman. He is also from the Pacific Northwest National Laboratory, and we really appreciate him taking the time to share the information on the lighting code requirements today. Eric, go ahead. It's all yours.

Eric Richman: Thanks, Pam, and good morning or good afternoon, whichever part of the country you're from.

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As Pam mentioned, this is on ASHRAE 90.1-2013 and IECC 2015: A Review of Lighting Requirements, and this is a review. In other words, not every little detail that's in the code itself will be detailed in here, we just don't have that much time. But I do want to give you a flavor of what the requirements are, what you might have to look out for even if you haven't adopted these or been faced with adopting these codes yet or not.

A few learning objectives we really want to impart today are an understanding of the basic requirements, so you understand what's coming in terms of what you have to look out for and maybe where to go to get more information about these two codes if they're the ones you're having to deal with. We want you to become familiar with some of the development basis for some of the requirements, 'cause that's often asked is where did this come from and why is it like it is?

Also like to provide as much as possible where I can some examples of acceptable paths to compliance or maybe some tricky issues you might want to have some help with or have in your back pocket.

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And finally, a better understanding of the actual process of compliance as it's used in real products, 'cause that's a real project. That's the reason you're here, you want to make sure you're understanding how the code, what the code requires and how you can be better at showing effective compliance.

So, a little bit of, I'll call, background, why these two codes? They're somewhat linked together. ASHRAE 90.1 2013 is adopting in some US states, and because of its development process and the organization behind it, represents some of the latest energy code requirements across the country which provides a basis for most other existing energy codes in the country.

A lot of the work that's done for ASHRAE 90.1 finds itself in one form or another in other codes and vice versa. IECC 2015 is the most widely adopted energy code in the US.

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It has many requirements that are identical or similar to 90.1 2013, so it's good to talk about both of them together.

IECC 2015 also references directly 90.1-2013 an alternative compliance path, so again, the two are linked. This presentation, just to provide a consistent format is based on requirements of 90.1-2013, but we're going to notice differences, additions, deletions, et cetera for 2015 so you get a flavor for both of them.

A little more relevant background, 90.1 is jointly sponsored by ASHRAE and IES. IES, of course, is the lighting part, Illuminating Engineering Society. It's developed by a whole group of volunteer engineer, builders, scientists. The provisions are often adopted or modified for other codes. Current code is 90.1-2013, and there other codes adopted and used in various states.

IECC is developed by the International Code Council and membership is primarily building officials.

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It is essentially a collection of provisions that have been developed or proposed by others, other states or organization codes. Its current version is 2015, other versions, again, have been adopted and used in various states.

The basis of – why do we have these code requirements? Back in

the 1990s the Energy Conservation and Production Act, which has been further amended by EPAct, required that states adopt an energy code, and the Department of Energy was tasked with determining what level each state had to adopt, and currently that's 90.1-2013.

States then adopt or develop their own codes or standards to meet this requirement. That's why many of the versions are nationally available within various states because we've adopted different versions of the code. Some states, of course, develop their own code and sadly, some states have no code yet.

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They've been able to avoid having to comply with that at this point for various reasons.

So, it's quite a mixed bag out there. What we're showing you is the latest, greatest, which will give you an eye for what you're having to deal with now or which you're likely to have to deal with in the future. So, let's go right into the first part, which are the Lighting Power Density Limits. These are the things most people are concerned about when they're looking at lighting energy codes.

The space-by-space's LPDs from the previous 90.1-2010 version have mixed changes. Some went up, some went down for various different reasons, and I'll explain a little bit of that later on. The building area LPDs, because they're an aggregate of all the different space in the buildings. Most of those stayed about the same, a few being reduced.

90.1-2013 did add some new spaces, a few minor ones plus a set of spaces specifically for the visually impaired. This would be nursing home, retirement home kind of –

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areas, and these generally have higher LPD allowances because older generations and people with visual impairment issues need additional lighting.

But these higher LPD allowances are very restricted. In other words, they can only be for facilities that meet a certain criteria, including being designed to an IES design guide RP-28. So, they're very restrictive. The LPD limits for IECC 2015, for whole building they're identical, they're the same as 2013.

For the space type LPDs, they're mostly the same, a few exceptions. IECC 2015 has a couple of lower numbers, hospital corridors and dining areas for the visually impaired. They just decided they could do with less, or it was more appropriate to use a lower number, but they're higher for a couple of others, electrical/mechanical room and for sales area.

Again, the IECC group decided those were appropriate for their standards going forward, but the rest of them are all identical.

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So, they're a pretty close match. We often get asked, where do these LPDs come from? There's always been concern that, gosh, you keep rationing them down, they get tighter and tighter and tighter and lower and lower and lower and where's it going to stop?

The point I want to make is these aren't just a squeezing of the numbers or just simply picking a lower number. There's actually a very involved development basis for it, and for the most part for IECC and 90.1 they're developed with the ASHRAE process, the 90.1 lighting subcommittee with some IES committee support.

So, generated using some building space models. About 120 different space type models using the IES lumen method calculation and applying a whole bunch of input. Current performance data on efficient products, current light loss factors for those efficient generally cost-effective products.

The latest IESNA recommended light levels and sometimes those do change, so those will affect what the LPD values are.

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And of course there's a lot of professional consensus of quality lighting in environments that's used in models to make sure lighting quality can be preserved.

These elements and some others are combined into the models to come up with a lighting power density, and the ISAS recommended light levels and professional consensus ensure that when you're faced with these LPDs you can design and provide good quality lighting and still comply with the energy codes using reasonably efficient cost-effective products that's the idea.

So, what about the whole building LPDs? There are 120-some models for space type whole building. These are generally based directly from those space models. There's a lot of data that's been taken from real building plans, currently 387 buildings representing 31 building types.

And what happens is all the individual lighting power density values in those space –

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types are aggregated into a whole building based on the space types that are in these real building sets of plans and takes averages over multiple buildings to come up with a whole building LPD.

Currently the way that works is if you had a building that exactly had the same mix of space types as an average of all the 20, 30, whatever buildings in each of the building types, you would come up with exactly the same number if you did the space by space or whole building method, but you won't have exactly the same number, but it comes out pretty close to being the same.

The advantage, of course, of the whole building method is that it's a lot simpler in terms of calculation. But anyway, that's where these values come from, and of course they're updated as things change in real time. So, another item that always gets asked about is what about LED technology because it's more efficient and it's the latest thing and where do those fall on energy codes.

The energy codes do limit the installed lighting power for interior and exterior.

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That's how they work, but the currently adopted energy codes do not specify individual technologies. Now, there's an energy code that –

Pam Cole: Everyone make sure your lines are muted. Sorry to interrupt you, Eric. Thank you.

Eric Richman: Please mute your phone if you can. Thanks. Okay. Back to LEDs and LPDs. The currently adopted energy codes do not specific individual technologies, they don't say, "Use this, use that." Or, "Don't use that." And they don't currently include LED product efficacies in determining LPD limits.

They use a mix, currently for the most part, of efficient fluorescent and halogen-type products. However, in the next version of 90.1 there will be LED technology as part of the driver for LPD limits.

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And this is simply the realization that over the years LEDs have proven their efficacy and energy savings, they continue to be reduced in cost, and there are lots of products available that make good sense.

So, we'll, in the future, see lower LPDs based on LED technology. However, until 90.1-2016 or maybe IECC 2018 or some other code are adopted with LED in the mix, you will find that using LED products will help you show compliance with LPDs because you'll have a much more efficacious system. That's just a few words about LEDs.

In terms of the lighting power density limits, one thing that's important to remember are the exemptions. Currently in 90.1-2013 there are 18 exemptions, and I know it's small and you weren't meant to be able to read this, but *[clears throat]* excuse me, the point is there are 18 different types of lighting you don't have to count at all, and you want to make sure you don't count that stuff 'cause you don't have to. They're for special purposes, and they aren't part of the lighting power density limits.

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IECC 2015 has these similar set of exemptions, but you'll want to read them specifically to make sure you've got them right, they're very similar. And, of course, compliance tools such as COMcheck or REScheck or anything else for that matter may not perfectly represent these exemptions or may not list them as detailed as they are here. So, you want to read the actual code and make sure you know what you can exempt and what you can't exempt.

Find lots of times that people don't realize these are exempted, so they end up counting those watts and they don't have to, so basically, don't leave those watts on the table. Make sure you're exempting whatever you're allowed to.

There is in 90.1-2013 a room cavity ratio adjustment, and this is put in there with the realization that some spaces are kind of odd or weird or have strange geometries, and the lumen method

calculation that I mentioned as the basis for LPD is really meant for normal kinds of spaces.

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So, there's an understanding that if you have a really weird space for whatever reason in terms of geometry you're going to have trouble meeting it with that lighting power density. So, if you can show that your room cavity ratio, which is a calculation of your room's geometry is higher than the threshold that's been determined by the code, you get a 20 percent allowance increase in your lighting power density to help you with that weird space.

And separately for corridor/transition space that it's not the RCR, if you have a width of less than eight feet it turns out it's hard to do that corridor. Now, I do want to note this adjustment is not included in IECC 2015. Of course it's not like you're going to use it a lot but when it is needed to have you may – if you're – if you have a lot of weird spaces you may have trouble, but that's the reason it's in here, and I'll show you later on where this RCR threshold comes from.

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Here's a graphic representation of how you calculate the RCR and this is in the code that's simply two and a half times their room cavity height times the room perimeter length, all that divided by the room area, and this kind of gives you an idea where that comes from. It's from workplane to luminaire height and it's the room area itself. So, you do need to do this room by room, it's a space by space provision. We can't do it for a whole building and get 20 percent for the whole building. It's each individual space.

One other point on that, when you do it by each individual space those extra watts gets added to your whole bucket of watts to your building. So, when you calculate that you get an extra 20 percent of watts for what's in that space I'd say that's another 500 watts, that 500 watts you can use anywhere in the building, but it's calculated based on that individual space.

So, another item that's in both 90.1 and IECC are retail display allowances, and –

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these have been around for many, many years with the realization

that retail lighting display is quite variable and so something had to be done to allow it when it's being used. So, these are allowances only for lighting that is to be installed and used to display merchandise. It has to be specifically for that only.

And the allowance in 90.1 is 1000 watts base plus, depending on what kind of retail area you have, a value watts per square foot and below you see the retail areas one through four kind of categories of what kind of merchandise it is. Now these are use it or lose it. In other words, you'd have to use this allowance only for those special luminaires that aimed at merchandise. You can't use it for any kind of overhead lighting or anything else that's in the space. It has to be just for spotlighting merchandise.

One way to look at that is if you were to turn off all of the lights that were –

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just for retail spotlighting and left on any lights you would use for just moving around in the space, even if they're double duty, those you have to count for compliance. So, if you're using spotlighting to both highlight merchandise and provide a way for patients to walk around, that lighting is general lighting and it has to be counted.

You can't use the lighting allowance for something that's already used for general lighting. So, you have to be careful of how you count it. But it does provide quite a bit of wattage, so you can get that highlighting merchandise lighting put in place. The only difference here for IECC 2015, they have the same allowances, but they only provide a 500 watt base allowance instead of 1000.

So, moving onto exterior lighting power, and as you may be familiar the allowances in most codes are provided in either tradable surfaces and nontradable surfaces. The reality is that like interior –

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where you can trade watts between spaces, you get a bucket of watts for the building, and you put them wherever you want. Similar with outdoor, you get a bucket of watts for the tradable surfaces, and you can use them wherever you want within those tradable surfaces.

But there are some specific places nontradable where you are given a lighting allowance, but it's kind of like you use it or lose it. You have to use that for that surface or area, you can't trade that for something else. So, if we look at the part of the table, this is the part of the table from 90.1, you'll see there is a base site allowance and it's based on the zone you're in. And then for each area type or application type there is a separate allowance, this is part of the tradable surfaces list, and you'll see it varies by zone.

But again, this is just part of the list. The zone, often you ask about, how do I know which zone I'm in? And what the energy code developers did –

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was looked at lighting zone descriptions which are based on lighting design not where you are on the map and translated them into something that building officials and building owners could more understand.

So, here are descriptions as best as you can kind of lay it out of where you might be. So, zone one is a developed area of a park, forest, or rural area, pretty much hardly any building there. Zone two and three are the most common ones, residential and mixed use neighborhood businesses, light industrial, limited night use. Zone four is the highest one, high activity commercial. That might be downtown New York City kind of thing or the Vegas Strip, a lot of light, lot of activity going on.

So, this is what the building official will use to help determine what zone you're in and once you find out what zone you're in that will determine which set of requirements you have to go with. So, for IECC the values are the same with a few exceptions.

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IECC 2015 has slightly lower LPD allowance for building façade and they do not include a few of the new categories in the 90.1-2014. They don't include landscaping and loading docks. Those are two new ones that were added late in the 90.1-2013 process and weren't picked up by IECC 2015. The rest of the requirements turn out to be the same.

So, let's move on now to the lighting control requirements, and we'll talk about the interiors first. Both 90.1-2013 and IECC have interior requirements that are based on a space by space application

with some exemptions, but they are treated space by space because every space has a different function and need. 2013 ended up in a tabular format for this, and I'll show you that, that includes these control requirements along with applicable LPD limits and separate definitions for each control site just for simplicity.

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IECC 2015 still maintains, for this version, kind of a previous version of doing it which has paragraphs and sections that define the code and define where it must be applied. Both have similar approaches to the control, but there are some differences, and I'll go through some of them here, at least the major ones.

So, again, I promise you that the tabular format you'll see that up at the top kind of in the gray there is a reference to a control type, like the first one's local control, second one's restricted to manual on, et cetera, et cetera. And there's one in yellow, which is a new one for 90.1. Off on the left you see all the space types. This starts with the common space types, down below on the table would be the individual specific building space types.

There's the LPD value there, watts per square foot. Right next to it is the RCR threshold, remember we talked about the RCR adder or additional allowance. That's the threshold you have to meet.

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So, for example in an audience seating area in a motion picture theater, if your RCR threshold is calculated at over 4 then you get a 20 percent addition. That's the way that kind of works.

And then you'll see across REQ that means it's required. So, in virtually every space type you're required to have local control, and in the case of the first one you're required to have bi-level lighting control where it's applicable. You're also required to have daylighting, again, where it's applicable.

For the daylighting specifically you're probably not going to have any daylighting in a motion picture theater, so that wouldn't apply to you. But if you did you'd be required to control it. The add ones and add twos, for example, again for motion picture theater you are required to have either restricted lighting turn on to manual on only or you must restrict it to only partial automatic on, and there are references in each of these cells to the section in the code where it describes in more detail.

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Going over to the far right you have an add to. This means you have to have either automatic full off or scheduled shutoff that you can choose between one or the other, and that's the way the table goes all the way through all the different space types. And of course there are exemptions here and there. You need to read each of these sections to understand what the code actually says about the control.

So, in summary, each space is required to have, and this is for IECC 2015 and 90.1-2013, either required to have or limited by one or more control functions. And I just showed in the table these are all the controls, the local on/off; manual on, that's one of the limited by items; partial automatic on, which is typically occupancy or timer based; partial automatic off, this is that new one which is not used in IECC 2015 but is in 2013 but only applies to a few spaces; –

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automatic full off; bi-level control; scheduled automatic off, and this, as you saw is one of those usually it has an add one or add two, you have two choices; and daylighting controls for side lighting and top lighting.

So, I'd like to go through some of these that maybe need a little more explanation. Occupancy-based or timer shutoff control, 90.1 and 2013 require either occupancy sensor or automatic, not manual but automatic, timer-scheduled shutoff in most spaces. There are some exceptions.

2015 IECC looks at it similarly but in a different way. They specify a limited list where occupancy sensors must be used and then in the rest of the places you have to use an automatic timer shutoff control. Similar look at it but a different way to do it, but effectively 2013 gives you more of a choice, but they still have to be automatic turn-offs –

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for most every space that you have in the building with certain exceptions, there are always exceptions.

The occupancy manual on control restriction, which was one of

those in the list, both codes require that the device must not be set to turn automatically full on. A typical occupancy sensor is usually set to turn everything on, and that's not allowed. You have to have it set so it can be manually turned on or, at most, 50 percent auto on. This has been shown to save a lot of energy 'cause a lot of times you don't need full on or even to turn the lights on if you're popping into the office only to drop off, for example.

There are exceptions to this where full on is on and here's a list of those places where it really needs to be auto on or has a safety issue. Those are exempted in both codes. If you look at bi-level space lighting control, which has been in energy codes for a long time, it's kind of been modified to provide –

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multiple steps, or at least one control step between 30 and 70 percent plus full on and off.

It applies to a lot of the spaces in 2013, in 2015 they stayed at only those spaces with timer control, so in IECC 2015 if you have an occupancy sensor already you don't have to have bi-level control, but if you only have a timer control then you do. And there are exemptions.

Note there's a first set here with corridors, mechanical rooms, lobbies, restrooms, storage rooms, IECC 2015 differs in that they do not exempt restrooms, stairways and storage rooms, they still require it in those places. And the other two spaces, only one luminaire and spaces with low lighting power densities are exempt, again because it wouldn't be cost effective to put in those spaces.

Partial auto off is the new control in 2015, and it was put in realizing that in some places you really can't have full off, –

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stairwells would become one of them because of security issues in the past. So, this partial auto-off control was put into at least provide some shutoff to some spaces but not turn it all the way down for security issues.

IECC 2015 doesn't have this at this point, so they either exempt it from control altogether or still require it full off. Now, this is one area where we know that state or local egress requirements may have an issue, they may overshadow that. But of course energy

codes have a provision in them that says if there are any other light health safety requirements the energy code gives way to that. That should cover that issue.

Daylighting control for both top lighting and side lighting, electric lighting must be controlled when there is daylight available, and made available when possible, at least in one situation. So, what that means is if you have top and side daylight, you have to have electric lighting control if the space is large enough, et cetera, and we'll talk about that.

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Also, if you have a large enough area that's directly under a roof, you're required to have a certain amount of skylights, again, certain conditions and exceptions apply, and then once those skylights are in then of course you have to control them. So, it's a little more detail on that. For top lighting it's applied to this daylight area under skylights plus daylight areas under rooftop monitors.

Basically, there's a defined daylight area. If your space meets this criteria then you have to comply. But only if you have over 150 watts of lighting in that space. If you have less than 150 watts you don't have to meet the requirement. The control is required only for the general area, general lighting in the area.

If you have some cast lighting it wouldn't necessarily apply to that, but all the general lighting in that area, and the control must be either multi-level photo control, at least two output levels or continuous dimming that choice is up to you. Sometimes it may make sense to do one or the other.

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If we look at this graphically, this is a top view or a plan view. If you're looking down on, say, a warehouse area, you have two skylights and three vertical shelving obstructions we'll call it. In the far left case with that skylight the wall is the boundary of the daylight area, top and bottom it extends to the full length, and there's a calculation for it. I won't go into it that deep, but there's a calculation based on the skylight area and height that tells you how far that daylight area is.

To the right that area is blocked by this vertical obstruction, which is high enough to block the light. That light gray area becomes the daylight area you have to control. On the right-hand skylight, if

you look to the left-hand side there's obstruction there, but it's really close to the skylight, and it's not tall enough to block all the lights. Not all light from the skylight will bleed over the obstruction, so the daylight area extends out to its full extent.

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Again, top and bottom it goes to the full extent, to the right it also goes to the full extent because the obstruction is far enough away. It's not going to block anything. That's kind of how the calculation works. And again, you see the note at the bottom, if you have a sidelighted area from some windows, you don't have to double count. You only have to do one.

So, if we look at control for sidelighting, again, if you have any sidelighting daylight it must be controlled. Again, the limit is 150 watts. If you have less than 150 watts you don't have to do it. Similar control requirements in terms of multilevel or continuous dimming and if we look at a schematic again we're looking at a plan view as if you pasted yourself to ceiling you're looking down onto this office, you've got two windows, you have less than four feet wide between the windows.

If it was more than four feet wide it would be considered two different daylight areas. In this case it's all a contiguous one. It stands out quite a ways to the right, –

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but you'll notice there are some partitions in the upper corner there, and those partitions are high enough, based on the calculation that they block the light. So, not enough light spills over them, so the control area is only within that area, in that section of those partitions.

So, again, there's a set of formulas that work for this, but this is kind of how it gets applied. So, that primary sidelight area is what must be controlled. In to your parking garage control, this is something relatively new for 90.1-2013. There's a realization that a lot of interior underground parking garages are lit 24/7. A lot of them, because they are used 24/7 but a lot of them are specific to an office park, for example, and they are essentially empty after hours and not used, the lights are on.

So, the requirement is that you have to at least reduce the lighting by 30 percent in lighting zones less than or equal to 3600 square

feet. This way at least there is some light in case someone's working late in the building, but it's not on at full power.

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There is an exemption for daylight transition zones. So, we know we come into a dark parking garage from sunlight or vice versa. We need to – our eyes need to adapt, so there are exemptions for those spaces.

And there's also a requirement for daylight. So, some parking garages have some walls. They're half walls or walls with openings in them, and if there's enough daylight coming through you have to have daylight shut off as well, and of course there are exceptions. I do want to know this is also not something that's in IECC 2015. It may be in the future, but it's currently not a requirement from there.

Looking graphically at this requirement, here's one that kind of shows, again, this is a view looking down on one floor of a parking garage and there's a 3600 square foot control zone. You've got two entry exits which are exempt, and they have their own requirements, and you have two open walls with the dotted lines, to the right and to the bottom.

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On the bottom it's an open wall. It has enough of an opening, there's daylight in it, so you have to have control open 20 feet that other little dotted line. To the right there's no daylight control zone, and that's because there's a building adjacent to it within 20 feet that's tall enough that it blocks significant sunlight so there's no requirement.

So, if we look at the daylight control requirement in terms of the opening in the wall, there's also a calculation for that. Here we have two floors and you have to have a wall, floor by floor, that has openings at least 40 percent of the total. So, on the top floor it's pretty obvious that's going to be 40 percent. The bottom floor maybe not. It's less than half of it has openings, those openings are probably maybe three-quarters of the wall section. So, that may not meet the requirement.

So, you may not have to have daylighting in the bottom floor, but you would have to have it in the top floor in this case.

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Exterior lighting control has always been in the energy code, but it's a lot of times been fairly simple, maybe just auto shutoff the parking lots. That's been advanced quite a bit. The dusk to dawn photos show shutoff there, but now there are requirements for façade and landscape lighting to be off from midnight or the closing of the business to either 6:00 AM or the opening of the business.

And this is the realization that façade landscape lighting is an important part of the look of the building, but it's not necessarily needed when the building isn't being occupied or patronized. However, signage, that's the other category, signage and other lighting can still remain on because you want your business people to know where your business is and what's offered there, but it has to be reduced by at least 30 percent after hours or when it's unoccupied.

This way it still remains lit up and at night it can be very visible, but you don't have to have it on full on when there's nobody patronizing your business.

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And of course there are exceptions that apply, you'll need to read those in the code. And this applies to both codes.

There's another provision in 90.1 that allows some credit for advance control. So, if you put in a really good control that's not required you can get some credit. So, after you've met all the mandatory requirements that are placed in the standard, you can then get additional power if you put into advanced control.

It's based on control of a specific space only, or spaces. You only get to calculate your allowance based on that space, but again, whatever credit you get you can then use the credit anywhere. But you can only base the calculation of the credit on the space that you're going to control. And it's a simple calculation, it's a lighting power under control of this advanced control system times control factor. This will get you another small bucket of watts you can use anywhere else.

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Now, the options are limited. There used to be more of them, but

of course more controls are required, so it's limited, and they do reflect some very advanced systems that tend to be – you have to spend more money to do them. They're usually fully automatic or programmable or they apply to secondary spaces.

So, they're tough to get, but if you need some extra watts it's one way to get it. Again, these are not part of IECC 2015, they chose not to include this table, and here the part of the table from 2013, on the far left is the control method, and some of them get very detailed in terms of programmable multi-level dimming kind of things or automatic systems where it's not automatic in the main part of the code or multi-level occupancy centers instead of on/off, these kind of things.

And over to the right you have the space type, so again limited to the space types you can't apply this everywhere, it's got to be just in these space types, and the numbers you see in here are conservative.

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But when these were calculated there was an analysis done of, hey what can this control save in this space type? And then a number which created the allowance left and what that total unit save is. So, you're not getting everything back, but you're getting a lot of it back.

So, again, whoever's on the phone, if you haven't muted your phone, please mute it 'cause we're getting some other background noise. Thank you. Alterations requirement, a big part of energy code compliance 'cause a lot of building is done with alterations not. Basically, retrofit projects must comply with the lighting power limits, which includes retrofits where luminaires are either added, replaced or removed to create almost any kind of lighting retrofit.

And for 2013 when you do an alteration you also have to apply the auto shutoff control, just a basic shutoff.

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IECC requires full lighting compliance of the entire section, which could include some other types as well. That's one difference between the two. In 2013 the current requirement is if you have an alteration of less than ten percent of the space you don't have to comply. It used to be 50 percent in 90.1.

IECC, for some reason, in both of those exception notes in there, I'm not sure why they're both included. They're in the same general area but in different sections, but that's something that maybe needs to be straightened out. And one other note, at least for 90.1 this is not included in IECC or specifically spelled out, but for 90.1-2013 if you were replacing the lamps and the ballasts in a fluorescent troffer, for example, that's considered a retrofit.

If you're just replacing the lamps that's maintenance, you don't have to comply. If you're just replacing the ballast 'cause it died or whatever that's considered maintenance, you don't have to comply. If you're putting both in the same luminaire that's an alteration, you have to comply with the requirement.

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Functional testing is also required in both the codes. The idea is you want to make sure these, especially with new additional control requirements, you want to make sure the controls are working as advertised before the building is turned over.

In 2013 there's a requirement that this functional testing or calibration must not be done by the exact same people who did the design, manufacture, installation just to make sure there's separation. IECC 2015 only specifies that the design professional in charge of that part of the building must verify the controls perform as designed. A little slight difference there. The primary focus of the functional testing section is the same in both, it's for occupancy sensors, time switches and daylight control sensors, and there's a whole list of step by step instructions for each of those three that talks about verifying the performance, confirming the time-out sensitivity settings –

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confirming the programming and confirming the photo cells work correctly.

And these are all important, as we know, for controls especially in daylighting controls to make sure it functions the way it's supposed to be. If it doesn't it'll either get deactivated or you won't get the energy savings. So, it's a very important part of the standard, and there are detailed instructions for each of these in those sections.

That basically covers all the requirements for the lighting section,

but I want to spend a little bit of time on the power requirements because those are included in both 90.1 and IECC. The basic requirements are for low voltage dry transformer efficiency, which effectively just must meet EPAct 2005 requirements, pretty standard. That's what all transformers are kind of designed to meet, so pretty straightforward to meet that one.

There is a voltage drop for efficiency purposes requirement in 90.1-2013. It's not included in IECC.

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Currently it's two percent of design load in feeder circuits and three percent in branch circuits. That will probably change in the future, but that's the way it currently is. Again, this is with an eye towards lighting design, you want to be as efficient as possible with potential voltage drop losses.

There's also a requirement in 90.1-2013 for automatic receptacle control for a percentage of receptacles in certain space types. Not by IECC 2015, I'll talk about that a little bit. There are also requirements in both for electrical metering, I'll talk about that a little bit, and both require document submittals, drawings and manuals, et cetera for turnover.

So, if we look at the receptacle wall control requirement for IECC 2015 it applies to a portion of receptacles in a space, not all of them. It applies to essentially 50 percent of the standard 125 volt –

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15 to 20 amp receptacles, and only in these spaces, private office, conference room, print/copy rooms and breakrooms, open office workstations, computer classrooms. Those space types only, and it also applies to 25 percent of modular furniture circuits.

So, if you have a design build office facility, you don't have the furniture moved in yet but you have modular furniture circuits coming out to the middle of the floor, you have to have 25 percent of those in some fashion controllable. It could be 25 percent to each furniture station or 25 percent of the stations that's kind of what's up to you but it has to be 25 percent of those circuits.

But the realization again that a lot of spaces are built without the tenants moved in yet, so you would capture at least those modular furniture circuits. A control must be an automatic control for

automatic time time-of-day scheduling, occupancy sensor or something else that's occupancy based. Again, there are different options there.

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There are exceptions of course for safety security or if it's a space that requires 24 hour electrical use then that portion would be exempted. There's also a requirement that the control receptacles must be marked and uniformly distributed.

So, you can't put them all on one side of the room. There's got to be some uniform distribution and it must be marked in some way, and there are some electrical industry requirements that have been developed for marking these and you would use that. The energy code doesn't specify how to mark it, they leave it up to you to use industry standards for that.

One other point I really want to make is that automatic devices comply with this and by plug in, there'll be power strips or modular that cover the receptacle that are plugged in and have one that's controllable right there at the plug in. If it isn't a firmly hardwired part of the building then it doesn't comply, and we've had several interpretation requests on this including ones for something that is a plug-in that has a screw to hold it onto the receptacle.

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That doesn't comply either. That's not considered permanently installed 'cause it's easy to unscrew.

So, plug-in type devices do not comply with this requirement, at least at this point. And again, this requirement is not included as a part of the IECC 2015.

If you look at electrical energy use monitoring, again, this is for new construction only, there's a requirement for separate measurements for total electric, HVAC electric, interior and exterior lighting separately and receptacle circuits so that users can see where energy is being used.

If you have tenants in a building, each tenant has to have its own set of these parts monitored if it's possible to do so. Now, there's a realization that sometimes buildings go without tenants or without the knowledge that there will be more than one tenant, and so it would only have one meter.

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Later on if the space is reconfigured and that doesn't trigger any code requirement then you may still have one meter, but in the beginning if you have multiple tenants you have to have them separately metered.

There are requirements for recording and data availability. It's important that each of the tenants have that date available to them so they can make good energy use choices. There are some exceptions of course. If the building's too small, less than 25,000 square feet or a tenants too small, less than 10,000 square feet you don't have to comply.

Or if it's a dwelling area. So, in 90.1-2013, you have a high-rise building that's considered part of the 90.1-2013 requirements, the dwelling units themselves do not have to have any metering. There's also an exception again for a high-rise residential for example that has less than 10,000 square feet of common area, you don't have to meet that either, and if you have critical emergency branch circuits defined within any E517 those don't have to be metered either.

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2015 I mentioned up above does have metering requirements, but they don't have any specified requirements for the first part of the building, but if you have dwelling units in a commercial building, high-rise residential for example, those do have to have a meter. So, kind of an opposite system here, one requires metering in all the non-dwelling spaces and one requires it in the dwelling spaces. Both have value, each of the codes looked at it differently in terms of how their coding apply.

There is another additional IECC 2015 requirement that is not in 90.1, it's something else that IECC requires for all projects. It's the additional efficiency package requirement. So, essentially what it says is that once you're done complying with everything else you must then pick one additional feature and comply with that.

Currently you have six options, more efficient HVAC, reduced lighting power density, enhanced lighting controls, on-site renewable, dedicated outgoing air system, *[clears throat]* excuse me, or a more efficient water heating system.

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So, the two I want to look at of course are the lighting ones and historically even when this list was shorter lighting tends to be one of the easier things to comply with, at least a lot of people believe it is and so it was kind of a primary target, so I want to just go through these.

The first one would be reduced lighting power, and it basically says if you're using the whole building method you've got to use only 90 percent of what's in the main tables. If you're using the space by space method you only get to use 90 percent of that. That seems pretty straightforward, 90 percent's only a 10 percent reduction, doesn't seem too bad, but as I explained earlier on about how the lighting power densities were developed, they're developed based on saving as much energy as possible and still providing enough light to do good quality design.

In a lot of spaces maybe especially if you're using LED maybe 90 percent's no big deal, easy to do. In some spaces it may not be as easy. So, there is a caution here of using this one, 90 percent. If you can meet that and still meet good lighting quality design and IES recommendations that's great.

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But in some cases you may not be able to do that in which case you have to pick another feature. One of those might be the enhanced digital lighting controls. And for this one you're basically required to have luminaires that are capable of continual skimming. That's kind of a core part of this. And then the luminaires need to be capable of being addressed with some kind of control system either individually or tied as a group of less than or equal to 40 luminaire.

For daylight zones it's less than or equal to eight luminaires. The trick is more advanced control function. So, you can reduce light levels when it's not needed in areas of the building. The fixtures must be controlled through a digital system, and that control must do a whole bunch of things, allow for control reconfiguration based on where the fixture is in space, so they're all digitally addressed to their location.

They must have a method of load shedding.

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They must have individual user control of the overhead general illumination. So, a person sitting under a certain amount of – a certain portion of light in their office area they must have some kind of general illumination control over that, and the occupancy sensors that are part of this system must be capable of being reconfigured through the digital system, so you don't have to go up to each fixture and do it manually. That's kind of the lay of how that affects.

Now it seems like a lot of stuff to put into a control, and it is, however, there are a lot of numerous systems who have this already in them, and they're being sold and marketed, quite a few of them. Again, it's an extra cost, but that's why it's the additional efficiency package.

So, kind of next to last, just a few words about compliance. As I mentioned, DOE requires adoption of code, but it's the state and local jurisdictions that monitor the compliance.

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Once a state has adopted a code or a local jurisdiction then there are states where local jurisdictions adopt a specific code on their own, whether their state has one or not.

They are the ones that monitor compliance, and they have building departments and building inspectors, and you're all familiar with that. Of course we also know that codes just aren't perfect. Your project may be odd in some way, it doesn't quite fit the requirement, so maybe you need an interpretation. Maybe you don't have time for interpretation, so you're at the mercy of the building official, I'm sure you've all been at that point.

But the point I'm trying to make is the building official isn't there out to get you, they're just as frustrated sometimes and interested in coming up with a reasonable application as you are. A lot of the questions we get on the help support line are from building officials who are trying to understand just like the builder is.

So, what we have found is that you're really trying to work to the intent of the requirement. You want to follow it to the letter of the law, sometimes maybe you can't do that, but if you –

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work with the building official and offer some kind of good effective solution for that that has been proven to be very successful. So, that's one suggestion I would give to you is try to work with your building official. You may find an easy path.

So, here are some links to the building energy codes program itself, to the help desk, I mentioned if you have a specific question about something about some software products or the code, you can send in a question. I will give you the standard caveat here, building energy codes program through DOE is not ASHRAE or IECC, so can't provide official interpretations, but have lots and lots of experience with the code so we can help steer you in the right direction or show you where you can get an interpretation.

There's a link here for the certificate of attendance, the self-reporting, and there is my name and contact if you can't get some help anywhere else I will try and help where I can.

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So, now we can go to questions, and I know a lot of them have been coming in and Pam has handed me some here. I'm going to go through these as quickly as I can and answer as many as I can.

It turns out we have quite a bit of time left, so this is good. The first one, why aren't costs factored into development of the LPDs? I didn't mention costs. They are factored in, it's not necessarily a specific calculation but one of the parts of the process is to look at the products that we use as one of the inputs to the LPD calculation.

So, what happens is we collect, for example, if we were looking at a two by four troffer fixture type we want to use in a bunch of different models, we'll collect a whole bunch of information on all kinds of two by four troffer products, fluorescent, and in the case for the next version of the code, LED, and we'll look at them as a whole. We'll throw out ones that are really not very efficient.

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We'll throw out ones that are maybe just fancy versions of another one that are very expensive. We'll look at those that are kind of good and efficient but middle of the road cost and use those at the basis of the LPD.

Now there has been some work where we looked individually at space types and took a typical efficient fixture of various types and put those into an analysis an determine that for that space type and several of them it was cost effective. So, we have been careful to only include products that are reasonably priced.

Now what happens when you have a new LPD is that the costs actually go down because you're getting less fixture, so it's been easy to show that they are cost effective. But there is reference to cost effectiveness. Now, it depends on which fixture you choose. You're left to that device yourself, but in general we have shown that the LPDs are reasonably cost effective and that includes the LEDs when those get in a newer version, same process.

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Another question here, will a space type be added that includes plant grow facilities, these are growing in the United States and there's no code out there delimiting energy use. Good question. Yes. At least 90.1 the committee has had long lengthy discussions about adding plant growth facilities. There is a plant growth exception in one of the exceptions of the 18 exceptions you want to look at that. That will either be modified or traded for, likely in the future, modified or traded for a grow facility. So, that will be something that happens in the future. So, yes it is being looked at.

Could we get the reference to calculations of daylight spread on the floor of the building? Yeah. There is a calculation method. If you go to the actual code book itself, it'll show you what that formula is. There are also two companion documents on the BECP website.

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One that goes into more detail about 90.1-2013, one that goes into more detail about IECC 2015. There might be more information in there that you can use, but the fallback is the code itself 'cause that has all the complete drawings and there's a couple more drawings than I showed you and the complete formula, so look for the code for that.

Another one here, does the functional testing section identify what credentials an individual must have in order to test? There is some language, but it's fairly generic. There isn't a specific certificate that you have to have, and I'm struggling with the requirements

right now, but again, go to the code, the code will tell you exactly what it intends for you to have, and I know there was a lot of discussion around that struggling with what to require.

So, it is somewhat generic, but there is some language. You'll have to read that yourself, and it does differ between IECC and 90.1-2013, so you want to look at each of those.

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Let's see, another question. I believe the voltage requirement has been changed five percent with all systems, similar proposal to five percent recommended for approval at the IECC group. That's true. For 90.1-2016 it will be five percent for total system, and other codes. This of course is just on IECC – I'm sorry on 90.1-2103 and IECC 2015 currently it's at two percent and three percent. But, yes, you're correct. That is being changed to a five percent total.

Another question, what about a new addition but where metering is not being changed as we get powers from the existing service. Are we required to separate and meter the HVAC? If it's a new addition it typically needs to meet the requirements of the entire code, and you would then have to tie that metering into – well, that's a good question.

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You would have to talk to your building official about that one.

If the metering's not being changed, if you don't have metering in the existing part of the building you may be required to add it. Although, there's part of the code that says you shouldn't have to change things that are already there. So, you may be required to put metering in that part of the building, particularly if it's a new tenant, but if it's an existing tenant, without giving you an interpretation I'd say you have to talk to your building official.

You can also send an official interpretation in to 90.1 or IECC and they will be able to address this. I'm just not comfortable with saying one way or the other, 'cause I'm not sure at this point, but that's a very good question. Another question here, what is intended to control unplugged wall receptacles?

I'm not sure what you mean by unplugged.

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The control requirement is to say that 50 percent of them have to be controlled by something, like an occupancy sensor, if 50 percent are not controlled it's up to the user to decide which is appropriate. There may be something and it has to be on all the time, it's gets plugged into a line and things that can be off, printers and other peripheral offices equipment those go in the other one.

Let's see. That's what I have so far in terms of questions unless I see some more come in, and I put the links back up here on the screen. So, by all means, if you do have questions that didn't get answered, please go to the BECP help desk link, and there's a way you can ask a question. But even before that if you go to the building energy codes program there are lots of training resources out there, I specifically mentioned one dedicated to 90.1-2013 goes into more detail and one that's dedicated to IECC 2015.

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Those will provide more detail than I was available to provide here. So, at that point I'll turn it over to Pam, I believe.

Pam Cole: Thank you, Eric, for taking the time to tell us about all the information about lighting code requirements today, and we really do appreciate it. Again, if you still have questions you can submit them through the help desk through Building Energy Codes, and thank you attendees, and all of you now can disconnect.

[End of Audio]