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Rosemary Bartlett: Welcome, everyone. I'm Rosemarie Bartlett with the Pacific Northwest National Laboratory and I'd like to welcome you to the US Department of Energy's National Energy Codes Conference Seminar Series. In light of the NECC being postponed this year, this weekly series was developed to share insights and spur discussion on a collection of timely and emerging energy code topics. Today's webinar will cover what's new in the commercial provisions of the 2021 International Energy Conservation Code. Looking ahead the series will cover other timely topics such as virtual remote inspections, what's new in the residential provisions of the 2021 IECC, advanced technologies, and even more. So we hope you'll join us Thursdays at 1:00 p.m. Eastern time and keep the conversation going.

So before we begin today, I'd actually like to start with a couple of polling questions to learn a little bit more about –

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each of you. So let me set up the first polling question, and it's going to ask you your profession. So let me launch that. So if you'll take a moment to answer that question for us, I'll give you a few seconds. Okay, I'm gonna close the poll and share the results so everybody can see who has joined us today. It looks like most people classified themselves as architects and engineers and some representation across the other groups as well, so that's great. Thank you very much for participating in that.

Our second poll has to do with your location. So if you would take a couple seconds and respond to that –

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for us, we'd appreciate it. Okay, I'm gonna close that poll and share the results. So somewhat even distribution, looks like mostly in the Midwest, though. Midwest wins today. So thank you very much. That's very helpful to us.

Now without further ado, let's jump into our presentations. Our first speaker today is Michael Tillou with the Pacific Northwest National Laboratory. And with that I've turned control over to Mike. Take it away.

Michael Tillou: Thank you, Rose. Welcome, everyone to today's webinar and the IECC 2021. Whether you're a builder, a –

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designer, or an owner, energy codes have become an important part of the overall building codes and contribute to the design and construction of buildings that are comfortable, cost effective, and energy efficient.

The 2019 IECC development cycle has really been an interesting one. The current cycle started back in 2018 and really got going in January of 2019 when code change proposal submissions were due. Throughout 2019 these proposals were reviewed, modified, and subjected to public comment and review, and the process culminated with the Online Governmental Consensus Vote in November of 2019 with a record number of participants. As allowed by the IECC rules, there were several appeals this cycle, five –

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against proposals that passed the final voting process. That appeals process finally concluded at the end of September, just last month, which helps explain in part the delay in the publication of the new standard, which we in a normal cycle would've expected to see already, but we're anxiously awaiting the final publication so we can actually see what all the new changed language is gonna look like.

For this code cycle there were a total of 248 code change proposals that were submitted, and in the end 141 of those proposals were approved either in whole or in part. As you'll notice, all of the commercial code change proposals are all labeled with a CE, and throughout the three presentations you're gonna see today we've included –

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the commercial proposal numbers as a reference for those of you that are interested in going and looking at the original language of the specific change on the IECC – in the files on the IECC website. The proposals can be found on the Group B Code Development website by accessing the files that are shown in the bulleted list on the screen, and those include the Group B Final Action and Report, the Group B Public Comments Agenda, their Consolidated

Monograph Updates, as well as the original Group B Proposed Changes.

I'm gonna be talking to you today predominantly about the changes to the building envelope. There were 36 proposals that were approved –

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that impacted the building envelope sections of the commercial IECC. The majority of those changes impact the opaque building envelope, a quarter impacted fenestration, and roughly 15 percent addressed air leakage. And as you can see in the second pie chart, a majority of the proposals also addressed changes to R value or U value requirements for insulation and fenestration performance, and these changes really bring the IECC into alignment with ASHRAE standard 90.1 2016 and ASHRAE 90.1 2019 requirements.

One of the new features for commercial buildings that was approved is a requirement for a thermal envelope certificate. Currently residential buildings are required to post a thermal envelope certificate on an electrical –

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panel or other prominent place in order to document the performance of the building envelope for future homeowners or future interested parties that want to know what's behind the walls. So starting with the 2021 version of the IECC, commercial buildings will need to include a similar certificate. And most likely the IECC 2021 version of COMcheck will be able to automatically generate this certificate, similar to the current capability within REScheck software for creating a certificate for residential buildings.

Now I'm gonna go through the different opaque envelope changes starting with roofs. There were six change proposals that impacted roofs.

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Predominantly these changes included updating the insulation R values in climate zones four through eight to match ASHRAE 90.1 2016 and 90.1 2019 requirements. There was a change that lowers the U factor of metal building roofs in climate zone one. The

requirement that single-ply membranes be fully adhered was removed, expanding the range of products that can be used – or expanding the range of products that comply with the IECC requirements. And then there was new language that further clarified how roof insulation needed to be installed, including clarity on the calculation of –

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paper roof insulation and how to calculate the R value, making it clear that insulation on suspended ceilings doesn't count towards roof insulation requirements, and then requiring that continuous insulation be installed in at least two layers with staggered joints.

Two of the other roof requirements dealt with vegetated and landscaped roofs. One requirement added a new definition for vegetated roof, and the other requirement removed the term roof garden and replaced it with vegetated roof. And really this change just was mostly editorial and helped align the IECC with wording in the IBC, the IFC, and the Solar Ready Appendix –

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within the IECC. So really just some editorial changes, no new – really new requirements.

Moving on to above-grade walls, again the R value and U value tables in climate zones four through eight were updated. Similar to roofs, these changes bring the IECC in alignment with the current requirements of ASHRAE 90.1 2016 and ASHRAE 90.1 2019. And I'm gonna be going through a lot of these R value changes for different opaque envelope requirements and I just – I wanted to remind everyone that by aligning these values with ASHRAE 90.1, these requirements pass cost-effective criteria that must be met when –

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proposals are adopted by ASHRAE 90.1. So these changes – by having changes in the IECC that align with ASHRAE 90.1, it helps ensure that insulation requirements achieve cost-effective energy status.

Another change to above-grade walls was to the definition to clarify that certain envelope features like between-floor spandrels, dormer walls, gable end walls are actually part of what's

considered an above-grade wall. And then finally there were a couple of additional proposals for metal building walls that align the U value requirements in table 402.1.3 to match – or I'm sorry, in –

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401.1.4 to match the R value requirements that are in 402.1.3. So just a couple of editorial changes there to make sure that values and tables line up.

Similar to the above-grade walls, below-grade wall insulation R values in climate zones four through eight were updated to align with ASHRAE 90.1 2016 and 2019 requirements. And similar adjustments were made to the R value requirements of exterior floors, which we typically find separating like an underground parking garage from continued conditioned spaces above or, you know, in a cantilevered floor that extends out past the wall of the building.

The F factors and equivalent R values –

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for both heated and unheated slabs were also updated again to match ASHRAE 90.1 2016 requirements. Another new change for – to the insulation requirements for slab insulation makes those insulation requirements mandatory and further clarifies that the – that new clarifying requirements for the insulation of full under-slab insulation. And so that language just makes it clearer what the requirements are.

And then the final set of changes to the opaque envelope assembles are for doors, and again I feel like a broken record saying this but the –

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proposed changes align with the current requirements of 90.1, ASHRAE 90.1. And those updates include removing R value requirements for non-swinging doors and creating – moving those to U value requirements, as well as lowering the U factors for swinging doors.

Another new change is requirements for horizontally-hinged doors that have fenestration and it sets a different U value criteria for

those doors when the fenestration area is between 14 and 25 percent. And because we haven't seen a final version of the IECC, it's unclear whether those requirements are gonna be a new row in table 4 of 2.1.4 –

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or whether they're going to be included as a footnote to the table as they were proposed to be. So we'll have to wait and see what the IECC decides how to include that requirement.

There are a few other changes for the building envelope that clarify the proper calculation of R value for continuous insulation in section 4, 2.1.3. And it also makes the section on air spaces a mandatory section. And as a reminder, the section on air spaces says that if an air space is used for compliance with the IECC that –

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those spaces need to be enclosed, unvented air spaces on the inside of the continuous air bay.

So moving on to fenestration, I'll start with vertical fenestration. Across the board fenestration requirements were updated to align with the new requirements of ASHRAE 90.1 2019. These fenestration changes were part of a broad effort to update fenestration performance within ASHRAE 90.1 and they were part of a very detailed addendum, Addendum AW, which amended ASHRAE 90.1 2016. Similar to the opaque changes, the fenestration changes all met ASHRAE cost-effectiveness criteria as part of their adoption into standard 90.1.

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Another important change to note about vertical fenestration is the move away from performance requirements by orientation, and the requirements are now based on whether fenestration is fixed or operable. And so this change, this move away from orientation to fixed versus operable fenestration applies to both the U factor and solar heat gain coefficients.

And here we can see, similar to the U factor changes, solar heat gain coefficient changes really impacted all of the climates zones, and you can see that in table 4, 2.4. The orientation the requirements –

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were removed and replaced with requirements for fenestration that are either fixed or operable. It's also I think important to note here that for the first time vertical fenestration in climate zones seven and eight will be required to meet maximum solar heat gain coefficient requirements.

In addition to performance changes for vertical fenestration, there are also improvements in the U factor and solar heat gain coefficient requirements for skylights. And these changes impact buildings in climate zones one through three and climate zones seven and eight.

Finally, there were a number of changes covering other fenestration requirements. There were two small changes that helped clarify –

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the current requirements for daylighting zones and daylight-responsive controls. There's new language that clarifies the requirements for skylights in section 402.1.2 and section 402.4.2 and exempts skylights from being required on storm shelters that comply with standard ICC 500.

Last but not least, there are new requirements that will be added to the IECC for tubular skylights. These include a new definition for annual visible transmittance and a reference to the NFRC 203 test procedure, which is specific to tubular skylights. So the skylights will now – tubular skylights will now have a better path and more applicable set of requirements within the IECC that are –

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applicable to the unique performance of that set of equipment.

And then moving on from fenestration to the last set of changes and probably the most complicated set of changes that are gonna be added to the IECC for the building envelope, and those are changes to – for air leakage. There were five proposals for air leakage that were approved in this cycle. The first two deal with requirements that expand air leakage testing requirement, and the biggest change that people are gonna find is that for certain classes

of building air leakage testing is now gonna be mandatory; it's no longer –

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gonna be an optional requirement.

And so the first proposal adds testing requirements for dwelling and sleeping units in class R and class I occupancies. The proposal includes a definition for testing unit enclosure area that clearly defines the testing boundary for dwelling units as including the side walls, bottom floor, and top ceiling and further clears that interior partition walls are not included in the boundary area. The air leakage target that will be for a test unit enclosure area is gonna be set at 0.3 cfm per square foot of surface area at 50 pascals. A building with fewer than eight dwelling units or sleeping units must test all the units, and larger buildings with more than eight units –

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will be allowed to use sampling and that sampling will requirement a minimum testing of at least seven units or 20 percent of the total number of units. And if any unit fails a test, you're gonna – projects will be required to test two more units. So – and then – so those are the testing requirements for class R and class I occupancies.

Then there are additional – the second proposal addresses testing for buildings that are not class R or class I, and again these testing requirements are gonna be mandatory for buildings in certain climate zone and of a certain size. The proposal retains the current air leakage –

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testing target that's in the 2018 IECC, which is 0.4 cfm per square foot of building thermal envelope area at 75 pascals.

The proposal _____ in two different methods of testing for these buildings. The first method allows a full-building test to be used and demonstrate that the air leakage of the whole building is at or below the target air leakage rate. The second approach allows for sampling different areas within the building and showing that the air leakage on an area-weighted basis is less than the target. When

you're using the second option, the sampling option certain areas need to be included –

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in the test, and those areas include any floor that's directly under a roof. The spaces on that floor need to all be tested. Also any floor with spaces that include a building entrance must be tested. And then at least 25 percent of the remaining above-grade wall area after you test the floors with building entrances and floor under a roof – at least 25 percent of the remaining above-grade wall area also needs to be tested. And in both test cases the language also includes – it takes language from the ASHRAE 90.1 air leakage requirements, testing requirements that allow buildings that test between 0.4 and 0.6 cfm per –

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square feet at 75 pascals to comply if they seal the leaks that are identified during the test. They will not be required to retest, so there's a little bit of a buffer there for this new mandatory testing requirement. And then buildings that are not required to test will still need to follow the current air barrier requirements using either the material or assembly requirements.

And then if we go look at the three other air leakage proposals, they're a little more straightforward. One adds the ASTM E3 158 test procedure for multizone buildings. It also adds ASTM D8 0523 –

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test procedure for sloped roofs as approved test procedures for air barriers. And then the final proposal adds requirements for air barrier verification and commissioning by a registered professional for buildings that are not required to do testing, so that would be an additional set of requirements beyond the material or assembly requirements that are currently in the IECC. And then changes also include some new documentation requirements for detailing air barrier and air sealing, as well as a new requirement to show the location of an air barrier in the project drawings.

And so during the public review period –

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it was commented that these new air barrier changes really have the potential to be very confusing within the current way that air barriers are addressed in the IECC. And so the IECC staff asked PNNL for help in developing draft language for how to incorporate the new testing requirements in a way that didn't create conflicts within the current language. And so you can see on the screen the – this was the draft sort of reorganization of section 402.5 in order to integrate these new requirements into the IECC without changing any of the current –

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intent or language that already exists.

So the first change is really – was revising the charging language of 402.5 to better address the new requirements. The – a new subsection, 402.5.1, is added and is entitled "Air Barrier Compliance" and will cover the three different compliance options. Another section, 402.5.2, will include the current air barrier requirements for buildings that aren't tested, as well as the new verification and commissioning requirements. And then sections 402.5.3 and 402.5.4 will address the new testing procedures for class R and class I occupancies, as well as the procedures –

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for occupancies other than class R and class I.

And I see Rose is giving me the wrap it up look, and so fortunately I'm wrapped up, and so with that I'll hand it back to Rose and we can move on.

Rosemarie Bartlett: Thanks very much, Mike. I'd like to remind everyone to please submit your questions using the questions pane. Please don't wait until the end to do that. And with that we're going to move on to our next presenter, Reid Hart. Reid, you should be ready to take it away.

Reid Hart: Okay, just getting my screen up here. All right, well, welcome, everyone. I'm gonna focus on the mechanical sections coming up and –

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also cover some of the performance changes as well as get into the energy credits, which were significantly revised this time around.

So just wanted to mention on a general basis – so this new code is gonna be published in the fall here or maybe early next year. We'll see how it goes. They've still got a lot of work to do. But just so you're aware, this map shows the adoption – now it's based on 90.1, but the IECC is somewhat similar to 90.1 or parallel in structure and requirements. And so most likely we'll see the adoption of this new code in the green-colored states. Some states do jump a couple of editions in their adoption, but that's just an idea of what might be coming to your state, so just wanted to give you a head's up there.

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Moving ahead in the mechanical HVAC service hot water area, you can see the breakdown of things. So I'll focus on HVAC equipment controls, general mechanical systems – there are some other things in there beyond just straight HVAC – look at the performance path changes; they're pretty minor. Also there's a new net zero renewable appendix that could be adopted by a local jurisdiction. And then we'll talk about service hot water and then the energy credits, which again have substantially changed. And I'll be referring to these by the proposal number. The section numbers are up at the top, although again we don't have a published version so those may be subject to change.

So the first thing that happened actually in the last edition of the IECC, there was a pretty big misalignment between the 90.1 tables and the IECC tables. That has been remedied with a significant –

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change in approach where the efficiency tables out of 90.1 are gonna be reproduced directly and inserted into the IECC code rather than having two sets of tables with separate sets of amendments. Now most of these tables are based on federal appliance manufacturing requirements anyway, so really the code issue only comes into play when we've got someone with a big stock of earlier-produced equipment that is not getting – you know, that might be dumped, if you will, into a marketplace and the code would require them to bring it up to the current manufacturing requirements. Some of those requirements, like for chillers and larger equipment, are set by ASHRAE 90.1. And there are new tables in here – for a long time getting new tables in has been a process of lags, but now all the tables are gonna come in so they're fully –

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available. Like we'll have the variable refrigerant flow table that has not been in there the last couple of cycles while it existed in 90.1.

CE140 adds a new area of equipment coverage, actually ahead of 90.1, covering smaller fans under 112 horsepower like your small bathroom fans. We do have some exceptions if the fan is built into a larger appliance or your range hood or dryer exhaust, the dryer – range hood booster fans also are exempt. But basically the HRV or ERV fans, any inline booster fans and bathroom and utility room fans are now going to be covered. There is a similar proposal going into 90.1 as we speak but it's not there yet.

CE111 actually provides for fault detection and diagnostic –

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to be installed in larger buildings. This only applies to buildings over 100,000 square feet in area, and basically it's an expansion of the direct digital control system that actually is checking the controls as we go along, and it checks the controls and makes sure that things are working properly. And then if it finds an error or suspects an error, it will report out to the DDC system or, you know, send a message to the building operator. So this is expected to improve long-term control operation in larger buildings.

We've got several other things – optimized stop has been added, so we're probably familiar with optimized stop that will vary the warm-up time or cool-down time in the morning for a building before occupancy so we aren't starting too early. Well, this actually says that we can let the temperature float in –

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the building up to two degrees plus or minus for the last say half hour or hour of occupancy, and actually this is compatible with ventilation requirements which do allow a lag period or an averaging period for a period of time that you cannot be actively ventilating the space, but because the space has a large enough volume, it's deemed to be adequate for ventilation. So that's an added requirement. It's pretty much a no-cost requirement that's available in most DDC systems.

Variable refrigerant flow systems no longer require outside air economizers. You might be aware that there is an exception for economizers for smaller fan units; however, in the IECC there is a maximum limit on how much cooling capacity there can be in the building without economizers. And so VRF systems were running afoul –

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of that limit, and so this basically allows them to not have outside air economizers. And they make up for it by lower fan power and higher operating efficiency.

CE127 expands demand-controlled ventilation requirements from an occupancy density of 25 down to 15 people per 1,000 square feet. Basically if you look at the IMC ventilation tables, what that means is pretty much retail sales area is the only new area. So before we covered classrooms, conference rooms, lecture halls with demand-controlled ventilation. Now we're also going to be including those large retail sales area, which have a pretty high ventilation requirement due to the large number of people that might be there on the big Thanksgiving sales day. But they spend a lot of time virtually almost empty at other times, so this does adjust that ventilation to be –

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appropriate for who's actually in the building.

All right, moving on to some more control changes, CE121 looks at the cooling tower or heat rejection device for a water loop heat pump. Formerly there was a requirement to shut off open cooling towers. This has just added closed-circuit towers, also called fluid coolers to that requirement – pretty straightforward.

CE129, the requirements that you turn down the parking garage exhaust based on some sensors for carbon monoxide and nitrous oxide, those requirements have been lowered from around 20,000 cfm down to about 8,000 cfm – or down to 8,000 cfm. And there were some control sensor specifications that were added there, but pretty much match the International Mechanical Code. So that's pretty straightforward but –

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more parking garages will fall under that requirement than have in the past.

CE135 relates to hotel guest room temperature and ventilation controls. Now those requirements were added the last cycle. This pretty much clarifies them primarily. There's not really a change in requirements, just understanding that there are three different operating modes: one mode for occupied, one mode for unoccupied for a rented room, and one mode for an unrented room and how those requirements work. There is a minor shift in the requirements where the shutoff was 30 minutes before; now it's 20 minutes to align better with the lighting shutoff controls as well.

HVAC controls for supply air temperature have been modified. Now supply air temperature reset was required in all zones for a VAV reheat system before. What this does in the moister –

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and more humid climate zones, the A climate zones from three down to zero, it requires that there be some special provisions made so that that supply air temperature reset can operate, continue to operate during dehumidification, and the dehumidification that's primarily of the outside air where the moisture is coming in. So there are a couple of ways to meet that. The code is not really specific although the user's manual and formative notes suggest how to do that. One way is to add an outside air sensor on the outside – or I'm sorry, not a sensor, but add a separate cooling coil for the outside air. The other way is to provide a bypass of return air so the outside air is getting the primarily cooling and dehumidification, and then the warmer return air is mixing in. So this should provide significant –

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savings. There are some size limits based on cost effectiveness, so if your main unit fan is below 3,000 cfm in those climate zones or below 10,000 in 2A specifically, it didn't show to be cost effective there so those would have an exception. And also if you're dealing with like a DOAS unit that – dedicated outdoor air that is basically 100 percent or 80 percent or more of outside air, then you would not be required to do this either since you don't have the opportunity to mix with the return air.

And there's also a requirement there to lock out the economizer during dehumidification so that we aren't bringing in excessive

outside air. That probably makes sense, but not everyone was doing it so that control requirement got added to the code.

CE133 – and these are both related to energy recovery.

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Now rather than just a blanket, more commercially-oriented requirement, we have provided a transition where residential or apartment exhaust has more specific energy requirements. Climate zone 3C is exempt. Smaller apartments under 500 square feet are exempt in certain climate zones. They just didn't look to be cost-effective there. This was based on an ASHRAE 90.1 proposal that did analyze the cost effectiveness. It provides a new definition for enthalpy recovery ratio that matches the ASHRAE definition. Now this is not the same as the H or I effectiveness which basically is independent of the balance of return or exhaust air and outside air. This requirement of enthalpy recovery –

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ratio does need to be calculated by climate zone, and the manufacturers are getting onboard to provide that information in their submittals. It does require a 50 percent cooling recovery and a 60 percent heating recovery, and that enthalpy recovery ratio covers both latent and sensible recoveries, so it brings them together.

CE143 is very specifically oriented at hospitals that have VAV or constant volume reheat systems, and it says that if you've got a chiller you're rejecting heat, so let's take that heat and put it into the reheat system. Basically if you've got more than 300 tons of cooling capacity in the hospital and in the total chiller plant, then you have to meet this requirement that says that seven percent of your total cooling capacity – so you'd have a separate, smaller chiller that would provide that heat recovery and use that –

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effectively to provide the reheat in the system. And again that's a very specific requirement currently oriented to hospitals. There may be some expansion of something like that in the future, but that's what we've got now as a new energy recovery requirement.

Moving along into more general system modifications, the refrigeration efficiency, CE146 – cleaned that up substantially. If

you look in the last edition, 2018 IECC, what happened was there were two competing proposals that both got adopted. They should've been merged together. Staff wasn't comfortable with – there wasn't clarity about how to merge those together so they both ended up in there. There were a few conflicts and questions. This cleaned it up by bringing it all together in one straight requirement, updated some of those requirements to match changes in the federal requirements, so that section of the code should be much cleaner and –

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easier to enforce.

CE160 relates to pool and spa cover exception for solar or heat pump heating, and it's now reduced from 75 to 70 percent. I believe that's in alignment with the spa and pool code that had that 70 percent number. Basically you're required to provide a cover that's used when the pool is not – or spa is not being used; however, there is an exception if you get 70 percent of the pool heating from either some recovered heat or solar energy or heating produced from a heat pump. So that just aligns those two codes better.

CE213 relates to escalators or moving walk speed controls and also power recovery, so regenerative – you know, where you –

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actually recover when an escalator's going down. Those requirements were in there before. This adds the requirement to do a traffic study. Now frankly the code language is not very clear on exactly how to adopt – you know, what that means as far as when this would be required or when not. I guess the assumption is the traffic study would actually look at cost effectiveness and when it's appropriate to add the speed controls. We anticipate that perhaps some guidance will be coming forward on that, but just point out, it is an area that could use some more clarification and will require jurisdictions to make some determinations about how to interpret those traffic studies.

All right, moving along, computer equipment, datacenters – we've got several items here. So the first one –

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is making a distinction between a computer room and a datacenter. So a computer room is either lower density, less than 20 watts per square foot of equipment, or it's small, less than 10 kW. That would be covered in the IECC and this aligns with the distinction that's been made in 90.1. Areas with computer equipment that are larger would go to standard 90.4, ASHRAE standard 90.4, which is designed specifically for datacenters. So that takes it basically to a different standard. Now be aware that that standard does refer back to 90.1 when there's questions about like an office area inside a datacenter. Those areas would be covered by 90.1 requirements, so it's sort of like a back and forth reference if you will. But this does make it clear what the boundary is between those and it's pretty crisp.

Now there's also –

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some additional information that's included there. 90.4 was under modification at the time and so the year standard that 90.4 referenced was a bit dated in the IECC. This basically brought in some new table updates that were gonna go in effect after the IECC. So it basically brings in essentially what is the newer version of major efficiency updates related to the mechanical load component values that are used in the 90.4 process.

There's a couple of changes to the performance path. They're relatively minor in C407. So basically the biggest change is that the proposed building must be 80 percent of the baseline building rather than 85 percent, so it's a little more stringent. And this accounts for the fact that there are multiple –

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interactions in the performance path calculation where a typical building is never gonna be all the way at the worst case prescriptive path, so it brings that information in or brings that adjustment in. It also accounts for the fact that there are energy credits we'll talk about in a minute that are required that are not covered in the proposed performance of the building or the baseline for that matter. There's also another minor change that standard reference wall designs will now be the same in the proposed as the baseline, so whether it's a wood frame wall, a steel frame wall, or a masonry wall, those are gonna be the same in both models.

All right, CE264 is a complete new appendix. It allows for a zero code – net zero building code that essentially uses renewable energy, whether it's onsite –

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photovoltaics or offsite purchased photovoltaics to make up the difference, so that a building could be accredited as net zero. And that may or may not get adopted by certain jurisdictions. It's a separate appendix in the standard.

All right, getting out of HVAC into hot water systems, service hot water systems, there is a slight change in requirement. Basically this only requires to very large systems, over a million BTUs of service water heat capacity in the building. So this would be a high-rise multifamily, maybe a large institutional school, something like that. And all it does is raises the average efficiency from 90 to 92 percent. Now that is a capacity-weighted average, and what that means is I could have condensing, which are actually higher, up around 95, 96 –

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percent efficiency for part of my water heating, and then I might have what you would call a peaking boiler that's less expensive and a lower efficiency that would only come on occasionally during very peak loads, might never come on if the system's overdesigned, so it would tend to weight that higher efficiency. So it allows for a mixture. It doesn't require everything to be condensing. It's a capacity-weighted average, so that again applies only to very large systems.

All right, let's talk about energy credits. So this is section C406 and the old approach – there were about eight different options that you could select from, and basically it was a pick one approach. You just had to pick one of those options. Well, PNNL had done some analysis early on I think for the state of Washington who was adopting the IECC and just discovered that there –

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was a wide variation between those different options. So the idea was to go through and look at all the options and try and arrive at not perfect equivalency but some equivalency between the options that you would select. And the basic idea was to require ten credits. We used a point approach or a credit approach based on – which

was equivalent to about two and a half percent of energy cost savings for the building as a whole. So we also modified some of the existing credits. HVAC was split. The original credit in 2018 said you had to increase all of the heating and cooling efficiency. Well, it makes sense to increase the heating efficiency in the north, colder climate zones. It makes sense to increase the cooling efficiency in the warmer climate zones. So the idea was to focus the efficiency where it made sense.

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Also lighting allows credits above 15 percent, lighting power reduction. Before the old credit was just a ten percent reduction. And there were also some credits added for sleeping and dwelling unit lighting efficacy as those were pretty much left out. They don't have a lighting power density approach you have in most commercial spaces.

And so the result of the analysis – we wanted to see is there a variation by climate zone, and it turns out, yes, there is. And you might think that, for instance, lighting power density doesn't have much variation. Well, when you reduce the lighting power, you need more heat in the building, you need less cooling in the building, so there is a reaction to climate zone. So we did the analysis and carried it through, and – to come up with the credits. Now one thing to point out as far as where this new proposal is relative to the old one, over on the far right you can see –

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this area here. We averaged four of the old credits. You can see they came in at around ten credits or around two and a half percent. There's a slight bump up in some climate zones, but basically the idea is to make these requirements somewhat equivalent to the old requirement if we average the heating-cooling efficiency, the lighting reduction, the UA changes, and the photovoltaics. So if you looked across those measures, what would you get?

We did add – there were some additional credit proposed. The HVAC cooling savings was extended up to 15 percent, also the energy monitoring and fault detection. So we have some requirements for those. I think energy monitoring below – or above 25,000 square foot building, fault detection above 100,000 square foot building. So if you chose to implement those things in a smaller building, then you could get credit for them in this –

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credit system here. Also kitchen equipment – not every building has a kitchen, but those that do, there are very significant changes in some of that equipment that can be implemented. For instance, a deep fat fryer has a huge savings if you get into an Energy Star piece of equipment. The same is true of like a warming oven and several other things where there are significant improvements 'cause there's not a lot of federal regulations in that area. So if those are installed as part of the permit, those credits come in.

And you can see these credits basically came into a table. So here's an example. We've got C46.1, so there are five of these tables. We've got separate tables again by climate zone and by individual credit type. So the idea is you would pick your climate zone and go down the list here and you'd just need to pick items that would total –

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ten or more credits. And they're divided up into office, multifamily and residential institutional buildings, schools, retail, and then there's an other category for buildings that aren't in those categories which basically is an average of the other building credits. So the idea is we've got a uniform target. All buildings need to reach ten credits or about ten percent of the buildings. Most of them could do it with renewable, which also does allow you to go above the limit shown here, or they can do it with lighting and possibly a combination of another credit. And there is a provision for tenant infills. Since the shell of the building had to achieve a certain amount of credits related to the envelope, then the tenant infill has a smaller requirement unless the full credits were achieved by the core part of the building. Then the tenant infill wouldn't necessarily have to require them.

And I think that completes my talk and I'll pass it back to Rose.

[0:56:00]

Rosemarie Bartlett: Great. Thanks much, Reid. Appreciate that. Another plug to please continue to send in your questions while I switch it over to our last but not least presenter, Michael Myer of PNNL. And, Michael, you should be able to have control now.

Michael Myer: Thanks, Rose. Just do a quick audio check since a computer setting changed, and I assume you can hear me fine? I'm gonna just do a

quick check. Perfect. I've got my confirmation and we'll continue on. I'll be presenting on both lighting as well as electrical and power.

This is a perfectly –

Rosemarie Bartlett: Michael, I'm sorry –

[0:57:00]

to interrupt you. I'm just gonna tell you that we're seeing the thumbnail view of your PowerPoint.

Michael Myer: Thank you very much.

Rosemarie Bartlett: But your audio is great.

Michael Myer: I'm gonna switch again. Sorry, it's….

Rosemarie Bartlett: There we go.

Michael Myer: Yes, my apologies. I'll be presenting on building power and electrical as well as lighting sections. There were three major changes to the power and electrical sections. They are voltage drop metering and monitoring as well as automatic receptacle controls.

The first one related to voltage drop –

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is pretty straightforward. It's just really some retitling and reorganization shown here, simply the voltage drop in feeders term. They just removed the in feeders and branch circuits to a simple voltage drop. They also just reorganized some of the text in the remaining part of the section in C405.9. The rationale here was it reduces some inconsistency and application compliance.

A larger change involved metering and monitoring. So the introduction of C405.10, which is energy monitoring, and it's mandatory, in buildings that are 25,000 square feet or larger. And then it outlays a number of provisions, one being electrical energy metering, and then it defines what the end use metering categories are shown down below. So your mechanical system, your –

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interior lighting needs to be metered, your exterior lighting needs to be metered separately. Plug loads and process loads and they're separated, and process loads is defined as really anything that's five percent of your peak connected load. And then finally there's a building operations and miscellaneous loads. The remaining sections deal with all the different types of meters as well as how the data acquisition needs to work, and then ultimately it needs to be automatic and present in a graphical energy report. That could be a dashboard, could be in a couple different forms, but the idea there is that not only are you gathering that information, you need to share it back with the building really to be effective and to make good use of that data.

The other change in the power and electrical section is the addition of automatic receptacle control. The image on the right is from a project I've worked on just showing how it works. One of the outlets is in a 24/7 operation meaning it's always getting constant –

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power. The other one is switched off when the space is unoccupied. I recently completed a project where 55 percent of the energy was being used when the building was completely closed, so it definitely demonstrates there's good potential savings there. It's geared toward 50 percent of all 120-volt nominal, 15- and 20-amp receptacles in a bunch of different spaces. They're your primary large occupancy spaces. Offices, conference rooms, copy/print functions, those type of things have to meet this requirement, or 25 percent of branch circuit feeders from modular furniture. So you can – depending on what type of space you are, there are slightly different parameters.

There are different ways to meet it. A simple way is done through a scheduling basis; however, there are some limitations in that you have to limit it to about 5,000 square foot per section that you are scheduling together, or a single floor. You can also do it through an occupancy sensor where after 20 minutes of inactivity in a space –

[1:01:00]

the control loads are turned off. And you can also do it through an automated signal from another control system, maybe a building alarm or some other means. Again, that 20 minutes kicks in either way. It's important it needs to be a permanently wired device; therefore plugin devices cannot comply. It must be hardwired.

We'll now move into the lighting sections. There were 19 different lighting components that were proposals, and of them a majority of them were controls-related. The figure on the right shows the different types of controls with daylighting and occupancy sensor proposals being the largest amounts.

The first major change in the lighting section is the addition of lighting for plant growth and maintenance. The provision is pretty straightforward, stating that at least 95 percent of permanently installed luminaires used for plant growth and –

[1:02:00]

maintenance shall have a photon efficiency of not less than 1.6 micromoles per joule. That's based on an ANSI/ASABE documentation on how it works. So some background – controlled environmental agricultural, your indoor growth facilities, could be any variety of organic material that you're growing. In this case I'm showing lettuce. This is essentially the requirement of a photon – photosynthetic photon efficacy function, PPE. It's a typical metric when we're talking about plants. The basic understanding is – many of you might be familiar with lumens. That's shown in the blue curve in the lower right. That's the photo response of the eye. PPE, photosynthetic photon efficacy is the green humps in the image on the lower right. That's how a plant sees the visible spectrum and uses that energy differently than a lumen. Therefore it needs to be a different metric, and micromoles per joule is that metric. So that's a requirement for those types of spaces.

[1:03:00]

Moving from plant spaces into more human spaces, there is a requirement here also for antimicrobial lighting. This adds a requirement to C405.3.1. This is a list of all the different types of applications that you don't have to include in your total connected lighting power calculations. The background here is that certain near low end visible spectrum, around 405 to 420 nanometers – that's that purple light in the upper right or UVC, which is in the lower right – those can be used either to inhibit microbe growth or for disinfection. So the idea is that that's really not for humans. This is done when you're not in the space, and therefore it's really meant to help disinfect and antimicrobial, therefore it's not calculated in terms of the calculation, only the lighting and the power used for that specific application.

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Another change is a change in the term general lighting. It's a small change in that it clarifies that it's interior lighting and it says throughout a space. Really it's just some clarification and states how some of the calculations will work. Terms weren't always flowing through in each section correctly, and so that's a clarification.

Larger changes would be the interior lighting power allowance, the building area method. I say larger 'cause it's a more detailed table shown here just as a sample of it. It's about twice the size of in reality. The black values are the current IECC values. The red will be when the new version is finally published. You'll see that many of the values did decrease; however, some did increase. Automotive facility is a good example of that. It went from 0.71 to 0.75. The change – and the rationale for changes in the value, one, is some to do with more efficient technology.

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Some of it is a realignment in the inputs for how the values are developed, either a change in materials, change in light levels which might require either more light or less light depending on what the space requirements are, and the guidance from the Illuminating Engineering Society. So there's multiple inputs that affect these values. Many did decrease because of changes mostly in technology, but I did want to call out a couple other changes.

Similarly the space by space method. So the previous one is if you have a whole building and you don't want to break it down and analyze the space, you would take that single value – this is the space by space method where you break down the whole building by each room, calculate the area for it, and then find it in a lookup table. Again, many of the values decreased; however, there's a handful that didn't decrease. Again, those were really changes in materials that were more standardized for those types of spaces. Food preparation is a great example. When the model input was being –

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developed, there were some changes in how food preparation spaces really are in reality now versus how they've previously been modeled, and that's why that value's slightly changed. Other ones were a major change from halogen technology. The lobby hotel is

a large shift. You can see that's really a shift from a standard halogen source to the much more efficient LED source. So that's why, again, a lot of different changes in the values, but that's how the background works and why the values are as shown.

Also a change is a requirement to use the space by space area method for spaces that actually are not built out, unfinished spaces, shown in the image on the right. This is really just an issue for core and shell buildings, and again it's a clarification in compliance. It was unknown sometimes how you applied it. This is shown here in two different sections. It first dictates that you're going to use the space by space method, and then second, it provides –

[1:07:00]

a value to use – a default value if you don't use anything at all.

There were a number of proposals related to daylighting changes. The first one is just that C405.2 – it removes an exception. This is a light reduction control requirement already that existed, and it had an option for an exempting for spaces that were daylight zone. They didn't have to do it. And this removes that exception. It also – some of the daylighting changes expand the continuous full range of dimming. Previously the IECC only had a handful of spaces where you were doing daylight dimming. Those spaces had to have full dimming down to 15 percent, full continuous dimming. Now this says all the spaces where you're doing daylight dimming should have that full continuous dimming, and that's really based on the shift from fluorescent –

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to now LED which allows for continuous dimming much easier than the way we used to do it with fluorescent. It also clarifies some language related to daylight-responsive controls, and the other major change in the daylighting section is adding a secondary side-lit zone and also one of the changes revises how the side-lit zone is exactly defined. So the idea there is that you have a primary zone, which is really a certain zone dependent on your architectural configuration, that's adjacent really to the side lighting, which is your vertical fenestration along on a building, and there's a certain distance where that's called the primary zone. And then beyond that where daylight can penetrate depending on certain circumstances, that's your second side-light zone. So the difference – it creates that and has some parameters on how it works.

Another change is a requirement related to parking garage lighting controls. These four pictures really show why it makes a lot of sense. First, you need to have –

[1:09:00]

an automatic time switch. The picture in the upper left is actually taken at 1:00 a.m. in an exterior parking garage, and you can see all the lights are on. So there are some requirements, and think about that as what IECC says about time switch. The picture on the right also shows kind of why you might want to also look at occupancy sensors. So IECC requires the lighting to be reduced by 30 percent when no activity in the lighting zone for 20 minutes, and your control zone is 3,600 square feet. That's consistent with some other energy codes, and again the upper right image showing a completely empty floor and yet all the lights are on at full output shows why that makes a lot of sense.

In addition, parking structures are often used during the daytime and they can get a fair amount of daylight, especially 30 to 40 feet from the perimeter. So the idea is shown in the bottom right that lighting within 30 feet of the perimeter, opening, and fenestration – there are some requirements – if it's a sold wall obviously don't have to do it. But if you're bringing daylight into that parking garage within the first 30 feet, you need –

[1:10:00]

to be able to reduce it by 50 percent.

And the final requirement is what's called the daylight transition zone. That's the image on the lower left. The idea with the daylight transition zone is to provide a lot more light than normal in the rest of the parking garage only at the entrances and exits so your eye can adapt to the normal daylight when you leave the parking garage. The problem is that at night, you're actually putting too much light in their eyes because you're really trying to mute that daylight adaptation during the day. So the requirement here says that at night you actually dim down that daylight entrance zone which makes it better and easier on people's eyes as they enter and exit parking garages.

And beyond parking garages occupancy sensors also had some modifications. One is that there was a list of spaces where occupancy sensors were required. Corridors were added to that as

shown in the image on the right. You must reduce by a full 50 percent –

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of power within 20 minutes of occupants leaving the corridor. It also modifies how occupancy sensors in warehouse spaces were configured. Lighting each aisleway – so if you think about rows and rows of shelving and then lighting between them, that essentially the lighting in between them creates your aisleway. You must now do them independently and they have to have a 20-minute timeout. That's because many times people may only be in one aisle and not all of them, and therefore you can dim down those other aisles when people are not in them at the time.

And also occupancy sensors also incorporated a requirement that manual control allow for occupants to turn off the lights. And then there was also an exception to occupancy sensors in open-plan offices that states where general lighting is turned off by a time switch, control complying with that. So there was an exception of not using occupancy sensors in open-plan offices only if you're already also using a time switch.

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Beyond occupancy sensor controls, there's also the enhanced digital lighting controls. This is again some clarification text. It adds the word general to lighting so that defining on what types of lightning needed to apply and meet those requirements for the enhanced lighting controls, and it also removed a provision for individual user control of overhead general illumination, in open offices again. As previously written it applied to all lighting, and so the challenge there was if you had a decorative fixture over let's say a lobby desk as well as the other type of normal, general lighting in that open plan, did it really apply to every lighting in that space? Decorative fixtures can have some challenges related to controls just because of the nature of their design, so that's why it only applies to the general lighting. Also the previous provision said it had to apply to all the lighting, so the question was is that the lighting over your workstation in an open plan or –

[1:13:00]

the entire floor? So this just added some clarity to how that all applies.

Finally, exterior lighting. So luminaires that are serving the outdoor parking area that have a wattage greater than 78 watts and a mounting height less than 24 feet or lower shall be connected so that lighting is reduced by at least 50 percent after 15 minutes of inactivity. The reason why those values are 78 watts is really near the threshold of where cost effectiveness applies. The 24 foot is also a limitation of some current devices and how well they can detect occupancy. When you start moving into the 30- and 40-foot mounting heights of typical light fixtures in some applications, certain sensors have some insensitivity issues. And so that's why it's set at those two values.

Also there was a change here that it removes the requirement for exterior lighting power, that it's –

[1:14:00]

powered through the energy service of the building. There are some standalone parking lots and other parameters where not all the power comes directly to an attached building. It might come from a different position, and that's how that addresses that.

And at this time I think I'm being fed questions as well as my teammates that we are going to answer now.

Rosemarie Bartlett: Yes – thank you, Michael. We are gonna move on to the questions, and I think we'll start with Mike Tillou. Mike, do you have some questions to go over?

Michael Tillou: I do, a lot of good questions. I'll try and get through as many as I can here in the time I have. One question was, "Will the new higher R values apply to remodels and re-roofs?" And I think the answer to that is that the requirements for alterations that are in the IECC –

[1:15:00]

have not changed this cycle. So the new higher R values will be applicable in the same instances as the current requirements in IECC 2018. I think re-roofing is one of the exceptions where requirements don't apply, but other cases where the alteration requirements would require you to use – to comply with the new construction requirements, those would still apply.

Someone asked whether the envelope – the ASHRAE 90.1 2016 envelope U and R value requirements were generally consistent

with 90.1 2019. The opaque envelope requirements in 90.1 9016 and 90.1 2019 are the same; however, the –

[1:16:00]

fenestration requirements and U values in solar heat gain coefficients are different between ASHRAE 90.1 2016 and ASHRAE 90.1 2019.

Someone asked a question whether the slab insulation mandatory requirements deal with post-tension slabs. I have to admit I'm not an expert on post-tension slabs, but I believe that the new – the language requires that insulation be continuous under the entire slab except for places where you have structural columns or surface penetrations. So I would think that that would – should cover post-tension slab. I apologize if there's a – some other aspect of _____ tension –

[1:17:00]

slabs I'm not quite sure about that might impact that differently.

Someone asked if the air barrier test is the same as a blower door test. Yes, blower door testing would probably be the most common way that you would do your air barrier testing.

And then there's another question – I'll do one more – and that asks whether the code has any requirements for insulation for exterior floors that separate an unconditioned space below an occupied space. And the requirements were extending that insulation out past the footprint of the building – a conditioned building above that has a smaller footprint than the unconditioned area.

[1:18:00]

And I don't believe the code addresses specifically that situation, so I think you would need to probably work with your AHJ at the local level to figure out what they would require.

So with that, I'll hand it back to Rose.

Rosemarie Bartlett: All right, thanks, Mike. We'll go next to Reid. Reid, do you have any questions to answer?

Reid Hart: Yes, I do. Let me hit a few of them here. So there was a question about fault detection and did it apply to non-DDC controls in the

system, and I think if you've got a building over 100,000 square feet the answer is yes. And I think the example in the question is smart thermostats. I think there are smart thermostats available that would have some of their own fault detection. There are smart packaged-unit –

[1:19:00]

controls that are part of the package unit that have some smart controls. Certain for economizers there are diagnostics built in. So yes, for over 100,000 square feet you would have to make sure that all of your individual controls report back to a central location, even if it was not a centralized EDC system.

Ah, here's a good one – COVID, COVID affecting this idea of optimum stop or ventilation. Well, I think one thing to be aware of is that the code itself does not directly impact the operation of the building. And if we're in what I would call an emergency situation as we are, you might suspend some of these control sequences. A new building being built would have to have that control sequence available. It might be suspended temporarily, but once we get past the COVID situation we'd likely – you know, you'd want that –

[1:20:00]

capability to then restore that type of control and make it available.

There was a question on hotel occupancy controls, what the changes are, and it was mostly clarification. The only change was going to a 20-minute timeout instead of a 30-minute timeout with the occupancy sensor used in the room.

And there was a question on escalator or moving walkways. Is it recommended to move faster if there is more traffic? The code addresses slowdown when there's no traffic, and that's – they're looking for that energy reduction. You know, any operator or different manufacturers could provide different sequences related to that. The reference is AFME A1 7.1 or CSAB 44 or some local codes –

[1:21:00]

apply to how you're gonna operate a walkway in an airport or an escalator. So I would look to those standards to get questions, or – there are requirements that you not speed up too fast or slow down too fast and that sort of thing.

Another question on efficiency credits: Is measure life taken into account? And the answer is not at this time. Those are based on first-year savings. That's being considered. In 90.1 we're going through the debate on efficiency credits and people are leaning towards simplicity and not to include measure life. But it's been a debate going back and forth.

And then one area of tenant infill or fit-out if that's handled separately, what's required of the shell with the – right now the way the code is written, and it could probably use some clarification and there may be some –

[1:22:00]

negotiation with the local jurisdiction, is that the initial core of the building with the shell has to meet the full credit requirement. Now it can meet that with – you know, it gets credit for the lighting that is installed at that time being, you know, reduced, or the UA or the photovoltaics or a combination. So frankly they could probably meet it with the lighting requirement in hallways and common spaces. And then the tenant fit-out is where if they are actually not required to do the full points, but if the main building met it with PV or some other things, then you know, if they used the lighting credit to meet it, then the tenant space also has to meet it with half the credits.

All right, I will pass it along. I've got a few more, but….

Rosemarie Bartlett: Okay, great.

[1:23:00]

Thanks, Reid. All right, Michael, any lighting questions, power questions for you to answer? All right, Michael.

Michael Myers: Thank you very much for _____. Yes, a handful of questions, both lighting as well as power, and thank you for the questions. I'll jump in with the antimicrobial lighting question. The person asks, "Would this exception also cover lighting use to prevent COVID-19?" Small difference – the exception for the antimicrobial lighting deals with lighting that is solely for use for antimicrobial or disinfection. So there are some light fixtures that are dual purpose. That's normal lighting when I'm in the space; then when I leave overnight it bathes the space in that special type of spectrum. It's all about how you calculate that special type of spectrum _____

power. In terms of preventing COVID, that's a different issue. All this issue does is disinfect the space, either the materials in the space or the surfaces.

[1:24:00]

So it's the antimicrobial aspects or UVC depending on what you're using, but yes, that would be exempted from the calculations.

Two questions related to metering. The first one is, "Are the meter requirements in IECC 2021 more stringent than the requirements of 90.1?" I haven't done a full, thorough comparison. So far they're very similar. I'm having a hard time finding the exact – which one I would call more stringent at the moment. There's a lot of similarities, though, in building size, output requirements, and a few other things. So at the moment I'm gonna pass on which one's more stringent.

But a person did ask this question related to metering as well. "Will C405.10 apply to hotel guest rooms?" Now 90.1 – since they're somewhat related I'll mention this. 90.1 does exempt dwelling units, which you could say is somewhat in that hotel guest room category. I was reading through the text while I was waiting.

[1:25:00]

I'm not seeing that currently in the IECC text, but we also are looking at a draft and not the finalized version. So at the moment I don't have a good answer on how it will relate to hotel guest rooms, but I know that's a question that's been addressed before. So we'll wait and see how IECC will officially address that answer.

And then there's just two items about daylighting that I'll address before I turn it over, I guess. If a daylight zones does not have any lights in it, you still have to provide responsive controls. I think there's a clarification issue there. The daylight zone is defined by both an architectural characteristic of how much light is coming into the space, but then also the connected wattage. So if you don't have light fixtures in the space, there are no controls required. If you have fixtures in the space but they don't meet the wattage threshold requirement, you're still not required to do the daylighting controls. It's only if you meet the daylighting architectural requirements and the connected load wattage –

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to then have to do the daylight responsive controls. I think the question relates to a more nuanced control question and I can follow up more separately. But I'll turn it back to you, Rose.

Rosemarie Bartlett: All right, thanks very much. Thanks to all the speakers and thanks to all of you for tuning into the US Department of Energy's NECC seminar series. As a reminder, we still have a great lineup of topics coming, so we hope you'll join us Thursdays at 1:00 Eastern time and keep the conversation going. Thanks again for joining us, everyone.

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