Overview of Commercial Mechanical Requirements of 2009 IECC
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Rosemarie Bartlett: Welcome, ladies and gentlemen. I'm Rosemarie Bartlett with the Pacific Northwest National Laboratory, and I'd like to welcome you to today's webcast, an Overview of the Commercial Mechanical Requirements of the 2009 International Energy Conservation Code brought to you by the U.S. Department of Energy's Building Energy Codes Program.

At this time, all participants are in a listen-only mode.

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A few logistical announcements before we begin. You may ask a question at any time during the webcast today by using the Q&A menu on your computer. Questions will not be answered via the computer but will be answered live by the presenter as time allows at the end of the presentation. Please do not wait until the end of the presentation to ask your question. Get it in the queue as soon as possible.

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Lastly, a copy of the presentation is available, and the link was provided to you in your confirmation email that was sent this morning.

We're very happy to have as our speaker today Michael Rosenberg of the Pacific Northwest National Laboratory Mike, please begin.

Michael Rosenberg: Thank you, Rose. Welcome to an Overview of the Mechanical Requirements of the 2009 International Energy Conservation Code. This section of the IECC applies to non-residential buildings. Non-residential buildings refer to buildings other than one- and two-family residential dwellings and residential buildings that are R-2, R-3, and R-4 that are three stories and less in height.

The process for complying with the IECC, you need to comply with envelope requirements, mechanical and service hot water heating requirements, and lighting requirements. You have two choices. You can either comply with the IECC in its entirety or an alternative you can comply with ASHRAE Standard 90.1 in its entirety. If you comply with the IECC, that's Sections 502 for Building Envelope, 503 and 504 for service hot water heating and mechanical requirements, and 505 for lighting requirements. If you comply with ASHRAE Standard 90.1, it's Sections 5, Section 6, and Sections 9. One important difference in this version of the IECC is that you must comply with either the IECC or Standard 90.1 in its entirety. In previous versions of the IECC, you could comply with one of the chapters from Standard 90.1 and the rest from the IECC, but that is no longer allowed. You must document your compliance with the IECC. There is plan review and inspection.

Section 503 is the section of the IECC that has the requirements for building mechanical systems. That has been simplified in the 2009 version into four sections. There are General Requirements, Section 503.1. Mandatory Provisions that apply regardless of the system type that you have, 503.2. There's requirements that solely apply to Simple Systems, 503.3. And requirements for Complex HVAC Systems, 503.4.

The mandatory requirements, as I mentioned, they apply to all mechanical systems, among those are HVAC load calculations, equipment sizing requirements, HVAC equipment efficiency requirements, system controls requirements, ventilation requirements, interview recovery ventilation requirements, requirements for duct and plenum insulation, and piping insulation, HVAC completion document requirements, air system design and control requirements, fan power requirements, and requirements for heating systems outside of a building.

The first of those requirements, load calculations, the IECC requires heating and cooling load sizing calculations to be performed, and you must use the procedures in ASHRAE/ACCA Standard 183 or other approved procedures. The exterior design conditions are those specified by ASHRAE. The interior design conditions are specified by Section 302 of the IECC, and those conditions are less than or equal to 72 degrees for the heating load calculations and greater than or equal to 75 degrees for the cooling load calculations.

There are requirements for equipment and system sizing. The equipment capacity shall not exceed the calculated load that you are required to do, and that is either for heating or cooling, whichever is greater. If you select equipment with a capacity that meets that the sizing for the greater of the heating or cooling load, it may be oversized for the remaining either the heating or cooling load and that is allowed. There are also exceptions for standby equipment that is not running at all times. That can exceed the sizing; and if you have multiple units with whose -- the sum of whose capacity exceeds the sizing load, the loads that are sized, that is allowed as well as long there are sequencing controls.

There are requirements for HVAC performance, minimum efficiency requirements. Those are contained in Tables 503.2.3(1) through 503.2.3(7), and these tables and equipment efficiency requirements apply to all equipment used in heating and cooling of buildings such as chillers, boilers, air conditioners, furnaces, heat pumps, et cetera. There is an exception from the requirements in the tables and that is if you've got water-cooled centrifugal chillers that operate at non-standard conditions, there is an adjustment factor. It's called the k_{adjust} that you can use to modify the IPLV, which is the efficiency metric used for chillers integrated part load performance.

This is an example of the one tables, 503.2.3(2) for unitary air conditioners and condensing units. As you can see, it lists the equipment type, the size category, the equipment, the subcategory of the equipment, the efficiency requirement. in this case the metric is SEER EER IPLV and then the test procedure AHRI or ASHRAE Standard Test Procedure is referenced.

This table 503.2.3(3) is for packaged terminal air conditioners and heat pumps. Similar layout - the equipment type, the size capacity, the rating condition, the efficiency requirement, and the test procedure.

There are a number of requirements for - - mandatory requirements for system controls. One of the most important being that you're only allowed one temperature or humidity sensor controller per zone, and that is so you don't have pieces of equipment fighting each other. If you had two thermostats controlling two different pieces of equipment in a zone, one could be in heating, one could be in cooling, and that wouldn’t be a good thing.

If you've got a heat pump, you must include a heat pump specific thermostat which limits the amount of electric resistance heat that the heat pump can use.

There's requirement for demand control ventilation, and demand control ventilation is a control strategy that provides for reduction in outdoor air below design rates when the actual occupancy of a space is less than the design occupancy. So that is you reduce, generally this is done by $C0_2$ sensing devices, but that's not the only way that you can implement demand control ventilation. But there… If you have a zoned or a space greater than 500 square feet with a high average occupant density, and that is an occupant load defined as greater than 40 people per 1,000 square feet or 25 square feet per person, and the HVAC system has an air-side economizer or modulating control of the outdoor air damper or more than 3,000 cfm of outdoor air, if it's meets any of those three requirements and that load factor and the size, you must utilize some form of demand control ventilation. And demand control ventilation, the types of spaces that it normally applies to are things like auditoriums, dining rooms, gymnasiums, those types of spaces that are large and have high occupant densities.

There are some exceptions to the demand control ventilation requirements, a number of them. If you've got a system with energy recovery that meets other portions of this - - other sections of Chapter 5, you don't need to do demand control ventilation. If you've got a multi-zone system that does not have DDC control of individual zones controlling to a central control panel, you don't need to do demand control ventilation. If you've got systems with outdoor airflow rate less than 1,200 cfm, you're exempt and if - - or if you've got a space where the supply airflow minus any makeup or outgoing transfer air is less than 1,200 cfm. An example of this might be a dining room which is transferring air to a kitchen hood exhaust system, so the dining room is providing the makeup air so there is less than 1,200 cfm left to do the demand control ventilation, you can't control - - you can't turn down any lower, otherwise you won't provide, be providing enough makeup air for that kitchen. That would be an example.

There are requirements for energy recovery ventilators. This is - - applies to any individual HVAC system that has a design supply air capacity of greater than 5,000 cfm and an outside air supply greater than 70 percent of that design supply airflow. The effectiveness of that energy recovery device must be equal to or greater than 50 percent.

There are a number of exceptions to the ERV or Energy Recovery Ventilator Requirement. If energy recovery is prohibited for that application by the IMC, the International Mechanical Code, you're not required to do it. Examples of that would be spaces that are exhausting toxic fumes or kitchen grease hoods. If you have those types of applications, you're not required to do energy recovery from them. If you've got a laboratory fume hood system, you've got some alternatives. Instead of the energy recovery ventilation, you can install a VAV fume hood exhaust system that reduces the flow from that system to less than 50 percent of the design value, that gives you an exemption. If you've got direct makeup air to the exhaust hood system that's at least 75 percent of the exhaust rate and minimally conditioned and the requirements for that are heated no warmer than 2 degrees below room setpoint and cooled to no cooler than 3 degrees above of room setpoint, you also cannot humidify that air and you can't do any simultaneous heating and cooling for dehumidification control. So if you meet those requirements for a lab fume hood system, you don't need to energy recovery ventilation. If you've got a system serving an uncooled space and a space that's heated to less than 60 degrees, you do not need to do energy recovery ventilation. There just isn't very much energy to recovery from that space. Where 60 percent of the outdoor heating energy is supplied by site recovered or site solar energy, you're exempt. Heating systems in climates of less than 3,600 heating degree days are exempt, and cooling systems in climates with a cooling design wet-bulb temperature less than 64 degrees are exempt. Systems that require dehumidification that use energy recovery in series with the cooling coil are exempt, and really what they're exempt from is the efficiency requirement, the requirement for 50 percent recovery effectiveness.

There are requirements for duct work and plenum insulation and sealing. This is required for all supply and return ducts as well as plenums. If the duct or plenum is located in unconditioned space, you're required to use R-5 insulation, and that's an unconditioned space within the building. If it's located outside of the building, R-8 insulation is required; and located within the condition space, no insulation is required. You may want to use insulation on ducts that supply cool air for condensation purposes, but it's not required for energy conservation.

There are requirements for duct sealing. Low pressure and medium pressure duct work and that's ducts designed to operate its static pressures less than or equal to 3 inches, those are classified as low and medium pressure duct systems. For those systems, all joints and seams must be sealed and fastened and that includes both longitudinal and transverse seams.

For high pressure duct work, and that is ducts that are designed to operate at static pressures greater than 3 inches, those systems need to be leak tested in accordance with the SMACNA HVAC Duct Leakage Test Manual. There's a maximum air leakage rate, CL, and that must be less than 6, and that's given by the formula CL equals F times P raised to 0.65 power. F is the leakage rate per 100 square feet of duct surface, and P is the test condition static pressure. A minimum of 25 percent of the duct area must be tested and must meet the maximum leakage rate.

There are requirements for piping insulation, and this is all hydronic systems. Heating and cooling piping systems must be insulated according to the values in the table shown below here, and those values are dependent on the diameter of the pipe less than or equal to 1.5 inch pipe and greater than 1.5 inch pipe and also the type of fluid that the pipe is conveying - steam, hot water, chilled water, brine, or refrigerant. And then within the body of the table, it gives you the pipe insulation in inches, and this is based on a standard pipe insulation with standard conductivity values. If you use non-standard pipe insulation, you can still do that, but you've got to do a calculation to determine the thickness of insulation that is required and there's some information provided in Section 503.2.8 that gives more direction on that calculation.

There are a number of exceptions to the piping insulation table. Piping that's integral to HVAC equipment, including packaged units, fan coil units that's factory installed and tested does not need to be insulated to the level in the table. If you've got piping conveying fluids that are within the temperature range of 55 degrees and 105 degrees, you do not need to insulate that piping. If you've got piping for fluids that are not heated or cooled by electricity or fossil fuels, that piping need not be insulated. And the finally runout piping between a controlled valve and an HVAC coil does not to be insulated provided that that runout piping is less than or equal 4 feet in length and 1 inch in diameter.

There are a number of HVAC system completion requirements. Air system balancing, hydronic systems must also be in - - must also be balanced, and O & M Manuals must be provided. And those O & M Manuals must include equipment capacity and required maintenance procedures, HVAC system - -

HVAC control system maintenance and calibration information, including wiring diagrams, control sequences, and system setpoints, and also a written narrative of each systems intended operations.

There are requirements for maximum allowable fan motor horsepower, and this applies to any HVAC system with a total fan system power greater than 5 horsepower, and that's the sum of all the fan motors within the system supplying, returning, and exhausting air from that system, and it's calculated at HVAC design conditions, and the fan motor horsepower cannot exceed the allowable system power shown in the table below and there are two options. The options are based on name plate horsepower and fan system brake horsepower, and the limits are determined by the supply cfm of the system times a multiplier, and as you can there is a different multiplier for constant volume systems and variable volume systems as well as a different multiplier for each option nameplate versus brake horsepower option. The nameplate option is a simpler option. There are… No calculations are involved; it's just based on the nameplate that's actually the nameplate denominal size of the motor while the Option 2 brake horsepower gives you some more flexibility in that there are adders allowed for systems with devices that have increased pressure drop, and that's the term A that's added to the end of the equation under Option 2, and we'll take a look at what some of those adders are.

This table is from the chapter that shows the adders, and I won't go through them all, but the adders are for things like fully ducted return and exhaust air systems give you a 0.5 inch of pressure drop added to your calculation, return or exhaust systems with air control - - airflow control devices give you an adder, different levels of filtration beyond standard filtration levels give you an adder. Heat recovery devices, humidifiers, and sound attenuation devices also give you an adder so that you can get increased fan motor horsepower windows devices that add increased pressure drop are required in your system.

There are a number of exceptions to the fan motor horsepower requirements. If you got a hospital or laboratory system that uses flow control devices on the exhaust or return side, even if that system is constant volume, you are allowed to use the variable volume limitation, so that gives you a little bit more fan power. Individual exhaust fans that are less than or equal to 1 horsepower need not be included in the calculation, nor fans that exhaust air from fume hoods, those are not included in the calculation as well.

There is a requirement to select nominal motor sizes that are only a certain amount larger than the calculated brake horsepower for a fan motor. In general, the selected fan motor must be no larger than the first available size greater than the calculated brake horsepower, and that is the fan brake horsepower that is shown on the design documents and that must be shown on the design documents. There is an exception or two exceptions. If you've got fans less than 6 brake horsepower and the first nominal motor size greater than the brake horsepower is within 50 percent of the brake horsepower, you can go up to the next larger motor size. If the fan is greater than 6 brake horsepower where the first available motor size larger than the brake horsepower is within 30 percent of the brake horsepower, then you can also go up to the next larger size motor.

There are requirements for heating systems located outside a building and these have become very popular now with bans on smoking in bars and restaurants, many of those applications have set up exterior areas for smokers and many of those are heated, so those types of systems need to be radiant systems. They need to be controlled by either an occupancy sensor device or a timer switch, and the intent here is that - - so that that system does not run when there are no occupants present.

Okay that includes an overview of the mandatory requirements that apply to both simple and complex systems. Now we'll talk about some of the individual requirements for either simple or complex systems.

First, simple systems. And simple systems are unitary packaged, single zoned systems controlled by a single thermostat within the zone served and those systems include unitary packaged heating and cooling systems, split system heating and cooling systems, packaged terminal air conditioners and heat pumps, fuel-fired furnaces and unit heaters, electric resistance heating, and two-pipe heating systems without cooling. So that's the only type of hydronic system that is included, a 2 pipe system heating system without cooling.

All simple HVAC systems must include an air side economizer dependent on the climate zone, and that air side economizer must be capable of providing 100 percent outdoor air even if additional mechanical cooling is required to meet the load, and that's generally referred to as an integrated economizer. In addition, means must be provided to relieve the excess outdoor air when the economizer is functioning.

The economizer, as I mentioned, is required only in certain climate zones, and this is the Climate Zone Map of the Continental United States. The 2009 IECC has eight climate zones, eight main climate zones. Seven of them are within the

Continental United States and Climate Zone 8 is only found in Alaska. These are also broken down into sub climate zones - Marine, which is Sub B - sub C, Dry B, and Moist A. So for example, you could have 5A, 5B, and 5C.

This is the table that tells you which climate zones require economizers. So in Climate Zones 1A and 1B, that's moist and dry, and Climate Zone 2A moist, and all of Climate Zone 7 and 8, there is no requirement for an economizer in any instance. All the other climate zones, economizers are required on any cooling system greater than 54,000 Btus per hour. And there's also this Footnote A, you can't have more than 480,000 Btus per hour of small equipment less than 54,000 that's exempt from the economizer requirements, so that's 40 tons. You couldn't have… You can't have a big building with more than 40 tons of small equipment that's exempt or 20 percent of the total cooling capacity, whichever is great. So if you had a very, very large building and 20 percent was more than 40 tons, then you could exempt up to 20 percent from the economizer if those systems were less than 54,000 Btus per hour.

There's also a trade-off table, which gets you out of the economizer requirement if you provide high efficiency cooling equipment in excess of the minimum standards, the minimum requirements. You're exempt from the economizer requirement and that's shown here in this Table 503.2.1(2) *[sic]*; and depending on the climate zone, it tells how you much better than the minimum requirements your cooling system needs to be in order to be exempt from the economizer requirement - 10 percent in Zone 2B, 15 percent in 3B, and 20 percent in 4B. In the other climate zones that aren't shown in the table, there is no efficiency improvement that can get you out of the climate zone requirement, so that would be Climate Zones 5 and 6, I believe.

Okay, requirements for complex HVAC systems and those complex systems include anything that is not categorized that does not fit into the simple system definition and they include systems like packaged VAV systems with reheat or without reheat, built-up VAV systems, single fan VAV, dual-duct fan - - dual-duct VAV systems, single or dual-fan dual-duct VAV systems, 4-pipe fan coil systems with a central plant, water source heat pumps with a central plant, any multiple zone system at all and any hydronic system that has cooling as well as heating.

There are economizer requirements for complex systems. In general, they're very similar to the economizer requirements for simple systems that we just discussed, the air side requirements are pretty much the same. It includes a trade-off exception, requirements based on climate zones, and size of equipment exception, same tables that were used for the simple systems. There is one additional exception. If you provide a water side economizer that's capable of providing 100 percent of the cooling system load at 50 degree dry-bulb/45 degree wet-bulb temperatures, then you're exempt from the air side economizer requirements.

Variable air volume fan control. If you've got a variable air volume system with a fan motor - - where the fan motor is greater or equal to 10 horsepower, that fan motor must be either driven by a mechanical or electrical variable speed drive or have controls or other devices that result in a fan motor demand less than 30 percent of the designed wattage at 50 percent of the designed airflow. An example of that might be a vane axial fan with a variable pitch blade might meet that requirement. And that's shown on the fan part load curve below, the point at which that it must meet 30 percent fan power/50 percent airflow.

There are a number of hydronic system controls. There are limits to the reheating and recooling of fluids. There's requirements for multiple boiler plants to include automatic controls that sequence the operation of the boilers; and if you've got a large single boiler plant greater than 500,000 Btus per hour, you must include either a multi-staged or modulating burner.

Another requirement for hydronic systems. 3-pipe systems are not allowed, systems that supply hot water through one pipe, cold water through another pipe, and return through a common pipe. That mixing of heated and cooled water through a return pipe is not allowed. You are allowed to have a 2-pipe changeover system. But if you do, you must have a dead band of 15 degrees outside air temperature before you can switch between heating and cooling in that 2-pipe system.

There's a number of requirements for water loop heat pump systems. For the loop itself, there must be a temperature dead band of at least 20 degrees before you switch between rejecting or adding heat to that loop. There is an exception. If you've got a controller that optimizes the efficiency of that loop and can determine the most efficient operating temperature based on realtime conditions of demand and capacity, then you don't have to abide that 20 degree dead band. There's some requirements for the heat rejection equipment for water loop heat pump systems. In Climate Zones 3 and 4, if you've got a closed-circuit cooling tower that's directly in the heat pump loop, you must isolate that tower either by using automatic control valves or positive closure dampers so that you can bypass all but minimal flow through the water - - of water through the tower when you don't need the heat rejection. If you've got an open circuit tower directly in the heat pump loop, you are required to use the automatic valves. You cannot use the positive closure dampers so that you bypass all heat pump water flow around the tower. If you've got an open-circuit tower used in conjunction with a heat exchanger that isolates the tower from the heat pump loop, that must - - you must control the heat loss by shutting down the circulation pump on their cooling towers so that you're not rejecting heat through the cooling tower when you don't need to be doing that, and that was Climate Zones 3 and 4.

In Climate Zones 5 through 8, if you've got either an open- or closed-circuit cooling tower, you must have a separate heat exchanger to isolate the cooling tower from the heat pump loop and the heat loss must be controlled by shutting down the circulation pump on the cooling tower loop and providing automatic valves to stop the fluid - - the flow of fluid. For the heat pump loop itself, you're required on each heat pump for systems that have a total system pumping power greater than 10 horsepower, each of the heat pumps must include a 2-way valve to isolate that heat pump and prevent flow through it when it's not running.

For any hydronic system greater than 300,000 Btus per hour, you must include either a temperature reset or a variable flow on that hydronic system. If it's a… If you use the temperature reset path, you must include automatic controls for resetting the supply water temperature by at least 25 percent of the difference between design supply and return flow. If you use the - - go the variable flow path, you must reduce the system pump flow by a minimum of 50 percent of design flow using either multiple staged pumps, adjustable speed drives, or control valves that modulate as a function of load.

If you've got a chiller plant with multiple chillers, you must have the capability to reduce flow through chillers that are not needed automatically when that chiller is shut down, and that's for chillers that are piped in parallel. If the chillers are piped in series, it's considered one chiller and you don't need to isolate that chiller. If you've got multiple boilers in a boiler plant, same thing, you must have the capability to reduce flow through the boilers when the boiler is not needed.

Cooling tower heat rejection equipment requirements, each tower fan or heat rejection equipment fan powered by a motor greater than or equal to 7.5 horsepower must include variable speed or variable speed drive or 2-speed - - variable speed or 2-speed fan. They need to have controls that automatically change the fan speed to control the leaving fluid temperature or the condensing temperature or pressure of the heat rejection device. There is an exception, if you've got factory-installed heat rejection devices within condensers and chillers that are tested and rated in accordance with the Efficiency Tables 503.2.3(6) and 503.2.3(7), they do not need to include those tower motor fans or the fan controls.

Multi-zone system airside control requirements. If you've got a multiple zone system, it must be a variable air volume system. There are some exceptions. We'll get to those in a couple minutes, but the variable air volume system must be designed and capable of being controlled to reduce the primary supply airflow to each zone before reheating, recooling, or mixing takes place. And there is a maximum… It must be reduced to a certain amount. There's a maximum flow of air that can be reheated, recooled, or mixed, and that flow must meet - - that maximum flow must meet one of the three following - - three of the following: It must be either 30 percent of the maximum supply airflow to each zone or less,

less than 300 cfm total where the maximum flow is less than 10 percent of the total fan system supply airflow rate, or that amount can be up to the minimum ventilation requirements of Chapter 4 of the International Mechanical Code. So you're allowed to reheat as much air as required for ventilation purposes.

Now as I mentioned, there are some exceptions to the variable air volume system requirements. If you've got zones with special pressurization or cross-contamination requirements, they're exempt, and some examples of that might be hospitals or laboratories need not use VAV controls. If you've got systems where 75 percent of the reheat energy comes from site recovered or solar energy sources, you do not need to use VAV systems. If you've got zones with special humidity requirements, they're exempt from the VAV requirement. If you've got a zone with less than 300 cfm supply airflow rate, peak supply airflow rate, and that flow rate is less than 10 percent of the total system supply airflow rate, you're exempt, zones where the reheated, recooled, or mixed volume or mixed air volume is less than the minimum ventilation requirements from Chapter 4 of the IMC, very similar to the exception we discussed earlier. And then if you've got systems that have controls that prevent reheating, recooling, or mixing of supply air that's been previously heated or cooled, that is exempt as well.

If you've got a single duct VAV system, you're required to have terminal devices capable of reducing the supply of primary air before reheating or recooling takes place, and that's a typical VAV terminal unit shown below.

Dual duct systems must also have terminal units that reduce the flow from one duct to a minimum before it's mixed with the other duct.

There are supply air temperature reset control requirements. If you've got a multi-zone HVAC system, it is required to - - you're required to automatically reset the supply air temperature in response to building loads or outdoor air temperature, and the idea here is to raise the supply air temperature so that you're limiting the amount of reheat that you're doing to only the necessary amount. Those controls must be capable of resetting the supply air temperature at least 25 percent of the difference between design supply air temperature and design room air temperature. There are a number of exceptions for that. If you've got a system that prevents reheating, recooling, or mixing of heated and cooled supply air, then you don't need to reset it. If 75 percent of the energy for reheating is from site-recovered or site solar energy sources, you don't need to do the supplier reset, and specific zones with peak supply airflow quantities less than or equal to 300 cfm are also exempt from the reset requirements.

There are requirements for heat recovery of service hot water and these are - - apply for systems where or systems or buildings where hot water loads are very large and well distributed throughout the day and that's where they're most effective. You're required to recover condenser heat to provide heating or reheating of the service hot water, and this requirement comes into play if you've got a facility that operates 24 hours a day. If the total installed heat rejection capacity or the total installed heat capacity of the heat rejected - - rejection of water cooled systems is greater than 6 million Btus per hour and the supply - - and the service hot water load is greater than 1 million Btus per hour, this is required. And the types of applications where you typically find these - - where you typically - - these requirements typically kick in would be hotels, dormitories, prisons, and hospitals. And that condenser heat recovery system must have the capacity to provide either 60 percent of the peak heat rejection capacity at design conditions or to preheat the service how water to 85 degrees during peak conditions as well. The exceptions for that is if you've got recovery heat used for space heating or when service - - when the recovered heat is used for space heating, then you wouldn't have any available for service hot water heating, that's allowed. Or when the service hot water heating is provided by renewable energy or site recovered energy sources, you also don't need to do the heat recovery, the condenser heat recovery.

Section 504 are the requirements for service water heating systems. There's an Efficiency Table 504.2 which gives minimum performance of water heating equipment. It covers various - - a variety of types of hot waters including electric storage heaters; gas and oil storage heaters; instantaneous water heaters, both gas and oil; hot water boilers; swimming pool heaters, and just unfired storage tanks as well. There are requirements for temperature controls in Section 504.3 and requirements for heat traps.

Service water heating systems require a pipe insulation under certain circumstances. If you've got a non-circulating system, only the first 8 feet of outlet piping need to be insulated, provided there is no integral heat trap in the water heater and 1/2 inch of insulation is required. If you have a heat trap, then you are not required to have insulation at all. If you've got a circulating system, you need 1 inch of insulation on the entire circulation loop.

Controls requirements for hot water systems. You must have the ability to turn off the circulating hot water pump or heat trace if you're using that when the system is not in operation, and that can be either an automatic or a manual control.

There are a number of requirements for swimming pools. Swimming pool heaters must have a readily accessible on-off switch. If you've got a gas fired pool heater, you can't have a continuously burning pilot light. You must have an intermittent ignition device, and you must have a time switch or other automatic control to control the operation of that pool heater and pump on a preset schedule. There are some exceptions where public health standards require 24-hour operation, then you don't need the time switch; or where you have a pump that's required to operate solar or waste heat recovery systems, then you don't need the automatic controls as well.

There is a requirement for swimming pool covers. If you've got a heated pool, you're required to have a pool cover, and that pool cover must be a vapor retardant cover. If the pool is heated to over 90 degrees Fahrenheit not only does it need to be a vapor retardant cover but it also needs to have a minimum of R-12 insulation. And the exception to that is if you've got a swimming pool that derives 60 percent of its energy for heating from site-recovered or site solar energy, then it is exempt from the pool cover requirement.

Thank you very much. This concludes our presentation for today.

Rosemarie Bartlett: Thanks very much, Mike. Before we begin having you answer as many of the questions that have come in as possible, I'd like to put up the link where you can complete an evaluation, provide us with your AIA information if you're an AIA member, or print a certificate of completion. Please write down the link very carefully and type it into your browser and please note that the link contains a hyphen.

Now for the questions. Mike, take it away. Mike, did you mute your headset?

Michael Rosenberg: Sorry about that. Thank you. We got quite a few questions, and I'm organizing them at the moment. Let's see what we can start with right here: **Okay, there was a question about water side economizers. I noted that for complex systems, there is an exception that a water side economizer is allowed instead of an air side economizer and the person wasn't sure what a water side economizer was.** So excuse me for not explaining that in the first place. When outdoor air conditions or ambient conditions are favorable, and that's a low wet-bulb temperature, water side economizer allows cooling water returning from a building to bypass the chiller, and it can be cooled directly by the cooling tower instead of by the chiller. There's an often a heat exchanger that's used to separate the cooling tower loop from the chilled water loop, but this means that the chiller doesn't need to run during these favorable conditions.

Okay, there was a question about system sizing. The… I mentioned that you could select if you have a single piece of equipment serving both heating and cooling loads, you could supply - - you could size to select the larger of those two. And the question is that this would imply that you could size a heat pump for the heating load which would result in AC being oversized 300 percent in Zones 5 and above, which is very cold climate zones. This results in reduced humidity, removal of reduced equipment efficiency due to short cycling, increased equipment wear, increased first cost, decreased comfort. Are you sure about that? So the questioner is saying that if we oversize this equipment for cooling because it's sized for heating that the equipment will short cycle and may not work very well, and that is true. That's allowed by the energy code and obviously it's probably not a good idea and a better solution would probably be to provide multiple pieces of equipment that can be sequenced or a multi-speed compressor that can run better at part load conditions, but that would be allowed by the Chapter 5 of the IECC. There isn't… Bad design, it can't prevent that in all cases, but it tries to maximize energy conversation.

Okay, there's a question about the pump isolation requirements. Somebody didn't understand exactly what that meant. Here's a schematic of that. Basically when you have a central plant that includes multiple boilers or chillers and they're piped in parallel, as shown in this schematic, it needs to include a means to shut down the flow to each piece of equipment when it's not operating, and this would be when the system is at less than peak load. For example, only one chiller was needed, you would be required to shut the pump down to the standby chiller, the chiller that wasn't running so that you didn't waste the pumping energy of flowing water through that chiller when it was not being used.

Okay, there was a question about: I mentioned the types of exceptions for energy recovery ventilation systems per the IMC. Can you state some of those again? And I just gave two examples, and I don't have the IMC with me so whosever wanting to verify this should probably check. But I believe that the IMC has a prohibition against doing heat recovery from systems that are exhausting toxic fumes and from kitchen grease hoods as well. But that should probably be verified, but I believe that's correct.

Okay, let me look here and get some more. **Okay, how does the condenser heat recovery for service hot water save energy?** So look at the schematic for that condenser heat recovery and this applies if a facility has a water cooled chiller with a large cooling load as well as a large service hot water load and the facility operates 24 hours a day, this requirement comes into play, and you can reject heat from the chillers condenser to preheat the service hot water instead of rejecting that heat to a cooling tower which would basically be wasted heat going out the cooling tower. Instead you could use it to preheat the service hot water, so it's basically free and it applies to facilities that operate 24 hours a day, that have a heat rejection load of at least 6 million Btus per hour from the water cooled chiller and a service hot water load of minimum of 1 million per Btus per hour designed service hot water load.

Okay, couple of questions it looks like about duct insulation. Is the space above a ceiling used for return air considered a condition space? Does the duct work need to be insulated? Well if the space above a ceiling is within the conditioned boundary, the thermal envelope of the building, then it's considered conditioned space. So if the insulation in that space, if it's between floors conditioned space and there is exterior insulation or there's insulation on the exterior walls of that space or if it's the top floor, if there is - - if it's the top floor and for instance there's a suspended ceiling and there's insulation on the roof deck above and insulation on the walls surrounding that space or if it's a return air plenum surrounding that, then it is considered conditioned space and that duct work does not need to be insulated. There was actually two questions about that, so it really… It's just dependent, the - - as long as that plenum is fully insulated, the insulation is not between the space being served and the plenum but rather around the exterior walls and either between two conditioned floors or the insulation is on the roof deck above the plenum, then it is considered condition space.

Question about insulation in crawl spaces. Is the ventilated under floor crawl space outside the building thermal envelope, it's still within the foundation walls inside the building for the purpose of duct insulation? I believe that that would be considered unconditioned space, not exterior space and that would require our R-5 insulation.

Okay. **Is the ceiling cavity between two conditioned areas, the floor above is conditioned space and below the ceiling is conditioned - - considered conditioned or non-conditioned?** As I mentioned, I think this is similar to two other questions, that would be conditioned space and therefore no insulation is required.

Okay, a question about the economizer limits. How can you meet the requirement for economizers with packaged terminal air conditioning units and the total building capacity is greater than 40 tons? You cannot put more than 40 tons of equipment without economizers in there even if it's all small equipment or there's a second exception, and let's take a look at that slide. I can't remember whether it was 10 or 20 percent of the total cooling load. Hang on a second, let me see if we can find that. Rose, this isn't letting me control that.

Rosemarie Bartlett: I'm going to try to find it here for you.

Michael Rosenberg: Thank you. I think we're…

Rosemarie Bartlett: Oops, sorry, that one? No.

Michael Rosenberg: Yeah, there it is 20 percent. You can't exceed 40 tons or 20 percent of the total cooling capacity, whichever is greater. So if you had… You couldn't put 80 tons of packaged terminal air conditioned units in a building with 100 ton cooling load, total cooling load. It is just not allowed.

503.2.1(1) even electric heat. So I'm not sure what the question refers to. Let's see if I can… I'm guessing it's something to do with the exterior heating - - the exterior of a building. Let's go to that slide and see if that's the section we're talking about. Rose, can you go there for me?

Rosemarie Bartlett: I'm working on it here.

Michael Rosenberg: Okay, sorry.

Rosemarie Bartlett: We had a lot of those mandatory requirements upfront didn't we?

Michael Rosenberg: Yep.

Rosemarie Bartlett: I got to work my way through it. There we go. That one?

Michael Rosenberg: Yes, so this is referring to 503.2.1(1). So yes, I guess I imagine this question is asking: Does it need to be controlled by an occupancy sensing device or timer switch even if it's electric radiant heat, and the answer is: Yes, it does.

There's a question, somebody is wanting to know how the 2009 IECC Standards are different and new and how can you identify what's new? And the answer to that is when you take a look at the standard, the 2009 Standard, there'll be a bold line in the margin for any section that has changed. Anything where there's new language or removed language, you'll see a bold line in the margin of that section when you get the printed version.

Okay, let me take a look through here. There may be some new ones that have just come in. **Is there an R-value requirement for hot water pipe insulation? Thickness doesn't guarantee thermal performance.** Yes, that is true. The thickness in the table that was shown is for pipe insulation with a standard conductivity value, so it equates to an R-value. If you have nonstandard pipe insulation that has a different conductivity, you need to do a calculation to ensure that you get the required R-value of that pipe insulation.

Where can we obtain a copy of these codes, and when do they go into effect? I'm going to ask maybe Rose to answer the first part of that question: Where do we get a copy of these codes? I believe it's from the IECC website you can order them.

Rosemarie Bartlett: It is. So they can go to… If you want a copy of the IECC or any of the I Codes for that matter, including the IMC, you can go to the ICC website, which is www.iccsafe.org.

Michael Rosenberg: Okay. **And the second part of the question is: When do the codes go into effect?** And that's really when a local jurisdiction adopts that code. So this code is out there right now and is available to be adopted by any jurisdiction that wants to adopt that, and the procedure is pretty much different throughout the country how codes are adopted. So even though the IECC has been released, many jurisdictions may refer to an earlier version of the IECC at this point, so it's in effect whenever the local jurisdiction adopts it.

There was… There's a question about sizing equipment and safety factors and are you allowed to include safety factors in your load calculations? Yes, you are allowed to include safety factors in your load calculations. As long as you're complying with the ASHRAE/ACCA Standard that was mentioned, safety factors are a part of load calculations, and I think that you're not prevented from being conservative in doing that. There really is a lot of flexibility both in the load calculation and the equipment sizing. I think the real intent is to make sure that engineers are doing true load calculations, but there seems to be enough flexibility in there that really… The ability to do what an engineer feels is necessary I think is sort of left in there; there's enough wiggle room.

Can we have handouts from the presentation, PDFs? Once again, I'm going to turn that one over to Rose.

Rosemarie Bartlett: Yes, the link to the PDF that's available out on the website was provided in the confirmation emails that were sent two days ago and then about one hour before the webcast began today, so that's where the handout is located.

Michael Rosenberg: Excuse me, let me go through these. There's a couple in here I don't really understand the question so can't really answer it.

Another question again related to the maximum amount of equipment that you can have without an economizer, and so this question is, it's similar to the last one about a PTAC, assisted living center with 153 quarter ton PTAC

that not being allowed so that would be greater than 40 ton limit. Assuming that there isn't a whole bunch of other cooling equipment in that space so that the 150 3 ton units was not - - 3 quarter ton units was not less than 20 percent, that would not be allowed. But there is an exception that I probably should've brought up on the last one as well: If you use high efficiency PTAC that meet the requirements in the table that showed, and let's maybe pull up that table real quick, Rose, on the economizer requirements. If you provide high efficiency equipment, you can supply equipment that does not have an economizer. So I can see why there's some questions about this. It seems like that's a very common design to have a lot of PTAC. I don't think there generally available with economizers. But depending on climate zone, if it's in 2, 3, or 4B, you can get out of the requirement by supplying equipment with efficiencies that are greater by that amount. The higher climate zones, the cooler climate zones you can't. So I believe that that is the case, that you could not supply that many PTAC in a building with almost all the cooling load being PTAC in Climate Zones 5, 6, 7, and 8.

Got a couple of blank questions. Another question about where to get the presentation. **Okay, there's a question about mentioning that European standards for pipe insulation are a thickness of insulation equal to the diameter of the pipes. Will the codes move toward this level of efficiency?** I don't know. I know that ASHRAE Standard 90.1 is looking at a whole bunch of increases in the pipe insulation requirements. I think that recently passed. I'm pretty sure that it's not the same insulation equivalent to the diameter of the pipes, but it is more than what's in the IECC right now and a lot of the requirements in Standard 90.1 end up being picked up by the IECC, but I have not heard of a push to go towards an insulation requirement as thick as the diameter of the pipe.

I have a couple here, I'm not quite sure what the question is. **On the VAV air volume system or zone exceptions, please define special humidity requirements?** Rose, can we go back go that slide?

Rosemarie Bartlett: Is that at the - - towards the beginning?

Michael Rosenberg: No, I think it's towards the end. Let me see if maybe I have control yet. No. Oops, is that you or me moving it? I think I'm moving it now, so let's see. There we go. Zones with special humidity requirements. This term is not defined in the IECC or really anywhere else that I am aware of, so I guess it would be up to interpretation of the jurisdiction or whoever the authority - - the ruling authority in the situation would be. But my general interpretation or where I've seen this used is places like museums, archives, places where archives are stored, possibly some areas of hospitals or laboratories where they need special humidity ranges need to be kept in place. I think if you can make the case that you need to keep your humidity in the zone within a narrow band that this exception would come into play. But those are the types of applications where I generally see this exception being used.

Does the balancing system balancing need to be done by a third party or can it be done by the installer? I don't believe there's any requirement for it to be done a third party.

Let me look through these a little bit. **Question: Is compliance using IECC and ASHRAE in combination, example envelope compliance using IECC and mechanical compliance using ASHRAE 90.1 allowed?** The answer to that is no, it is not allowed. That is one of the big changes in the 2009 version of the IECC. You must use either ASHRAE 90.1 or IECC in its entirety. You can't pick and choose and use one section from each of those.

Will there be an electronic version of the code available in the future? I believe so. But, Rose, I'm going to let you answer that.

Rosemarie Bartlett: There is an electronic version of the code available again from www.iccsafe.org. You can choose to either purchase the code book itself, the print code book, or an electronic PDF that you'll be given a serial number for.

Michael Rosenberg: **Okay, and it looks… Here's one about swimming pools. If a pool is indoor, does it require a pool cover?** And the answer is: Yes, it does require a pool cover. Besides heat loss, the direct - - there's evaporation that is the largest component of the heat loss I believe and the pool cover helps prevent that even if the temperature within the pool room is close to the temperature of the water itself.

There's a question about whether ASHRAE 90.1 allows use of over 40 tons of PTACs without an economizer. And I believe it does. I don't believe ASHRAE 90.1 has that same limitation. I know that that is in several other codes, but I don't believe it's in ASHRAE 90.1 at this point.

Rosemarie Bartlett: Looks like you're getting towards the end of the list of questions we have, so I'll just give everybody one last warning. If you have a question that you have not asked yet, please do so now.

Michael Rosenberg: **This question: If codes are mandatory, why do we have to pay for them? Shouldn't these be public domain?** Rose, you got any input on this?

Rosemarie Bartlett: All I can say is that both ICC and ASHRAE for 90.1, they earn money from the sale of their publications and so they do charge for them.

Michael Rosenberg: And I don't know about the IECC, but I know ASHRAE 90.1, you can view a copy of it for free online. While you can't download that for free, you can view a copy of it online. Do you know if ICC allows the same courtesy?

Rosemarie Bartlett: I have not seen that on ICC's website. We looked for that awhile back and did not see a similar thing. Do you have one last question there, Mike?

Michael Rosenberg: **Well it's not really a question, it's just a statement. Pool covers are not recommended by all pool professionals. Pools need to vent at night.** And I think maybe you're talking about water chemistry issues, and I'm not an expert on that subject. I just can tell you what the requirement in the IECC is. And I don't know that… The requirement is there that you need a pool cover, I don't think it tells you how and when you have to use that pool cover.

Rosemarie Bartlett: Okay, that looks like the last question. So we'll thank everyone very much for attending today and thanks to you too, Mike.

Michael Rosenberg: You're welcome. Thank you, Rose.

Rosemarie Bartlett: And everyone may disconnect. Thanks again.

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Please Note: * Proper names/organizations spelling not verified.
[sic] Verbatim, might need confirmation.
- - Indicates hesitation, faltering speech, or stammering.