SDCI

Director's Rule 9-2018

Applicant:	Page	Supersedes:
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Subject: Clarification and corrections to energy modeling procedures of the 2015 Seattle Energy Code	**Code and Section Reference:** Seattle Energy Code	
	Type of Rule: Technical Requirements	
	Ordinance Authority: SMC 3.06.040	
Index: Energy Code	**Approved** (Signature on file) **Date** 6/22/2018 Nathan Torgelson, Director, SDCI	

PURPOSE:
This Rule provides clarifications and corrections to the energy modeling procedures in Section C407 of the 2015 Seattle Energy Code, specifically for the integration of the "high performance heating" provisions that took effect January 1, 2018, and for the modeling of multi-family dwelling unit HVAC systems.

BACKGROUND:
In early 2017, a committee of expert Seattle-area energy modelers volunteered to create a new SDCI "Tip" to clarify and coordinate the application of energy modeling rules. The rules had become considerably more complex in the 2015 code with the advent of the Section C406 additional efficiency options, Dedicated Outdoor Air System (DOAS) requirements, and the Seattle high-performance heating requirements. In particular, it appeared that the high-performance heating requirements had inadvertently created a circular reference loop between Sections C407 and C402. Additionally, energy modelers and the SDCI plans examiners had differing opinions about allowable modeling assumptions for HVAC systems in individual dwelling units. It was agreed that clarifications and corrections to the code language were needed to ensure that all modelers and SDCI staff were working from the

same set of understandings, and furthermore that a specific date would be set for these clarifications and corrections to take effect.

RULE:
Energy modelers should use the revised code language that follows (in underline and ~~strikeout~~ text) in place of the existing code language.

To clarify the application of modeling rules for dwelling units in multi-family buildings, footnotes i and j refer to a new footnote p for Table C407.5.1(4). Footnote p is also referenced in the "fan control" column for five system types in this table. These revisions will take effect for permit applications that are accepted as complete on or after October 1, 2018.

Section C403.2.11.6 is deleted, as it is redundant with an adjacent paragraph.

The remainder of the revised code language in this Director's Rule are intended to resolve the circular reference issue mentioned in the background section. It eliminates the "Column B" heating system types from Table C407.5.1(4), along with the associated footnotes m, n, and o, and makes further changes to Table C407.5.1(1), Table C407.5.1(3), and Section C402.4.

C402.4 Fenestration (*Prescriptive*). Fenestration shall comply with Sections C402.4 through C402.4.4. *Daylight responsive controls* shall comply with this section and Section C405.2.4.

Fenestration shall comply with Table C402.4. U-values from Column A shall be used in buildings where the HVAC heating energy is provided by electric resistance or fossil fuel combustion appliances. Electric resistance HVAC heating appliances include but are not limited to electric baseboard, electric resistance fan coil and VAV electric resistance terminal reheat units, as well as heat pump systems that use electric resistance as the heating energy for the condenser water loop when the outside air temperature is above 32°F (0°C). Fossil fuel combustion HVAC heating appliances include but are not limited to appliances burning natural gas, heating oil, propane, or other fossil fuels, as well as heat pump systems that use fossil fuel as the heating energy for the condenser water loop when the outside air temperature is above 32°F (0°C).

Exceptions.

1. *U*-values from Column B are permitted to be used under any of the following conditions:

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1.5. Buildings in which electric resistance or fossil fuel auxiliary heating is not provided or is provided only when the outdoor temperature is below 32°F (0°C) or when a defrost cycle is required. Such systems shall be sized and configured to lock out electric resistance or fossil fuel heating from operation when the outdoor temperature is above 32 °F (0°C) unless the system is in defrost operation.

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C403.2.11.6 (Reserved) ((~~Single Zone Variable-Air-Volume Controls.~~ ~~HVAC systems shall have variable airflow controls as follows:~~

~~1. Supply fans for air handling and fan coil units with chilled-water cooling coils and supply fans with motors greater than or equal to 5 hp shall be controlled by variable-speed drives or electronically-commutated motors. At cooling demands less than or equal to 50 percent, the supply fan controls shall be able to reduce the airflow to no greater than the larger of the following:~~
~~1.1.One half of the full fan speed; or~~
~~1.2. The volume of outdoor air required to meet the ventilation requirements of the International Mechanical Code.~~
~~2. Supply fans for air conditioning equipment and air handling units with direct expansion cooling and a cooling capacity greater than or equal to110,000 Btu/h that serve single zones shall be controlled by variable-speed drives or electronically-commutated motors. Cooling capacity shall be determined at the rating conditions in the AHRI standard appropriate to the equipment, at cooling demands less than or equal to 50 percent, the supply fan controls shall be able to reduce the airflow to no greater than the larger of the following:~~
~~2.1. Two-thirds of the full fan speed; or~~
~~2.2. The volume of outdoor air required to meet the ventilation requirements of the International Mechanical Code.~~))

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TABLE C407.5.1(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Vertical fenestration other than opaque doors	Area 1. The proposed vertical fenestration area; where the proposed vertical fenestration area is less than 30 percent of above-grade wall area. 2. 30 percent of above-grade wall area; where the proposed vertical fenestration area is 30 percent or more of the above-grade wall area. U-factor: From Column A of Table C402.4 for the same framing material as the proposed fenestration unless the proposed building area complies with exception 1 of C402.4 then use Column B of Table C402.4 for the same framing material as the proposed fenestration SHGC: From Table C402.4 except that for climates with no requirement (NR) SHGC = 0.40 shall be used External shading and PF: None	As proposed As proposed As proposed As proposed
Heating System	Fuel Type: ((~~Same as proposed~~)) Per Table C407.5.1(2) and Table C407.5.1(3)	As proposed
Cooling System	Fuel Type: ((~~Same as proposed~~)) Per Table C407.5.1(2) and Table C407.5.1(3)	As proposed

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TABLE C407.5.1(3)
HVAC SYSTEMS MAP

		STANDARD REFERENCE DESIGN HVAC SYSTEM TYPE[c]

CONDENSER COOLING SOURCE[a]	CLASSIFICATION[b]	Single-zone Residential System (Groups R-1, R-2, R-3)	Single-zone Nonresidential System (Other occupancies)	All Other
Water/ground	Electric resistance	System 5	System 5	System 1
	Heat pump	System 6	System 6	System 6
	Fossil fuel	System 7	System 7	System 2
Air/none	Electric resistance	System 8	System 9	System 3
	Heat pump	System 8	System 9	System 3
	Fossil fuel	System 10	System 11	System 4

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TABLE C407.5.1(4)
SPECIFICATIONS FOR THE STANDARD REFERENCE DESIGN HVAC SYSTEM DESCRIPTIONS

SYSTEM NO.	SYSTEM TYPE	FAN CONTROL	COOLING TYPE	HEATING TYPE (((~~Column A)[m]~~))	~~HEATING TYPE~~)) (((~~Column B)[n]~~))
1	Variable air volume with parallel fan-powered boxes[a]	VAV[d]	Chilled water[e]	Electric resistance	((~~Hot water with electric heat pump[e]~~))
2	Variable air volume with reheat[b]	VAV[d]	Chilled water[e]	Hot water fossil fuel	((~~Hot water with electric heat pump[e]~~))
3	Packaged variable air volume with parallel fan-powered boxes[a]	VAV[d]	Direct expansion[c]	Electric resistance	((~~Hot water with electric heat pump[e]~~))
4	Packaged variable air volume with reheat[b]	VAV[d]	Direct expansion[c]	Hot water fossil fuel	((~~Hot water with electric heat pump[e]~~))
5[k]	Two-pipe fan coil	Constant volume[i, j, p]	Chilled water[e]	Electric resistance	((~~Hot water with electric heat pump[e]~~))
6[k]	Water-source heat pump	Constant volume[i, j, p]	Direct expansion[c]	Electric heat pump and boiler[g]	((~~Electric heat pump and boiler[g]~~))
7[k]	Four-pipe fan coil	Constant volume[i, j, p]	Chilled water[e]	Hot water fossil fuel	((~~Hot water with electric heat pump[e]~~))
8[k]	Packaged terminal heat pump	Constant volume[i, j, p]	Direct expansion[c]	Electric heat pump[h]	((~~Electric heat pump[h]~~))
9[k]	Packaged rooftop heat pump	Constant volume[i, j]	Direct expansion[c]	Electric heat pump[h]	((~~Electric heat~~
10[k]	Packaged terminal air conditioner	Constant volume[i, j, p]	Direct expansion	Hot water fossil fuel	((~~Hot water with electric heat pump[e]~~))
11[k]	Packaged rooftop air conditioner	Constant volume[i, j]	Direct expansion	Fossil fuel furnace	((~~Hot water with electric heat pump[e]~~))

Keys for Table C407.5.1(4)
For SI: 1 foot=304.8mm, 1 cfm/ft2= 0.0004719 1
Btu/h = 0.293/W, °C = [(°F) -32/1.8].

Footnotes for Table C407.5.1(4)

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i. Constant volume: For building types governed by Section C403.6, fans shall be controlled to cycle with load, i.e., fan operation cycled on calls for heating and cooling. If the fan is modeled as cycling and the fan energy is included in the energy efficiency rating of the equipment, fan energy shall be modeled per C407.5.3. Effective October 1, 2018, residential dwelling or sleeping unit fans shall be controlled per footnote p of Table

C407.5.1(4). For all other buildings, and residential dwelling or sleeping units prior to October 1, 2018, fans shall be controlled in the same manner as in the proposed design, i.e., fan operation whenever the space is occupied or fan operation cycled on calls for heating and cooling. If the fan is modeled as cycling and the fan energy is included in the energy efficiency rating of the equipment, fan energy be modeled per C407.5.3.

j. Fan speed control: Effective July 1, 2018, residential dwelling and sleeping unit fan speed control shall operate per footnote p of Table C407.5.1(4). For all other building areas and residential dwelling or sleeping units prior to October 1, 2018, fans ((~~Fans~~)) shall operate as one- or two-speed as required by Section C403.2.11.5, regardless of the fan speed control used in the proposed building.

k. Outside air: For building types governed by Section C403.6, outside air shall be supplied by a separate dedicated outside air system (DOAS) operating in parallel with terminal equipment. The terminal equipment fan system cycle calls for heating and cooling. DOAS shall include an *Energy Recovery Ventilation System* with a minimum effectiveness in accordance with Section C403.5.

l. (reserved)

m. (Reserved) ((~~Heating type Column A:~~ ~~Used for buildings with area-weighted average fenestration U-values that comply with Column A of Table C402.4, or buildings that comply with exception 1 to Section C402.4.~~))

n. (Reserved) ((~~Heating type Column B:~~ ~~Used for buildings with area-weighted average fenestration U-values that do not comply with the values in Column A of Table C402.4, and that do not comply with exception 1 to Section C402.4.~~))

o. (Reserved) ((~~Air-to-water Heat pump:~~ ~~For systems using purchased hot water or steam, the heat pumps are not explicitly modeled. The standard reference design heat pump plant shall be modeled with a single air-to-water heat pump and an auxiliary electric boiler. The heat pump capacity shall be equal to 50% of the building's heating load at design conditions and modeled such that 100% of the design capacity is available under all conditions. The heat pump energy consumption shall be modeled such that coefficient of performance (COP) only varies as a function of outdoor air temperature, per the following: 20°F & less: COP=2.0, 30°F: COP=2.25, 40°F: COP=2.5, 50°F: COP= 3.0, 60°F & greater: COP=3.5. The heating plant equipment shall be staged such that the heat pump is used first to meet the heating load, with the auxiliary electric boiler only used when the plant load exceeds the heat pump capacity. Hot water supply temperature shall be modeled at 120°F design supply temperature and 105°F return temperature. Piping losses shall not be modeled in either building model. Hot water supply water temperature shall be reset in accordance with Section C403.4.2.4. Pump system power for each pumping system shall be the same as the proposed design; if the proposed design has no hot water pumps, the standard reference design pump power shall be 19 W/GPM (equal to a pump operating against a 60-foot head, 60-percent combined impeller and motor efficiency). The hot water system shall be modeled as primary only with continuous variable flow. Hot water pumps shall be modeled as riding the pump curve or with variable speed drives when required by Section C403.4.2.4.~~))

p. Dwelling unit and sleeping unit Standard Reference Design: Effective October 1, 2018 the Standard Reference Design for dwelling units and sleeping units in R-1, R-2 and R-3 occupancies shall comply with one of the following:

1. Where the proposed HVAC system utilizes whole house ventilation with exhaust fan systems in accordance with SMC Section 403.4.6, or whole house ventilation integrated with forced-air systems in accordance with SMC Section 403.4.7, the

reference model ventilation system will utilize whole house exhaust with a fan power allowance of 1.4 cfm/watt in accordance with Table C403.2.11.4. The reference model outdoor airflow rate will be modeled as continuous or intermittent ventilation, in accordance with SMC Section C403.4.5.1, as defined by the proposed design. The reference model ventilation system will operate in parallel with the heating and cooling system. The reference model heating and cooling systems will cycle to meet the heating and cooling load in the space. Heating and cooling system fan speed control will operate as one- or two-speed as required by Section C403.2.11.5, regardless of the fan speed control used in the proposed building and have a fan power allowance as defined by Table C407.5.1(1). The fan power, operating schedule, and airflow rates of bath, laundry, dryer, range, and other miscellaneous exhaust fans will be identical between the reference and proposed energy models.

2. Where the proposed HVAC system includes whole house ventilation with supply fan systems in accordance with SMC Section 403.4.8, or whole house ventilation with heat recovery or energy recovery ventilation systems in accordance with SMC Section 403.4.9, the reference model will include a supply fan system without heating and/or cooling with a separate "all other systems, including DOAS" fan power allowance as defined by Table C407.5.1(1). The reference model will not include energy recovery or heat recovery per Exception 9 of C403.5. The outdoor airflow rate and the mode of operation (continuous or intermittent per SMC Section 403.4.5.1) of the proposed design and the reference design will be the same. The reference model ventilation system will operate in parallel with the heating and cooling system. The reference model heating and cooling systems will cycle to meet the heating and cooling load in the space. Heating and cooling system fan speed control will operate as one- or two-speed as required by Section C403.2.11.5, regardless of the fan speed control used in the proposed building and have a fan power allowance as defined by Table C407.5.1(1). The fan power, operating schedule and airflow rates of bath, laundry, dryer, range, and other miscellaneous exhaust fans will be identical between the reference and proposed energy models.