Submit a comment

Proposed Change 2056

Code Reference(s):	**NECB20 Div.B 3.1.1.5. (first printing)** **NECB20 Div.B 3.1.1.7.(4) (first printing)** **NECB20 Div.B 8.4.2. (first printing)** **NECB20 Div.B 8.4.3.9. (first printing)**
Subject:	Performance Compliance - Other
Title:	Energy Modeling Software Requirements
Description:	This proposed change updates the edition year of ANSI/ASHRAE 140, "Method of Test for Evaluating Building Performance Simulation Software," to 2023 and adds new Articles on acceptance criteria for energy modeling software and on exceptional calculation methods.
Related Code Change Request(s):	CCR 2158
Related Proposed Change(s):	PCF 2067

This change could potentially affect the following topic areas:

- [ ] Division A
- [ ] Division C
- [ ] Building operations
- [x] Small Buildings
- [ ] Fire Protection
- [ ] Accessibility
- [ ] Building Envelope
- [ ] Heating, Ventilating and Air Conditioning
- [x] Division B
- [ ] Design and Construction
- [ ] Housing
- [x] Large Buildings
- [ ] Occupant safety in use
- [ ] Structural Requirements
- [x] Energy Efficiency
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

The 2020 edition of the National Energy Code of Canada for Buildings (NECB) references ANSI/ASHRAE 140-2011, "Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs," to identify acceptable software to be used for carrying out compliance calculations for energy modeling.

The 2011 edition of this referenced standard includes test cases for the evaluation of building performance software, but does not include information about the acceptable software results for those test cases. This means that authorities having jurisdiction would only require that the software was capable of running the tests, but not that the results were within an acceptable range. The absence of pass/fail criteria in the 2011 edition of the standard presents a gap in the Code for authorities having jurisdiction when they determine if the software used to demonstrate Code compliance complies with the standard.

In addition, the Code uses inconsistent terminology when referring to energy modeling software, which may cause confusion for Code users.

Justification

Referencing the 2023 edition of ANSI/ASHRAE 140, "Method of Test for Evaluating Building Performance Simulation Software," would address the problem by providing pass/fail criteria by which compliance of the software with the standard may be determined.

The 2023 edition of ANSI/ASHRAE 140:

- Introduces acceptance criteria for determining if the energy modeling software is suitable for use by a citing authority having jurisdiction (AHJ).
- Adds informative sections for AHJs on developing the acceptance criteria.

The 2023 edition also includes test suites that are new or have been updated since the 2011 edition in the following addenda[1]:

- ground coupled slab-on-grade analytical verification tests (ANSI/ASHRAE 140-2011, Addendum *a*),
- air-side HVAC equipment analytical verification tests (ANSI/ASHRAE 140-2014, Addendum *a*),
- building thermal envelope and fabric load tests (ANSI/ASHRAE 140-2017, Addendum *a*), and
- weather drivers tests (ANSI/ASHRAE 140-2020, Addendum *a*).

Consistent use of the term "energy modeling software," as appears in Article 8.4.3.9. of the NECB 2020, would clarify the Code requirements in other provisions that reference this software.

[1] The listed addenda are available at https://www.ashrae.org/technical-resources/standards-and-guidelines/standards-addenda.

PROPOSED CHANGE

[3.1.1.5.] 3.1.1.5. Thermal Characteristics of Building Assemblies

Note A-3.1.1.5. Thermal Characteristics of Building Assemblies.

Thermal characteristics of building assemblies can also be determined through the use of ~~computer simulation models~~energy modeling software.

[3.1.1.7.] 3.1.1.7. Calculation of Overall Thermal Transmittance

[1] 4) Where a component of the *building envelope* is protected by an enclosed unconditioned space, such as a sun porch, enclosed veranda or vestibule, the unconditioned enclosure may be considered to have an *overall thermal transmittance* of 6.25 W/(m^2×K). (See Note A-3.1.1.7.(4).)

Note A-3.1.1.7.(4) Effect of an Unconditioned Space.

The conservative overall thermal transmittance allowed in Sentence 3.1.1.7.(4), which is equivalent to that of a layer of glass, is intended to provide an easy credit under the prescriptive path for any unconditioned space that may be protecting a component of the building envelope.

The value given does not take into account the construction of the enclosure surrounding the unconditioned space; the construction of this enclosure being uncontrolled by this Code, too many variables, such as its size or airtightness, may negate any higher credit that could be allowed. There may be ~~simulation tools~~ energy modeling software under the performance path that can provide a better assessment of the effect of an indirectly heated space, which may be used to advantage when an unheated space is designed to provide significantly better protection than the worst-case scenario assumed here. Vented spaces, such as attic and roof spaces or crawl spaces, are considered to be part of the exterior space; therefore, Sentence 3.1.1.7.(4) does not apply when calculating the overall thermal transmittance of their building envelope components.

[8.4.2.] 8.4.2. Compliance Calculations

[8.4.2.1.] 8.4.2.1. General

[8.4.2.2.] 8.4.2.2. Calculation Methods

[1] 1) Except as provided in Sentence (5), the energy model calculations shall account for the *annual energy consumption* of

[a] a) space-heating equipment,

[b] b) space-cooling equipment,

[c] c) fans,

[d] d) *interior* and *exterior lighting* devices,

[e] e) *service water* heating equipment,

[f] f) pumps,

[g] g) auxiliary HVAC equipment (see Note A-8.4.2.2.(1)(g)),

[h] h) receptacle loads and miscellaneous equipment as per Article 8.4.2.7.,

[i] i) appliances, and

[j] j) elevators and escalators.

[2] 2) The energy model calculations shall be performed for a one-year period (8 760 hours) using time intervals no greater than one hour.

[3] 3) Operating schedules and climatic data input in the energy model shall use a time interval no greater than one hour.

[4] 4) Energy modeling software that~~If a computer program~~ is used for the energy model~~to carry out the compliance~~ calculations~~, the calculation methods employed in the energy model~~ shall conform to

[a] a) the testing requirements for energy modeling software stated in Article 8.4.2.11.,~~ANSI/ASHRAE 140, "Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs",~~ or

[b] b) an equivalent test method.

[5] 5) Redundant or back-up equipment is permitted to be excluded from the energy model, provided it is equipped with controls that operate the equipment only when the primary equipment is not operating.

[6] --) *Building* components that cannot be modeled by the energy modeling software in Sentence (4) shall be modeled using an exceptional calculation method in accordance with Article 8.4.2.12.

[8.4.2.3.] 8.4.2.3. Climatic Data

[8.4.2.4.] 8.4.2.4. Thermal Mass

[8.4.2.5.] 8.4.2.5. Space Temperature

[8.4.2.6.] 8.4.2.6. Heat Transfer Between Thermal Blocks

[8.4.2.7.] 8.4.2.7. Internal and Service Water Heating Loads

[8.4.2.8.] 8.4.2.8. Building Envelope

[8.4.2.9.] 8.4.2.9. Air Leakage

[8.4.2.10.] 8.4.2.10. HVAC Systems Calculations

[8.4.2.11.] --- Testing of Energy Modeling Software

[1] --) Energy modeling software shall be tested in accordance with ANSI/ASHRAE 140-2023, "Method of Test for Evaluating Building Performance Simulation Software," except for Section 12, and including the following tests described in Sections 6 to 11:

[a] --) weather drivers tests,

[b] --) building thermal envelope and fabric load tests,

[c] --) ground coupled slab-on-grade analytical verification tests,

[d] --) space-cooling equipment performance tests,

[e] --) space-heating equipment performance tests, and

[f] --) air-side HVAC equipment analytical verification tests.

[2] --) For each version of the energy modeling software tested in accordance with ANSI/ASHRAE 140, the following shall be provided:

[a] --) test results demonstrating that the energy modeling software was tested in accordance with Annex A3 and that the values for the "Minimum Number of Range Cases within the Test Group to Pass" given in Table A3-14 were met or exceeded for all test groups,

[b] --) the input files used to generate the test cases, the test results, and the example results from other energy modeling software included in Annexes B8 and B16 for comparison, and

[c] --) the modeler report provided in Annex A2, Attachment A2.8 with Report Blocks A and G completed for any test results exceeding the maximum or falling below the minimum reference values shown in Tables A3-1 to A3-13, and with Report Blocks A and E completed for any omitted test results.

[3] --) The same tested version of the energy modeling software shall be used to model the proposed *building* and the reference *building*.

[8.4.2.12.] --- Exceptional Calculation Methods

[1] --) Where the energy modeling software is not used to model a design, material or device, an exceptional calculation method shall be used that complies with ANSI/ASHRAE 140-2023.

[2] --) Where multiple designs, materials or devices cannot be modeled by the energy modeling software, the energy savings for each shall be calculated separately using the exceptional calculation method, and the sum of the calculated energy savings shall be determined.

[3] --) The sum determined in Sentence (2) shall not constitute more than 50% of the difference between the *building energy target* of the reference *building* and the *annual energy consumption* of the proposed *building*.

[8.4.3.9.] 8.4.3.9. Ice Plants

Note A-8.4.3.9. Heat Recovery from Ice Plants.

Where the energy modeling software does not allow for modeling of ice plants, a water-cooled, double-bundle water chiller with a load profile corresponding to the expected loading on the ice plant is adequate for the purposes of Part 8 and allows the modeling of heat recovery using most types of ~~simulation~~energy modeling software.

The following documents may be helpful in setting a more detailed model using refrigeration equipment rather than a water chiller and modeling the ice sheet itself and its interaction with adjacent components and spaces:

- Zmeureanu, R., E.M. Zelaya and D. Giguère. (2002). Simulation de la consommation d'énergie d'un aréna à l'aide du logiciel DOE-2.1E. ESim 2002 Conference, Montreal.
- Ouzzane, M. et al. Cooling Load and Environmental Measurements in a Canadian Indoor Ice Rink. ASHRAE Transactions, Vol. 112, Pt. 2, Paper no. QC-06-008, pp. 538-545, 2006.
- Sunyé, R. et al. ASHRAE Research Report 1289, Develop and Verify Methods For Determining Ice Sheet Cooling Loads, 2007.
- Teyssedou, G., R. Zmeureanu, and D. Giguère. (2009). Thermal Response of the Concrete Slab of an Indoor Ice Rink. ASHRAE HVAC&R Research, Vol. 15, No. 3, May 2009.

Since ice-making for rinks is often associated with resurfacing activities, which require a significant amount of heated service water, the energy models of the proposed and reference buildings should account for this load.

Impact analysis

This proposed change is expected to be cost neutral. The energy modeler must use software that complies with ANSI/ASHRAE 140, which is no different than the current practice. The additional burden of testing software using the 2023 edition of the

standard rests with the building performance software vendor, many of whom already incurred much of this cost when submitting results during the development of the acceptance criteria.

All major developers of energy modeling software for buildings were invited to participate in the process to determine the acceptance ranges, and many software developers participated. The acceptance ranges were set so that most commonly used software programs are within the ranges, and additional software programs are expected to be within the ranges once software developers address outlying results.

Overall, this approach would encourage building performance simulation software to be more accurate and consistent. No comments were provided during the public review of the new acceptance criteria in ANSI/ASHRAE 140-2023, which reflects the consensus reached within the software and modeling community.

Enforcement implications

Currently, building officials need to confirm that the energy modeling software complies with ANSI/ASHRAE 140 by visiting the website of the energy modeling software vendor. While the vendor needs to provide enough information to allow others to verify that the results meet the criteria set in ANSI/ASHRAE 140, it is not expected that building officials would themselves do this. Instead, third-party certification of software is expected to certify that the software meets the requirements of ANSI/ASHRAE 140-2023.

Who is affected

Energy modelers, energy modeling software vendors, and building officials.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[3.1.1.5.] 3.1.1.5. ([1] 1) [F92-OE1.1]

Intent 1:

To limit the probability that the thermal characteristics of building envelope materials will be determined incorrectly, which could lead to excessive thermal transfer through the building envelope, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[3.1.1.5.] 3.1.1.5. ([2] 2) [F92-OE1.1]

Intent 1:

To limit the probability that the thermal characteristics of building envelope materials will be determined incorrectly, which could lead to excessive thermal transfer through the building envelope, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[3.1.1.5.] 3.1.1.5. ([3] 3) [F92-OE1.1]

Intent 1:

To limit the probability that the overall thermal transmittance of fenestration and doors will be determined incorrectly, which could lead to the underestimation of overall thermal transmittance values, which could lead to excessive thermal transfer through the building envelope, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[3.1.1.5.] 3.1.1.5. ([4] 4) [F92-OE1.1]

Intent 1:

To limit the probability that the overall thermal transmittance of fenestration and doors will be determined incorrectly, which could lead to the underestimation of overall thermal transmittance values, which could lead to excessive thermal transfer through the building envelope, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[3.1.1.5.] 3.1.1.5. ([5] 5) [F92-OE1.1]

Intent 1:

To limit the probability that tests to determine the thermal characteristics of building assemblies other than fenestration and doors will be conducted incorrectly or that the thermal characteristics will be improperly determined, which could lead to the underestimation of overall thermal transmittance values, which could lead to excessive thermal transfer through the building envelope, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[3.1.1.7.] 3.1.1.7. ([1] 4) no attributions

Intent 1:

To state the overall thermal transmittance of unconditioned enclosures protecting a building envelope component.

[8.4.2.1.] 8.4.2.1. ([1] 1) [F99-OE1.1]

Intent 1:

To limit the probability that assessment of conformance will be performed incorrectly, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead toexcessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.2.] 8.4.2.2. ([1] 1) [F99-OE1.1]

Intent 1:

To limit the probability that the annual energy consumption of the proposed building will not take into account the impact of all components that are addressed by the Code, which could lead to underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.2.] 8.4.2.2. ([2] 2) [F99-OE1.1]

Intent 1:

To limit the probability that the calculations will be performed for a period that is insufficiently long to represent the annual performance or over intervals that are too large to provide enough accuracy in the result, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.2.] 8.4.2.2. ([3] 3) [F99-OE1.1]

Intent 1:

To limit the probability that the schedules and climatic data for the energy model will use intervals that are too large to provide enough accuracy in the result, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.2.] 8.4.2.2. ([4] 4) [F99-OE1.1]

Intent 1:

To direct Code users to Article 8.4.2.11. for the testing requirements for energy modeling software.~~To limit the probability that the calculation methods will not be performed to a level set by an industry-recognized standard, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.~~

Intent 2:

To limit the probability that the calculation methods will not be performed to a level equivalent to an industry-recognized standard, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.2.] 8.4.2.2. ([5] 5) no attributions

Intent 1:

To exempt redundant or back-up equipment whose operation does not impact the building energy consumption from the modeling requirements of Sentence (1).

[8.4.2.2.] -- ([6] --) no attributions

Intent 1:

To direct Code users to Article 8.4.2.12. for the testing requirements for exceptional calculation methods.

[8.4.2.3.] 8.4.2.3. ([1] 1) [F99-OE1.1]

Intent 1:

To limit the probability that inappropriate or insufficient climatic data will be used, which could lead to inaccurate modeling, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.3.] 8.4.2.3. ([2] 2) [F99-OE1.1]

Intent 1:

To limit the probability that inappropriate, insufficient or incomplete climatic data will be used, which could lead to inaccurate modeling, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.4.] 8.4.2.4. ([1] 1) [F99-OE1.1]

Intent 1:

To limit the probability that the effects of thermal mass will not be accounted for in the energy model, which could lead to inaccurate modeling, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.5.] 8.4.2.5. ([1] 1) [F99-OE1.1]

Intent 1:

To limit the probability that the model will not perform a dynamic calculation of space temperatures that accounts for all effects, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.6.] 8.4.2.6. ([1] 1) [F99-OE1.1]

Intent 1:

To limit the probability that the model will not account for adjacent thermal blocks with significant temperature differences, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.6.] 8.4.2.6. ([2] 2) [F99-OE1.1]

Intent 1:

To limit the probability that heat transfer calculation between thermal blocks not fully separated by solid partitions or walls will use an inappropriate value of equivalent heat transfer coefficient, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.7.] 8.4.2.7. ([1] 1) [F99-OE1.1]

Intent 1:

To limit the probability that the model will not account for all internal and service water heating loads that affect the energy performance, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.7.] 8.4.2.7. ([2] 2) [F99-OE1.1]

Intent 1:

To limit the probability that the sensible and latent loads will not be accounted for in the energy model, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the

energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.7.] 8.4.2.7. ([3] 3) [F99-OE1.1]

Intent 1:

To limit the probability that the interior loads will not be properly adjusted for each time interval based on the appropriate schedule, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.7.] 8.4.2.7. ([4] 4) [F99-OE1.1]

Intent 1:

To limit the probability that the calculation of sensible loads due to lights will not take into account all effects, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.7.] 8.4.2.7. ([5] 5) [F99-OE1.1]

Intent 1:

To limit the probability that other equipment located within a conditioned space that affect the energy performance of the building will not be accounted for in the energy model, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.8.] 8.4.2.8. ([1] 1) [F99-OE1.1]

Intent 1:

To limit the probability that the energy model will not account for heat transfer through all relevant building envelope elements for each thermal block, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

Intent 2:

To limit the probability that the dynamic response due to thermal characteristics of the building envelope assemblies will not be accounted for in the energy model, which could lead to inaccuracy of the model, which could lead to overestimation of the

energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.8.] 8.4.2.8. ([2] 2) [F99-OE1.1]

Intent 1:

To limit the probability that the effect of solar radiation on heat transfer through walls and roofs will not be accounted for in the energy model, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.8.] 8.4.2.8. ([3] 3) [F99-OE1.1]

Intent 1:

To limit the probability that the heat transfer through fenestration, including skylights, will not be appropriately accounted for in the energy model, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.8.] 8.4.2.8. ([4] 4) [F99-OE1.1]

Intent 1:

To limit the probability that the impacts of solar radiation through fenestration on the heating and cooling loads will not be appropriately accounted for, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.8.] 8.4.2.8. ([5] 5) [F99-OE1.1]

Intent 1:

To limit the probability that the insulated surface area of roof assemblies will be incorrectly determined, which could lead to incorrect modeling of the reference building, which could lead to overestimation of the energy used by the reference building, which could lead to excessive consumption of energy by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.8.] 8.4.2.8. ([6] 6) [F99-OE1.1]

Intent 1:

To limit the probability that the insulated surface area of exterior above-ground wall assemblies will be incorrectly determined, which could lead to incorrect modeling of the reference building, which could lead to overestimation of the energy used by the reference building, which could lead to excessive consumption of energy by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.8.] 8.4.2.8. ([7] 7) [F99-OE1.1]

Intent 1:

To limit the probability that the insulated surface area of above-ground exterior floor assemblies will be incorrectly determined, which could lead to incorrect modeling of the reference building, which could lead to overestimation of the energy used by the reference building, which could lead to excessive consumption of energy by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.8.] 8.4.2.8. ([8] 8) [F99-OE1.1]

Intent 1:

To limit the probability that the insulated surface areas of roof assemblies in contact with the ground will be incorrectly determined, which could lead to incorrect modeling of the reference building, which could lead to overestimation of the energy used by the reference building, which could lead to excessive consumption of energy by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.8.] 8.4.2.8. ([9] 9) [F99-OE1.1]

Intent 1:

To limit the probability that the insulated surface areas of wall assemblies in contact with the ground will be incorrectly determined, which could lead to incorrect modeling of the reference building, which could lead to overestimation of the energy used by the reference building, which could lead to excessive consumption of energy by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.8.] 8.4.2.8. ([10] 10) [F99-OE1.1]

Intent 1:

To limit the probability that the insulated surface area of floor assemblies in contact with the ground will be incorrectly determined, which could lead to incorrect modeling of the reference building, which could lead to overestimation of the energy used by the reference building, which could lead to excessive consumption of energy by the

proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.9.] 8.4.2.9. ([1] 1) [F99-OE1.1]

Intent 1:

To limit the probability that the model will not account for air leakage through the building envelope, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.9.] 8.4.2.9. ([2] 2) [F99-OE1.1]

Intent 1:

To limit the probability that the adjusted air leakage rate will be inappropriately calculated, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.10.] 8.4.2.10. ([1] 1) [F99-OE1.1]

Intent 1:

To limit the probability that the HVAC system of the reference building will be incorrectly modeled, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.10.] 8.4.2.10. ([2] 2) [F99-OE1.1]

Intent 1:

To limit the probability that energy model will not take into account the effects of terminal devices, secondary and primary systems, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.10.] 8.4.2.10. ([3] 3) [F99-OE1.1]

Intent 1:

To limit the probability that the compliance calculations for secondary systems will not take into account all relevant factors, which could lead to inaccuracy of the

model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.10.] 8.4.2.10. ([4] 4) [F99-OE1.1]

Intent 1:

To limit the probability that the energy model will not take into account how many hours the primary system, secondary system and terminal device loads are not met, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.10.] 8.4.2.10. ([5] 5) [F99-OE1.1]

Intent 1:

To limit the probability that the energy model will not take into account the efficiency and capacity of HVAC equipment as a function of part load and all relevant parameters, which could lead to inaccuracy of the model, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.11.] -- ([1] --) [F99-OE1.1]

Intent 1:

To limit the probability that the calculation methods will not be performed to a level set by an industry-recognized standard, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

Intent 2:

To limit the probability that the testing of energy modeling software will not include all applicable sections of the testing standard, which could lead to inaccuracy of testing, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.11.] -- ([2] --) [F99-OE1.1]

Intent 1:

To limit the probability that the energy modeling software will not satisfy the criteria

set by an industry-recognized standard, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.11.] -- ([3] --) [F99-OE1.1]

Intent 1:

To limit the probability that different versions of the energy modeling software will be used for modeling the proposed and reference building, which could lead to underestimation of the energy used by the proposed building or overestimation of the energy used by the reference building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.12.] -- ([1] --) [F99-OE1.1]

Intent 1:

To limit the probability that an exceptional calculation method will not be performed to a level set by an industry-recognized standard, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.12.] -- ([2] --) [F99-OE1.1]

Intent 1:

To limit the probability that energy savings for multiple designs, materials, or devices will not be calculated separately, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.2.12.] -- ([3] --) [F99-OE1.1]

Intent 1:

To limit the probability that the sum of the results from the exceptional calculations for multiple designs, materials or devices will be more than 50% of the difference between the building energy target and the annual energy consumption, which could lead to overestimation of the energy used by the reference building or underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.

[8.4.3.9.] 8.4.3.9. ([1] 1) [F99-OE1.1]

Intent 1:

To limit the probability that ice-making loads will be inappropriately set, which could lead to inaccuracy of the model, which could lead to underestimation of the energy used by the proposed building, which could lead to excessive use of energy, which could lead to an unacceptable effect on the environment.