Errata

2013 Nonresidential Alternative Calculation Method (ACM) Reference Manual

Section	Description of Change
2.4 Unmet Load Hours	Revised wording to describe spaces that won't have UMLH applied to them.
2.5 (Flow Chart)	Revised flowchart to indicate the warning that will be displayed to the user if the proposed simulation has more than 150 UMLH. It will allow the user to stop the simulation to correct the sizing of the HVAC system, or continue to run the simulation and report the zones that exceed 150 UMLH on the compliance form.
2.5 (wording)	Revised the wording to 'lift' the hard-stop simulation requirement if any thermal zone has more than 150 UMLH.
2.6.1 (wording)	Revised the wording to reflect that the 150 UMLH is more of a suggestion rather than a requirement.
5.5.7 Fenestration	Revised the wording for the Standard Design of Vertical Fenestration to reflect Fixed, Operable, Curtainwall, or Glazed Doors as the comparison to the proposed design.
5.5.7 Fenestration	Revised the wording for the Standard Design of Skylights to reflect Glass, Curb-mounted, Deck-mounted, or Plastic skylights as the comparison to the proposed design.
5.9.1.2 Water Heaters	Revised the wording for the Standard Design to allow the resizing of the water heater to match that of the proposed water heater if the Exceptional Condition is checked. The Standard Design water heater will have the volume of 40% of the proposed and the heating capacity of 60% of the proposed (in BTUH).
General	Various corrections to typos, reference errors, and visual corrections throughout the manual. These are all minor corrections and do not affect compliance results.

2013 Nonresidential Alternative Calculation Method (ACM) Reference Manual Background

CBECC-COM currently has a requirement to stop a simulation whenever any thermal zone exceeds 150 UMLH. An UMLH is a count for every hour that a thermal zone's HVAC system cannot keep it within 1°F of its setpoint (70°F winter, 75°F summer). This is to ensure that the HVAC systems are properly sized and not grossly undersized for reasons of human comfort and energy efficiency.

During an energy simulation, once any thermal zone exceeds 150 UMLH the simulation will stop and the user is required to make changes to the HVAC system (increasing the capacity, etc.) and rerun it until there are less than 150 UMLH, at which point the simulation continues until its finished. The UMLH requirement is a requirement in most other energy simulation software (E-Quest, etc), including EnergyPro 6.4 (DOE2.1 Based). However, EnergyPro will automatically upsize the HVAC system (without requiring the user to do anything) and continue to run until completion with the majority of EnergyPro users never aware of this since it just happens in the background of their simulation.

Now that EnergyPro 6.4 (DOE2.1 based) will expire on March 31, 2015 and the new version will use EnergyPlus as its engine, the staff is concerned that the majority of the users will not know how to deal with the 150 UMLH 'stop' requirement once they begin simulation with the new software and flood EnergySoft and the CEC with questions and comments and complaints.

To help remedy this 'wave' of complaints, we are proposing to not have the forced stop of the simulation once 150 UMLH is reached. Instead, it will allow the user to continue with the simulation (just as they are used to with EnergyPro), however there will be a warning flashed to the user letting them know of the 150 UMLH requirement and how the hard stop will happen in a future version. So it would be an educational warning to provide temporary relief to allow the typical user to provide compliance reports, yet giving them time to educate themselves of the upcoming 150 UMLH stop requirement.

2.4 Unmet Load Hours

This manual uses the term “Unmet Load Hours” (UMLH) as a criterion for sizing equipment, for qualifying natural ventilation systems, and for other purposes. The concept of unmet load hours applies to individual thermal zones but is summed for hours whenever any thermal zone in the building has unmet loads. For a thermal zone, it represents the number of hours during a year when the HVAC system serving the thermal zone is unable to maintain the set point temperatures for heating and/or cooling. During periods of unmet loads, the space temperature drifts above the cooling setpoint or below the heating setpoint. A thermal zone is considered to have an unmet load hour if the space is outside the throttling range for heating or cooling. The throttling range is defined in Chapter 5 as the space temperature difference between no cooling and full cooling or between no heating and full heating. It is assumed that the cooling and heating setpoints are “centered” on the throttling range, so that a cooling setpoint of 75°F results in an acceptable temperature band of 74°F to 76°F. The throttling range is fixed at 2°F for simulating both the standard design and proposed design.

An unmet load hour can occur only during periods when the HVAC system is scheduled to operate. Unmet load hours are accounted for in each zone of the building. No zone in the building ~~can~~ should exceed the maximum allowed unmet load hours.

Unmet load hours can occur because fans, air flows, coils, furnaces, air conditioners or other equipment is undersized. Unmet load hours can also occur due to user errors including mismatches between the thermostat setpoint schedules and HVAC operating schedules or from other input errors, for instance, high internal gains or occupant loads. The term, as used in this manual, only addresses equipment that is undersized. It is the responsibility of the user to address other causes of unmet load hours in the proposed design.

Unmet load hours apply to thermal zones that contain any space type that is normally occupied. Thermal zones that only contain the space types listed below will not be considered to have unmet load hours:

- Commercial and Industrial Storage Areas
- Corridors, Restrooms, Stairs, and Support Areas
- Electrical, Mechanical, Telephone Rooms
- Laundry Rooms
- Locker/Dressing Room
- Parking Garage Areas
- Unoccupied Gross Floor Areas

2.5 Calculation Procedures

The general calculation procedure is illustrated below in Figure 2. *The* proposed design *TDV energy use* is compared *to the* standard design.

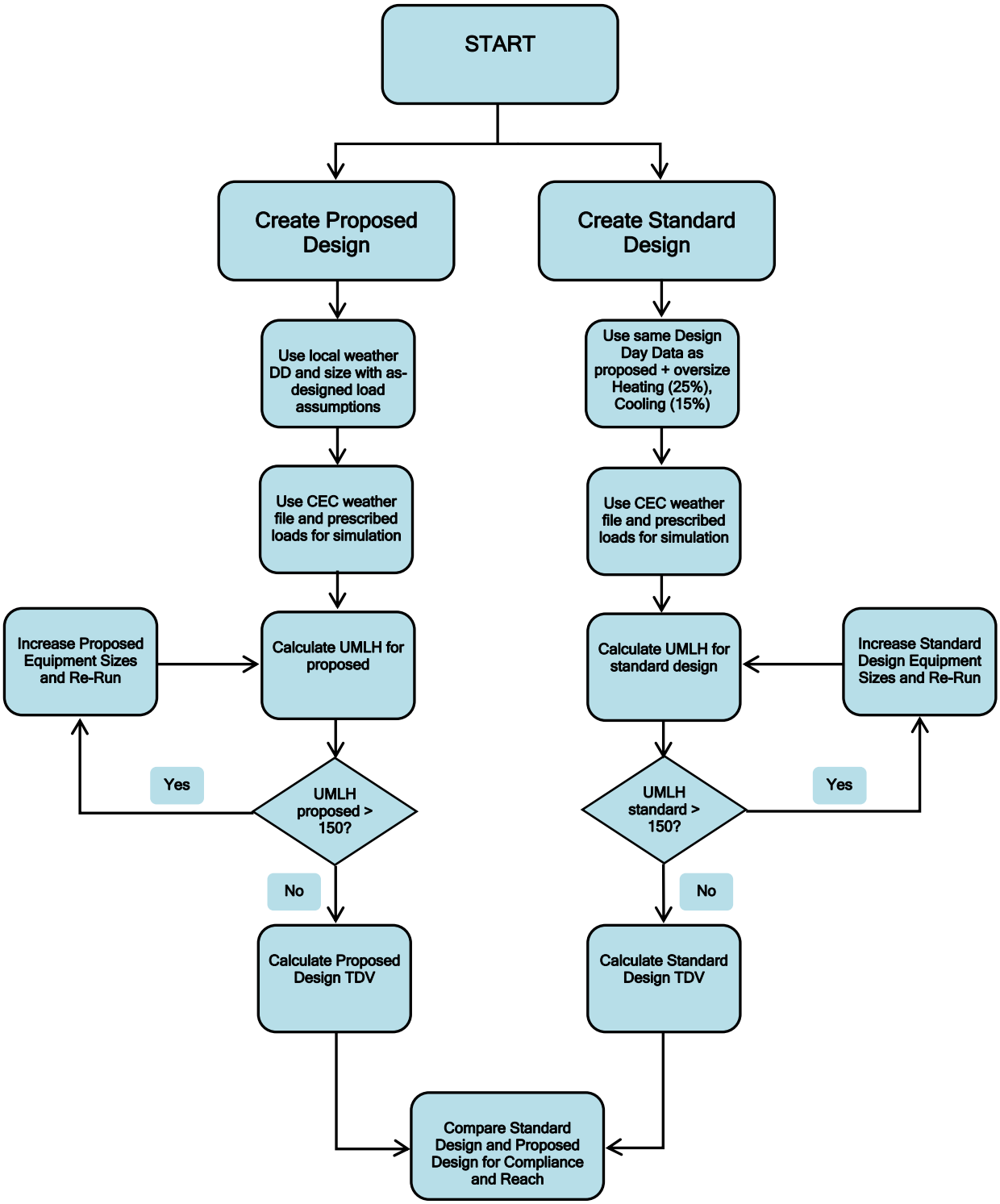

Figure 2 – Calculation Process for Title 24 Compliance and Reach

1. The process begins with a detailed description of the proposed design. Information is provided in enough detail to enable an estimate of annual energy use for a typical weather year. This information includes the building envelope, the lighting systems, the HVAC systems, the water heating systems and other important energy-using systems. This collection of information is referred to in this manual as *building descriptors*. Details on the building descriptors are provided in Chapter 5.

2. Before the calculations are performed, some of the building descriptors are modified for the proposed design to incorporate *prescribed* modeling assumptions. Prescribed modeling assumptions include occupant density, equipment power density, ventilation rates and water heating loads.

3. The next step is to make a simulation of the *proposed design* to determine how well the heating and cooling loads are being satisfied. The indicator is *unmet load hours*, the number of occupied hours during the year when the space temperature in one or more thermal zones is ~~below the heating set point temperature or greater than the cooling set point temperature~~outside of the throttling range. A large number of hours indicate that the equipment is undersized.

4. Test the number of unmet load hours and proceed only if the hours for each zone in the building are less than or equal to 150 for the year of the proposed design simulation.

5. If the unmet load hours are greater than 150 for the year, then the proposed building simulation model is adjusted by the user to reduce the unmet load hours to less than or equal to 150, or the user has the option to continue with the simulation but the thermal zones that exceed 150 hours will be reported on the compliance form.. ~~No zone may exceed 150 unmet load hours.~~ If the problem is heating, then the size of the boiler or furnace may need to be increased. If the problem is cooling, then the size of the coils or chillers may need to be increased. It is up to the designer to adjust equipment sizes as necessary; in some cases adjusting the zone airflows may solve the unmet load issue.

6. If the unmet load hours are less than or equal to 150, then the final simulation is performed. If no changes are made in the model, this may be the same simulation in step 3. These calculations produce the results that are compared to the standard design, which is calculated in steps 7 through 16.

7. Create the standard design following the rules in this manual. The standard design has the same floor area, number of floors and spatial configuration as the proposed design; however, systems and components are modified to be in minimum compliance with the *standard design*. The HVAC systems for the standard design are established according to rules in this manual and depend on the primary building activity (residential or non-residential), the floor area, and the number of stories. See Section 5.1.

8. Sizing calculations are performed for the standard design and heating equipment is oversized by 25% and cooling equipment by 15%.

9. The standard design is simulated to determine the number of unmet load hours. This process is the same as performed for the proposed design in step 3.

10. The number of unmet load hours for the standard design is then tested to see if they are greater than 150 for any zone(s). This is not likely to occur since the heating and cooling equipment is oversized by 15% for cooling and 25% for heating in step 8.

11. If the unmet load hours in the standard design are greater than 150, then equipment capacity in the standard design is increased so that the unmet hours are less than or equal to 150. See the discussion below on how equipment sizes are increased.

12. Once the tests on unmet load hours are satisfied, then the energy consumption of the standard design is calculated. If the tests on unmet hours are satisfied the first time through, this step is the same as step 9.

13. Finally, the proposed design TDV energy use and standard design TDV energy use are compared for compliance or Reach.

2.6 HVAC Capacity Requirements and Sizing

To ensure that the simulated space-conditioning loads are adequately met, adequate capacity must be available in each of the components of the HVAC system; e.g., supply-air flow rates, cooling coils, chillers, and cooling towers. If any component of the system is incapable of adequate performance, the simulation may understate the required energy inputs for space conditioning and report unmet load hours. Adequate capacities are required in the simulations of both the proposed design and standard design. The subsections below describe the procedures that shall be followed to ensure that both versions of the design are simulated with adequate space-conditioning capacities.

2.6.1 Specifying HVAC Capacities for the Proposed Design

As shown in

Figure 2

~~Figure 2~~, the proposed design ~~shall~~ should have no more than 150 unmet load hours. If this ~~requirement~~ limit is ~~violated~~exceeded, the software ~~shall require~~ allows the user to make changes to the proposed design building description to bring the unmet load hours equal to or below 150. This process is not automated by the software. There are two tests that must be met to avoid excess unmet load hours:

- Space loads must be satisfied: Space temperatures in all thermal zones must be maintained within one half of the throttling range (1°F with a 2°F throttling range) of the scheduled heating or cooling thermostat setpoints. This criterion may be exceeded for no more than 150 hours for a typical year.
- System loads must be satisfied: Plant equipment must have adequate capacity to satisfy the HVAC system loads. This criterion may be exceeded for no more than 150 hours for a typical year.

If either the space or system loads do not meet the above criteria, the equipment in the proposed design shall be resized by the user such that the criteria are met. If the space conditioning criteria are not met because the HVAC equipment in the proposed design lacks the capability to provide either heating or cooling, equipment capable of providing the needed space conditioning must be specified by the user.

Equipment sizes for the proposed design shall be entered into the model by the energy analyst and shall agree with the equipment sizes specified in the construction documents. When the simulations of these actual systems indicate that specified space conditions are not being adequately maintained in one or more thermal zone(s), the user shall be prompted to make changes to equipment sizes or zones as necessary. This occurs when the unmet load hours exceed 150 for the year. The use of equipment sizes that do not match the actual equipment sizes as indicated on construction documents triggers an Exceptional Condition that is noted on the compliance forms.

5.5.7 Fenestration

Note that fenestration includes windows, doors that have more than 50% glazed area, and skylights. A skylight is fenestration that has a tilt of less than 60° from horizontal.

Fenestration Name	
Applicability	All fenestration, optional input
Definition	A unique name or code that relates the fenestration to the design documents and a parent surface.
Units	Text: unique
Input Restrictions	No restrictions
Standard Design	Not applicable

Fenestration Type (Vertical Fenestration)	
Applicability	All vertical fenestration
Definition	This is a classification of vertical fenestration that determines the thermal performance and solar performance requirement for vertical fenestration.
Units:	
	List: Fixed, Operable, Curtain Wall, or Glazed Doors
Input Restrictions	As designed
Standard Design	~~Fixed~~Same as the proposed design

Fenestration Type (Skylights)	
Applicability	All skylights
Definition	This is a classification of skylights that determines the thermal performance and solar performance requirement for vertical fenestration.
Units:	List: Glass, curb-mounted, Glass, deck-mounted, or Plastic
Input Restrictions	As designed.
Standard Design	~~Glass, curb-mounted~~Same as the proposed design

Default Fenestration Type	
Applicability	All fenestration that uses default thermal performance factors
Definition	This is a classification of fenestration that determines the thermal performance for fenestration using defaults from Standards Section 110.6, Table 110.6-A. This is used for fenestration without NFRC ratings, or for fenestration for altered buildings that includes window films.
Units:	List: Fixed, Operable, Greenhouse/garden, doors, or Skylight
Input Restrictions	As designed
Standard Design	Not applicable

5.9.1.2 Water Heaters

This section describes the building descriptors for water heaters. Typically, a building will have multiple water heating systems and each system can have multiple water heaters, so these building descriptors may need to be specified more than once.

Water Heater Name	
Applicability	All water heaters
Definition	A unique descriptor for each water heater in the system. Some systems will have multiple pieces of equipment, for instance a series of water heaters plumbed in parallel or a boiler with a separate storage tank.
Units	Text, unique
Input Restrictions	Where applicable, this should match the tags that are used on the plans such that a plan reviewer can make a connection.
Standard Design	The naming convention for the baseline building system shall be similar to the proposed design.

Water Heater Type and Size	
Applicability	All water heaters when the proposed design has a service water heating system

Definition	This building descriptor includes information needed to determine the criteria from baseline standards. The choices are listed below.
	• Electric water heaters (storage and instantaneous)
	  o Small (≤ 12 kW)
	  o Large (> 12 kW)
	  o Heat pump
	• Gas storage water heaters
	  o Small (≤ 75,000 Btu/h)
	  o Large (> 75,000 Btu/h)
	• Gas instantaneous water heaters
	  o Small (> 50,000 and < 200,000 Btu/h)
	  o Large (≥ 200,000 Btu/h), <10 gal
	  o Large (≥ 200,000 Btu/h), >= 10 gal
	• Oil storage water heaters
	  o Small (≤ 105,000 Btu/h)
	  o Large (> 105,000 Btu/h)
	• Oil instantaneous water heaters
	  o Small (≤ 210,000 Btu/h)
	  o Large (> 210,000 Btu/h), <10 gal
	  o Large (> 210,000 Btu/h), >= 10 gal
	• Gas hot water supply boiler

	• Oil hot water supply boiler
Units	List (see above)
Input Restrictions	As designed
Standard Design	Gas storage water heater

Rated Capacity	
Applicability	All water heaters when the proposed design has a service water heating system
Definition	The heating capacity of a water heater at the rated conditions specified in DOE 10 CFR Part 430 or ANSI Z21.10.
Units	Thousands of British Thermal Units per hour (MBH)
Input Restrictions	As designed. If the loads are not met, the user has an option to specify an Exceptional Condition if the as-designed loads are significantly smaller than the load assumptions defined in the ACM Reference Manual for the specified space types.~~autosize~~.
Standard Design	Autosize if the Exceptional Condition above is not checked. If the Exceptional Condition is checked or enabled, then the standard design capacity equals 60% of the total proposed design capacity (combined rated capacity, converted to gph, and storage capacity in gallons).

Storage Volume	
Applicability	Gas-fired water heaters
Definition	The storage volume of a gas-fired water heater. This is used in the Standby loss calculations and baseline calculations of Energy Factor.
Units	gallons
Input Restrictions	As designed. If the loads are not met, the user has an option to specify an Exceptional Condition if the as-designed loads are significantly smaller than the load assumptions defined in the ACM Reference Manual for the specified space types.~~autosize~~.
Standard Design	Autosize if the Exceptional Condition is not checked or enabled. If the Exceptional Condition is checked, the compliance software shall size the storage tank to 40% of the proposed total rated capacity and storage volume for the peak hour, in gallons

Energy Factor	
Applicability	Equipment covered by NAECA, which includes small storage and instantaneous water heaters
Definition	The energy factor (EF) is the ratio of the energy delivered by the water heater divided by the energy used, in the same units. EF is calculated according to the DOE 10 CFR Part 430 test procedure, which specifies a 24-hour pattern of draws, a storage temperature, inlet water temperature, and other test conditions. These conditions result in the energy delivered for the test period. Energy inputs are measured for the same test period and the EF ratio is calculated.
Units	Unitless ratio
Input Restrictions	Building descriptors for the proposed design should be consistent with equipment specified on the construction documents or observed in the candidate building.
Standard Design	The EF for the baseline building system shall be determined from the CEC Appliance Efficiency Regulations. The following baseline EF applies for water heaters: Gas-fired storage type water heaters: 0.67 – 0.0019 x V