**eQuest Model Review Checklist – Level 3**

July 21, 2017

This model check list is for an in depth review, and should be used if the review team believes the modeling results are suspect. The following reports should be requested:

BEPU: Building end use breakdown by fuel type

ES-D: Utility costs

LV-B: Summary of Spaces

LV-D: Details of Exterior Surfaces

LV-H: Details of windows

LV-I: Details of Constructions

SV-A: System Design Parameters for HVAC (1 for each system)

PV-A: Plant Design Parameters

PS-E: Energy End-Use Summary for All Meters (one report for electricity, one for fuel)

**REPORT: BEPU**

| **Mark** | **Test** | **Reference #** |
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|  | Is the “Weather file” consistent with the building location? | 1 |
|  | Dividing the “Lights” by report model power yields a reasonable EFLH?Notes:Equivalent Full Load Hours will not match design schedule exactly due to daylighting. Reasonable is defined as between 2,000 and 3,000 for the prototypical schedules. | 2 |
|  | “Task Lighting” is the same between the Baselines and Proposed? | 3 |
|  | “Misc Equipment” is 20-35% of the Total Electricity? If outside of the range, is the reason documented in the report? | 4 |
|  | All differences in “Misc Equipment” proposed & baseline values are documented in the report? | 4 |
|  | “Domest Hot Wtr” is not more than 20% if work includes a new cafeteria and no more than 10% without? If yes, is there a reason documented in the report? | 5 |
|  | Is the split between electricity & natural gas “Space Heating” consistent with report documentation?Note:Example: Proposed (and/or baseline) space heating electricity is 30% of the total electricity, but documentation says the primary heating source is natural gas.Some electricity is acceptable, depending on modeler’s preference to model onboard controls. | 6 |
|  | Does the GSG baseline show electric use for heating? Note: the GSG baseline should only show electric heating under very special circumstances.  | 6 |
|  | Is Proposed “Space Cooling” more than 30% Total Electricity? If yes, is there a reason documented in report? | 7 |
|  | Is there a value in “Heat Rejection”? Does the report document a separate cooling tower? Are the EFLH consistent with the “Space Cooling” number?Notes:A value should not show up here if an air-cooled chiller or a packaged RTU are properly modeled. Values should existing only when a water based condenser loop is required (GSG baseline for schools > 150,000 ft2). | 8 |
|  | Is the “Pumps & Aux” EFLH consistent with the design? i.e. total pump EFLH should be roughly equal to the sum of respective plant EFLH for plants with pumps. | 9 |
|  | Is Proposed “Vent Fans” more than 30% Total Electricity? If yes, is there a reason documented in report? | 10 |
|  | Is the split between electricity & natural gas “Domest Hot Wtr” consistent with report documentation? Notes: Example: Proposed (and/or baseline) domestic hot water is only electricity, but documentation says the hot water heater should be natural gas.Some electricity is acceptable, depending on modeler’s preference to handle the recirculation pump power and/or the onboard controls. | 11 |
|  | Is the “Ext Usage” EFLH more than 2,200 per the report design value?Notes:ASHRAE 90.1 rules requires exterior lighting only operate in dark. Even the worst estimate should not exceed 2,200 EFLH for this latitude. | 12 |
|  | “Hours any zone above cooling throttling range” plus “Hours any zone below heating throttling range” are less than 300, and the sum of the proposed hours is no larger than the baseline hours plus 50 hours? | 14 |
|  | Is the sum of the hours above cooling throttling range and heating throttling range above 300? | 14 |
|  | Does the total amount of hours the design is out of range (heating + cooling) differ from the GSG baseline by more than 50 hours? | 14 |
|  | Does the total amount of hours the design is out of range (heating + cooling) exceed the LL86 baseline by more than 50 hours? | 14 |
|  | “Percent of hours any plant load not satisfied” more than 0%? If yes, is a reason documented in report?Notes:If this value is greater than 0% then it is indicative of an undersized plant, or oversized cooling/heating load. | 14 |
| NA | General Report Notes:The usage by area (kWh/sqft-yr) may include unconditioned areas like plenums. The EUI should be determined using the project area.  |  |

**REPORT: ES-D**

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| **Mark** | **Test** | **Reference #** |
|  | Do the utility costs match the values in the report?  | 1 |

**REPORT: LV-B**

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| **Mark** | **Test** | **Reference #** |
|  | Are the lighting power densities consistent with the report/ photometric drawings/ code requirements? Are the occupancy sensor controls accounted for in the LPD?Note:The lighting power density may be entered as averages for a space type, or may be entered as a space specific value. | 1 |
|  | Are the equipment power densities reasonable? | 2 |
|  | Is the modeled project area within 5% of the design area?Note:The total area may include plenums or other unconditioned spaces that are not part of the design, but are required for proper modeling. The areas for each space do not take into account the floor multipliers, but the total area does. | 3 |

**REPORT: LV-D**

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| **Mark** | **Test** | **Reference #** |
|  | Is the “Window Area” divided by the “Window+Wall Area” for the “All Walls” line consistent with the report window to wall ratio?Note:Once a DOB submission set has been completed the summary values of this report should match within 5% of the values documented on the EN drawings. Door areas and U-values are not accounted for in the LV-D report. The wall area includes the doors. | 1 |
|  | Roof area consistent with the footprint of the building? | 2 |
|  | Select a few representative wall definitions, are their U-values consistent with report values? In general, the U-value from the LV-D report will be lower than the reported value, and should be within 5%. Note:The LV-D and LV-I reports calculations are not consistent with the protocol established by ASHRAE 90.1 Appendix A. The interior air film coefficient default does not account for the orientation of the construction. The LV-I U-value calculation does not consider the exterior air film, and the LV-D U-value calculation uses a different value than specified by ASHRAE 90.1 Appendix A. During the simulation, eQuest calculates the exterior air film hourly based on the wind speed from the weather file. | 3 |
|  | Select a few representative window definitions, are their U-values consistent with report values?Note:The window U-values include an exterior film with R-value = 0.3. NFRC uses 0.17 to calculate the U-factor. The U-value from the LV-D report will be 3-5% lower than reported value.  | 4 |

**REPORT: LV-H (Select a few representative window definitions)**

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| **Mark** | **Test** | **Reference #** |
|  | Is the weighted average U-value ([Frame U-value \* Frame area + Center-of-Glass U-value \* {Glass Area – Frame Area}]/Glass Area) consistent with the report values?Note:It is common to see a frame area of zero. Many modelers do their own weighted average calculation outside the software or get the overall U-value from the manufacturer’s rep so enter the values in a simplified form than trying to calibrate a layered input to match manufacturer data. | 1 |
|  | Is the “Glass Shading Coeff” and “Glass Visible Trans” consistent with the report values? | 2 |
|  | Is a “setback” modeled? If yes, is it consistent with the design? No “setback” should be modeled in a baseline for new construction. | 3 |

**REPORT: LV-I**

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| **Mark** | **Test** | **Reference #** |
|  | Are the “U-values” within the acceptable range of the report values? Note:Please see note in LV-D report section regarding U-value calculations. The U-value from the LV-I report will be higher than the reported value, but the variation is dependent on the thermal properties of the wall.

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| --- | --- |
| Reported U-value | LV-I deviation |
| <0.07 | < 5% higher |
| 0.07-0.13 | 5-10% higher |
| 0.13-0.17 | 10-15% higher |
| 0.17-0.2 | 15-20% higher |

 | 1 |
|  | “Delayed” surface types are used for exterior wall, and roof construction definitions? If no, then ask for clarification to ensure building massing is being accounted for elsewhere in the model. | 2 |
|  | Are the “Number of Response Factors” consistent with report mass vs. framed construction?Note:Example: The report states that the proposed exterior walls are 4” face brick with 2” continuous insulation & 8” CMU which you would expect to have a “Number of Response Factors” ≈ 30. The model output states that the exterior wall has a U-value of 0.104, delayed, but only 6 for the “Number of Response Factors”. They may not have the proper specific heat/density in the materials. The number of response factors is higher for constructions with high thermal capacity than ones with low thermal capacity. | 3 |

**REPORT: SV-A- General**

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| **Mark** | **Test** | **Reference #** |
|  | Has an SV-A report been provided for all systems referenced in the report? | NA |
|  | Is there a 1-1 correspondence in the number of systems between the Proposed and LL86 baseline?  | NA |
|  | Is there one system per floor for the GSG baseline, with the exception of the public assembly spaces and 24hr data rooms? | NA |

**REPORT: SV-A**

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| **Mark** | **Test** | **Reference #** |
|  | Are “Capacity (CFM)” and “Power Demand” consistent with report? | 1 |
|  | Is the “outside air ratio” consistent with the ratio as calculated using the report values?Notes:Due to round-off error, the outdoor air flow calculated by this ratio and the “Capacity (CFM)” will not generally match the report CFM, but should be within 5%. If you total up the “Outside Air Flow (CFM)” for each zone for that system, it should match the report CFM exactly. | 2 |
|  | Is the “outside air ratio” bigger than the “minimum flow”? If yes, ask modeler to correct.Notes:eQuest has a known bug where even though the software should reset the minimum flow up to the outside air ratio despite what is specified, it will not.  | 3 |
|  | Are there “baseboards” defined in the proposed system? Is this consistent with the report? No “baseboards” should be defined in the baseline system.Notes: Sometimes modelers use baseboards in the baseline to eliminate sources of unmet load hours in non-essential spaces. While this is acceptable per the rules, it is advantageous for the documented savings to call the baseline zone thermostat “reverse-action” and allow the VAV boxes to reset back to design airflow in the heating season. | 4 |

NOTE(1): When reviewing systems take note that Terminal type units will present information slightly differently in SV-A rather than multi-zone type units. A terminal type system is a single definition in the model that generates one system per attached zone. As such a terminal type system will report individual fans, airflows, cooling capacities, and heating capacities. If a common outdoor air system serves the terminal units, then the associated heating/cooling for that sub-system will be listed in top half of the report.

NOTE(2): It is a commonly accepted practice that modelers treat multiple heating coils in series as a single coil as long as they are connected to the same heating plant and proper controls are implemented to prevent reheat if none is designed. This approximation is acceptable as models do not consider coil freeze-up. For this reason, it is not unusual to see “no” central heating capacity in the SV-A report. Instead all of the heating load will be listed in the reheat coils.

**REPORT: PV-A**

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| **Mark** | **Test** | **Reference #** |
|  | Are “rated capacity” of proposed equipment consistent with report values?  | 1 |
|  | Does \*Pumps\* “Head” match between the Proposed and LL86 baseline?  | 2 |
|  | Calculate the GSG baseline “Power” / “Flow” for secondary & primary pumps. Does it add up to 19 W / gpm for heating, 22 W / gpm for cooling, and 19 W / gpm condenser loop? | 3 |
|  | Are “Capacity Control” values consistent with the report?Note: If a loop is served by more than one pump (ie a hot water loop with two boilers and a pump for each boiler), then variable speed pumps will be reported as “VFD & STAGED”. | 4 |

**REPORT: PS-E**

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| **Mark** | **Test** | **Reference #** |
|  | Use Max kW in this report to determine equivalent full load hours (EFLH) in the BEPU report for the various end-uses. | 1 |
|  | Do “Task lighting”, “Misc equip”, Domest Hot Wtr”, and “Ext Usage” all have the same Max kW for all months? If not, is this explained in the report? i.e. Were a different set of schedules used?Note:Prototypical schedules are designed to have consistent maximums for all months. Additionally, the periodicity built into the prototypical schedules means that the month to month energy use for these end uses should only differ by the number of days. Deviations point to non-prototypical schedules were used. | 2 |
|  | If daylighting is specified, does “Lights” Max kW have a minimum in the summer & maximum in the winter? Note:If daylighting is claimed, but not modeled the lighting use will only be determined by the schedule and the peak will not vary. The peak varies because of the change in solar angle from summer to winter. The use varies also because the number of hours of daylight changes as well. When daylighting is modeled the EFLH will not match the schedule. | 3 |
|  | Is “Space Heating” zero for June to September? If not, is it explained in the report? i.e. is there reheat specified?Note:Prototypical model has heat indexed “off” for this period, and uses discharge air reset and VAV box position to eliminate any need for reheat. | 4 |
|  | Is “Space Cooling” minimal in winter? Are these values consistent with the data room equipment sizes?Note:The only HVAC equipment that should be running in winter months are the dedicated data closet and EMR split units. If the peaks in the winter exceed the estimated input power for this equipment then it is likely the central units are operating which should either be fixed or explained.  | 5 |