EA Credit 1.3 - Option A - Optimize Energy Performance, HVAC - Narrative

EQUIPMENT EFFICIENCY

HVAC SYSTEM

The HVAC system consists of variable air volume air cooled air conditioning unit located on the roof with variable air volume terminal units serving the interior zones and exterior zones. The supply ducts off the air handling units provide overhead cooling to the space via a Variable Air Volume (VAV) system. The supply system is through a conventional duct layout. Heating is provided to the space from the existing perimeter steam radiators.

The HVAC system has been designed and installed to comply with the efficiency requirements outlined in the New Buildings Institute, Inc.'s publication "Advanced Buildings: Energy Benchmark for High Performance Buildings (E-Benchmark)" prescriptive criteria for mechanical equipment efficiency requirements, sections 2.4(less ASHRAE standard 55), 2.5, and 2.6.

Section 2.4 of E-Benchmark focuses on sizing the cooling system. This includes properly sizing the fan and cooling capacity of the new roof top unit. When sizing the cooling load capacity the actual interior lighting design was used, equipment layouts and the actual building envelop was modeled. Loads were assessed at partial and peak levels by taking into account diversities within the space. When sizing the fan for the new roof top unit, the ductwork layout and flow rates were used to determine the system external static pressure requirements. This was used to find the break horsepower to satisfy the space requirements. A load analysis summary for the new RTU and a static pressure calculation is included for the credit as reference.

Section 2.4 mandates that the new roof top unit meets the minimum efficiency requirements as described in the E-Benchmark. For an electrically operated air cooled unitary air conditioner over 240 MBH as we have on this project, the EER has to be at least 10. The RTU used on this project has an EER of 10.5.

Section 2.5 of E-Benchmark requires any motor over 10 hp to have variable speed control devise. As part of this project both the supply and return fans are controlled by a variable frequency drive that meets the requirements of this section.

APPROPRIATE ZONING AND CONTROLS

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Carbon dioxide sensors have been located in the three meeting rooms and the kitchen. These carbon dioxide sensors are capable of modulating the amount of outdoor air to the space based on the demand.

The control zones were first determined by interior zones and exterior zones. All spaces with similar function that did not have an exterior exposure were connected to the same control zone. All spaces with similar function and similar exterior exposure were connected to the same control zone. The number of spaces connected to the same control zone was limited to provide additional control and comfort.

CONTROL LOGIC

1. Rooftop Air Handling unit (RTU)

   A. Warm-up

      1) A warm-up program shall be invoked if the return air temperature is below 60°f (adj.) Upon unit start up. The warm-up program shall reset the supply air temperature to 80°f (adj.). The supply air temperature shall be reset linearly and inversely from 80°f (adj.) To 70°f (adj.) As the return air temperature increases from 60°f (adj.) To 70°f (adj.). During the warm-up mode, the air handling unit shall operate on 100% return air (outside air damper shall remain closed). After warm up (return air above 70ºf (adj.)), the unit shall be controlled as described in occupied mode.

   B. Occupied mode

      1) The air handling unit shall be started based upon a start time optimization program, time of day schedule, or manual command and run continuously.

      2) All associated vav boxes shall be enabled prior to the supply fan starting.

      3) Upon a command to start, all associated isolation dampers shall open. Isolation dampers shall be hardwire interlocked to the supply fan starter by the atc contractor. The outside air dampers shall modulate to minimum position. Hardwired associated damper end switches on all two-position dampers shall energize the supply and return fan starters when all associated dampers are

in their fully open position.

4) Supply and return fan variable frequency drives shall start unloaded and slowly ramp up to speed as required. In the occupied mode, the supply and return fans run continuously. The supply fan variable frequency drive shall be controlled to maintain the supply static pressure setpoint, as sensed at a point 2/3 downstream of the supply fan. The return fan variable frequency drive shall be controlled to maintain the return cfm, as sensed by a return airflow measuring station, at the return cfm setpoint. The return cfm setpoint shall be calculated by adding a fixed value (the value may be positive or negative and shall be adj.) To the supply cfm, as sensed by a supply airflow measuring station.

5) Economizer mode shall be available whenever the outside air enthalpy is less than the air handling unit return air enthalpy. If economizer is available and there is a rise in supply air temperature above the supply air temperature setpoint, the outside air dampers shall be modulated open from minimum position to 100% open as necessary to maintain the supply air temperature setpoint. If the outside air damper is 100% open and there is a further rise in temperature above supply air temperature setpoint, the outside air damper shall remain 100% open and the dx-cooling shall be staged as necessary to maintain the supply air temperature setpoint.

6) When economizer mode is not available, the dx-cooling and gas-fired heating shall be staged in sequence as necessary to maintain the supply air temperature setpoint.

7) The supply static pressure setpoint shall be reset based on vav box damper position. If no vav box is greater than 95% (adj.) Open, decrease the supply air static pressure until at lease one vav box is greater than 95% (adj.) Open. If a vav box is greater than 95% (adj.) Open and not maintaining the space temperature setpoint, increase the static pressure setpoint until the space temperature setpoint is being maintained.

8) The supply temperature setpoint shall be reset based on vav cfm. Every 15 minutes each vav box shall be polled. If any vav box is providing maximum cfm, lower supply air temperature by .25°f. If no vav box is providing greater than 75% (adj.) Of maximum cfm, increase the supply air temperature by .25°f. If neither condition exists, supply temperature setpoint shall remain unchanged. This program shall be activated 1 hour after occupancy start time.

9) The outside air dampers associated with RTU and outdoor air damper associated with outside air monitoring station shall be overridden open as necessary to maintain each individual space carbon dioxide level at the space carbon dioxide setpoint. The space carbon dioxide level setpoint shall be equal to 700 ppm (adj.).

C. Unoccupied mode

1) The supply and return fans shall remain off and the variable frequency drives shall be set to 0%. The outside air dampers shall be close. The dx-cooling and gas fired heating shall be de-energized.

2. Variable Air Volume (VAV) boxes

A. The VAV boxes shall operate as per the manufacturer provided controls.

B. The VAV box shall modulate as necessary to maintain the space temperature setpoint.

C. If the supply air temperature entering the VAV box rises above setpoint, the VAV box damper shall open fully to facilitate warm-up mode.

POTENTIAL ENERGY SAVINGS

The VAV system allows for energy savings by allowing the main systems fans to ramp down based on unoccupied areas. Once the temperature sensor is satisfied, the damper within the VAV box will modulate to minimum position. The increase in pressure within the ductwork is sensed by pressure sensors within the ductwork which send a signal to the base building air handling unit. The fans within the unit will ramp down to maintain the pressure set-point within the ductwork.