Colorado Springs Utilities
It's how we're all connected

Strategic Facility Guidelines

For Improved Energy Efficiency in New Utility Buildings

06-09-05

Purpose:

- Implementation of the contents of this guideline will reduce facility energy use by 30 to 50 percent compared to ASHRAE 90.1 Base Building and Minimum Local Energy Codes.
- These measures will demonstrate Colorado Springs Utilities commitment to energy conservation as a customer-owned utility provider.

General:

- Design documents must include a detailed narrative description of the electrical and mechanical systems, including design parameters, features and limitations, etc. (expand).
- Project commissioning that includes, as a minimum, identifying measurable energy savings goals and monitoring the design and construction activities with these as Project Intent items, with early detection and notification of any project changes that impact energy use or demand.
- Project final payment contingent upon receipt of accepted accurate as-builts, test and balance report, and control shop drawings
- Building design must prevent negative pressure condition.
- Electric resistance space heating, air heating, water heating not allowed, unless there is no means to get natural gas to the site (requires special permission).

Energy Use, Overall Performance:

- Using ASHRAE 90.1 as a baseline, demonstrate through computer modeling that the building energy use will be at least 30 percent less than this value.

Water Use, Overall Performance:

- Using standard Kentucky Bluegrass sod as a baseline, demonstrate that irrigation use will be 50 percent or less of this value.

Test and Balance:

- Balance using “proportional balancing”, a technique that strives to reduce throttling losses.
- Any motor over 5 hp found to be throttled with a resistance element (valve or damper) more than 25 percent must be altered by sheave change, impeller trim, or VFD.
- Vertical return air shafts serving multiple floors require a balancing damper at each branch outlet to proportion the return air by floor.

Electrical Service:

- Locate transformers in perimeter areas that do not require air conditioning for cooling.
- Arrange switchgear to allow manual or automatic metering of the following loads (requires segregating loads):
  - Lighting.
  - Motors and Mechanical.
  - Plug Loads and Other.

Envelope:

- Orient buildings long dimensions E-W to reduce E-W exposure and associated solar load.
- Building entrance vestibule large enough to close one door before the next one opens (air lock).
- Minimum wall insulation R-19 or code minimum whichever is greater.
- Minimum Roof insulation R-30 or code minimum whichever is greater.
- Glazing meeting the following requirements:
  - Thermal breaks required.
  - U-factor of 0.35 or less.
  - Shading coefficient of 0.4 or less.
  - Low-E coatings on East and West facing glass.
- Glazing not more than 25 percent of gross wall area, without using high performance glazing, defined as:
  - Winter: 50 degree interior glass surface temperature with 0 degrees outside temperature and 70 degree space temperature.
  - Summer: Max shading coefficient of 0.2. Note: awnings or other exterior shading can be used to achieve this.
- Skylight / Clerestory elements must meet the following requirements:
  - Thermal breaks required.
  - At least double pane (layer) construction with sealed air space(s)
  - Overall U-value of 0.25 or less.
  - Skylight shading coefficient must be 0.3 or less
  - Low-E construction.
- Skylight / Clerestory area not to exceed 5 percent of roof area.
- Return plenums and shafts designed with an air barrier for leakage not exceeding 0.25 cfm/square foot of building envelope surface area @ 50 Pa (EBBA Criteria). Shaft construction requires field testing and verification.
- Building envelope devoid of thermal short circuits. Provide thermal break at all structural members between outside and inside surfaces.
- Building leakage testing required (new buildings), with no more than 0.25 cfm/square foot of building envelope surface area @ 50 Pa (EBBA Criteria).

Lighting:

- Follow ASHRAE 90.1 Lighting Power Budget Guidelines, and verify that designs do not exceed these limits.
- Where practical, depend more on task lighting and less on overhead lighting for desk work.
- Separate circuits for perimeter lights within10 feet of the wall, to allow manual or automatic light harvesting.
- Use 1-2-3 switching for large open interior area spaces.
- Ballast that will tolerate removing at least one bulb with no detriment, and with proportional energy use reduction.
- "Switching ballast" that will tolerate large numbers of on-off cycles as in with an occupancy sensor, without bulb or ballast life span detriment
- High power factor ballast, with minimum PF of 95 percent at all loads.
- Occupancy sensor in conference rooms, warehouses, and multi-function rooms.
- No U-tube lights.
- No incandescent lights, other than special accent lighting, with special permission.
- Outdoor lighting on photocell or time switch.

Motors and Drives:

- All motors meet or exceed EPACT-1992 efficiency standards
- VFD on all motors larger than 10 hp.
- Motor nameplate HP not more than 20 percent higher than actual brake horsepower served (don't oversize motors).

HVAC:

- Provide HVAC calculations and demonstrate equipment is not oversized. Equipment selection should not be more than 10 percent greater capacity than calculated values indicate.
- Design HVAC zoning to require heating OR cooling, not both. This will improve comfort and also reduce the inherent need for simultaneous heating and cooling.
- Design and control settings for ASHRAE Standard 55 comfort envelope, which indicates 90 percent comfort in our climate at the following space temperatures:
  - 72 degF heating
  - 60 degF heating for warehouses
  - 77 degF cooling
- Do not use electric resistance heat (special permission required).
- Do not use perimeter fin-tube hydronic heating (special permission required).
- Packaged equipment not less than SEER-13 or EER-12, as applicable
- Air-side economizers for all rooftop equipment, regardless of size.
- Air handler systems designed such that the fan kW at full load be kept to no more than 20 percent of the cooling equipment kW.
- Avoid duct liner and fiber-board ducts due to higher air friction and energy transport penalties (special permission required).

- Use angled filters in lieu of flat filters, to reduce air friction loss.
- Do not use series-fan-powered VAV boxes (special permission required).
- Heat recovery for any 100 percent outside air intake point that is greater than 5000 cfm.
- Air filter requirements:
  - Terminal units (fan coils, fan powered boxes, unit vents): 20 percent (1-inch pleated) Note: this may require an oversize fan on small terminal equipment, and not all manufacturers can accommodate.
  - Air handlers with 25 percent or less OA: 30 percent - MERV-7
  - Air handlers with 25-50 percent OA: 45 percent - MERV-9
  - Air handlers with more than 50 percent OA: 85 percent - MERV-13
- Air cooled condensing units over 25 tons, provide evaporative pre-cooling
- Make-up meter for all hydronic systems to log system leaks and maintain glycol mix.
- Separate systems for 24-7 loads to prevent running the whole building to serve a small load.
- Direct evaporative post cooling for all chilled water systems.
- Require duct leakage testing for all ducts 2 in. w.c. design pressure class or greater.
- For process exhaust and fume hoods, design for variable exhaust and make-up.
- Utilize general exhaust air as make-up for toilet exhaust and other exhaust where possible.
- Dedicated Outside Air System (DOAS) for large office facilities with VAV systems, allowing ZERO minimum settings for all VAV boxes. This will eliminate the VAV reheat penalty, and eliminate the internal zone over-cooling effect from VAV minimums which often requires runing the boilers throughout the year for comfort control.
- Do not use grooved fittings (e.g. Victaulic) in heating or cooling hydronic piping systems to avoid any operational constraints (such as starting or stopping equipment when needed) on account of these fittings.

Hydronic Circulating Systems:

- Heating: minimum 40 degree dT design, to reduce circulating flow rates and pump HP.
- Cooling: minimum 16degree dT design, to reduce circulating flow rates and pump HP.

Boilers and Furnaces:

- No atmospheric burners.
- No standing pilots.
- Minimum efficiency of 85 percent at all loads down to 25 percent load.
- For heating load turn-down greater than 4:1, provide modular boilers or a jockey boiler.

Chillers:

- Efficiency 0.5 kW/ton or less.
- Able to accept 55 degree condenser water at 3 gpm per ton, all loads.
- Air cooled chillers over 25 tons, provide evaporative pre-cooling.

Cooling Towers:

- Selected for 7 degree wet bulb and 0.05kW/ton or less.
- Water treatment control for minimum 7 cycles of concentration.

Controls:

- All analog instruments must be calibrated initially (or verified for non-adjustable devices). Merely accepting out-of-the-box performance without verification is not acceptable.
- 2-year guarantee on calibration, with 18-month re-calibration of all analog inputs.
- Air handler control valves with a residual positive seating mechanism for positive closure. Use of travel stops for this is not acceptable.
- Terminal unit control valves characterized ball valves.
- Erie valves not allowed.
- Valve and damper actuator close-off rating at least 150 percent of max system pressure at that point, but not less than 50 psid (water) and 4 inches w.c. (air).
- Dampers at system air intake and exhaust with leakage rating not more than 10 CFM per square foot at 4" water column gage when tested in accordance with AMCA Standard 300.
- Provide main electrical energy and demand metering, and main gas metering. Establish baseline and then trend and log “kBtu/SF-yr” perpetually and generate alarm if energy use exceeds baseline.
- Separate heating and cooling set points for space control.
- Space temperature user adjustment, if provided, limited to +/- 2 degrees.
- 5 degree dead band between space heating and cooling set points.
- 5 degree dead band between air handler heating and cooling (or economizer) set points, e.g. preheat coil cannot share a single, sequenced, set point with the economizer or cooling control.
- Separate lighting and HVAC time schedules.
- For chillers (condenser) and hot water boilers, use temperature sensors to log heat exchanger approach values, to prompt predictive maintenance for cleaning fouled heat exchange surfaces.
- Optimization routines:
  - Some method of adjusting ventilation rates for actual people count.
  - Optimal Start.
  - Demand limiting point, that will throttle all VFD-driven components to 90 percent load.
  - Optimal static pressure setting based on VAV box demand, not a fixed set point.

- Optimal supply air reset that will not reset the supply air temperature upwards until at least 80 percent of the boxes served are at minimum air flows, not reset from return air.

Plumbing:

- Max urinal water flow 0.5 gpf.
- Max lavatory water flow 0.5 gpf.
- All domestic hot water piping insulated
- If a circulating system is used, provide aquastat or timer to prevent continuous operation.
- Max domestic hot water temp for hand washing 125 degrees.
- Gas water heaters in lieu of electric.
- Consumptive use water sub-metering for evaporative cooling systems and cooling towers over 25 tons.
- Irrigation sub-metering.
- Domestic water heater is to be separate from the building boiler and heating system.
- Water fountains instead of chilled water coolers.
- Operate the building at reduced pressure (such as 50 psig) instead of 70 psig, to reduce overall usage. Verify that design maintains at least 5 psig over the required minimum pressure at all flush valves.