UNG CAMP WILLIAMS ENERGY UPGRADE

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Implementation of New Technologies for Improved Building Performance in Comfort and Energy Management

This study outlines the technologies and steps taken to modernize, repair, and enhance the HVAC systems and the TAC INET Control system installed at the Utah National Guard Camp Williams facility.

Equipment Upgrades to Variable Volume Air Handlers:

Adding Occupancy Sensors to VAV Boxes

Occupancy Sensors which are better termed 'Vacancy Sensors' were installed in individual offices and spaces which are intermittently vacant during a normal operating day. These sensors will ensure minimal use of HVAC equipment installed in these areas. Sensors are selected based on greater sensitivity to detect vacancy in the space. Each VAV box received a design and special programming to insure proper and optimal performance for usage and energy management. Through intelligent design many other factors were reconsidered for advantages to the operation of the spaces. Several qualifying criteria were used to determine the design so as to tailor the controls to the needs of the unique building layout and other factors.

CO2 Sensors

Controls and sensors were upgraded or replaced to to create accurate control of the outside air sequences. This allowed minimum necessary outside air to be utilized in order to reduce energy costs. An outside air CO2 sensor was also added as a reference. Outside air is only used to improve indoor air quality.

Return Fan Pressure Control

The VAV air handlers are equipped with Return Fans operated by a VFD. The Return Fans operate as Relief Fans when the Relief Dampers on the air handler are open. The Return Fan VFD's were operated by the control system to supply the same volume of air as the Supply Fan in the air handler. A new energy saving control sequence was installed to allow the Return Fan VFD to speed up only when it is needed. All conditions of the air handler now allow the Return Fan VFD to operate at a much reduced speed. Building static pressure control is also greatly improved.

Controls System Upgrades:

Optimized Start

Optimized Start is an intelligent method used to start an air handler in the morning. Optimized Start is now included on each air handling system.

Warmup & Purge

During winter months, the air handlers are programmed to keep all outside air dampers closed during the optimized start period each morning. The air handlers will then add heat to the space to warm it up as quickly as possible. In the summer, the air handlers force the outside air dampers open and keep the chilled water valves and DX cooling systems off. This allows the building to cool down as much as possible using natural cooling and keeps the mechanical systems off as much as possible.

Central Plant Heat

During warm-up mode as described above, the VAV air handlers and VAV boxes received additional energy saving modification that utilize the preheat coils. This will allows the building to warm-up more quickly minimizing the operation of the air handler. VAV Terminal boxes are programmed to have a 'Central Plant Heat' mode that considers the unique sequencing and avoids several heating and cooling issues. The overall design provides corrective solutions that avoid any complication from the approach.

Temperature Differential Between Setpoints

The constant volume air handling systems in the building had a single set point. If the temperature in the space is above this set point the air handler would provide cooling. When below the set point the air handler would provide heat. This single set point can be a very inefficient way to operate an air handling system. The new air handler sequences this inefficiency. The problems between the heating and cooling modes is eliminated. It also allows automatic seasonal adjustments for more comfortable and efficient operation.

Outside Air Economizing Adjustment

An air handler can only use the outside air for cooling purposes when the temperatures are cooler outside than they are inside of the building. The old programs in the air handlers compared the outside air temperature to the return air temperature. Using outside air to cool a building is called 'economizing'. Certain designs and programs have inherent problems. It was common to discover that air handlers would continue economizing when the outside air temperature was higher than useful. This forced excessive warm air into the building in the summer months wasting energy and forcing the cooling systems to work harder. The new program in the air handlers properly controls the economizing feature for the best utilization of outside air and energy cost savings.

Air Handler Discharge Temperature Reset

In the old control sequence, the discharge air temperature of the VAV air handlers was being set as a value independent of the needs of the VAV boxes that they serve. An outside air temperature reset schedule was used which allowed the discharge air temperature of the air handler to vary as the outside air temperature changed. This method of control is able to save some energy, but newer technology in control systems can now measure the exact needs of the VAV system and control the discharge air temperature of the air handler to meet those needs. It is not uncommon to reduce heating and cooling energy consumed by an air handler by 30% using these newer type of sequence but the increase in comfort is its largest appeal to the building occupants.

Air Handler Discharge Pressure Reset

The basic design concept of a VAV air handler requires the air handler to discharge a constant duct static pressure to supply the VAV boxes that it serves with the proper amount of air. As the VAV box dampers begin to close, the duct static pressure rises and the control system begins to slow down the VFD on the supply fan to maintain a constant discharge pressure. When a VAV box needs more air the VAV damper opens, the duct static pressure drops, then the control system speeds up the VFD to maintain the proper discharge pressure set point. The sequence described above saves energy, however greater savings can be achieved using newer technology. The idea behind the newer technology is to ensure that air handler automatically calculates and controls the duct static discharge set point through lower levels rather than the typical standards. It is not uncommon to reduce fan energy consumed by an air handler by 50% using this type of sequence.

Dual Maximum VAV Box CFM Set Points

VAV boxes typically have two air flow (CFM) set points. The maximum CFM set point is used when the box is in full cooling, and the minimum CFM set point is used when the box is either satisfied or in the heating mode. Most VAV boxes have an air delivery system that distribute the air for HVAC purposes from the ceiling of the space. In these cases the heat must be forced from the ceiling to the floor. Energy can be saved utilizing a newer technology that involves using an improved type maximum air flow set point scheme for a VAV box. Using this method, a VAV box now saves energy by allowing the air handler to deliver less air to the space. In addition, other set points allow less air to the space when the box is satisfied, improving the over-cooling condition that is common to VAV systems.

Runtime Optimization & Reports:

Runtime Logging

All of the air handlers in the building were operating more than they were needed. Many of them were operating 24 hours a day, seven days a week. This is particularly wasteful because most of the building is on a four day work schedule presumably to save money. To diagnose the severity of the problem daily runtime of each unit was implemented and is now easily viewed in several configurations on the graphics pages of the control system.

Change Schedules – Add Holiday Schedules

Many of the occupancy schedules have now been changed on the HVAC equipment to more accurately reflect the building occupied time. Several schedules have not been changed, but are being monitored for future optimization. Holiday schedules have also been added to minimize the runtime of the air handling equipment. Override timers have also been added to the constant volume air handlers in the building. These timers have allowed most of the unscheduled changes as described above while causing minimal discomfort to the building occupants and providing better energy management.

Runtime Reports

Runtime reports have been created for all air handlers in the building. These reports show a summary of the daily accumulated runtime history of each air handler. Problems of air handlers running longer than they should or operating on weekends or holidays when they shouldn't are easily identified. These reports also identify the percent usage of the air handlers for a given period (i.e. for each month). The percent usage for the air handlers of the building before the scheduling changes was near 70%. Since the runtime has been optimized, the percent usage has dropped to nearly 30% of the time. These reports are now continually monitored so that even greater savings can be achieved.

System Testing and Checkout:

Point to Point Testing

All points connected to the DDC control system were checked. The temperature sensors were all calibrated. A flow hood was used to recalibrate the air flow sensors in all VAV boxes. A calibration report was produced to show the current status of the building.

Making the Building Automation System More Efficient::

Graphics Pages

All graphic pages in the building automation system were modified. Navigation between graphics was simplified and new graphics were added to show more information.

A general building equipment alarm page was added to quickly identify equipment malfunctions in the building.

Air handler summary pages were also added which now allow an operator to quickly observe the performance of the building. These pages quickly show which areas of the building are in need of heating or cooling so that the operator can identify problem areas. These pages greatly assist the continuous commissioning process to enable the building to operate at its peak efficiency.