

TECHNICAL NOTE: THE NEW YORK TIMES DEMAND RESPONSE STRATEGIES FOR THE HVAC SYSTEM

Prepared by Flack + Kurtz, 2006

1 Duty Cycle ECM Motors

Normal Operation

The ECM motors control the amount of air delivered to the perimeter by the Fan Powered Boxes. Under normal operating conditions, when the space temperature is below setpoint, the ECM motors are at minimum speed and the heating coil control valves are modulated. Upon a rise in space temperature, the heating coil control valve modulates closed, and when fully closed, the ECM motor speed increases to maximum speed as required to maintain space temperature at setpoint.

DR Strategy

There are six zones per floor on the tower portion of the building with approximately four (4) perimeter fan powered boxes (FPBs) per zone. During the DR mode, the motors in 2 non contiguous FPBs in the zones on the floor that are not experiencing a solar load (determined by the mechoshade programming)¹ shall be commanded to stop for a period of 5 minutes (adjustable). After the five minute time period, the selected FPB will be returned to normal control after the next two non-contiguous FPB motors are stopped. The zones that are on a solar zone will not shut off.

End of DR Mode

Demand recover mode for this strategy will occur when either the DR mode is concluded by the BMCS based upon the duration of the event planned, or when the normal un-occupied mode for this floor occurs, and that un-occupied mode has not been overridden.

Recover form DR Mode

The BMCS will examine the Time of Day schedule and determine if the space should be occupied or not, and based on that determination will recover.

If the floor is scheduled to be unoccupied at the same time as the DR period ends, the entire floor system will shut down and restart based upon the Time of Day Schedule.

¹ Interface capability to be determined and subject to approval by NYT

If the floor is scheduled to be occupied, the zone motors that are off when the DR event concludes will have their space temperatures returned to normal occupied setpoints at the rate of 1 degree F per hour.

2 Perimeter Temperature Reset

Normal Operation

Under normal operating conditions, when the space temperature is below setpoint, the ECM motors are at minimum speed and the heating coil control valves are modulated. Upon a rise in space temperature, the heating coil control valve modulates closed, and when fully closed, the ECM motor speed increases to maximum speed as required to maintain space temperature at setpoint.

DR Strategy

There are six zones per floor. During the DR mode, the zone temperature setpoint shall be reset warmer by an adjustable amount.

End of DR Mode

Demand recover mode for this strategy will occur when either the DR mode is concluded by the BMCS based upon the duration of the event planned, or when the normal un-occupied mode for this floor occurs, and that un-occupied mode has not been overridden.

Recover from DR Mode

The BMCS will examine the Time of Day schedule and determine if the space should be occupied or not, and based on that determination will recover.

If the floor is scheduled to be unoccupied at the same time as the DR period ends, the entire floor system will shut down and restart based upon the Time of Day Schedule. Original temperature setpoints will be restored (but floor remains off until next scheduled on).

If the floor is scheduled to be occupied, the zone temperature setpoints shall be restored in 2 degree increments, each 10 minute period.

3 Interior Thermostat Setpoint Reset (Also resetting underfloor pressure)

Normal Operation

The interior temperature sensors are mounted higher than the normal sensor height. They act as a watchdog to reset the static pressure setpoint of the underfloor static pressure based upon the temperature sensed. Normally this temperature is 78 degrees, resulting in a chest height temperature of 74 degrees. If the temperature sensed begins to drop, indicative that the floor load is less

than design, the underfloor pressure will be lowered slightly to cause less cooling to pass through the floor. Upon a rising temperature, the reverse would occur.

DR Strategy

When this strategy is implemented, the setpoint will be raised to as high as 82 degrees.

End of DR Mode

Demand recover mode for this strategy will occur when either the DR mode is concluded by the BMCS based upon the duration of the event planned, or when the normal un-occupied mode for this floor occurs, and that un-occupied mode has not been overridden.

Recover form DR Mode

The BMCS will examine the Time of Day schedule and determine if the space should be occupied or not, and based on that determination will recover.

If the floor is scheduled to be unoccupied at the same time as the DR period ends, the entire floor system will shut down and restart based upon the Time of Day Schedule.

If the floor is scheduled to be occupied, the setpoint will be returned to normal occupancy setpoint gradually over the next 15 minutes.\

4 Duty Cycle Toilet Exhaust Fans

Normal Operation

The toilets are served by fans TX-28-1 and TX-C-1. These fans start and stop with the outside air fans serving the NYT floors. When the NYT floors are placed in the occupied mode, the outside air supply fans start. The supply air volume is read by the system and the toilet and general exhaust fans speed are modulated to maintain system differentials.

DR Strategy

When this strategy is implemented, the toilet exhaust fans will be turned off for 5 minutes out of each 15 minute period. The setpoint for the associated general exhaust fan (GX-28-1) will be "locked" to prevent it from ramping up in an attempt to achieve the CFM not exhausted by the TX fans.

End of DR Mode

Demand recover mode for this strategy will occur when either the DR mode is concluded by the BMCS based upon the duration of the event planned, or when the normal un-occupied mode for the system occurs, and that un-occupied mode has not been overridden.

Recover form DR Mode

The BMCS will examine the Time of Day schedule and determine if the space should be occupied or not, and based on that determination will recover.

If the system is scheduled to be unoccupied at the same time as the DR period ends, the entire system will shut down and restart based upon the Time of Day Schedule.

If the floor is scheduled to be occupied, the setpoint will be returned to normal slowly over a two minute ramp up time period.

5 Raising Space Humidity

Normal Operation

The outside air handling units supplying conditioned fresh air to the floors presently delivers air at 47⁰ degrees db and 46.9⁰ degrees wb resulting in a space humidity of 50%.

DR Strategy

When this strategy is implemented, the control loop setpoint would be reset upward to cause the system to deliver supply air at 52⁰ degrees db at 51⁰ degrees wb resulting in a space humidity of 55%.

End of DR Mode

Demand recover mode for this strategy will occur when either the DR mode is concluded by the BMCS based upon the duration of the event planned, or when the normal un-occupied mode for the system occurs, and that un-occupied mode has not been overridden.

Recover form DR Mode

The setpoint for discharge air temperature will be reset to 47^{0db}/46.9⁰ wb.

6 Graphical User Interfaces (GUIs) For DR Operations Using the Building Management System

6.1 Duty Cycle GUI

The Screen will consist of a grid that has a row for each floor 2 through 28, and 14 columns. Column 1 would show the floor number, column 2 is for a check box (☑) where the operator can include the numbered floor in the strategy by checking the box, and the remaining columns (2 per zone) would have a status box to show which zones on a particular floor are currently off, and the second column for the particular zone would be that zone's exterior temperature. (Solar zones on a particular floor would be blanked out.)

6.2 Perimeter Temperature Reset GUI

The Screen will consist of a grid that has a row for each floor 2 through 28, and 14 columns. Column 1 would show the floor number, column 2 is for a check box (☑) where the operator can include the numbered floor in the strategy by checking the box, and the remaining columns (2 per zone) would have a status box to show the zone temperature, and the second column would show the offset from setpoint (2 to 6 degrees).

6.3 Interior Thermostat Setpoint Reset GUI

The Screen will consist of a grid that has a row for each floor 2 through 28, and 14 columns. Column 1 would show the floor number, column 2 is for a check box (☑) where the operator can include the numbered floor in the strategy by checking the box, and the remaining columns (2 per zone) would have a setpoint box where the operator would fill in the DR upper limit temperature (any temperature between 78 and 282 based upon floor usage and experience), and the second column for the particular zone would be that zone's interior temperature.

6.4 Duty Cycle Toilet Exhaust Fans GUI

The Screen will consist of a grid that has four rows total for fans TX-C-1 and TX-28-12. Row 1 (Column 2) would show the fans descriptor (TX-C-1) and the second row would be that fan's current status (On or Off). Rows three and four would show the same data for TX-28-1. There would be two columns. Columns 1 (Rows 1 and 3) are for check boxes (☑) where the operator can include the associated fan in the strategy by checking the box.

6.5 Raising Space Humidity GUI

The Screen will depict the outside air supply system (same graphic as used for normal operation) with the addition of a graphical "DR Mode" switch. When this

“switch” is placed in the “DR” mode, the discharge temperature setpoint will be raised to the DR Mode setpoint (adjustable).

7 Feedback and Reporting

The BMCS shall have a CR reports log. Whenever the Demand Response mode is initiated, the system will create a log that will capture the current setpoints and readings for each system and parameter adjusted. This shall include;

1. DR Strategies - Status of each zone on a floor by floor basis
 - a. Fan Powered Box Fan status
 - b. Solar Load Status
 - c. Duty Cycle Time interval setpoint
 - d. Perimeter Space Temperature
 - e. Perimeter Space Temperature setpoint
 - f. Interior Space Temperature
 - g. Interior Space Temperature Setpoint
 - h. Toilet Exhaust Fan status
 - i. Outside Air Supply System discharge temperature (WetBulb)

2. General Reports
 - a. Entire Building Electrical Load Shape
 - b. Electrical Energy measurements as described in the implementation.
 - c. Cogen Plant Load profile

7.1 Master Demand Response Screen

The system shall be set up so that there is a master Demand Response screen. Whereas the specific strategy screen will have option boxes to check or uncheck floors/zones /equipment to be included in the response for a given event, the Master screen will, with a single stroke, initiate the selected DR strategies as configured at their individual screen level. The intent would be to pre-select the strategies or elements of those strategies beforehand on their individual screens and implement them globally on the main screen at the DR event horizon.