Automated Ventilation System

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Project Description

Design a Demand Control Ventilation (DCV) method that will control ventilation equipment so it turns on only when required. The ventilation equipment that will be controlled are the Make Up Air Units (MUA) and exhaust fans; they currently operate based on a daily/hourly schedule. The new Control method to use new air quality sensors to determine when the ventilation equipment should operate.

Background

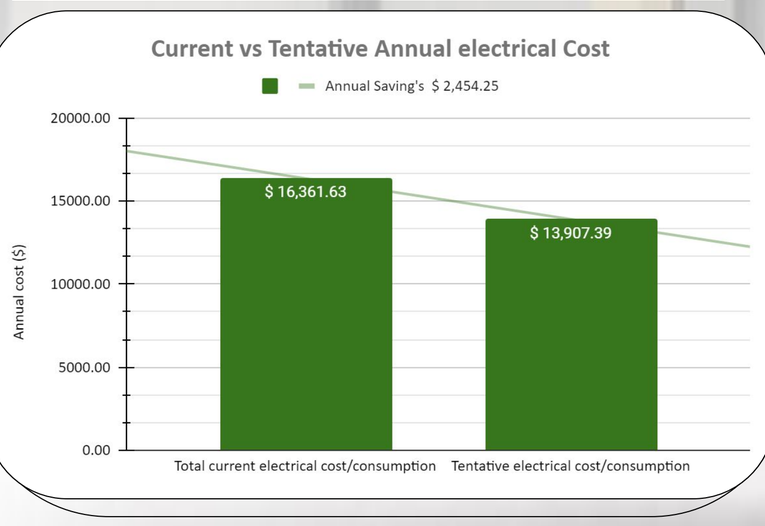
The company has three different HVAC systems which includes heating, dust collection and ventilation. The heating system is controlled by thermostats, the dust collection system has been automated already and it turns on when particulate is detected in the air, and the ventilation system includes the makeup air units and exhaust fans which are running on time-based system, so the ventilation equipment are on for the weekdays from 7:00 am to 3:30pm. Due to the time-based system, the company has high electricity consumption.

Project Goals

The objective is to design a Demand Control Ventilation (DCV) method that will control ventilation equipment including Makeup air units and exhaust fans, and the equipment will be on only when it's required. So, the company's current ventilation system which is timed-based will be converted to an automated ventilation system. When CO2 and/or CO sensors detect CO2 and/or CO gas above recommended threshold limits, the new system will turn on the ventilation equipment to bring the CO and/or CO2 levels below those limits. Through this design, it will reduce the plant's carbon footprint by consuming less electricity for ventilation while ensuring the correct amount of ventilation is provided to the employees in the facility.

Financials

East plant Total Cost		
Quantity	**Description**	**Total (CAD)**
4 units	CO_2 Sensor Cost ($1184.41/ unit) CAD ($936.00/ unit) USD	$ 4,737.64
0 units	CO Sensor Cost ($224.13/ unit) CAD	$ 0.00
-	Maintenance Cost	$ 850.00
-	PPM rent equipment (240$/week /Per 1.5 years)	$ 240.00
300 ft	Wiring Cost (0.88 $/ft)	$ 264.00
-	Shipping Cost Estimation	$ 267.38
10 hr	Labour Cost Estimation($45 / hr)	$ 450.00
	TOTAL	**$ 6,809.02**



Process

Zone locations:

The east plant is divided into four different zones. The purpose of identifying the zones is to locate sensors in each zone and to determine which ventilation equipment will turn on and off when they are triggered by the sensors at certain zones. The zones are determined based on barriers, and CO and CO2 levels in the plant.

Sensor Locations:

Four CO_2 sensors are placed in the east plant. One sensor per zone. Sensor location was based on the areas with the highest CO and CO2 peaks, barriers and molecular weight of the pollutant.

Sensors:

The CO2 sensor will be used to control the ventilation equipment.

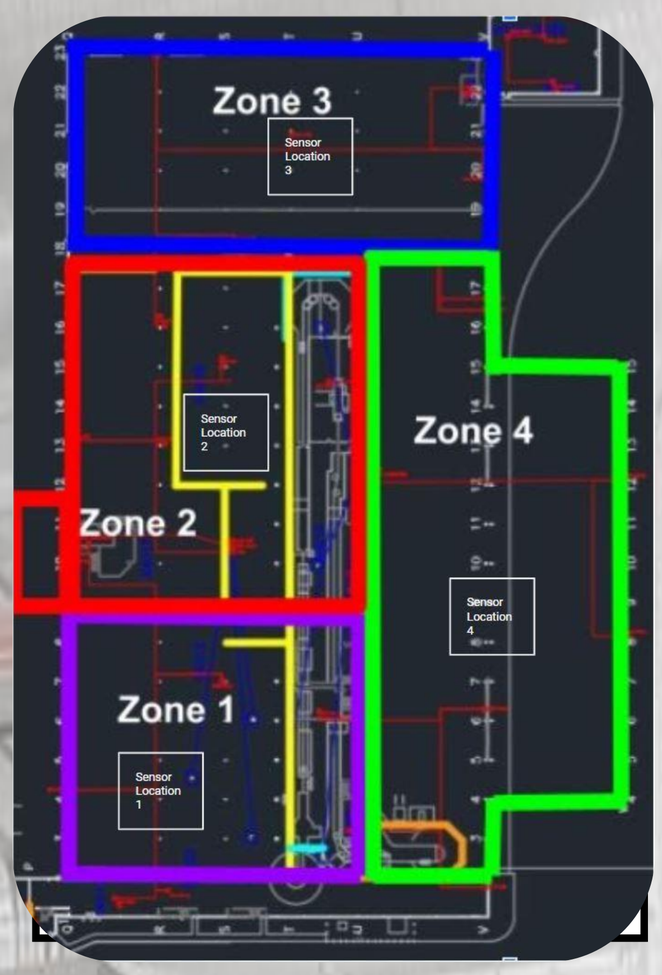
Control options:

When the CO2 level is above 1100 ppm, the exhaust fan and MUA will turn on. Exhaust fans would keep working for an extra 30 seconds longer than the MUA unit.

Retrieved from: https://www.gasdetectorsusa.com/gdusa/product.asp?pid=6747-PROSENSE_PQD-7133_gas_detectors_carbon_dioxide

Results

The east plant of the facility will have four CO2 sensors located as shown on the image. The CO2 sensor will be triggered when the contaminants are above 1100 ppm, to bring the contaminant below that level, the particular ventilation equipment in certain areas will be on.



New Facility Control Map

Conclusions and Recommendations

- CO2 sensors will operate only when the ppm is above 1100.
- By switching the DCV system from a schedule-based (7 am-3:30 pm) system to a CO and CO2 sensor system, a decrease of the annual electrical consumption of at least 15% is projected.
- Sensor location was based on the areas with the highest Carbon Monoxide and Carbon Dioxide peaks. An effort was made in avoiding areas with structural barriers, exits and windows that could disrupt the airflow. The height location was based on the molecular weight of CO, CO_2, air and the recommended height by ASHRAE Standards.
- Simulations with a prospective sensor and equipment rented by the company to test the ppm could take place in the plant to verify the accuracy of the readings of the new sensors on a regular schedule.

Acknowledgments

- Dr. Adisorn Aroonwilas
- Eng. Robert Thomas
- Eng. Celine Bierman
- Eng. Kyle Gebauer
- Eng. Brad Lulik
- Eng. Robert Jones.
- ASHRAE
- OHS
- Servomex, Pem-Tech, Johnson Controls

References

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