**ENGINEERING SPECIFICATION**

**Toxic Gas Monitoring and Ventilation Control System for  
Enclosed Parking Garage**

**Including Provisions for California Title 24 (2013) Compliance**

1. Overview
   1. The purpose of this monitoring and control system is to ensure that the concentration of toxic carbon monoxide [and nitrogen dioxide] gas is maintained at safe levels at all times while minimizing the garage’s energy consumption and environmental impact.
   2. The system must comply with all applicable codes and standards currently in effect with the Authority Having Jurisdiction (AHJ).
   3. This project is deemed to require compliance with the California Title 24 Building Energy Efficiency Standards (2013).
2. Gas Sensors
   1. General
      1. In order to provide maximum useful life and measurement accuracy, all toxic gas sensors shall utilize electrochemical sensor elements and shall drift no more than 5% per year under normal operating conditions.
      2. Each sensor shall cover no more than 5,000 square feet of the garage floor and shall be located in the highest concentration locations, with at least two sensors per proximity zone. A proximity zone is defined as an area that is isolated from other areas either by floor or other impenetrable obstruction.
      3. To minimize installation and lifecycle maintenance costs, all gas sensor electronics shall be removable from the sensor enclosure without disconnecting any wiring including power and communications.
      4. All gas sensors must be in NEMA 4X enclosures to ensure adequate protection from dirt and moisture and must operate continuously between 14°F and 122°F.
   2. Carbon Monoxide (CO) Transmitters
      1. CO transmitters must be accurate to ±3 parts per million with a full scale measurement range of 0-250 parts per million.
      2. CO transmitters must be third-party certified to UL-2075 and UL-61010. Transmitters containing UL-2075 certified sensing elements but not UL-2075 certified as a complete transmitter are not acceptable.
   3. Nitrogen Dioxide (NO2) Sensors
      1. NO2 sensors must be accurate to ±0.2 parts per million with a full scale measurement range of 0-10 parts per million.
      2. NO2 transmitters must be third-party certified to UL-61010.
3. Ventilation Controller
   1. The Ventilation Controller shall continuously monitor all gas sensors. In order to support the initial system configuration and provide expansion capability for future safety and energy efficiency enhancements, the Ventilation Controller must include at least 96 sensor input channels.
   2. The Ventilation Controller shall include an LCD display and menu navigation pushbuttons. Password security shall be provided to prevent unauthorized changes in operating parameters. In normal operating mode, the LCD shall continuously scroll through all of the gas sensor current measurement values.
   3. The Ventilation Controller shall continuously compare all gas readings to pre-defined threshold values. At least five threshold values shall be available for each gas sensor. There shall be a user-defined hysteresis associated with all threshold alarms to prevent rapid toggling of threshold events.
   4. Fan Control
      1. The Ventilation Controller shall be capable of associating any gas sensor with any individual fan or combination of fans.
      2. The Ventilation Controller shall be capable of implementing on/off and variable speed fan control.
      3. Control signals may be generated at the ventilation controller and at remote relay/analog output modules located on the multi-drop sensor network.
      4. If any on/off control functions are utilized, the Ventilation Controller shall provide a minimum on time / minimum off time setting independently for each piece of controlled equipment to prevent harmful short cycling.
   5. The Ventilation Controller must include an audible alarm horn rated at least 85 db.
   6. The Ventilation Controller must include clearly visible LED’s indicating system power, fault mode and alarm states and fan control override.
   7. The Ventilation Controller must have a programmable service due date.
   8. The Ventilation Controller must archive power cycling and communication fault events to facilitate lifecycle troubleshooting.
   9. The Ventilation Controller must include a communications port through which the building management system (BMS) can read all gas values, control relay states, and analog output values. This port shall support [BACnet-IP / Modbus-RTU] communications.
   10. The Ventilation Controller must be in NEMA 4X enclosure to ensure adequate protection from dirt and moisture and must operate continuously between 14°F and 122°F.
   11. The Ventilation Controller must be third-party certified to UL-2017 and UL-61010
4. Sequence of Operation
   1. General
      1. Minimum and design ventilation rates (cfm per square foot) shall be in accordance with applicable codes and standards.
   2. Occupied Mode
      1. The system must operate according to a user-supplied occupancy schedule.
      2. During scheduled occupied hours the ventilation rate shall be at least 0.15 cfm/ft2.
      3. The Ventilation Controller shall increase fan air flow to maintain CO concentration at 25 ppm or less [and NO2 concentration at 2 ppm or less} at all sensors.
   3. Unoccupied Mode
      1. During scheduled unoccupied hours, all ventilation fans may be turned off.
      2. The Ventilation Controller shall increase fan air flow to maintain CO concentration at 25 ppm or less [and NO2 concentration at 2 ppm or less] at all sensors.
5. Fault Detection and Notifications
   1. The Ventilation Controller must be capable of diagnosing the following faults:
      1. System or sensor scheduled maintenance past due.
      2. Communication loss to any sensor.
      3. Sensors determined to be an “outlier” based on the magnitude and duration of deviation for the average of all sensors in its proximity zone as specified in the Title 24 Standard.
   2. Upon detection of a fault condition:
      1. The Ventilation Controller shall activate its audible annunciator.
      2. The Ventilation Controller shall illuminate its LED fault indicator.
      3. The Ventilation Controller shall operate all fans at full design flow.
      4. [The Ventilation Controller shall generate an email message to user-specified recipients clearly identifying the garage location and the nature of the fault.]
6. Acceptance Testing and Certification
   1. The Toxic Gas Monitoring and Ventilation Control System must be designed to facilitate the Acceptance Tests as prescribed in the Title 24 Standard.
   2. Rotary switches are to be provided which signal the Ventilation Controller to load the necessary test parameters for each of the five acceptance test steps and to reload the normal operating parameters at the conclusion of each step. If email connectivity is provided, informational emails shall be generated at Acceptance Test step.
   3. Systems requiring the input of test mode parameters through the Ventilation Controller’s pushbutton/LCD operator interface are not acceptable as this method is deemed to be too time consuming at the time of inspection and too prone to error when normal operating parameters are restored.
7. Documentation
   1. The system shall be supplied with a single-line riser diagram showing the logical location of each sensor and remote control device and summarizing the sequence of operation.
   2. Installation / commissioning guides and user instruction manuals shall be provided.
8. Lifecycle Maintenance
   1. The Gas Sensors and Ventilation Controller shall require maintenance no more than once per year under normal operating conditions.
9. Approved Equipment
   1. INTEC Controls DGC-series Ventilation Controller with DT5- and AT-series gas sensors and REL5-series remote control modules (Contact INTEC Controls at (858) 578-7887).