SECTION 40 91 13

GAS DETECTION DEVICE REQUIRMENTS FOR LIFE SAFETY SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 263111 – Digital Addressable Fire Alarm System

1.2 REFERENCE CODES AND LISTINGS

A. National Fire Protection Association (NFPA) – the latest adopted edition of the Code referenced:
   1. NFPA 2 Hydrogen
   2. NFPA 30 Flammable and Combustible Liquids
   3. NFPA 55 Compressed Gases and Cryogenic Fluids
   4. NFPA 318 Standard for the Protection of Semiconductor Fabrication Facilities
   5. NFPA 497 Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas

B. International Building Code (IBC)

C. Underwriters Laboratories (UL)

D. State and Local Codes

E. Approval from the Office of the Georgia Tech Fire Marshal

1.3 SUMMARY

A. This specification defines the requirements for the Georgia Tech Dangerous Gas Monitoring System (DGMS). The DGMS provides hazardous gas detection and notification in buildings where hazardous chemicals and gases are handled.

B. The system will be implemented in two sub-systems:
   1. Local Gas Detection equipment, controls, and alarming through the building fire alarm control panel (FACP)
   2. Data and User Interface for campus to DGMS over Ethernet (Indusoft Server).

C. Separate vendors may be used to provide the two sub-systems.

D. The Local Gas Detection consists of the following components:
   1. Gas detectors, including transmitters and sensors
   2. Emergency stop buttons (E-stop)
   3. Light stacks

E. The Fire Alarm system and the Local DGMS will share some devices. These include:
   1. Alert Strobes equipped with speakers
   2. LED screens for messaging
   3. FACP screen for displaying information on emergency conditions
   4. Digital dialer to alert 3rd party monitoring

F. The FACP will be programmed to control supply equipment for hazardous chemicals/gases and to place that equipment into a safe state upon detection of a hazardous gas at pre-determined levels. This equipment will also be placed into a safe state during a fire alarm condition. In some situations, the FACP will signal the BMS to modify HVAC settings to provide additional ventilation to the space.

G. The Local DGMS devices will have power provided through the FACP and both the Local DGMS and FACP will be on battery backup and emergency power.

H. The Indusoft Server provides a Data and User Interface for DGMS. The Server provides a rich graphical user experience via wired and wireless network devices. Interfaces include interactive web pages with detail ranging from entire campus overview to an individual gas sensor, interactive stationary displays, with capabilities depending on login credentials.

I. The Indusoft Server receives data through Ethernet connections to each gas detector located on the campus. Individual Ethernet cables are routed through an Ethernet switch and onto the GTLAN.

J. The ONYXWorks™ graphical workstation provides centralized control and monitoring of fire alarm and gas detection systems. Data is routed to the ONYXWorks workstation through the GTLAN. This workstation provides text and email messaging independent of the Indusoft Server.

1.4 DEFINITIONS

A. DGMS: Dangerous Gas Monitoring System

B. FACP: Fire Alarm Control Panel

C. IBC: International Building Code

D. GTLAN: Georgia Tech Local Area Network

E. LED: Light-emitting diode

F. LEL: Lower Explosive Limit, the lowest concentration (percentage) of a gas or a vapor in air capable of producing a flash of fire in presence of an ignition source (arc, flame, heat).

G. NFPA: National Fire Protection Association

H. PEL: Personnel Exposure Limit, is a legal limit in the United States for exposure of an employee to a chemical substance, given as a time-weighted average (TWA) over eight hours.

I. UL: Underwriters Laboratories

J. SLC: Single Line Circuit

1.5 ACTION SUBMITTALS

A. All vendors providing submittals under this specification must attend a mandatory pre-bid meeting that will review the scope and details of this work. No submittals will be accepted without attendance.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Include performance parameters and installation details for each gas transmitter and sensor, verifying the unit is suitable for use in the temperature and humidity conditions as well as for the range of the target gas for that sensor. Include sensor data sheets for planned sensors that indicate detection levels and potential cross-talk with other gases.
   2. Include DGMS device power requirements.
   3. It is the responsibility of the vendor to provide integration between the following systems by coordination with other system providers:
      a. Fire Alarm System
      b. Building Automation System (supply and exhaust systems)
      c. Gas Delivery equipment (gas shutoff valves, gas cabinets, etc.)
   4. The DGMS integrator vendor shall provide:
      a. Electrical Diagrams: Include wiring diagrams depicting safeties and automated relay contacts.
      b. Instrument Mounting/Field Connection Diagrams: Include mounting details of sensor types to be used.
      c. System Architecture: Show location of each main panel, field panels, auxiliary equipment, I/O devices, and other major system components.
      d. Installation Overview Drawings: Four sets of drawings, dimensioned and drawn to scale with appropriate symbols, including system wiring requirements.
      e. Communications riser diagram.

f. Panel Layout/Diagrams including bill of materials and mounting details for recessed, surface, mounted or free standing panels. Provide installation details and mounting requirements.
g. Specific list of any exceptions to the drawings and specifications.
h. Final DGMS drawings for submission to the City for permit of the Life Safety System.

D. CLOSEOUT SUBMITTALS
1. Operation and Maintenance Data: Provide operation and maintenance information for all devices.
2. As built drawings showing device locations, wiring diagrams, device numbers, controlled devices (valves, cabinets, etc.).
3. Controls and operation manual for DGMS operation.
4. Program Software Backup: electronic media with data files.

E. QUALITY ASSURANCE
1. Installer Qualifications: Installers shall be trained and have experience in the handling and installation of gas detectors.
2. Equipment of a given type shall be from a single manufacturer and shall be supported by a manufacturer authorized, established service organization. Service for the Honeywell Midas sensors shall be through Honeywell with no substitutions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Basis-of-Design Products: Subject to compliance with requirements, the following shall be provided:
1. The Georgia Tech standard for gas detector is the Honeywell Midas® Gas Detector where technically feasible. Exceptions include, but may not be limited to, the following:
a. NEC 500 Class 1 and Class 2 Flammable Gas zones where the analyzers are expected to function in atmospheres potentially greater than 25% of the Lower Explosive Limit (LEL). Preferred gas analyzers for NEC rated Class I, Div 1 or Div 2 hazardous areas are Honeywell APEX series of gas detectors.
b. Specific gas monitoring applications that measure a gas that is not supported by Honeywell Midas® Gas analyzers. All non-Midas® system must be approved by the customer or the delegate engineering representative.
c. Outdoor installations where Midas® Gas analyzers will not perform satisfactorily.
d. Flame detection for silane. Honeywell Model FS20X Multi-Spectrum Fire and Flame Detector will be used.
2. Light Stack Hardware
a. The following are the light stacks specified for standard use. In buildings that will be renovated and light stacks are existing, these can remain and be reused if they have the following features:
1) Power is 24V DC
2) Light is a stack with colors of green, yellow, and red. Green must be bottom, yellow middle, and red on top.
3) Light stack is capable of activation of each light individually.
4) When activated, the yellow and red lights shall blink.
5) Stacks are mounted in a vertical position and are clearly visible.
6) Is mounted in the appropriate location as shown on project drawings.
b. If the stack is not in accordance with drawings or these specifications, the vendor should verify with the design team if the stack should be relocated or can remain.
c. Existing light stacks that have integral audible alarms should have these disabled. Audible alarms will be provided through the fire alarm notification system.
d. Indoor Light Stacks
1) Inside Rooms and Corridors, Non-Classified - Patlite LME 60 mm
2) Inside Class 1/Div 2 – Patlite AR-078 60 mm
3) Inside Class 1/Div 1 – Patlite EDWM
e. Outdoor Light Stacks

1) Allen Bradley 855T (grey) Modular Stack Light/Light Tower Systems

3. E-Stop Button: Pilla WPS-MP-BS-CLM, red mushroom button, with the clear cover and the "PULL TO RESET" instruction on the button face.

2.2 LOCAL SYSTEMS OPERATIONAL DESCRIPTION

A. Refer to Division 26 Digital Addressable Fire Alarm System specification. The specification covers integration of the DGMS with the Fire Alarm System.

B. This section describes the architecture, components, and operation of gas detections systems, their components, and how these systems shall operate in normal and emergency/failure scenario.

C. Alarms and Notification Overview
1. A detection of a gas leak at 10% of the LEL or PEL (Level 1) will send a supervisory signal to the FACP, and provide local messaging and lights to indicate a warning of potential unsafe conditions.
2. A detection of a gas leak at 25% of the LEL or PEL (Level 2) will both alarm and will send signals to local equipment to provide actions that ensure the safety of personnel and minimize potential damage to equipment. Equipment that may be controlled includes, but is not limited to, automatic shut-off gas supply valves, additional room exhaust ventilation, and isolated contacts for process equipment interlocks.
3. Gas detectors monitoring carbon monoxide (CO) in combustion test areas in Ben T. Zinn and CNES shall have the following detection levels. At the given level, the actions outlined in 1 & 2 above shall occur:
   a. Level 1 PEL (CO) Zinn only: 50%
   b. Level 2 PEL (CO) Zinn only: 100%
4. Ga Tech personnel will be able to determine the exact nature of the incident by viewing information in multiple locations, including the FACP, handheld devices, local displays, and through the Indusoft HMI. Information from the DGMS on the type of alarm is also emailed and/or texted to selected GA Tech personnel and security via the FACP.
5. Buildings with multiple floors shall have a fire alarm annunciator panel on each floor that can display both fire and gas alarms.
6. DGMS notifications and alarms will be transmitted through the FACP's digital dialer to a monitoring company.
7. The FACP will transmit information to ONYXWorks workstation(s) located around the campus. These workstations will provide viewing of all sites on Honeywell FACP and will text and email notifications to specified staff.

D. Each room where hazardous chemicals and gases are used shall be equipped with two 3-color light stacks minimum, with one inside and one outside the room in the corridor.

E. Color coding of the light stack response for LEL and PEL shall be:
1. Green ≤ 10% LEL or PEL (normal/okay)
2. Yellow = 10 - 25% LEL or PEL / exhaust failure (Level 1)
3. Red ≥ 25% LEL or PEL (Level 2) or E-stop activation

F. Color coding of the light stack response for asphyxiation and high oxygen hazards:
1. Green >20% O_2 and < 23%
2. Yellow = 20% to >19.5% OR 23% to <23.5%
3. Red = ≤ 19.5% OR ≥ 23.5%
4. All lights off indicate a failure of an DGMS device in the room

G. When activated, yellow and red lights shall be flashing.

H. Buildings containing rooms or labs handling hazardous gases may contain one or more gas sensors.

I. For gas detectors located inside a ventilated gas cabinet, gas detection reaching Level 2 will not activate the fire alarm evacuation. It will activate the light tree associated with the laboratory, place the gas cabinet into a safe state, and make an audible announcement of the alarm type and location.

J. All gas detection devices local to the room are networked to the building FACP on its SLC loop. Each gas detector's analog output and fault point, and the room's Emergency Stop button are read by the FACP through interface modules. This allows the FACP to display gas concentrations directly.

K. In small installations where the FACP does not have analog (4-20mA) interface modules, the gas detector's discrete alarm points may be used for the two levels of gas alarms.

L. As required, additional SLC relay interfaces shall control gas supply valves, gas cabinets, or other equipment. Boolean logic in the FACP controls these relay devices based on the state on the gas detectors.

M. The FACP will contact third party monitoring for all notifications through a digital dialer as outlined in the messaging section of this specification.

N. Level 2 alarms in the breathing area of the rooms (not inside ventilated cabinets) will also activate the Fire Alarm speakers and strobes to initiate an evacuation of the building.

O. Power for gas detection devices, light stacks, and modules requiring external power shall be provided by the FACP and shall be 24V DC. Additional FACP power supplies may be required.

P. In cases where the power requirements are not satisfied by the FACP power supply, UL 864 rated battery backed up power supplies shall be provided.

Q. The gas detectors for each room shall have a 4-20mA gas concentration signal and a Fault relay. In the absence of the 4-20 mA signal, Alarm 1 (Level 1) and Alarm 2 (Level 2) relays may be used.

R. The fault contact shall be configured as normally closed / fault open to handle the case of loss of power (or being switched off) to the gas detector as a fault.

S. The detector shall provide Modbus TCP/IP connectivity for the Data and User Interface Network (Indusoft). If the detector does not provide native Modbus TCP/IP, the Data and User Interface Network shall use the FACP Modbus TCP/IP or other means to obtain the detector data.

T. The Midas® HTML (Web page) access capability via GTLAN connections shall be used for resetting alarms, troubleshooting through the Indusoft server.

2.3 GAS MONITORING SYSTEM DEVICE IDENTIFICATION

A. General
1. The following devices in the DGMS will have unique I.D. numbers assigned by the Design Firm and/or the Installer:
   a. Gas detector/transmitter
   b. E-stop
   c. Light stack
2. I.D. numbers shall be on any layout drawings and/or schedules of devices.

B. Numbering format
1. The general format is:
   DEV-ROM-CHEM-SERIAL
2. The designations are:
   a. DEV = Device designator
      1) AIT – designates an analytical instrument
      2) HS – designates hand switch (e-stop)
   b. ROM = Room Number (may be combined with building number)
   c. CHEM = chemical type being detected (limit to 4 charc if possible). Examples are:
      1) H2 - hydrogen
      2) L – lower explosion limit (volatile organic compounds)
      3) CO – carbon monoxide

4) SIH4 – silane
5) CL2 - chlorine
6) HCL – hydrogen chloride
7) BCL3 – boron trichloride
8) ASH3 - arsine
9) HBR – hydrogen bromide
10) NH3 - ammonia
11) PH3 – phosphine

d. SERIAL = serial number of devices in a single room that are duplicate gases

3. All devices shall have a tag or label applied with the ID number clearly displayed.

2.4 INDUSOFT DATA SERVER OPERATIONAL DESCRIPTION

A. The DGMS is monitored and can be controlled through a campus wide Ethernet network linked to a server located in the Bunger Henry building. This server is running Indusoft software which has been developed to provide the following:

1. System shall be available on the Internet and accessible without a VPN.
2. System shall be available 24 hours per day.
3. System shall be accessible by mobile devices.
4. System shall support full-featured interactive display screens per building.
5. System shall support consolidated trending and logging.
6. System shall have consolidated graphical display of alarm points.
7. System shall have consolidated graphical display of gas concentration and other data.
8. System shall allow access to individual Honeywell gas detectors and transmitters to view sensor status and reset alarms via remote access.
9. System shall have UPS or other backup to minimize system failure. The building Ethernet switches and each room which is part of the DGMS shall have a UPS.
10. System shall have a data historian that can store and retrieve a minimum of 90 days of data from all detectors on campus.

B. As a part of the implementation of the DGMS as a new system or renovation of an existing system, the Indusoft server screens and programming must be updated. This update shall be coordinated through the GT Facilities and Engineering group. It is the responsibility of the contractor to provide information as required to support the Indusoft updates.

PART 3 - EXECUTION

3.1 GENERAL

A. Sampling and Exhaust Lines

1. Sampling and Exhaust Lines for Gas Detectors shall be a ¼" sampling line, thick wall, with a 1/8" I.D. The line material must be Teflon FEP. Other material must be approved by engineering.
2. The ¼" sampling and/or exhaust lines may not exceed a total length of 100 feet and the configuration shall be verified using calculations in the Midas Technical Manual, Section 4.3 Sample and Exhaust Tubing Calculations.
3. The sampling line drops must be attached to walls using brackets a minimum every 24 inches. Horizontal runs may be placed in trays and held down with loose cable ties or run in conduit.
    a. Lines running outside should be Teflon FEP inside steel tubing, to prevent damage from the elements.
    b. All pumped gas sampling tubes (such as used on Midas® analyzers) must have a disposable dust filter installed at the sampling location inlet. Use particulate filter Honeywell part number 780248 for non-corrosive gases and part number 1830-0055 or 1991-0147 for corrosive gases.
    c. Tubing shall have open ends capped when installed and the end cap shall be removed only when the filter is installed.

d. Tubing shall have permanent labels installed at the end point with the gas detector ID and the target gas. Note tape will not adhere directly to Teflon so labels must be wrapped fully around.
e. Transmitters using aspirated sampling shall be vented either back into the room where the sample originated or into a chemical exhaust system. Vent lines should not return near the original sampling line to prevent cross contamination. Vent lines shall be routed to exhaust systems approved by engineering.
f. Vents cannot be routed to room HVAC return ducts.

4. Gas Detectors
   a. Gas detectors shall be anchored to a wall or firm support using the mounting bracket supplied with the unit.
   b. Minimum spacing of the gas detectors from each other or other objects on the wall is 3.5" on both sides. Note space must be allowed on top and bottom of the unit for sample inlet and exhaust tubing and for power and communication cables.
   c. Analyzers installed at outside locations must be install out of the direct sunlight as well as with rain protection to prevent moisture and condensation inside the unit.
   d. Good instrument wiring practices shall be incorporated in the gas detector installation.
   e. Power: the detector will be powered via the FACP with 24V DC. The power wiring will parallel the SLC communication wiring. The sensor shall be configured for this power wiring using the diagrams in the Honeywell Midas Technical Manual.
   f. Grounding: all gas analyzer components must be effectively grounded to a structural ground free of induced emf "noise". Grounding of shielded cables connecting sensors/transmitters should be grounded only at one point, preferably at the same ground point of the system. Hazardous location wiring runs require a passive barrier where the grounding is also isolated at the barrier. It is critical that the grounding not become a potential source of excessive energy, hence it is safest to always ground the shielding at the hazardous location end to a noise free structural ground.
   g. Accessibility: Since it is desirable to calibrate on a periodic basis, gas sensors should be installed in a location permitting reasonable access.
   h. Moisture protection: Sensors should be mounted where they are protected from immersion or direct contact with water.
   i. Midas® detectors are not ETL approved for monitoring in or sampling from classified areas above 25% LEL. Transmitters that are to be utilized in rated Class I, Div 1 or Div 2 flammable environments (as rated by NEC 500) must be certified either intrinsically safe or explosion-proof. Ensure that Midas® detectors are installed away from any potential gas concentrations that could exceed the LEL.
   j. Flame Detection: Honeywell Model FS20X unit will be connected to the SLC loop using the 4-20 mA analog output and fault relays.
   k. Dust protection: Gas analyzer dust covers should be used if the gas sensors are mounted in dirty or dusty environments.
   l. Security: To control tampering and accidental damage, transmitters in public hallways should be installed in a locked case with a viewing window to be able to read the LCD display on the device.
   m. Labeling: All gas detectors shall have a label with the target gas and the device ID that can be clearly seen on the detector.

B. Ventilation Monitoring
   1. HVAC is monitored by MetaSys throughout the Georgia Tech campus.
   2. Based on lab requirements, the FACP may provide an output through BacNet to the BMS to modify ventilation of the area. Programming for this control in the FACP, if required, is a part of the scope of the DGMS.

C. Manual Emergency Alarm System
   1. Manual emergency stop buttons shall be provided at each area where hazardous gases are stored or utilized and active devices can be placed into a safe state. For some laboratories, this button may not be provided based on an analysis of the hazard posed by allowing operation to continue versus the hazard of stopping operations suddenly.

2. When activated, these will initiate a response corresponding to >25% LEL or PEL. Gas detection alarm stack lights will activate flashing red. Emergency stop buttons will also trigger safety interlocks to automatic gas supply shut-off valves or process equipment.
3. Emergency stop buttons will not activate the building's fire alarm system to initiate an evacuation.

D. Visual and Audible Alarms
1. Stacks shall be vertically mounted with colors as follows (bottom to top):
   a. Green – Normal operation
   b. Yellow – ≥10% LEL or PEL
   c. Red - ≥ 25% LEL or PEL
2. Light stack shall be mounted inside and outside rooms on the wall at top of door height level but not above 9 feet.
3. Light stacks may be mounted from the ceiling if wall mounting is not possible or if the stacks are to be installed in cleanrooms.

3.2 SYSTEM MESSAGING

A. Messages will be displayed and transmitted from the Fire Alarm/DGMS to provide information to building occupants, 3rd party monitoring company, Georgia Tech staff, and emergency responders.

B. Messages will be for both the fire alarm and DGMS, including other safety devices such as e-stops.

C. See Specification 263111, Section 3.6 Digital Addressable Fire Alarm System for details on messaging.

3.3 SYSTEM START UP AND TESTING PROCEDURES

A. General Requirements:
1. Intent of acceptance test procedure is to demonstrate that exact functions of control systems meet requirements outlined by this specification and the Design documents.
2. The Contractor shall subcontract with Honeywell Analytics for final setup and calibration of the Midas gas detection devices.
3. Verify each piece of equipment functions correctly in automatic mode of operation, utilizing actual field devices and final control elements.
4. Develop testing sequences that demonstrate proper operation of life safety systems in failure modes. The alarm matrix shall be used as the DGMS integrator is for testing. Document all testing results. In the event of a failure to operate as documented, the systems shall be corrected and a re-test conducted.
5. Indicate type and cause of failures, as well as required remedial actions, on test report.
6. Start-up and testing will be witnessed and verified by Ga Tech or its representatives. Requested tests, not outlined herein, will be evaluated for feasibility and impact on schedule and cost.
7. Systems will not be accepted by Ga Tech without approval of tests and required remedial action.

B. Verification Checklist: Submit sample forms to be used for installation and operational verification checklist. This checklist shall be submitted to Owner and will become parts of Owner's commissioning documentation.
1. Installation Verification Checklist, including as a minimum:
   a. Verification of device tagging.
   b. Point-to-point wiring, grounding, and tubing verification. Include identification of wires (tubing).
   c. Verification that system is installed in conformance with design documents.
   d. Instrument calibration verification.
2. Operational Verification Checklist, including as a minimum:

a. Verify testing of each systems sequence of operation
b. Each checklist shall provide a space for Owner or Owner representative signoff and date.

END OF SECTION