KLM Technology Group
#03-12 Block Aronia,
Jalan Sri Perkasa 2
Taman Tampoi Utama
81200 Johor Bahru
Malaysia

GAS DETECTION SYSTEM

(PROJECT STANDARDS AND SPECIFICATIONS)

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SCOPE

This Project Standard and Specification defines the minimum mandatory requirements governing the design and installation of fixed hydrogen sulfide and combustible gas-in-air monitoring systems for personnel and plant protection.

REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

1. International Electrotechnical Commission (IEC)

   (IEC) 61000-4-3 Electromagnetic Compatibility (EMC) Part 4-3

2. International Society for Measurement and Control

   ANSI/ISA-12.13.02 – 2003
   (IEC 61779-6 Mod) Recommended Practice for the Installation, Operation , and Maintenance of Combustible Gas Detection Instruments

   ISA-RP92.0.02
   Part II – 1988 Installation , Operation , and Maintenance of Toxic Gas-Detection Instruments ; Hydrogen Sulfide

3. National Fire Protection Association (NFPA)

   NFPA 72 National Fire Alarm Code
   NFPA 325M Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids for LEL of Gases

DEFINITIONS AND TERMINOLOGY

Attended operation - 24-hour-per-day operation where personnel are continuously in attendance.

Control building - A structure which contains process control equipment. It may be an operator shelter, a process interface building, or a central control room.

Distributed Control System (DCS) - A process control system that is composed of distinct modules. These modules may be physically and functionally distributed over the plant area. The distributed control system contains all the modules and associated software required to accomplish the regulatory control and monitoring of a process plant, excluding field instruments, remote terminal units, auxiliary control systems and Plant information systems.

Emergency Shutdown System (ESD) - A system composed of sensors, logic solvers, and final control elements for the purpose of taking the process, or specific equipment in the process to a safe state when predetermined conditions are violated, i.e., to isolate, de-energize, shutdown or de-pressure a process unit or process equipment. Other terms commonly used throughout the hydrocarbon and petrochemical industry include Safety
Instrumented and Safety Interlock Systems (SIS).

Fail-safe state - The condition to which an instrument or system shall revert upon loss of power, logic signal or motive force. Unless otherwise specified, the fail-safe state for a normally energized safety system shall be the de-energized state, with no power or logic voltage being applied to an element or final operator.

Lower explosive limit (LEL) - This is the minimum concentration of a gas in a gas/air mixture at which the mixture will explode if exposed to an ignition source.

Parts per Million (ppm) - A unit of measurement used for small portions or concentrations. In gas analysis, it expresses the volume of gas present in terms of its relationship to a whole of 1 million parts of air. 1% = 10,000 ppm. 1% of volume =
10,000 ppm, 100% of volume=1,000,000 ppm.

Programmable logic controller (PLC) - A digital, electronic controller, designed for use in an industrial environment. A PLC uses a programmable memory for the internal storage of user-oriented instructions for implementing specific functions to control, through digital or analog inputs and outputs, various types of machines or processes.

Triple modular redundant (TMR) system - An emergency or safety shutdown system which employs a 2-out-of-3 (2oo3) voting scheme to determine appropriate output action, based on the application of three separate processors with triplicate inputs and outputs (I/O) components and bus structure, with all systems running in parallel.

Unattended operation - One shift operation, two shift operation or operation at unmanned stations.

DESIGN

General

1. Fixed gas detection systems shall measure and provide alarms for high concentration of hydrogen sulfide or combustible gas in air as specified in the "NFPA 325M "for flammable applicable gas groups.
   The system shall be designed to provide a timely response to an alarm situation and to prevent unauthorized system bypass or alarm reset. The design shall allow for each gas detector (sensor) to be accurately and effectively tested or calibrated at regular periods. The system design shall provide the means for testing each detector without disabling the entire system or causing accidental shutdown of equipment as per ANSI/ISA-12.13.02 - 2003 (IEC 61779-6 Mod).
2. The system shall comprise one or more detectors connected to a control unit or logic system to provide audible and visual alarms in the field and in attended control buildings.
3. The system shall not be used to automatically initiate a shutdown of process equipment.
4. Fire detection and control shall not be incorporated into the gas detection system.

Environmental Conditions

Each part of the detection system, alarms and associated electronic circuits shall be designed to operate in an environment, in accordance with its particular application and location.

SYSTEM DESCRIPTION

General

Continuous surveillance of ambient air to detect the presence of hydrogen sulfide or combustible gas in designated areas shall be accomplished by a gas detection system which incorporates the following components:

- Detectors and enclosures (detector housings);
- Logic system or control unit;
- Interconnecting transmission cable;

- Visible and audible alarms inside attended control buildings, at detector locations, and at the entrance gates of unattended locations.

Detector Selection

1. Detectors (sensors) shall use poison-resistant elements.
   a. Solid state, diffusion adsorption-type detectors shall be used for continuous monitoring of hydrogen sulfide. Sensor response shall not be affected by ambient temperature variations.
   b. Catalytic bead-type diffusion detectors are preferred for continuous monitoring of combustible gas.

      Utilization of infrared open path detectors shall require prior approval of the Manager of the Proponent Organization and the General Supervisor, Process Instrumentation Division, Process & Control Systems Department.
   c. The specific or predominant gas which is to be detected at the designated location shall be specified, and the detector shall be calibrated for that gas.
   d. When more than one combustible gas is present at a particular location, the detector shall be specified to be calibrated for the hardest-to-detect (least sensitive) component.
   e. The combustible gas to be used for calibration shall be as per the CSA for the following conditions:
      - for instruments intended specifically for sensing methane or intended for general purpose combustible gas detection, methane shall be used for LEL sensors calibration,
      - for instruments intended for general purpose combustible gas detection but excluding methane, propane gas can be used for LEL sensor calibration,
      - for instruments intended for sensing a specific combustible gas or vapor other than methane, the actual specific gas shall be used as recommended by the manufacturers.
2. The calibrated range for fixed detectors shall be:
   a. 0 to 100 PPM - hydrogen sulfide in air
   b. 0 to 100% LEL - combustible gas in air
3. Detectors which have a transmitter located with the sensing element shall be used. The transmitted signal shall be linear, within a range of 0 to 22 mA, per the following requirements:
   a. Detector trouble/open loop alarm (0-4 mA DC)

b. Detector bypass/calibration mode alarm (0-4 mA DC)
c. Analog output signal (4-20 mA DC)
d. Signal overrange alarm (greater than 20 mA DC)

Alternately the detector transmitter output signal can utilize digital communications protocols options such as Modbus RTU, HART, ASCII, or Foundation field bus if applicable. The above alarm requirements still apply when using signals other than 0-22 mA.

4. Detectors shall incorporate an integral linear scale or digital indicator, or a temporary connection for detector calibration.
5. Detectors shall incorporate smart microprocessor calibration and fault diagnostic features. Calibration shall be non-intrusive, i.e., may be performed without opening the sensor/transmitter enclosure.
6. Detectors shall incorporate non-interactive zero and span adjustments
7. Hydrogen sulfide and infrared point combustible gas detectors shall have automatic temperature compensation for ambient temperature and humidity changes.
8. Detectors shall be protected against radio frequencies and electromagnetic interferences in accordance with IEC 61000-4-3, Level 3 (at a 10 V/m power level).
9. Detectors shall also be furnished with sunshades if required by site conditions.
10. Special detectors must be specified to be installed in the gas turbine high temperature compartments with remote calibration facilities.

Detector Sitting

1. The need and specific location for fixed detectors shall be assessed on a case-by-case basis as per ISA-RP92.0.02, Part II – 1998.
2. Detection shall be provided on the basis of protection of specific spot hazards rather than general gridded area protection.
3. Detectors should normally be located adjacent to identifiable, singlepoint, potential release locations where there is a significant risk of a hydrogen sulfide or combustible gas leak, such as pump and gas compressor seals, valves, etc.
4. For hydrocarbon liquids, combustible gas detection shall be used only for potential release sources of flammable liquids with a true vapor pressure equal to or greater than 200 kPa(abs) (29 psia) at 54°C.