RDCG (Rotterdam Capacity Growth) – FEASIBILITY PHASE
NESTE

FIRE AND GAS DETECTION SYSTEMS PHILOSOPHY

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1. GENERAL

1.1. Introduction

Neste has a target to increase its renewable diesel production capacity in Rotterdam with a new NEXBTL2 Unit; in particular the units in RDCG scope of work are:

- Units in MNA Area:
  - Process Units:
    - Heat Treatment Unit (HTU) — Unit 11;
    - Pretreatment Unit — Unit 12;
    - NExBTL — Unit 21;
    - Hot oil — Unit 57;
  - Auxiliary Units, Utilities and Offsites:
    - Tank Farm (MNA) — Unit 42;
    - Utilities (MNA) — Unit 53;
    - Waste Water Treatment (MNA) — Unit 61;
    - Flare System — Unit 67;
    - Fire Water — Unit 86;
  - Other Units:
    - Technical Buildings (MNA) — Unit 76;
    - Interconnecting (MNA) — Unit 81;
    - Interconnecting (Corridor) — Unit 82,
- Units in Existing Refinery:
  - Auxiliary Units, Utilities and Offsites:
    - Existing Tank Farm (Refinery) — Unit 40;
    - New Tank Farm (Refinery + Blake) — Unit 41;
    - Jetty Loading Expansion — Unit 46;
    - Utilities (Refinery) — Unit 52;
    - WWT (Refinery) — Unit 60;
  - Other Units:
    - Civil/Industrial Buildings — Unit 70;
    - Technical Buildings (Refinery) — Unit 75;
    - Interconnecting (Refinery + Blake) — Unit 80.

New process, utilities and storage units are essentially located outdoors; in some cases, the process equipment (e.g.: compressor) are located in partially enclosed area but still to be considered as an area where the natural ventilation is mainly present; in following two cases at MNA the new facilities are totally enclosed into a process structure:

- facilities associated to pretreatment of feedstock,
- fire water pumps and associated diesel storage drum.

The expansion facilities will comprise, in terms of civil works, also the provision of:

- new buildings at Refinery Area: Secondary Substation and Laboratory;
- revamping/extension/refurbishing of existing buildings in the Refinery Area: Substation and Operation Building Centre;
- new building at MNA: Main Substations and Operator Building.

1.2. Scope of Present Document

Present document establishes the general criteria related to location and type of Gas and Fire Detector to be adopted in Project and it defines the basic requirements which shall be followed for what concerns:

1) fire detection system,
2) fire alarm system,
3) gas detection system,
4) gas alarm system.

The purpose of safe design of the installations is to promote and to define the safety systems needed to protect plant equipment, personnel and environment.
This could be achieved by preventing liquid spillages, gaseous release to atmosphere (flammable, toxic or corrosive effluents), and minimizing their consequences (fire, explosion and toxic, flammable gas dispersion) should such an event occur.
To minimize accident, the safety systems have to be designed to provide, automatic or manual (via manual call point), warning alarms and means to mitigate the consequence of incidents by using the Plant own resources.

1.3. Fire Protection Workflow

The general approach to fire protection at Neste is HAZARD based and the active fire protection approach is:

- Active Fire Protection Standard sets basic requirements for the fire water system (basis for capacity definition, deluge, etc.)
- Active Fire Protection System Integrity Assurance Standard sets basic requirements for testing etc.

Fire Protection Design Process for new installations is as follows:

1. Define the fire scenario area(s).
2. Identify fire hazard (fire type and duration of fire i.e. scenario) of equipment based on content (chemical properties and process conditions) and equipment type ("FHA part 1").
3. Perform "Consequence Analysis" of potential accident originated by hazardous equipment.
4. Perform "Major Hazard Identification" and "Layout Risk Analysis" for new units/major equipment - avoid domino effects and ensure adequate separation distances.
5. Develop preliminary design for fire protection.
   a. Fireproofing shall be uniform for the whole structure and shall be based on fire scenarios (or 30 min jet + 60 min pool fire) according to L104.
   b. Identification and definition of fireproofing/protection of Safety Critical Equipment needed for safe unit shut down.
   c. Firefighting system design shall be designed according to Active Fire Protection Standard as a minimum.

d. Definition of Gas Detectors, Fire Detectors and Surveillance Cameras shall be based on (fire) hazard of equipment and experience. FHA and HAZOP shall give the input to equipment amount and locations.

6. Perform "FHA part 2" to check that the preliminary design is adequate to detect fires and leakages and to prevent escalation of the situation to adjacent equipment and/or units.
7. Perform "HAZOP and LOPA" (typically HAZOP identifies some additional detection needs).
8. Modify design based on PHAs (i.e. FHA, HAZOP and AEA) results.
9. Generate Fire Pre Plan and Fire protection documents (description of the systems).
10. Verify the integrity of fire protection equipment.

~~1.3. Project Scope of Work~~

~~Two different areas have been identified for the new facilities:~~

- ~~The "Refinery Area" for Feedstock, Biopropane, Renewable Diesel, Renewable Naphtha and Renewable Jet Fuel Storage (Unit 41; note: BLAKE area considered for the allocation of the new Feedstock), and Jetty 2 Expansion (Unit 46).~~
- ~~The "Maasvlakte New Area" (MNA), for the NEXBTL2 (Unit 21), Heat Treatment Unit HTU (Unit 11), Pre-Treatment UNIT PTU (Unit 12), Hot Oil System (Unit 57), Intermediate Storage (Unit 42), Utilities (Unit 53), Flare (Unit 67), Fire Water System (Unit 86) and Waste Water Handling (Unit 61).~~

~~New process, utilities and storage units are essentially located in open space with natural ventilation; in some cases, the process equipment (e.g.: compressor) are located in partially enclosed area (shelter) but still to be considered open areas; in following two cases at MNA the new facilities are totally enclosed into a process structure:~~

- ~~facilities associated to treatment of feedstock,~~
- ~~fire water pumps and associated diesel storage drum.~~

~~The expansion facilities will comprise, in terms of civil works, also the provision of:~~

- ~~new buildings at Refinery Area: Secondary Substation and Laboratory;~~
- ~~revamping/extension/refurbishing of existing buildings in the Refinery Area: Substation and Operation Building Centre;~~
- ~~new building at MNA: Main Substation and Operator Building.~~

~~Other facilities are included in the scope of Project but for those elements there are no special requirement deriving from the scope of present document.~~

1.4. Updating of Present Document

Present document may be updated during Project development on the basis of review/analysis developed according to Ref. [4] as described in above paragraph 1.3.

1.4. 1.5. Applicable Codes, Standards, Guidelines and Analyses

Codes and Standards

This philosophy contains the necessary aspects for the preliminary design of the fire and gas detection system. For additional requirements not covered by the present philosophy, the following have to be taken into account (in order of priority):

Local codes (including their referenced code):

PGS 29: 2016	Directive for aboveground storage of flammable liquids in vertical cylindrical tanks
EI 19: 2012	EI Model code of safe practice part 19: fire precautions at petroleum refineries and bulk storage installations
PGS 19: 2013	Propane and butane: storage
NEN 2535:2017	Fire safety of buildings - Fire detection installations - System and quality requirements and guidelines for detector siting
NEN 2575-1:2012	Fire safety of buildings - Evacuation alarm installations - System and quality requirements and guidelines for locating of alarm devices - Part 1: General
NEN 2575-2:2012	Fire safety of buildings - Evacuation alarm installations - System and quality requirements and guidelines for locating of alarm devices - Part 2: Loud alarm evacuation alarm installation type A
NEN 2575-3:2012	Fire safety of buildings - Evacuation alarm installations - System and quality requirements and guidelines for locating of alarm devices - Part 3: Loud alarm evacuation alarm installation type B
NEN 2575-4:2013	Fire safety of buildings - Evacuation alarm installations - System and quality requirements and guidelines for locating of alarm devices - Part 4: Wireless silent alarm installation
NEN 2575-5:2012	Fire safety of buildings - Evacuation alarm installations - System and quality requirements and guidelines for locating of alarm devices - Part 5: Silent alarm installation with advisory panels

Neste guideline:

Draft version 18.9.2020 ~~XXXXXX: 2020~~	HSE Design Guidelines (Draft version 1~~);~~ ~~included in "HSE Related Standards and Principles – Rotterdam Expansion Project Feasibility Phase –~~

~~RDEXP01 – NESTE RP” doc. n° PC-CUPC10-003 rev. 1~~)

IEC codes:

IEC 60079-29-1:2019	Explosive atmospheres - Part 29-1 Gas Detectors – Performance requirements of detectors for flammable gases
IEC 60079-29-2:2015	Explosive atmospheres - Part 29-2 Gas Detectors - Selection, installation, use and maintenance of detectors for flammable gases and oxygen
IEC 60079-29-3:2014	Explosive atmospheres - Part 29-3 Gas Detectors - Guidance on functional safety of fixed gas detection systems.
IEC 60079-29-4:2009	Explosive atmospheres - Part 29-4: Gas detectors - Performance requirements of open path detectors for flammable gases.

EN codes :

EN 14604: 2009	Smoke Alarm Devices
EN 54-1: 2011	Fire detection and fire alarm systems – Part 1: Introduction
EN 54-2: 2006	Fire detection and fire alarm systems – Part 2: Control and indicating equipment
EN 54-3: 2019	Fire detection and fire alarm systems – Part 3: Fire alarm devices – Sounders
EN 54-5: 2018	Fire detection and fire alarm systems – Part 5: Heat detectors – Point heat detectors
EN 54-7: 2018	Fire detection and fire alarm systems – Part 7: Smoke detectors – Point smoke detectors that operate using scattered light, transmitted light or ionization
EN 54-10: 2005	Fire detection and fire alarm systems – Part 10: Flame detectors - Point detectors
EN 54-11: 2005	Fire detection and fire alarm systems – Part 11: Manual call points

EN 54-12: 2015	Fire detection and fire alarm systems – Part 12: Smoke detectors - Line detectors using an optical beam
EN 54-14:2004	Fire detection and fire alarm systems - Part 14: Guidelines for planning, design, installation, commissioning, use and maintenance
EN 54-20: 2006	Fire detection and fire alarm systems – Part 20: Aspirating smoke detectors
EN 54-21:2006	Fire detection and fire alarm systems Part 21- Alarm transmission and fault warning routing equipment
EN 54-23: 2010	Fire detection and fire alarm systems – Part 23: Fire alarm devices - Visual alarm devices
EN 54-28: 2016	Fire detection and fire alarm systems – Part 28: Non-resettable line-type heat detectors
EN 45544-1: 2015	Workplace atmospheres – Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours – Part 1: General requirements and test methods
EN 45544-2: 2015	Workplace atmospheres – Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours – Part 2: Performance requirements for apparatus used for exposure measurement
EN 45544-3: 2015	Workplace atmospheres – Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours – Part 3: Performance requirements for apparatus used for general gas detection
EN 45544-4: 2016	Workplace atmospheres – Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours – Part 4: Guide for selection, installation, use and maintenance
EN 50104:2019	Electrical apparatus for the detection and measurement of oxygen - Performance requirements and test methods
~~NFPA 70: 2020~~	~~National Electrical Code~~

~~NFPA 72: 2019 National Fire Alarm and Signalling Code~~

~~Fire, siting and lay-out Risk Analyses~~

~~The ultimate goal of project HSE activities is that all process installations are safe, also against fire hazards, these are environmentally sustainable and fulfil all legal and Neste requirements. Several risk analyses related to fire, siting and lay-out risks will be carried out according Neste procedures (ref. [4]) to ensure HSE goal are fulfilled. It is also important to ensure that requirements of local legislation are reviewed and implemented, checking of this is a part of analysis.~~

~~Fire protection design workflow is as follow:~~

1. ~~identify fire area (on the basis of ref. [3]),~~
2. ~~consider input from Consequence Analysis performed on high hazard equipment,~~
3. ~~perform Major Hazard Identification (including Siting Analysis),~~
4. ~~perform Fire Risk Analysis part 1 (FRA-1) to identify fire hazard (fire type and duration of fire) of equipment based on content (chemical properties and process conditions) and equipment type,~~
5. ~~perform Layout Risk Analysis,~~
6. ~~perform preliminary drawing for Fire and Gas Detection (as well as for Passive Fire Protection and Active Fire Protection) on the basis of criteria in present document and inputs from previous analyses,~~
7. ~~perform Fire Risk Analysis part 2 (FRA-2) to check that the preliminary design is adequate to detect fires and leakage and to prevent escalation,~~
8. ~~modify design based on FRA-2 and input, if any, from other risk analyses (HAZOP study and QRA),~~
9. ~~generate additional documentation required for detailed design of the fire protection systems,~~
10. ~~perform Fire Protection review to validate the systems,~~
11. ~~finalize design of fire protection systems.~~

~~1.5.~~1.6. References

Present document should be read in conjunction with:

Ref [1] HSE Design Criteria (082755C-000-JSD-1900-0003)

Ref [2] Passive Fire Protection Philosophy (082755C-000-JSD-1980-0001)

Ref [3] Active Fire Protection Philosophy (082755C-000-JSD-1900-0001)

Ref [4] Six Step Procedure in Plant Investment Projects (Standard) NOQD-230/EN version 6

~~1.6.~~1.7. Acronyms and Abbreviations

AEA	Action Error Analysis
DCS	Distributed Control System
EI	Energy Institute
EN	European Standard
FHA	Fire Hazard Analysis (note: in current revision of Six Step Procedure (ref. [4]) the analysis is called Fire Risk Analysis, anyhow Neste informed that proper name which will be used in future is Fire Hazard Analysis)
~~FRA~~	~~Fire Risk Analysis~~
FRP	Fire Repetition Panel
HAZOP	HAZard and OPerability
HTU	Heat Treatment Unit
HSE	Health Safety Environment
HVAC	Heat Ventilation Air Conditioning
IDLH	Immediate Danger to Life and Health
IR	Infra Red
LFL	Low Flammable Limit

LOPA	Layer Of Protection Analysis
MAP	Main Alarm Panel
MCC	Motor Control Center
MNA	Maasvlakte New Area
PGS	Publicatiereeks Gevaarlijke Stoffen
PID	Photoionization Detector
POR	Port of Rotterdam
PTU	Pre Treatment Unit
QRA	Quantitative Risk Analysis
RJF	Renewable Jet Fuel
RIU	Remote Instrument Unit
RH	Relative Humidity
ROR	Rate of Rise
SAP	Sub Alarm Panel
SWS	Sour Water Stripper
TPIT	Technip Italy S.p.A.
UV	Ultra Violet

1.7. 1.8. Definitions

Fire Repetition Panel (FRP): FRP is a panel, part of Fire Detection System with LED indicator light relevant to each building floor monitored, located near the entrance. One SAP and one FRP will be installed in each building with visual and audible annunciation.

Sub Alarm Panel (SAP): SAP is an addressable panel, part of Fire Detection System with LED relevant to each building area monitored. One SAP and one FRP will be installed in each building.

Main Alarm Panel (MAP): MAP is capable to supervise all signals connected to each SAP. MAP is connected with external Fire brigade. MAP is installed in existing Control Room operating centre.

Lower flammable limit (LFL: Lower Flammable Limit): relative amount of combustible gas / vapor in the air, below which the gas-air mixture cannot ignite.

Upper flammable limit (UFL: Upper Flammable Limit): relative amount of combustible gas / vapor in the air, above which the gas-air mixture cannot ignite.

~~1.8. Objectives~~

~~The purpose of safe design of the installations is to promote and to define the safety systems needed to protect plant equipment, personnel and environment.~~
~~This could be achieved by preventing liquid spillages, gaseous release to atmosphere (flammable, toxic or corrosive effluents), and minimizing their consequences (fire, explosion and toxic, flammable gas dispersion) should such an event occur.~~
~~To minimize accident, the safety systems will be designed to provide automatic warning alarms and means to mitigate the consequence of incidents by using the Plant own resources.~~

2. FIRE DETECTION SYSTEM

This chapter covers the requirements relevant to the equipment and devices to be installed for fire detection and alarm purpose.
Fire detection signals will be initiated either by personnel (via manual call point) or automatically by detectors.

2.1. Automatic Fire Detection in the Plant (~~Open~~ Process Area Outdoors)

General description for detectors types is given in the following paragraphs.

2.1.1. Flame Detector

2.1.1.1. Triple IR / multi IR Flame Detector type

Flame detectors utilize optical technologies to detect flames. Flames are known to emit electromagnetic radiation in the infrared (IR), visible light, and ultraviolet (UV) wavelengths depending on the fuel source. Because of this, optical flame-sensing technologies have been developed utilizing multi-spectrum infrared.
Triple IR / multi IR flame detectors are suitable to detect a wide range of hydrocarbon and non-hydrocarbon flaming fires and can cover a large risk area. Far faster than other technologies, by responding to flaming fires in seconds enabling a more rapid response to danger before the fire can escalate.
Triple IR / multi IR flame detector is also effective for hydrogen.

2.1.1.2. Visual Flame Detector type

Visual based flame detectors are flame detectors, which use pixel analysis and live video feeds to detect fires instead of simply monitoring for IR radiation at specific frequencies: in this way from the video it is possible to confirm fire presence.

Visual Flame Detectors are able in the detection of hydrocarbon fires that are not detectable in the visible spectrum. The flame detection algorithms to ensure maximum false alarm immunity.
Visual Flame Detector has an unrivalled 120° horizontal and 80° vertical field of view with an increased range of 60 meters to an n-heptane 0.1 m2 pan fire.
The vast coverage provided from this detector will optimize the number of units required.
The Field of View is a rectangular pyramid shape and represents a radial projection of the sensing element; therefore, giving it the largest coverage area of any flame detector currently available.

2.1.2. Heat Detector

2.1.2.1. Fixed Temperature Detector type

Fixed Temperature Detector type is the most common type of heat detector. Fixed temperature detectors operate when the heat sensitive eutectic alloy reaches the eutectic point changing state from a solid to a liquid. Thermal lag delays the accumulation of heat at the sensitive element so that a fixed-temperature device will reach its operating temperature sometime after the surrounding air temperature exceeds that temperature

2.1.2.2. Rate Of Rise Detector type

Rate-of-Rise (ROR) heat detectors operate on a rapid rise in element temperature of 6.7° to 8.3°C increase per minute, irrespective of the starting temperature. This type of heat detector can operate at a lower temperature fire condition than would be possible if the threshold were fixed. It has two heat-sensitive thermocouples or thermistors. One thermocouple monitors heat transferred by convection or radiation while the other responds to ambient temperature. The detector responds when the first sensing element's temperature increases relative to the other.
Rate of rise detectors may not respond to low energy release rates of slowly developing fires. To detect slowly developing fires, it is commonly used a combination of detectors equipped with a fixed temperature element that will ultimately respond when the fixed temperature element reaches the design threshold.

2.1.2.3. Heat Sensitive Cable type

The Heat Sensitive Cable is used to detect fire: it detects heat conditions anywhere along its length.
The sensor cable is comprised of two twisted steel conductors individually insulated with a heat sensitive polymer.
Mechanical tension is kept constant throughout the whole length of the cable.

When the pre-established temperature is reached, the polymer layer surrounding the two conductors melt, making them to contact each other, leading to a~~n~~ closed ~~open~~ circuit fault condition and thus producing an alarm.

After the alarm, the affected part of the cable must be replaced. There is no need to replace the whole cable, only the damaged part, using a connections cable or any other useful device for this purpose.

2.1.2.4. Pneumatic Tubing

Also the Pneumatic Tubing is used to detect fire: it detects heat conditions anywhere along its length.
When the tubing is melt by the fire condition, the pressure in the tubing reduces and this produces an alarm.

After the alarm, the pneumatic tubing must be replaced entirely or partially depending on its damage.

~~2.1.2.4.~~2.1.2.5. Fiber Optic Cable type

The Fiber Optic Cable measures temperatures by means of optical fibers functioning as linear sensors. Temperatures are recorded along the sensor cable as a continuous profile. This ensures high accuracy of temperature discrimination over great distances or large surfaces, while reducing measuring times.
The system utilizes the so-called Raman effect to measure temperatures with optical fibers.

After the alarm, the affected part of the cable shall not be replaced or restored.

2.2. Automatic Fire Detection application in the Plant (~~Open~~ Process Area Outdoors)

Fire detection shall be provided according to results from Risk Analyses carried out in the ~~performed on~~ Project (refer to paragraph 1.~~4~~3). In addition, specific application cases where provision shall be guaranteed are listed in following paragraphs with reference to equipment present in Project.

2.2.1. Fire Detector

2.2.1.1. General requirement

The Fire detector type selected in the Plant open area is Triple IR/multi IR flame detector type, to be installed at ground level and/or at elevation.
Detectors may be single detector or double detectors. For protection of process and utilities area, detectors shall be installed in pairs, either by facing each other or with line-of-sight crossing each other, covering high risk areas of leakage (e.g. big flanges) and/or fire originating from the equipment.

When one detector is activated, it will give:

- an audible and visual (dedicated for each detector) alarm to SAP and FRP located in the pertinent local building present in the area,
- an audible and visual (dedicated for each detector) alarm to the MAP located in the Operation Building Centre (for Refinery Area) or Operator Building (for MNA),
- a general alarm on DCS,
- an audible and visual alarm (common alarm grouped by area) in the pertinent guardhouse (only one guardhouse alerted, the one afferent to the site),
- a visual alarm (one or more red flashing lights in the relevant area) in concerned plant area.

When two pair detectors are activated, they will give in addition to the above alarms:

- a general alarm to external Fire Brigade (via MAP),

- an audible alarm (one or more fire horns in the relevant area) in concerned plant area.

Fire monitoring devices shall be placed within the vicinity of major risk areas. Installation of fire detectors shall be considered in places of potential leakage of hydrocarbons or other flammable process media. In addition, plant accident history and history of similar plants shall be taken into account.

Fire detectors shall be located close to potential ignition and heat sources, for example above the seals of hot pumps containing flammable materials. Fire detectors shall also be located at the vicinity of potential leak sources such as around compressors (not present in current Project) and pumps, or at critical locations where a risk of leakage of combustible gas or liquid exists in the vicinity of ignition sources. Elevated locations where hydrocarbon detectors would not be effective are also recommended locations for fire detectors.

Detectors shall cover as a minimum:

- Heat exchangers and pumps where the content is above auto-ignition temperature;
- Compressor shelters containing process compressors;
- Pump rooms;
- Specific locations that have ignition or fire history and fire detectors would have been beneficial based on previous incidents and production appraisal.

Refer to Neste "HSE Design Guideline" (included in Ref.[1] for clarity) for additional details and requirement.

Final location of the fire detectors shall be based on 3D model since it is difficult to evaluate obstacles between detector and equipment based on lay-out.

2.2.1.2. Specific application

Flame detectors triple IR/multi IR type shall be provided to monitor (note: numbers of detectors indicated below are indicative, coverage and number of detector to be confirmed/revised during F~~R~~HA-2 and 3D model check):

- pump (two fire detectors per pump or group of pumps) when both following criteria are met:
  - pump handles liquefied flammable gas or liquid handled above its flash point,
  - pump is not provided with automatic fixed fire water spray system;
- compressor handling flammable gases;
- heat transfer oil pumps (note: typically, degradation of heat transfer oils decrease autoignition temperature and flash point);
- heat exchanger when the content is above autoignition temperature (two fire detectors per exchanger);
- Renewable Naphtha tank ~~pit~~ bund (N fire detectors to ensure at least double coverage on each portion of tank ~~pit~~ bund area);
- RJF tank ~~pit~~ bund (N fire detectors to ensure at least double coverage on each portion of tank ~~pit~~ bund area);
- ~~RJF tank fixed roof (4 fire detectors to monitor roof openings and potential openings (relief, panel, roof to shell welding) from where tank internal fire is visible)~~All equipment provided with fixed spray systems (N fire detectors to ensure

at least double coverage on each portion of the equipment); Note; the fixed spray water systems provided for cooling surface and roof of storage tank will be activated only manually by operator.

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For fire detector located to monitor tank pitbund, the activation of 2ooN detectors will initiate, after timer period is elapsed, the foam provision inside the tank pitbund; the delay period is set as preliminary figure to 180 seconds on a timer having a range of 0-180 and it will be calibrated to minimum practicable figure at field on the basis of spurious signal during operation.
For fire detector located to monitor tank roof, the activation of 2oo4 detectors will initiate, after timer period is elapsed, the foam provision inside the tank; the delay period is set as preliminary figure to 180 seconds on a timer having a range of 0-180 and it will be calibrated to minimum practicable figure at field on the basis of spurious signal during operation.

2.2.2. Heat Detector

The Heat detector type selected in the Plant open area is the Pneumatic TubingHeat Sensitive Cable, to be installed:
to follow the entire routing of piping where the fire water sprays are installed in process and utilities area;
to monitor

- Renewable Naphtha tank roof (annular surface between floating roof and shell), in case the tank (internal floating roof type) is being the not tank (internal floating roof type) not provided with blanketing system;
- RJF tank roof (annular surface between floating roof and shell), being the tank (internal floating roof type) not provided with blanketing system.

-

Two Heat Sensitive Cables shall be provided for:
equipment provided with automatic fixed water spray system in process and utilities area;
Renewable Naphtha tank roof (annular surface between floating roof and shell) provided with automatic foam system.

Note; the fixed spray water systems provided for cooling surface and roof of storage tank will be activated only manually by operator.

For alarming actions, the same criteria specified for Fire detector shall apply.
In addition, when the two heat sensitive cables are activated:

- on Renewable Naphtha tank roof, also the foam system is initiated, after timer period is elapsed.
- on process/utility equipment/circuit, also the fire water spray system is initiated, after timer period is elapsed.
- on Renewable RJFNaphtha tank roof, also the foam system is initiated, after timer period is elapsed.

The delay period is set as preliminary figure to 180 seconds on a timer having a range of 0-180 and it will be calibrated to minimum practicable figure at field on the basis of spurious signal during operation.

2.3. Plant Manual Call Point

Location shall be provided according to results of from Fire Risk Risk Analysies carried out in the performed on Project (refer to paragraph 1.3).
In addition, specific cases where application shall be guaranteed are listed here below with reference to equipment present in Project.

Manual Call Point, break glass type, shall be installed in a closed housing/enclosure and it shall be constructed in accordance with the requirements of relevant hazardous area classification.
The manual call point shall be located within the plant area:

- along the roads or accesses to the process and utility units.

The maximum travelling distance at ground to reach a manual call point, shall not be more than 60 meters from any point in the process or utility.
The maximum distance shall be checked on a case by case basis together with local Fire Authority especially in hazardous areas.

When plant manual call point is activated, it will give:

- an audible and visual (dedicated for each detector) alarm to SAP and FRP located in the pertinent local building present in the area,
- an audible and visual (dedicated for each detector) alarm to the MAP located in the Operation Building Centre (for Refinery Area) or Operator Building (for MNA),
- a general alarm on DCS,
- an audible and visual alarm (common alarm grouped by area) in the pertinent guardhouse (only one guardhouse alerted, the one afferent to the site),
- a visual alarm (one or more red flashing lights in the relevant area) in concerned plant area,
- a general alarm to external Fire Brigade (via MAP),
- an audible alarm (one or more fire horns in the relevant area) in concerned plant area.

2.4. Fire Detection in Building

Audible and optical visual alarm is associated to the evacuation from the concerned building.

Specific cases where application shall be guaranteed are listed in following paragraphs with reference to building present in Project.

2.4.1. Smoke detector

Scattered light optical type and beam type smoke detectors shall be installed in the building present in Project (Laboratory, Substation, Operator Building and in case for extension of existing Substation and Operation Building Centre) to cover offices, corridors, service rooms and, if any, related false floor and false ceiling.

When smoke detection in building is activated, it will give:

- an audible and visual (red flashing light) alarm (general alarm in the building) on SAP and FRP located in the building,
- an audible and visual alarm (general alarm in the building) to the MAP located in the Operation Building Centre (for Refinery Area building) or Operator Building (for MNA building),
- an alarm (general alarm in the building) on DCS,
- an audible and visual alarm (general alarm in the building) in the pertinent guardhouse (only one guardhouse alerted, the one afferent to the site),
- ~~an alarm to external Fire Brigade (via MAP),~~
- the building HVAC shutdown.

Two smoke detectors, when activated, will give, in addition:

- an alarm to external Fire Brigade (via MAP),
- initiation of fire suppression gas discharge (if any).

For building having clean agent protection, the following have to be provided:

- a switch with two positions “automatic discharge” and “manual discharge”;
- a warning panel outside each room protected by clean agent,
- a push button.

If the switch is turned on “automatic discharge” the clean agent system will be activated by smoke detectors located in protected room it will activate warning panel/panels and it will provide gas discharge after 60 seconds.
If the switch is turned on “manual discharge” the smoke detectors will not provide gas discharge.
Operator can activate manually the gas discharge trough push button located close to the door of protected room; upon pushing it will activate warning panel/panels and it will provide gas discharge after 60 seconds.

2.4.2. Building Manual call point

Manual Call Point, break glass type, shall be installed in a closed housing and constructed in accordance with the requirements of relevant hazardous area classification.
The manual call point shall be located inside the building near each entrance door.
Other manual call point may be required depending on maximum travelling distance in order to ensure that no more than 30 meters (including elevation in case of more than one floor) have to be travelled to reach a manual call point.

When manual call point in building is activated, it will give:

- an audible and visual (red flashing light) alarm (general alarm in the building) on SAP and FRP located in the building,

- an audible and visual alarm (general alarm in the building) to the MAP located in the Operation Building Centre (for Refinery Area) or Operator Building (for MNA),
- an alarm (general alarm in the building) on DCS,
- an audible and visual alarm (general alarm in the building) in the pertinent guardhouse (only one guardhouse alerted, the one afferent to the site),
- an alarm to external Fire Brigade (via MAP).

2.4.3. Building requirements summary

EU legislation and Local requirements by authorities are guiding engineering of automatic fire detection systems, especially with occupied buildings.
Following requirements shall be considered for buildings, but are not limited to:
Operator Building, Laboratory and Operation Building Centre in case of extension

- Manual Alarm Call Point.
- Smoke detectors detection in all rooms and in the relevant area below false floor, with exception of toilets.
- Visual and Audible Alarms.
- Building Addressable Alarm Panel (SAP).
- Repetition panel/display (FRP).
- HVAC shutdown by fire detection and recirculation by gas detector.
- Remote Instrument Unit (RIU) signal (to allow opening of accesses for evacuation)

Substation

- Manual Alarm Call Point.
- Smoke detectors detection in all rooms and in the relevant area below false floor, with exception of toilets (if any).
- Beam Type Smoke detectors above Motor Control Center (MCC) cabinets.
- Visual and Audible Alarms.
- Building Addressable Alarm Panel (SAP).
- Repetition panel at the entrance (FRP).
- HVAC shutdown by fire detection and recirculation by gas detector.
- Remote Instrument Unit (RIU) signal ~~(to allow opening of accesses for evacuation)~~.

2.5. Fire Detection Application in the Plant (Process Area Indoors)~~Enclosed Technological Areas~~

This paragraph applies to PTU Building and Fire Water Pumps Buildings.
Audible and ~~optical~~ visual alarm is associated to the evacuation from the concerned enclosure.

2.5.1. Enclosure Manual call point

Manual Call Point, break glass type, shall be installed in a closed housing and constructed in accordance with the requirements of relevant hazardous area classification.
The manual call point shall be located inside the enclosure near each entrance door.
Other manual call point may be required depending on maximum travelling distance in order to ensure that no more than 30 meters (including elevation in case of more than one floor) have to be travelled to reach a manual call point.

When manual call point in building is activated, it will give:

- an audible and visual (red flashing light) alarm (general alarm in the enclosure) on SAP and FRP located in the enclosure,
- an audible and visual alarm (general alarm in the enclosure) to the MAP located in the Operator Building,
- an alarm (general alarm in the enclosure) on DCS,
- an audible and visual alarm (general alarm in the enclosure) in the pertinent guardhouse,
- an alarm to external Fire Brigade (via MAP).

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3. AUTOMATIC GAS DETECTION SYSTEM

The flammable and toxic gas detection system have the intent to provide continuous and automatic monitoring, for the presence of flammable and toxic gas in the plant areas and buildings.
When plant gas detector is ~~activated~~triggered, it shall activate ~~provide~~ audible and visual (dedicated per each detector) alarm to DCS with repetition to MAP.
This chapter covers the requirements relevant to the equipment and devices to be installed for fixed automatic gas detection purpose.

3.1. Gas Detection in the Plant (~~Open~~ Process Area Outdoors)

General description for detectors types is given in the following paragraphs.

3.1.1. Flammable Gas Point Detector

In order to select the most appropriate measuring technics/detection, the following shall be taken into account:

- gases required to be measured and measurement range,
- interfering gases and vapor,
- environmental conditions and their variations,
- the intended use of the gas detector: alarming of gas leak, personal protection,
- required minimum measurement response time when alarm shall take place because of dangerous gas amount.

The differences on the different measurement technics is presented on EN 60079-29-2.

According the above mentioned conditions flammable gas detectors type can be:

- Catalytic combustion,
- InfraRed point (IR),
- Semiconductor,
- Electrochemical.

There is nothing that prevent the use of other measurement methods, as long as they meet the above standards in design and performance requirements.

3.1.1.1. Catalytic Sensor type

This sensor type is the most commonly used to detect flammable gases on process area. The sensor is suitable to so-called point type measurement at installation location. Catalytic type sensor oxides combustible gases on the surface of element rising it`s temperature. The change in resistance is proportional to the gas content of the element. The atmospheric pressure, the effect of changes in temperature and relative humidity to be compensated by the reference element, which in turn does not respond to combustible gases. This special advantage of the sensor type is that it burns flammable

gases and vapors. The sensor's sensitivity, however, varies according to the different gases.
The sensor is suitable to detect several combustible gases present at the same time. The sensor must be calibrated for that gas to which it is least sensitive. In this case, most sensitive gas causes alarm earlier. Gas detector manufacturers supply correlation tables for different combustible gases in relation for the calibration gas.
Catalytic type gas sensor is suitable to measure combustible gases up to lower flammable limit 100 % (LFL).
Catalytic type sensor should not be used in applications where high sensitivity is required of the sensor and when alarm limit is at the bottom of measuring range (0-10% LFL flammable gas).

Due to its operating principle, the sensor requires at least 10% volume of oxygen when oxidizing combustible gases to work properly. Because of this feature particular procedures shall be taken on consideration:
The sensitivity of catalytic type sensor decreases or stops totally because of the impact of certain substances:

- Silicone compounds (silane, silicones, silicates), lead tetra ethyl, sulphur compounds, arsenic compounds, antimony and phosphorus compounds might poison sensor permanently.
- Hydrofluorocarbons may poison sensor temporarily.
- Some compounds, such as acrylonitrile, styrene and butadiene, may be susceptible to spontaneous polymerization on the surface of the sensor element.

These weaknesses have been known by the device manufacturers and that is why many manufacturers have developed poison resistant sensor to withstand better harmful substances.

Catalytic type sensors are also sensitive to large gas concentrations. Because of this, the sensors must not be "tested" with 100% flammable gas, because sensor recovery from this kind of treatment will last for a long time.
The response time (T90%) of catalytic combustion sensor to the content change is typically within 10 -20 seconds.
Catalytic combustion type sensor is suitable for measuring combustible gases in the relative humidity (RH) of the ambient air with continuous content ranges from 20 ... 90%, or momentarily 10 ... 99%.

Note 1: If oxygen concentration may fall to less than 10% then some other measurement principle type flammable sensor shall be chosen.

Note 2: If the sensor might get exposed to high hydrocarbon concentration, replacing oxygen in the air, then catalytic combustion-based sensor does not work, and meter indication falls to zero.

3.1.1.2. Infrared (IR) Sensor type

Infrared sensor based on absorption of the gas being measured with an infrared beam.

This sensor type is suitable for point type measurements.
The sensor is also suitable for the control of various hydrocarbons present at the same time. The sensor's sensitivity, however, varies according to the different gases. Therefore, the sensor shall be calibrated to the gas for which it is the least sensitive. Detector manufacturers supply for various gases correlation curves compared for the calibration gas.

Infrared sensor is suitable for the control of hydrocarbons in the areas where there is no oxygen, or oxygen is partly excluded due to the gas leak.
The sensor is not sensitive to large gas concentrations. The infrared sensor is not affected from poisonous gases which poisons catalytic combustion sensors.
The infrared sensor can be used to measure concentrations above of the LFL.
The above-mentioned features due to the infrared sensors can, in some cases, also be used to process applications to measure hydrocarbons in a process where allowed uncertainty of ± 5%.

Infrared sensor response time to (T90%) to concentration change is about 2-5 seconds.
Infrared sensors long period drift is less than the catalytic combustion-based sensor.

Infrared sensors are suitable for monitoring applications with relative humidity constant content ranges from 10 ... 95%.
Depending on the manufacturer the infrared sensors installation on the maximum constant relative humidity varies between 95-99%.

Note: it is important to be aware that the infrared sensors are not suitable for the measurement of hydrogen at all.

3.1.1.3. Semiconductor Sensor type

Semiconductor sensors measurement is based on conductivity change of the heated element of the semiconductor as a result of the chemical absorption of the gas being measured.

Semiconductor sensors weakness is the fact that, in some cases, the measurement result is greatly affected by atmospheric oxygen content, and/or moisture and/or variations in temperature.
The same sensors are sensitive to some of the gases, which are able to "poison" the sensor and cause a large error in the measurement results. Such harmful substances such as Silicones, tetra ethyl compounds, cyanides, halogens, sulphur components, etc.

Semiconductor sensors can be used to detect small concentrations of combustible and/or toxic gases. These can be used for case-by-case as long as it has been taken into account the limitations of the sensor type.
The variation of the temperature and humidity compensation circuits shall operate reliably. The device manufacturer shall demonstrate the performance of the device manufactured to meet the requirements of the standard EN-60079-29-1.

3.1.1.4. Electrochemical Sensor type

Electrochemical type sensors measurement is based on the change of electrical parameters in electrolyte solution. The change is due to the chemical reduction of electronic parameters/oxidation of the electrode on the surface of sensor.

Electrochemical type sensor is capable for measuring hydrogen up to the lower flammable limit on range 0-100 % of the LFL. The sensor type is also suitable for the measurement of oxygen content typically on range 0- 25% and with some model 0-100 vol-%.

The response time (T 90 %) of electrochemical sensor is typically ≥ 20 seconds.

The possible cross sensitivity to other gases compared to the measured gas shall be checked when purchasing electrochemical type sensor.

Calibration of sensors shall be done in accordance with the instructions of the manufacturer of the device. Electrochemical sensor lifetime might exceed 2 years.

3.1.2. Flammable Open Path Gas Detector

Standard IEC 60079-29-4 specifies open path gas detector performance requirements.
Open path detectors are more specific detectors and use lot of calculations, self diagnostic etc. It is very important that maintenance has service connections to the detectors, so in some case it need some extra cabling from sensors to the cross connection room for that.
When selecting measurement technics shall following be taken into account:

- The detector operation is based on measured gas absorption on infrared wave length. The result will also be affected by the measurement length of the beam. The detector is also suitable for the control of various hydrocarbons in the area at the same time.
- The sensor's sensitivity, however, varies according to the different gases.
- Therefore, the sensor must be calibrated at the factory to combustible gas for which it is the least sensitive.

Because the measurement result is affected by the measurement of the concentration, but also the of the path length, so the open path gas detector output is "LFL meters". For example, the concentration of 4% LFL meter over 1 meter path is equal to 1% LFL result over 4 meter path. The measurement range of open path gas detector is typically chosen to 0 - 5 % LFL meter.

This detector type can be used to measure hydrocarbons over long distances. The measurement device is composed of a combined transmitter/receiver unit and dozens of meters away from the reflector plate or the receiver. More than 100 m measurement path can be achieved with a separate transmitter and receiver.

This detector type can be used for hydrocarbon monitoring on places, where might exist number of simultaneous potential leaks. Open path gas detector has successfully been used in the oversight of hydrocarbons in pump rows, tunnels, pipelines and on oil production platforms. The investment cost of open path gas detector is around 5 times compared to point type infrared gas detector. It is worth to consider when it can replace number of point type detectors. For example, Shell has specified open path gas detectors to the preferred measurement technics for combustible gases.
Open path gas detector is suitable for the control of hydrocarbons in the areas where there is no oxygen or where oxygen is partly excluded due to gas leak. The detector is not sensitive for large gas concentrations. The detector does not suffer from so-called poisoning phenomenon of which the catalytic combustion detectors might suffer.
Open path gas detector measurement results correspond the average of the hydrocarbon concentration in the entire measurement path. It is not accurate locating point type leak. However open path gas detector monitors gas leak on wider range than point type detector.
The response time (T90%) with open path detectors is around 2-3 seconds.
Open path gas detectors are suitable for flammable gas detection within relative humidity variation between range 0 ... 99%.
The long time drift of open path gas detector is less than the catalytic combustion-based sensor.
Note: Open path gas detectors are not at all suitable for the detection of hydrogen.

Open path detectors are sensitive to snow and sometimes water fumes. They are also difficult in areas where constant maintenance or operation exists i.e. persons are crossing the beam often, thus locating of open path detectors need to be done carefully. It is often better to install the beams higher than people heads.

3.1.3. Toxic Gas Detector

Toxic gas detectors type can be Electrochemical cell type or Photoionization Detector (PID) type. The recommended type for toxic point gas detector is the Electrochemical cell.

3.1.3.1. Electrochemical cell type

Electrochemical cells can measure poisonous gases like: ammonia, hydrogen fluoride, carbon monoxide, hydrochloric acid, hydrogen sulfide, and sulfur dioxide. However electrochemical cell is not selective for certain toxic gas. The measurement is based on electrical parameter change between the electrolyte and electrodes. When specifying the measurement shall attention be paid to possible other gases at the same area which may have cross sensitivity to measured gas. Oxidizing or reducing gases can interfere with the measurement of the specified component in the desired range.

The response time (T90%) of electrochemical cell varies depending of measured component from a few seconds to more than a minute.

Sensors calibration must be done in accordance with the instructions of the device manufacturer and following maintenance instructions. The lifetime of electrochemical cell might exceed 2 years operation time.

3.1.3.2. Photoionization detector (PID) type

Photoionization detection principle is based on gaseous sample ionization by ultraviolet radiation source. Gas molecules with lower ionization level than UV source are photo-ionized. With this technic poisonous gases can be measured at low ppm level. Measurement method, however, is not selective for a particular component. This measurement method can be used when controlling the parts per million level of hydrocarbon leaks as a result of a summarizing measurement.

There is available gas detector which is based to the photoionization method for the measurement of benzene. This is provided with technics that separates other typical hydrocarbons before entering PID detector.

If there are only few benzene measuring points, then this technique could be considered because investment / maintenance costs are lower than with gas chromatograph or with the mass spectrometer.

3.1.4. Toxic Open Path Gas Detector

Toxic gases can be measured with the open path technics. On applicable parts EN 60079-29-4 standard for flammable gases can be applied.

Open path gas detector based laser technology are available to measure Ammonia (NH3), Hydrogen Fluoride (HF), Hydrogen sulfide (H2S) and Hydrogen chloride (HCl).

Open path toxic gas detectors have some device manufacturers built in such a way that inside transmitter there is gas reservoir where is current toxic gas. Part of the measuring beam will by-pass via reservoir allowing detector to have harmonic fingerprint of measured gas. Gas detector can be defined to validate automatically for example 24 hours interval with toxic gas on known value. Because of this there is no needed for separate calibration with gas sample during detector life time.

Transmitter and receivers distance can be chosen between 5-120 m.

Open path detectors are sensitive to snow and sometimes water fumes. They are also difficult in areas where constant maintenance or operation exists i.e. persons are crossing the beam often, thus locating of open path detectors need to be done carefully. It is often better to install the beams higher than people heads.

3.2. Automatic Gas Detection application in the Plant (~~Open~~ Process Area Outdoors)

Flammable and toxic gas detection shall be provided according to results of Analyses performed on Project (refer to paragraph 1.3). In addition, specific cases where application shall be guaranteed are listed in following paragraphs with reference to equipment present in Project.

3.2.1. Flammable Gas Detector

The Flammable Gas detector shall be installed at ground level and/or in elevation.
Gas detectors shall alarm of possible gas leaks as early as possible and inform where leak takes place. When locating gas detector in the plant area following matters could be evaluated:

- point type gas detectors shall be located close to equipment which potentially might leak,
- point type Gas detectors shall be located such a way that they cover several potential leaks if possible, just to optimize the number of detectors,
- hazardous process area shall be surrounded with point type gas detectors or /and with open path gas detectors.

For the Flammable Point Gas detectors, the selected type is Infrared type, with exception of the detection of hydrogen and acetylene, where catalytic type gas detectors shall be used.

Point or open path flammable gas detector shall be located:

- around pumps handling liquefied flammable gas or liquid handled at temperature close or above its flash point (Note: flammable gas detectors are not required on pumps handling fluid well above autoignition point where instead the fire detector are installed, refer to above),
- around compressors handling flammable gases;
- to ensure coverage of process area perimeter with reference to gases heavier than air,
- at critical points (and/or perimeter) where there is the danger that the leakage can approach the permanent source of ignition (e.g.: heater) located in adjacent area.

Detailed installation engineering matters for point gas detectors shall be taken into account:

- Point type detector with weather protection shall be installed close to potential gas leaking point so that meteorological condition cannot reach detector.
- When monitoring combustible gases lighter than air, detector shall be located above release source.
- When monitoring combustible gases heavier than air, detector shall be located at 0.5 m from ground.
- The detector must be installed in such a way that maintenance and calibration is easily accomplished.

- The location of the detector must consider protection against mechanical damage.
- The detector shall not be installed close to equipment causing strong electromagnetic interference.
- The detector shall not be placed in the proximity of regular steam blowing.
- The detector shall not be installed in a location where ambient temperature is high, because constant high temperatures shorten the life of the detector.

Detailed installation engineering matters for open path gas detectors shall be taken into account:

- Transmitter and receiver shall be installed on pathways typically on 2.2- 4 m height from ground level. The diameter of open path for beam shall be 0.2-0.3 m.
- Open path transmitter and receiver shall be protected against meteorological condition and from direct sun beam to optics.
- When monitoring combustible gases lighter than air, detector shall be located above release source.
- When monitoring combustible gases heavier than air, detector shall be located at 0.5 m from ground.
- The measuring equipment shall be installed in such a way that maintenance and calibration is easily accomplished.
- Installation design of the measuring equipment shall take care of account the protection against mechanical damage.
- The transmitter and receiver shall not be installed close equipment causing strong electromagnetic interference.
- Receiver shall not be installed close to the powerful infrared sources. For example, high pressure xenon lamp interferes with measurement.

The sensitivity of gas detectors varies with different flammable gases. Normally gas sensors shall be calibrated to gas which gives lowest response on selected gas sensor and which also exist on current process area. This will provide detection and alarm of all flammable gases on current process area when there is leak.

The point flammable gas detectors will give a pre-alarm at 10% of LFL and an alarm at 20% of LFL.
The open path flammable gas detectors will give a pre-alarm at 1% of LFL meter and an alarm at 2% of LFL meter.
The pre-alarm shall initiate for all type of flammable gas detectors the following:

- a visual alarm (one or more blue flashing lights in relevant area) in the concerned plant area,
- an audible and visual (dedicated per each detector) alarm to DCS with repetition to MAP.

The alarm shall initiate also the following:

- an audible alarm (one or more horn with gas tone) in the concerned plant area,
- an audible and visual (common alarm grouped by each area) alarm in the pertinent guardhouse (only one guardhouse alerted, the one afferent to the site).

- ,
- a general alarm to external Fire Brigade.

When the flammable gas detectors activate a fire water curtain, the alarm shall initiate the system in logic 1ooN between selected group of point gas detector or in logic 1ooN between selected group of open path gas detector.

3.2.2. Toxic Gas Detector

For the Toxic Point Gas detectors, the selected type is the Electrochemical cell.

The location of toxic gas detector shall be defined case by case on the basis of vulnerable receptor located in the surrounding area.

The calibration range shall be 0-100% IDLH (Immediate Danger to Life and Health).
The H_2S toxic gas detectors will give a pre-alarm at 10 ppmv and an alarm at 15 ppmv.
The NH_3 toxic gas detectors will give a pre-alarm at 25 ppmv and an alarm at 30 ppmv.

A pre-alarm shall initiate the following:

- a visual alarm (one or more blue flashing lights in the relevant area) in the concerned plant area,
- an audible and visual (dedicated per each detector) alarm to DCS with repetition to MAP.

The alarm shall initiate also the following:

- an audible alarm (one or more horn with gas tone) in the concerned plant area,
- an audible and visual (common alarm grouped by each area) alarm in the pertinent guardhouse (only one guardhouse alerted, the one afferent to the site).
- ,
- a general alarm to external Fire Brigade.

Detailed installation engineering matters for toxic gas detectors shall be taken into account:

- Detector with weather protection shall be installed close to potential gas leaking point so that meteorological condition cannot reach detector.
- When monitoring gases lighter than air, detector shall be located above release source.
- When monitoring gases heavier than air, detector shall be located at 0.5 m from ground.
- The detector must be installed in such a way that maintenance and calibration is easily accomplished.
- The location of the detector must consider protection against mechanical damage.
- The detector shall not be installed close to equipment causing strong electromagnetic interference.
- The detector shall not be placed in the proximity of regular steam blowing.

- The detector shall not be installed in a location where ambient temperature is high, because constant high temperatures shorten the life of the detector.

3.3. Gas Detection in Building

Flammable and toxic (NH3 and H2S) gas detectors shall be installed at HVAC air intake of new buildings.
Type of gas detector shall be:

- flammable: InfraRed point (IR) detector type,
- toxic: Electrochemical cell type.

Gas detectors (flammable and toxic) installed in air intake of HVAC in case of pre-alarm activation will:

- close the inlet air damper through HVAC panel and activate the recirculation,
- ~~provide~~ initiate audible and visual (dedicated per each detector) alarm to DCS with repetition to MAP.

No additional actions are in place in case of alarm threshold achievement.