Rafał Frączek
Technical Analysis Department ASE

+ 48 603 056 211
R.Fraczek@ase.com.pl

Area classification -

An explanation of the importance to correctly address the hazards and extent of these hazards prior to design and operation of any new plant along with the need to control and re-evaluate changes to existing plant and infrastructure.

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CONTENT

1. Introduction.
2. The formation of explosive atmospheres.
3. Complex risk assessment.
4. Hazardous areas classification in terms of the risk of explosion.
5. Preliminary ATEX audits.

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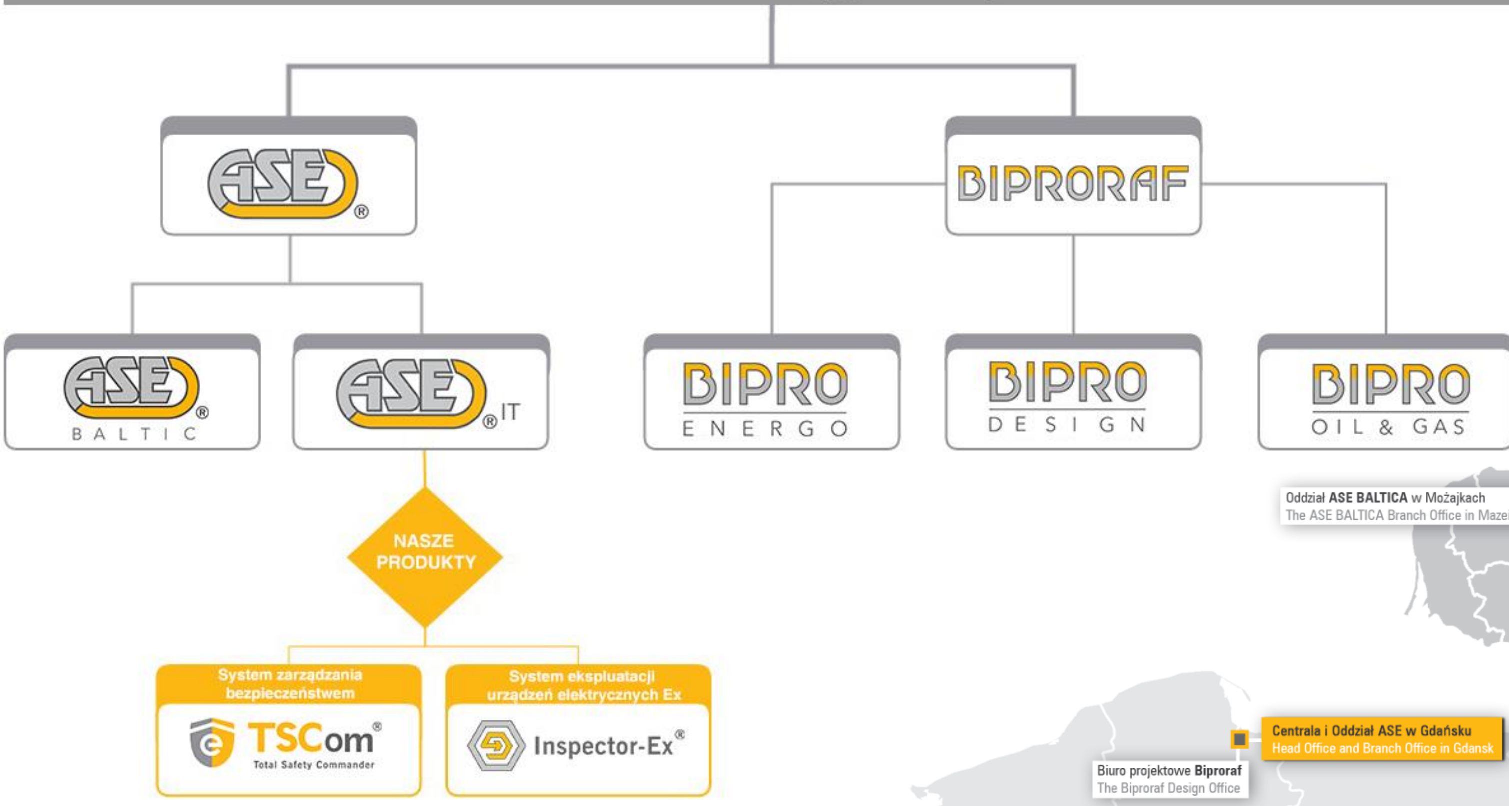

SAFETY LIFECYCLE

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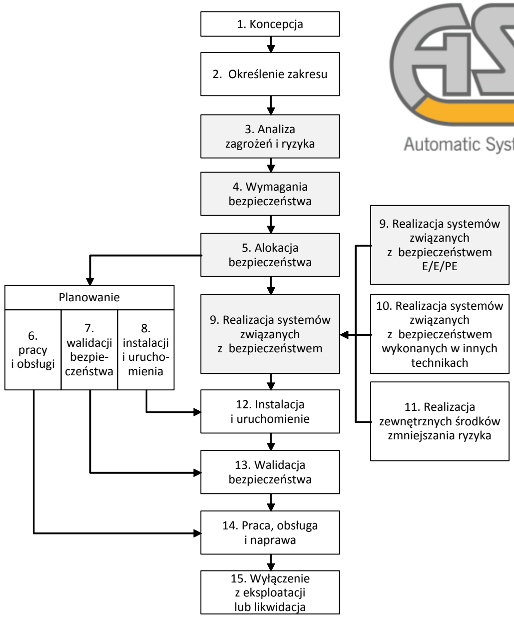
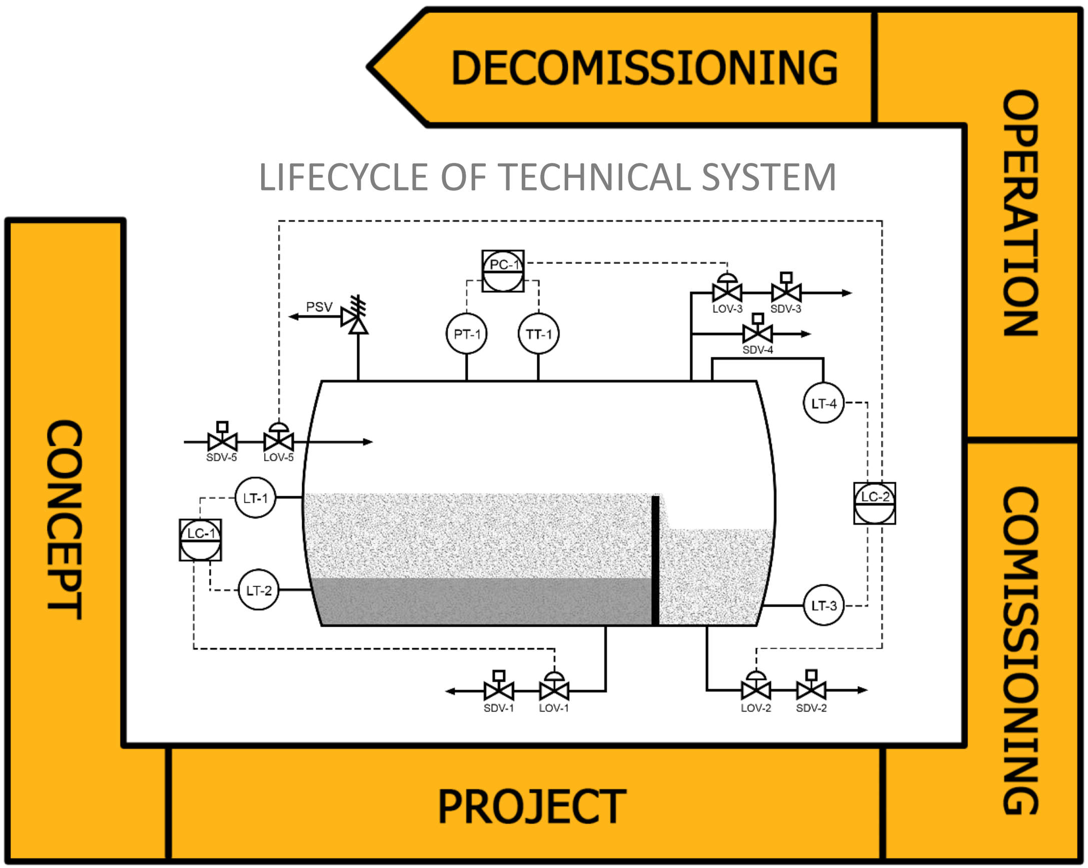
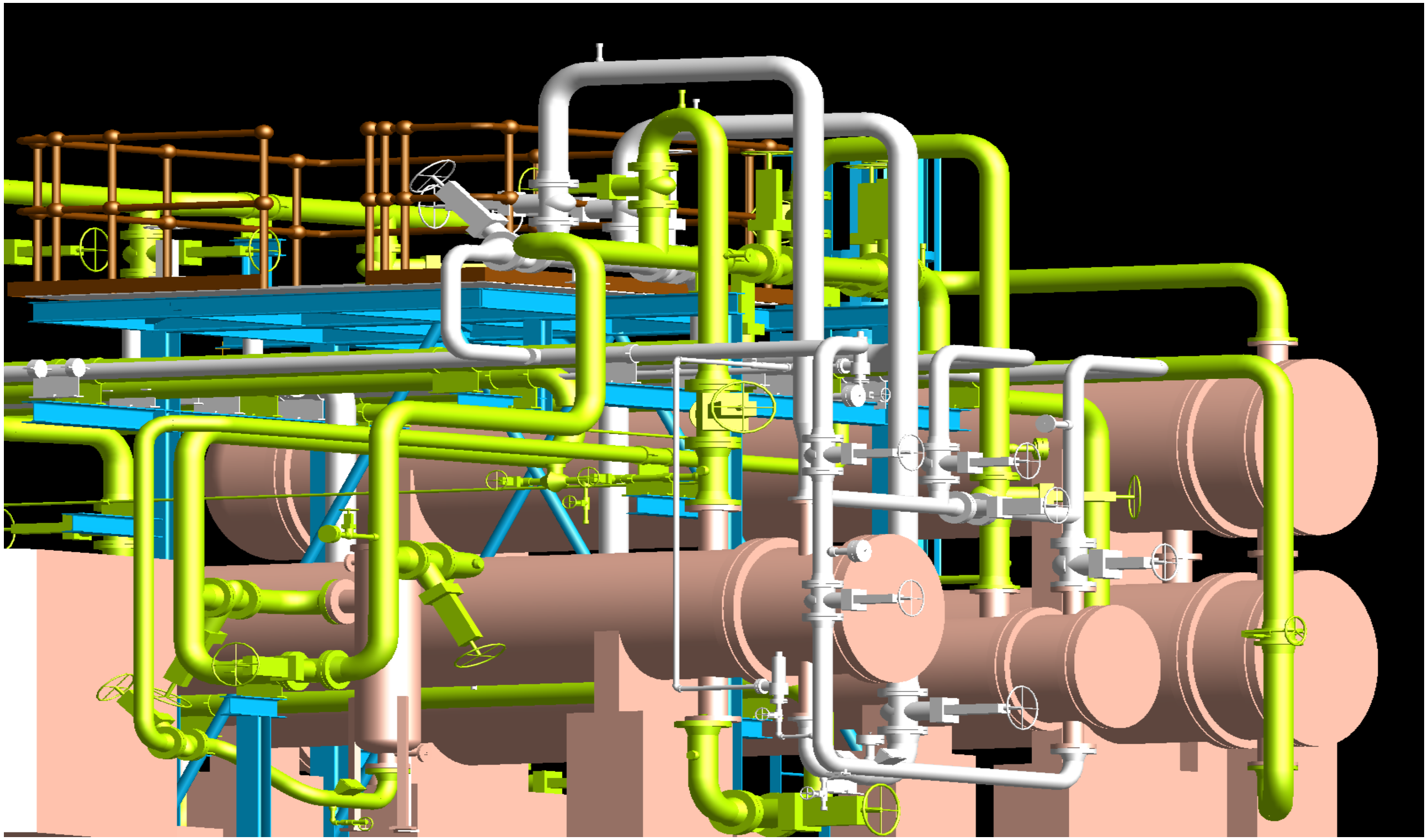


Each phase of the safety life cycle requires taking specific actions, as well as utilizing the competence and independence of people, departments or organizations implementing them.



Risk management covers all stages of the system life cycle

Modernization of an installation



3D model

Modernization of an installation

TECHNICAL ANALYSIS DEPARTMENT:

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According to Confucius
Man knows three ways of learning:

First, by considering, it is the noblest.

In terms of safety, to **consider** means using systematic techniques for risk analysis: HAZOP, LOPA, explosion risk evaluation, other.

Second, by imitation, it is easiest.

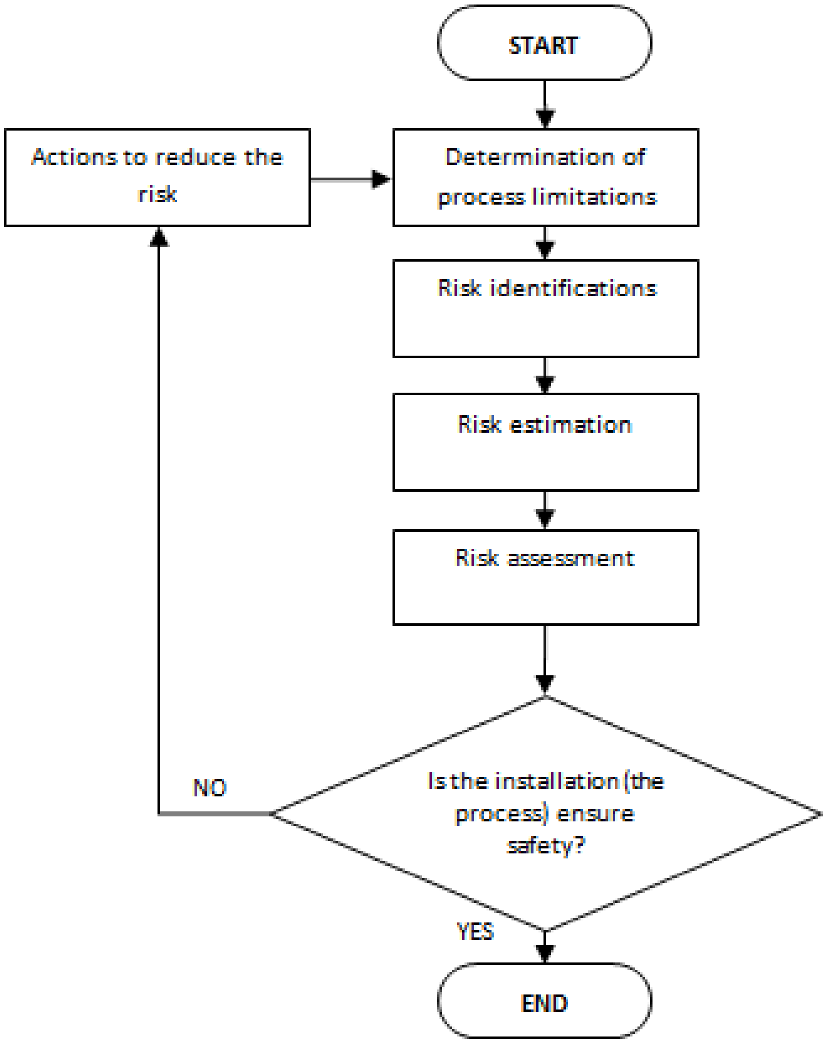
Imitation includes learning from the experience of others, as described in the standards of design, codes of practise, accident reports.

Thirdly, by experience. It is bitter.

Experience, in practice, means waiting for an accident.

* Based on the Foreword to *Safety Management: The Hong Kong Experience,* by Lee Hung-Kwong, Lorrainelo Concept Design, Hong Kong, 1991.

RISK: Method of analysis and assessment



IEC 60300-3-9 Risk analysis in technical systems

BASIC REQUIREMENTS OF REGULATION ATEX 137: COMPREHENSIVE ASSESSMENT OF RISK

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The employer should make comprehensive RISK ASSESSMENT associated with the possibility of working in an explosive atmosphere, taking into account:

- the likelihood and time of occurrence of an explosive atmosphere;
- the likelihood of occurrance and activation of ignition sources, including electrostatic discharges;
- installations operated by the employer, used substances and mixtures, processes and their interactions;
- the predicted effects of an explosion.

Risk of explosion must be fully assessed.

Rozporządzenie Ministra Gospodarki, z dnia 8 lipca 2010r.
w sprawie minimalnych wymagań, dotyczących bezpieczeństwa i higieny pracy, związanych z możliwością wystąpienia w miejscu pracy atmosfery wybuchowej. (Dz.U. Nr 138, poz. 931) .

The procedure for achieving safety

Safety should be maintained in the following order:

1. **Preventing the formation of an explosive atmosphere:**
   (the use of non-combustible materials, dilution, tightness, eliminating sources of emissions)

2. **Avoiding ignition of an explosive atmosphere**
   (sources of ignition)

3. **Reducing the effect of explosion**
   (venting, explosion suppression)

THE FORMATION OF EXPLOSIVE ATMOSPHERES: flammable materials

- **Flammable gases**,
- **Flammable liquids with a flash point below 328.15 K (55 ° C),**
- Substances which, in contact with water, emit flammable gases,
- Materials undergoing spontaneous decomposition or polymerization.
- **Dusts**.

Flammable gases, vapors and mists of flammable liquids, dusts and fibers, combined with air or oxidizing agents (eg. Chlorine), form **explosive atmospheres**.

Should such atmoshere ignite, it will cause an explosion, which may pose a human safety and production facilities hazard.

THE FORMATION OF EXPLOSIVE ATMOSPHERES: gas explosive atmosphere

AIR

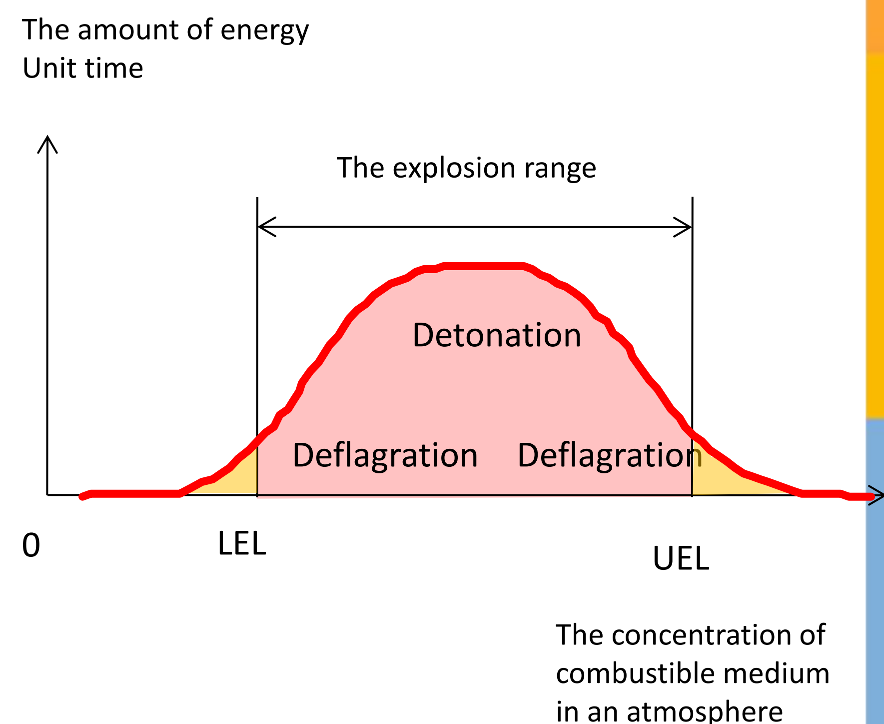
FLAMMABLE GASES, FLAMMABLE LIQUID VAPOR

IGNITION SOURCE

	DGW	GGW
Methane	5.0%	15%
Hydrogen	4.0%	75%
Acethylene	2.5%	82%
Propane	2.1%	9.5%

The following three components, present in the correct proportions, are the cause of explosions: :

- Explosive Atmosphere (mean values) for each combustible gas or vapor in a liquid under ambient conditions: for pressure 1013,25hPa and temperature 20C



RISK OF EXPLOSION: definition and parameters

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Risk of explosion		Consequence		Probability of damage
Considered event related to potential accidents	is a function of	Possible damage resulting from an event which led to an accident	and	➢ Frequency and duration of exposure, ➢ probability of a hazardous event

PRINCIPLES OF AREA CLASSIFICATION IN TERMS OF EXPLOSION HAZARD - taking into account the effect of ventilation

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Grade of release	Ventilation						
	Degree						
	High			Medium			Low
	Availability						
	Good	Fair	Poor	Good	Fair	Poor	Good, fair or poor
Continuous	(Zone 0 NE) Non-hazardous[a]	(Zone 0 NE) Zone 2[a]	(Zone 0 NE) Zone 1[a]	Zone 0	Zone 0 + Zone 2	Zone 0 + Zone 1	Zone 0
Primary	(Zone 1 NE) Non-hazardous[a]	(Zone 1 NE) Zone 2[a]	(Zone 1 NE) Zone 2[a]	Zone 1	Zone 1 + Zone 2	Zone 1 + Zone 2	Zone 1 or zone 0[c]
Secondary[b]	(Zone 2 NE) Non-hazardous[a]	(Zone 2 NE) Non-hazardous[a]	Zone 2	Zone 2	Zone 2	Zone 2	Zone 1 and even zone 0[c]

Influence of the type of ventilation zones:

- decreases the range
- reduces the residual time of an explosive atmosphere
- prevents the formation of explosive atmospheres.

INFLUENCE OF VENTILATION

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Marking the degree of emission

C – Continuous emission, which occurs continuously or whose occurrence can be expected over long periods;
P – the first stage of the emission, which under normal operating conditions can be expected to occur periodically or occasionaly;
S – the second stage of the emission, which act in normal operating conditions can not be expected, and if it actually occurs then only rarely and for short periods.

Determining the degree of ventilation

VH – high level at which there is a very rapid decrease in the concentration of the substance around the source of emissions below the lower explosive limit,
VM – average level at which emissions under constant lowers the concentration of the substance below the lower explosive limit, the occurrence of an explosive mixture does not last too long after the emission;
VL – low level at which there is no concentration control when emitting and / or there is no effective prevention of the occurrence of an explosive mixture after emission.

INFLUENCE OF VENTILATION

Determining the ventilation availability

Good – good availability, at which ventilation is provided and operates continuously;
Fair – quite good availability, at which ventilation is working under normal operating conditions with only short, acceptable interruptions of the ventilation;
Poor – poor availability, at which the ventilation does not meet the criteria for good and quite good operation, yet the downtime is not too long.

Note:
If ventilation is not even meet the conditions of poor ventilation can not be taken into account when assessing the risk of explosion.

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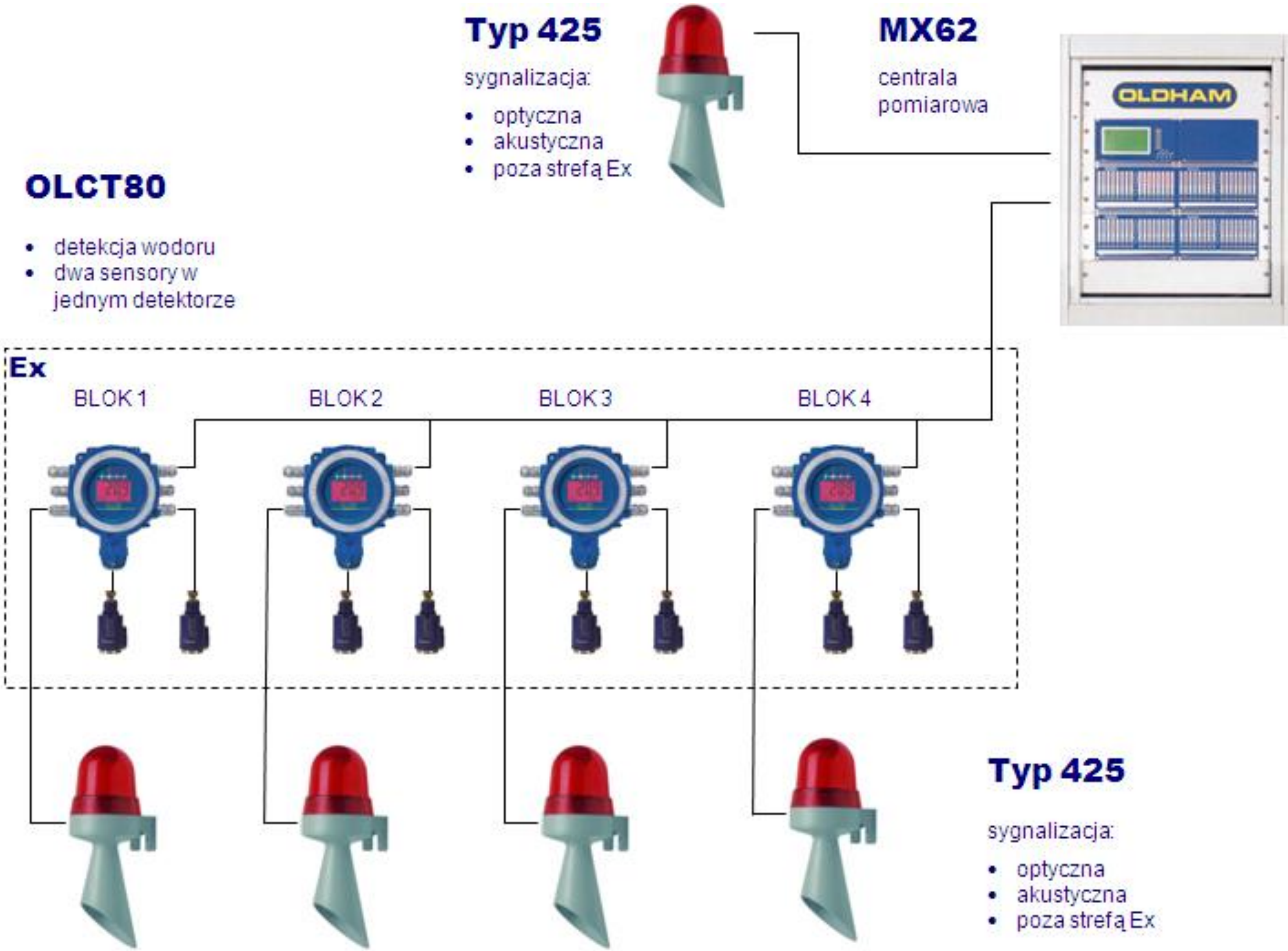


Prevents the formation of an explosive atmosphere ATEX

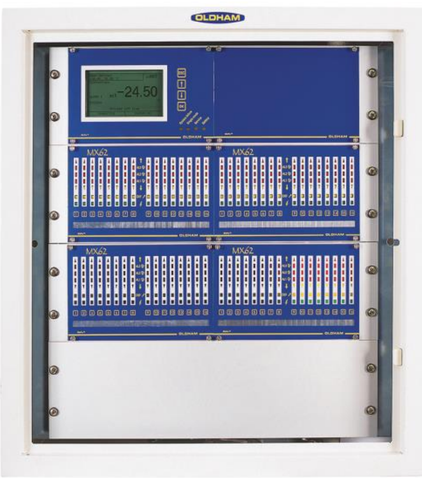
Means installing gas detection system

- Gas detection system is considered a „**SAFETY SYSTEM**", if measured directly and implements security functions. Safety systems are designed to reduce the risk of an explosion (<u>disconnect the power supply</u>, shutdown solenoid, start signaling, etc.)

- Included in the Directive ATEX 94/9 / EC Annex II, Article 1.5.

-

The control panel must be performed in accordance with the Directive as a "SAFETY DEVICE"



- ATEX Directive 94/9 / EC, Article 1: The scope of this directive also includes safety, controlling and regulating devices intended for using outside hazardous areas, but which are required or contributing to the safe functioning of equipment and protective systems against threats explosives.
- Gas detectors have to meet requirements of the directive
- Control panel marking: Ex **II (1/2) G**

Gas detection system: hazardous areas classification

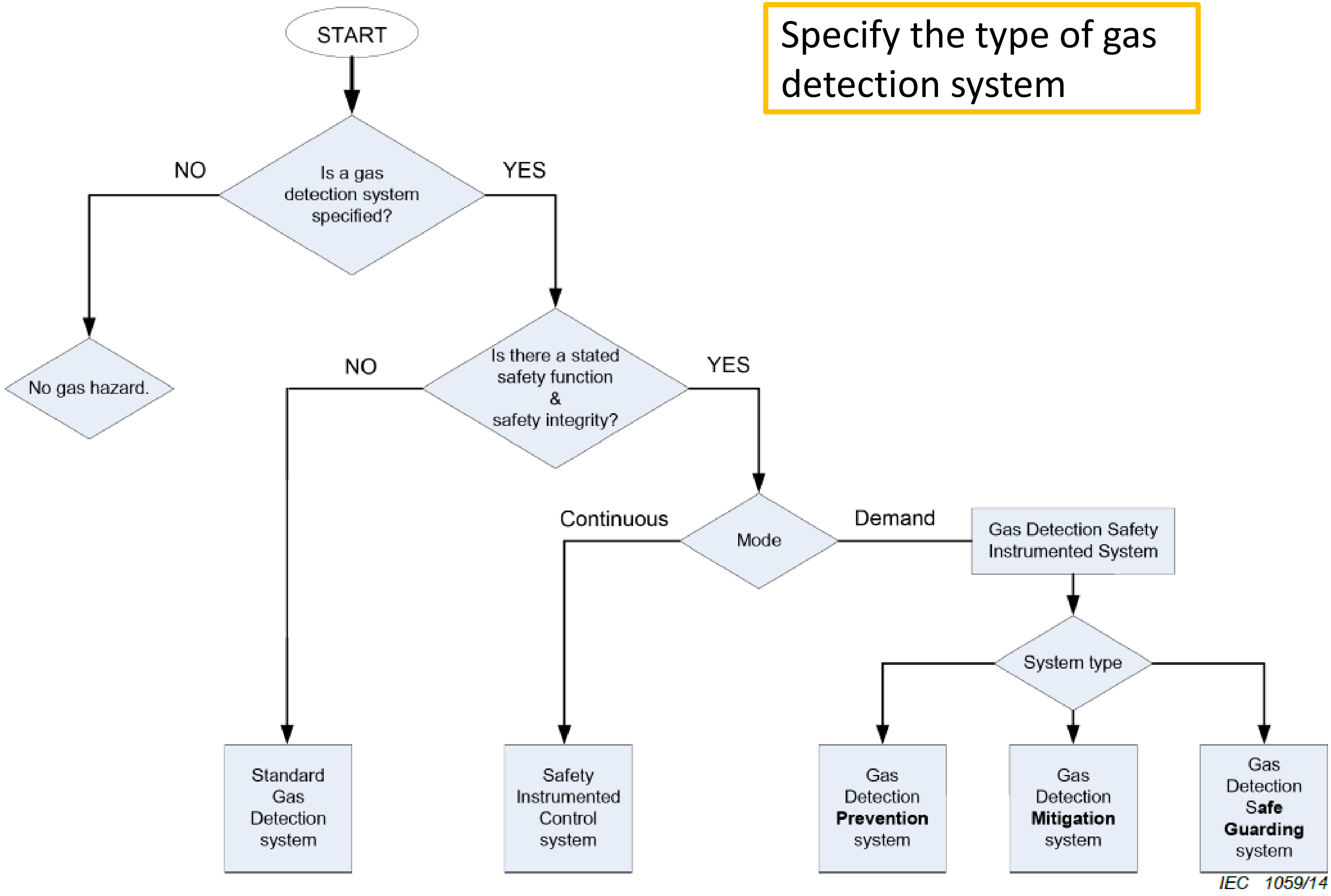
Gas Detection Systems

PN-EN 60079-29-3: new standard binding requirements of the basic PN-EN 61508 with the specificity of gas detection systems

Safety system associated with the gas detection

- PN-EN 61508 — Manufacturer of gas detection system devices
- PN-EN 61511 — Safety system integrator and a gas detection
- PN-EN 60079-29-3 — System integrator and the manufacturer

Specify the type of gas detection system



Gas detection system: hazardous areas classification

PN-EN 15233 Methodology for functional safety assessment of protective systems for hazardous areas

In the interests of both the manufacturer and the user is to establish a common methodology for achieving functional safety, reliability and efficiency of protective systems. Thus, the functional safety assessment is a tool that provides the essential link between producers and users, but this standard contains only aspects related manufacturers.

The overall explosion safety is designed to protect against the formation of explosive atmospheres as well as sources of ignition and reduce the effects of an explosion.

Measurement methods of gas detection

1. Catalytic

2. Electrochemical

3. Infrared absorption

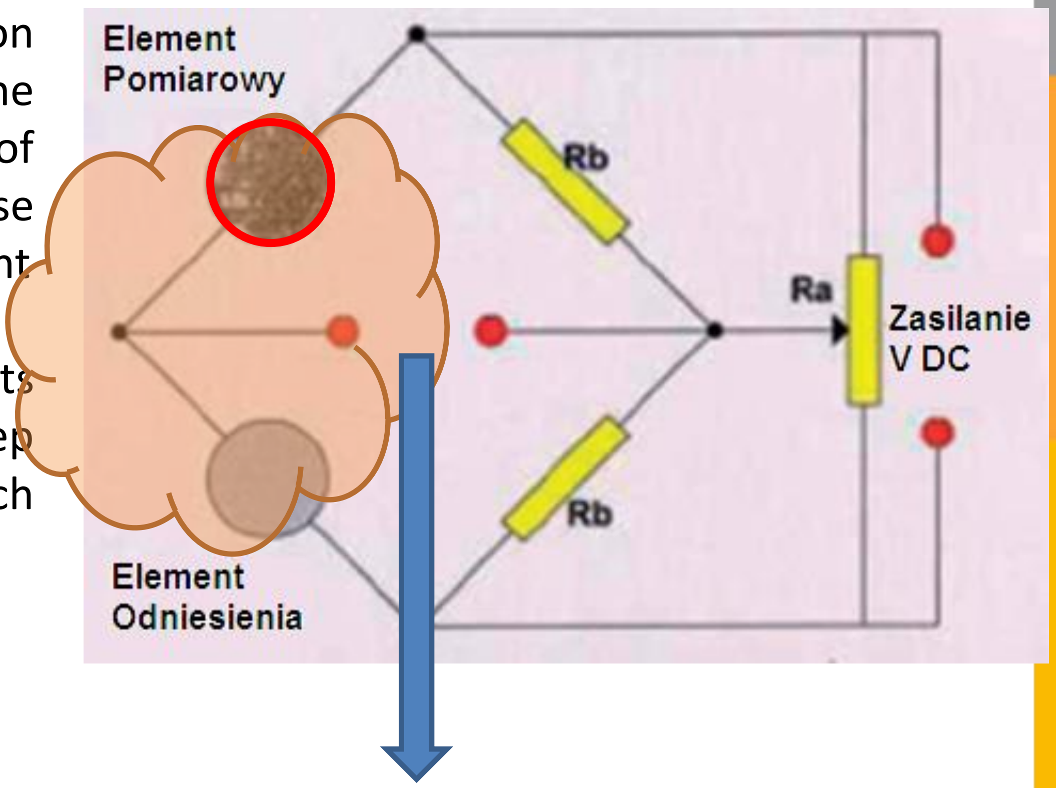
4. Semiconductor


Catalytic method

- The sensor consists of two platinum coils coated with a layer of aluminum oxide
- One of the fibers is impregnated with a special catalyst for accelerating the oxidation process (**measuring element**)
- The other fibers is designed as to avoid oxidation (**reference element**)
- Everything is placed in a **flameproof** enclosure cell.

Catalytic method

- The measuring principle is based on the use of the oxidation of the combustible gases on the surface of the sensing element and an increase in the temperature of sensing element.
- The purpose of the flowe of currents through the sensing element to keep the temp. in the area of 450 °C, which enables the oxidation of the gas.
- The combustion of flammable gas, that is followed by an increase in the temperature of sensing element causes the asymmetry of the electrical bridge.



Measurement of gas concentration

Catalytic method

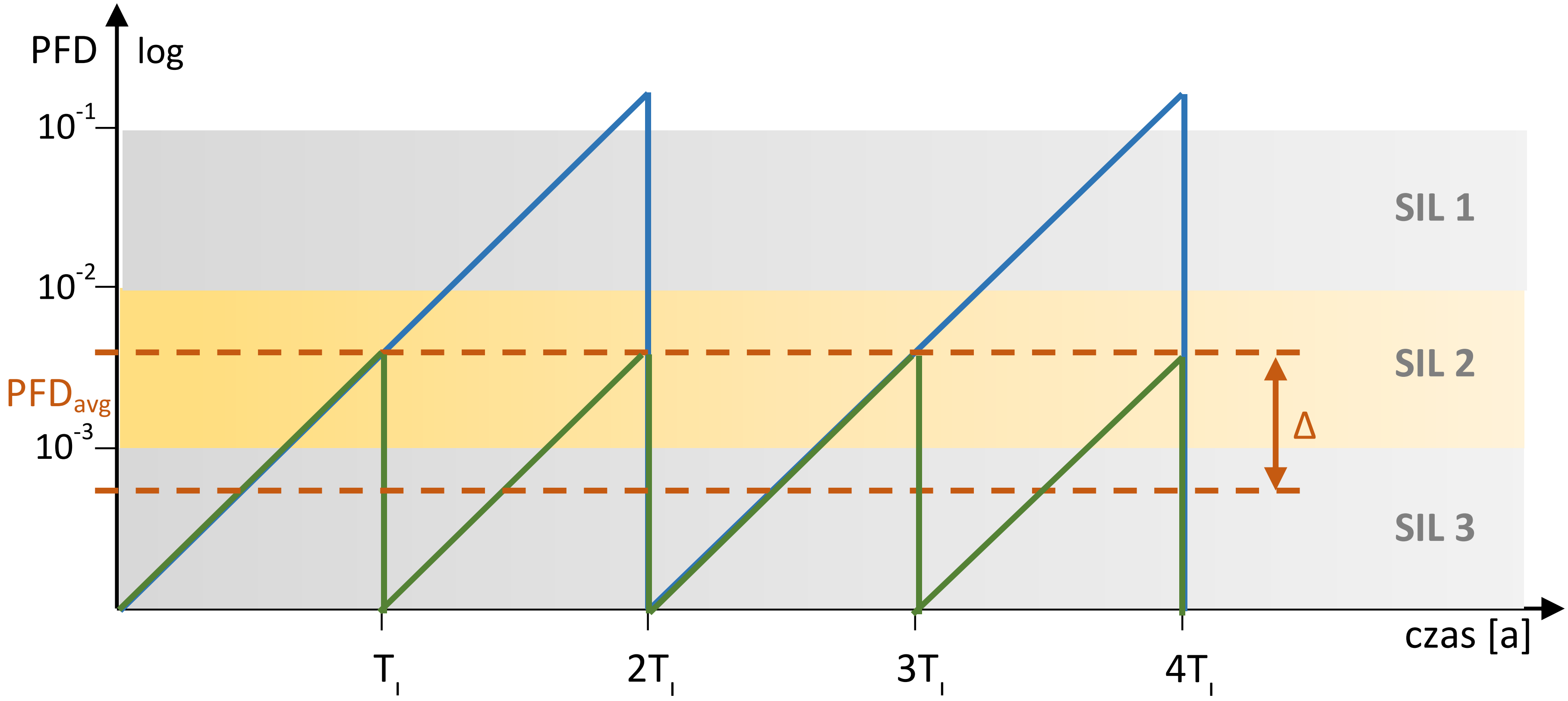
Advantages:

- Linear signal in the range of the LEL
- High repeatability
- High stability indications
- Low sensitivity to changes of humidity
- Short response time (<15 s)
- Long life (depending on working conditions, exposure to poisonous gases)
- Detection most of the combustible gases
- Suitable for measuring gas mixtures
- Relatively low price

Limitations:

- Damage caused by the exposure to H_2S, silicones, mixtures of metals (Pb, Hg ...), chlorine (Cl, ..) etc.
- Ambiguous signal above 100% LEL
- Influence of non-flammable gases on correct measurement (e.g. > 6% CO_2)
- Detection possible only in the presence > 10 % O_2

Influence of the test time to maintain a given level of SIL



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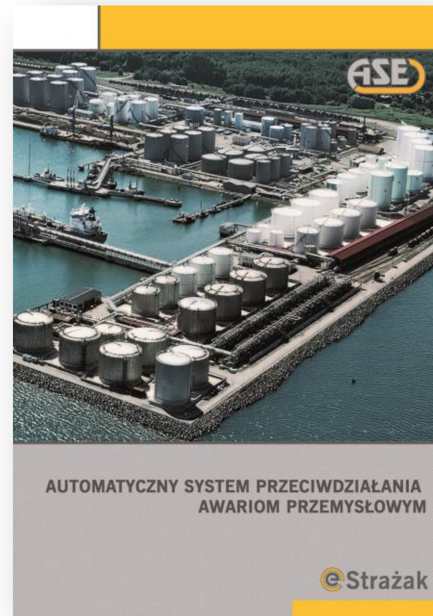
Our technologies associated with monitoring Safety Maintenance

Inspector-Ex®



TSCom
Total Safety Commander

eStrażak

Identification of effective ignition sources.

1. The following potential ignition sources should be taken into account:
    1. Hot surfaces – if an explosive atmosphere comes into contact with a heated surface, ignition can occur.
    2. Flames and hot gases (including hot particles) – flames are associated with combustion reactions at temperatures of more than 1 000 °C.
    3. Mechanically generated sparks
    4. Electrical apparatus
    5. Stray electric currents and cathodic corrosion protection
    6. Static electricity – the discharge of charged, insulated conductive parts can easily lead to incendive sparks.
    7. Lightning
    8. Radio frequency (RF) electromagnetic waves from 104 Hz to 3 x 1011 Hz
    9. Electromagnetic waves from 3 x 1011 Hz to 3 x 1015 Hz
    10. Ionizing radiation
    11. Ultrasonics
    12. Adiabatic compression and shock waves
    13. Exothermic reactions, including self-ignition of dusts

EXAMPLE OF CLASSIFICATION OF PETROLEUM PRODUCTS TANK

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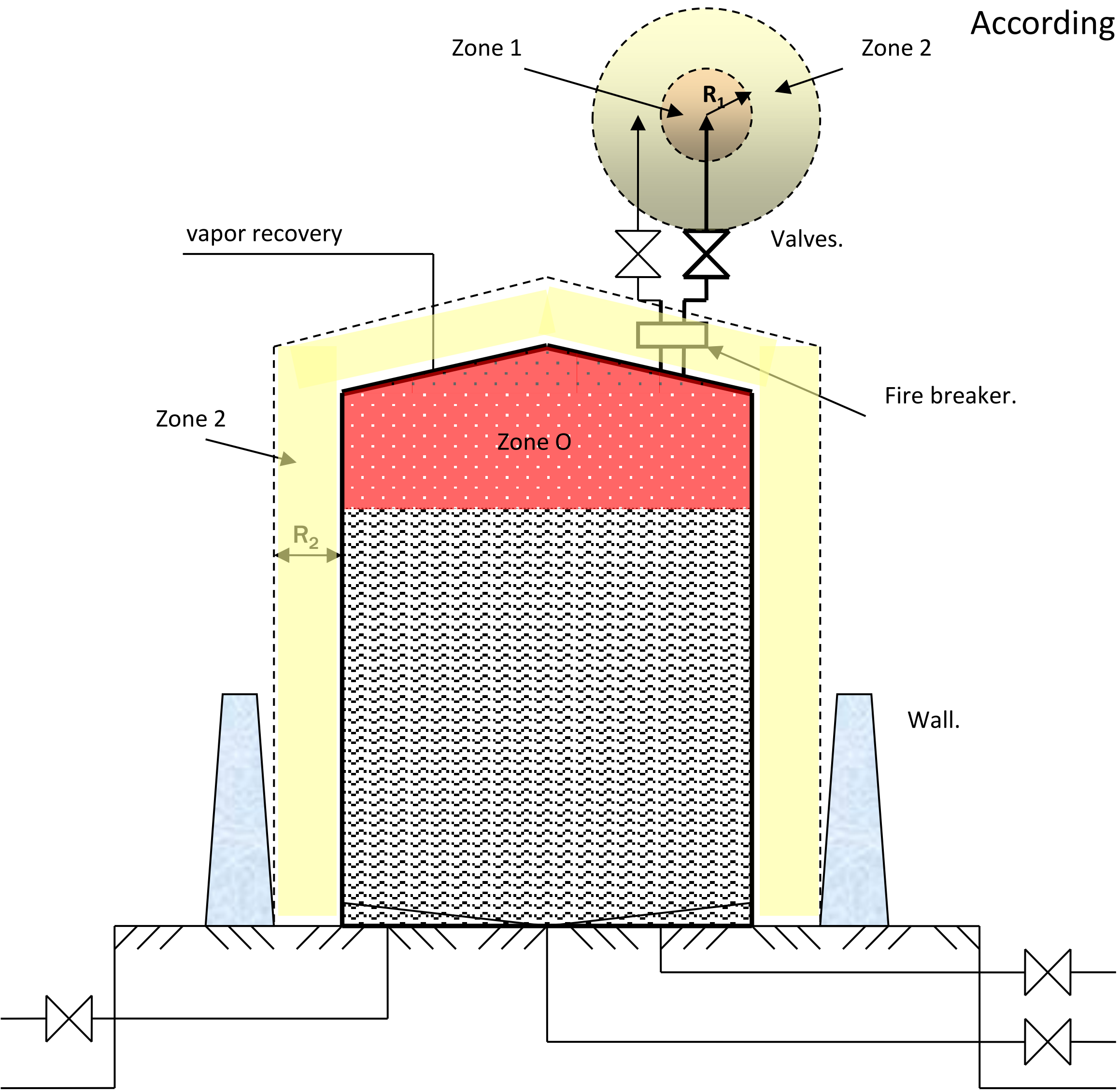
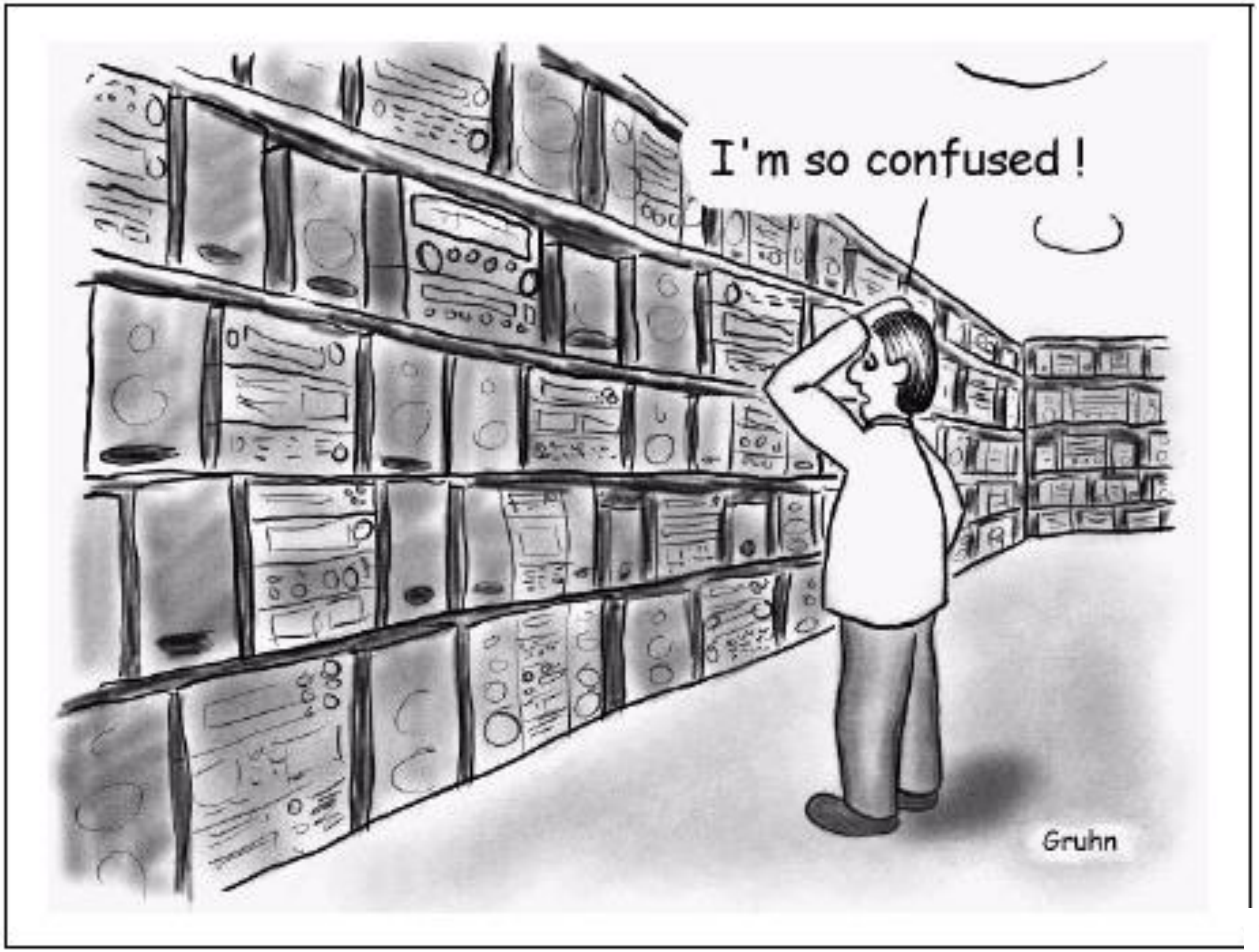
According to the regulation / base fuel /



Tank petroleum product II CLASS (21ºC<Tingnition< 55 ºC).

The main factors affecting the type and size of the zones.

Installation and process: fuel storage.
Location: outer space limited bunding or wall covering.
Ventilation: outer space, the level of high, availability of good.
Product: Tignit = 35 C, operation temperature was ambient temperature.
Emission source: (P) the overpressure valve. Inside the tank continuous emission (C) outside the emission of the second stage (S). Efficiency emissions low.
Detection: -
Hazardous areas:
Nozle: Zone 1 - a sphere of radius R 1 = 1.5 m from the outlet of the pressure relief valve and Respiratory Division 2 for a distance of 2m from the end of Zone 1.
Reservoir: Zone 2 - R 2 = 2 m from the tank shell.
Hazardous areas:
Nozzle: Zone 1 - a sphere of radius R 1 = 1.5 m from the outlet of the pressure relief valve and Zone 2 for a distance of 2m from the end of Zone 1.
Tank: Zone 2 - R 2 = 2 m from the tank shell.



SAFETY ANALYSIS

TECHNICAL CONSULTING

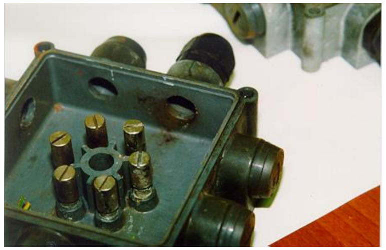
Automatic Systems Engineering

AKADEMIA BEZPIECZEŃSTWA

AUDITS

FUND OPTIMIZATION FOR SAFETY

COHERENCE FOR THE WHOLE PLANT



DETERMINATION OF RESPONSIBILITY

The preliminary stage

Identification of the initial state + guidelines

Preparation stage

Strategic decisions and actions, competency program

System implementation

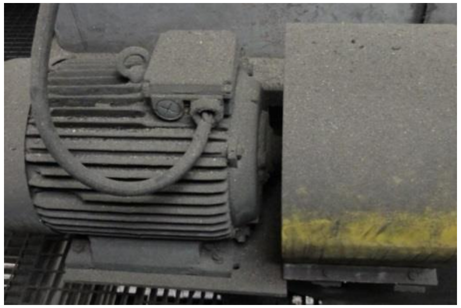
Implementation of standards and verification

Operation and maintenance stage

Implementation and maintenance of standards

Audits concern each stage of the life cycle safety

Any changes made in the project after the transition to the next stage require verification that does not introduce significant changes affecting the level of safety.



- Analysis of the PHA, HAZOP, FTA, FMEA, LOPA
- SRS safety requirements specification
- Determination of SIL
- SIL verification
- ATEX audits, process safety and functional
- Process safety management
- Certified training system with ATEX issues, process safety and functional

RAFAŁ FRĄCZEK
Dział Analiz Technicznych
Automatic Systems Engineering Sp. z o.o.
R.Fraczek@ase.com.pl
+48 603 056 211