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Analysis and Evaluation of Safety Barriers of the Crude Oil Storage in Regional Directorate Haoud Berkaoui

HBK- Ouargla

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Dedication

I dedicate this work to myself first and then to those who endeavoured with me to complete this journey.

I dedicate the fruit of this effort to my dear mother who carried me, protected me, gave me life and surrounded me with her tenderness, my dear mother who made sure to teach me with her patience and sacrifices for my success

and to my dear sisters, especially my younger sister Fatima who is fighting malignant cancer, I ask God for a speedy recovery for her and all patients

and also to everyone who contributed from near or far, I say thank you very much.

Mabed abd elwahab

Dedication

I Dedicate this work to **my dear Mother**. The depths of my heart I dedicate this achievement to you today and I give you all my greetings and gratitude to you because you are my biggest support and that you gave birth to me and I am proud to have a mother like you. Words cannot praise you, **Mommy**.

You will always stay proud of your son.

I Dedicate it to my family

my brothers and my little sister.

DEHANE ISMAIL

Thanks

I thank God Almighty for allowing me to implement this project, and I extend my full thanks to our supervisor, Mr. Abdul Bari Abbas, thank you very much. ,. I extend my sincere thanks to Dr. Mohamed Mahdi Kadri, Mr. Abd

el Basset Mahboub, Mishri Al-Eid at the University of Ouargla.

Mr. Djebbar abd elkrim, Head of the Security, Safety and Environment, Benyagoub Abdelkader inspcteur HSE-Regional Directorate Haoud Berkaoui - Ouargla

We also extend our full thanks to everyone who contributed to our academic, educational and applied journey, and I wish all the best for those who are approaching graduation.

Good luck and more successes

الملخص:

مشروع نهاية التخرج يتمحور حول دراسة تطبقية في محطة فصل وتخزين النفط الخام والغاز ب حوض بركاوي ورقلة.

الغرض من دراستنا هو التعرف على مختلف حواجز الامن والسلامة وكيفية عملها

وأيضا تحليل وتقيم الحواجز الامنية بعملية تخزين النفط الخام على مستوى الخزانات بواسطة الطرق المتبعة في شركة سونطراك

وأخيرا أهم المخاطر وكيفية الوقاية منها، مع وضع إجراءات وتوصيات السلامة.

الكلمات المفتاحية: تقيم ، حواجز السلامة،خزان النفط الخام،طريقة

Abstract

The final graduation project revolves around an applied study in a crude oil and gas separation and storage station in the Houd Berkaoui-HBK- Ouargla .

The purpose of our study is to learn about the various security and safety barriers and how they work

Also, analyzing and evaluating the security barriers in the process of storing crude oil at the tank level using the methods used by Sonatrach.

Finally, the most important risks and how to prevent them, along with setting safety procedures and recommendations.

Keywords: evaluation, safety barriers, crude oil tank, method

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Abbreviation :

ADD: arbre de défaillance

ADC : arbre des causes

ADE : arbre des événements

AFNOR : Association Française de Normalisation

ALARP : le plus raisonnablement possible

AMDEC : Analyse des modes de défaillance de leurs effets et de leur criticité

AMDE : les modes de défaillance de leurs effets

APR : analyse préliminaire des risques

ARAMIS : Risk Assessment Methodology for IndusrielS

ATM : Atmosphérique

BT : barriers technological

BTS: barriers technological safety

BU : barriers use or Operational

BLEVE : Boiling Liquid Expanding Vapor Explosion

CEA : Commissariat à l'énergie atomique et aux énergies alternatives

CEI : La Commission Electrotechnique Internationale

CEI : Communauté des États indépendants

Courbe F/N : Courbe fréquence/nombre

CUSSTR : Commission Universitaire de Sécurité et de Santé au Travail Romande

DF : Danger Flux

DP : Division Production

E : Événement

EI : Evénement initial

EIA : Événements Initiateurs externes

EII : Evénements déclencheurs internes Urgences : événement redouté

E in : Evénement indésirable

EM : Effets majeurs

ERC : Evénement redouté central

HAZOP : HAZard and OPerability

HBK : HAOUD BERKAOUI

INRS : Institut National de Recherche et de Sécurité pour la Prévention des Accidents du Travail et des Maladies Professionnelles • Santé et Sécurité au Travail.

Abbreviation

ISO : Organisation internationale de normalisation

G : Gravité

GPL : Gaz pétrole liquéfié

LOPA : Layer Of Protection Analysis

MADS : Méthodologie d'analyse des dysfonctionnements du système

MOSAR :Méthodes Organisées Analyse Systématique Risque

P : Probabilité

PB : pression de base

PDSA :(Planifier-Faire-Étudier-Agir)cycle

PFD: probability of failure on demand

PHA :International Federation of Red Cross

PH D : Phénomène dangereux

P&ID : Piping and Instrumentation Diagram

PSA :Public service announcement

QRA : Quantitative Risk Assessement

RCR : Réanimation cardio-pulmonaire /Réanimation cardio-pulmonaire

RGA: Récupération du gaz associé

RNNS: Recurrent neural networks

RRF: Risk reduction factor

Sc: Scenario

SIL: Safety Integrity Level

SIS: Safety Instrumented Systems

SST : Santé et sécurité au travail

TRC: Transport par canalisation(Pipeline transport)

TSB: Technical safety barrier

TVR :tension of vapor red

UTG: Usine de traitement de gaz(gas processing plant)

UVCE : Unconfined Vapour Cloud Explosion

General introduction

The world is currently witnessing a significant increase and high pressures on the fuel sector in general and the distribution of products in particular from high-risk sectors. Risks specific to each product. The latter increases over the course of the various receiving, operating, storage and transport operations.

Currently, the main risk likely to occur at the level of oil facilities, given the activity of the hydrocarbon sector, is fire and/or explosion, according to risk studies at the level of various Sonatrach regions in particular. The accident record also shows that accidents that occur in hydrocarbon storage areas cause major phenomena at industrial sites.

The method of studying our research, which consists of analyzing and evaluating the security barriers in crude oil storage places in the Houd Berkawi/Sonatrach Ouargla ,

Is divided into two parts:

- The first section consists of a theoretical study of the various safety barriers, their types, performance and role, and identifying methods for storing crude oil, as well as methods for evaluating the quality and effectiveness of these barriers.
- *The second section consists of an applied study in the storage and separation station for gas and oil Analyze and evaluate the most important risks that threaten the storage process and develop some accident scenarios using the risk analysis method*
  - ✓ **Methodology for evaluating technical safety barriers by the INERIS**
  - ✓ **ADD: fault tree**
  - ✓ **ADE: event tree**

Problematic;

We also notice today that the whole world is moving towards burning and exploiting fossil energy

- What is the fuel storage process?
- What are the different risks they are likely to cause?

To protect against these risks and disasters, security and safety barriers are put in place

- What are these barriers and how can they be evaluated?

Chapter I: Conceptual study safety barriers and *Crude Oil Storage*

Chapter I: Conceptual study Safety barriers and Crude Oil Storage

Introduction :

The means to be implemented to reduce risks are numerous and varied. The design of the process and the choice of equipment primarily contribute to risk reduction.

Currently, industries are expected to put in place risk management and control strategies, these can only be achieved if there is a considerable deployment of efforts in risk management and analysis which has aimed at identifying accident scenarios that could occur on an installation. The frequency of occurrence of the different initiating events is estimated and all of the safety barriers likely to reduce the occurrence and/or the consequences of the scenarios are listed.

The barrier approach consists of verifying, on the basis of certain criteria, whether safety barriers can be retained for the scenario studied. The combination of the frequency of occurrence of the initiating event and the confidence levels of the safety barriers making it possible to control the same scenario and makes it possible to estimate a class of probability of occurrence of the scenario.

1 Analysis and evaluation of safety barriers in *Crude Oil Storage*

1.1 Definition and overview :

One of the main events triggering escalation is primary fire (Landucci et al., 2015). For this reason, the study focuses on technical safety barriers related to fire scenarios.

Barriers used to prevent escalation in process plants can be divided in active barriers, passive barriers, and human actions (Hourtolou and Bernuchon, 2004). Active barriers require a sequence of detection, diagnosis, decision, and action. The sequence is performed by a detection system, a logic solver or an electro-mechanical device, and a mechanical or instrumented system – or alternatively a human (Hourtolou and Bernuchon, 2004).

The main scopes of active fire protection systems are (Landucci et al., 2015):

- To mitigate fire exposure of targets that could be equipment or structures. It can be done keeping a water film on exposed surfaces to cool them and absorb radiant heat to prevent material loss of strength.
- To isolate and empty the target vessel, reducing the potential loss and consequent damages due to the release of inventory in undesirable locations.

- Control of the primary fire and prevention of fire spread in nearby units.
- On the basis of these scopes, active fire protection systems can be divided in two categories (Landucci et al., 2015):

a. Systems for the delivery of fire-fighting agents such as water or foam. They can be fixed, semi-fixed, mobile and portable systems.

b. Emergency Shutdown (ESD) Systems and Blowdown (BD).

The most common way to deliver fire-fighting agents (usually simply water or water with some additives) is by means of the deluge system. The effect of this barrier system is multiple. It can reduce the likelihood of escalation by controlling fires dimensions, providing cooling of equipment near the fire, and reducing consequences of a gas explosion if activated before the ignition (van Wingerden, 2000). The deluge system can be used to cover a whole process area providing non-specific coverage of pipe work and equipment; It can protect a specified equipment or structural elements providing a dedicated coverage, or it can be used to form a water curtain that can reduce thermal radiation and control smoke and dangerous gasses dispersion.

in the event of a leakage (NORSOK, 2008). ESD valves are actuated valves which are closed The purpose of the ESD system is to prevent escalation of abnormal conditions into a major hazardous event and to limit the extent and duration of any such event that may occur. To perform this safety function, ESD valves shall isolate and sectionalize the installations in a fast and reliable manner, in order to reduce the total amount of released hydrocarbons when triggered by a signal during emergency conditions. ESD can also command the execution of other automatic actions, for instance main power generator shut down and possible ignition sources isolation (NORSOK, 2008), in order to avoid more severe consequences.

The BD drains liquid from the vessels by opening a certain number of blowdown valves (BDVs). Its main purposes are (NORSOK, 2008):

- In the event of a fire, to reduce the pressure in process segments, reducing the risk of rupture and escalation;
- to reduce the leak rate and leak duration and thereby ignition probability;
- In some cases, to avoid leakage at process upsets;
- to route gases from atmospheric vent lines.

The BD is considered the primary means of protection and its intervention time should be reduced as much as possible to limit the need for passive fire protection.

Natural and mechanical ventilation can also be considered a preventing fire escalation measure

(NORSOK, 2008). In fact, it dilutes flammable gas concentrations and reduces the size of flammable gas clouds. In case of fire, it dilutes harmful concentration of smoke and toxic gasses, ensuring acceptable environment for evacuation or intervention. Natural ventilation can be considered a passive protection. On the contrary, mechanical ventilation is an active measure as it is activated by engines triggered by fire and gas detection.

In offshore platforms also passive barriers have a key role in preventing escalation due to fire. In particular we can mention passive fire protection (PFP) system. For instance, the objective of passive fire protection is to reduce heat transfer to equipment, structures, and enclosures, while limiting escalation (ISO, 2015). Fire division is used to avoid that fire and explosion escalade into surrounding areas. Fire divisions are made by fire walls and blast walls, ensuring that thermal effects, propagation of fire and explosion overpressure are prevented. Critical structures, piping and equipment components shall have adequate fire resistance with regard to load bearing properties, integrity and insulation properties during a dimensioning fire and contribute in reducing consequences in general (NORSOK, 2008). Containment basins can be al

1.2 Identify Analysis and Evolution of safety barriers :

1.2.1 Analysis:

Consists in the intellectual action of decomposing a whole into different parts in order to study it, to examine it, or to explain the relations that they maintain with each other. It is a method, a reasoning process that goes from complex to simple, from consequences to principles, from facts to causes and/or laws. In this sense, the analysis precedes the synthesis and evaluation.

1.2.2 Safety barriers :

This security bar is a physical device or material misplaced to prevent accidents, injuries or damaged materials. It can be used to protect the danger zones, protect people and protect against dangerous substances, or limit the exposure to substances.

It follows the standard **NS-EN ISO 13702 (ISO: 13702, 1999)** The definition of a barrier is “Elements techniques, operations and organizations that are individually used collectively to prevent the possibility / error, a danger or a specific accident. occur, or limit its damage / inconvenience. From the point of view of **Sklet** (**Sklet, 2005**), the definition of the following: “The security barriers are the physical and/or other physical ones intended to prevent, control or expect unwanted events or accidents.” Previously**, Nijs Jan Duijm** (**Duijm, 2009**) the definition such as "A security barricade is a series of elements that require a function of the barricade, which causes an element that consists of a technical system or a human action." These definitions indicate that the security bar is a device (technique, organization and/or human) that is not in place in a system having to remove the object or remove the system risks.

1.2.3 Types of safety barriers:

- **Physical barriers :** These are the most common barriers and include items such as fences, gates, guardrails, warning signs and access control systems. They are used to prevent access to dangerous areas, such as construction sites, areas of moving machinery or high traffic areas.
- **Light barriers :** These barriers are less visible than physical barriers and include elements such as safety procedures, training, signage, and personal protective equipment (PPE). They are used to raise awareness of potential dangers, promote safe behavior and protect people from dangers that cannot be avoided by physical barriers.

1.2.4 Examples of use of safety barriers:

- **In industry:** Safety barriers are used to protect workers from dangerous machinery, dangerous chemicals and falls from height.
- **In transportation**: Safety barriers are used to protect pedestrians and motorists from traffic, falling vehicles, and other road hazards.
- **In buildings:** Safety barriers are used to protect people from falls from heights, slips and trips, and fires.
- **In homes:** Safety gates are used to protect children from potential hazards in the home, such as stairs, swimming pools and household chemicals.

1.2.5 Importance of safety barriers:

Safety barriers play an essential role in preventing accidents and protecting people and property. By identifying and implementing appropriate safety barriers, businesses, organizations and individuals can significantly reduce the risk of accidents and injuries. **(§1.2)**

1.2.6 Barrier system:

As we saw in the 2nd chapter, the system is a set of elements brought together to achieve a well-defined objective, for this the barrier system is according to Sklet **(Sklet, 2005): "A barrier system is a system which has summer**

Contribution to improving safety barriers in an industrial system

Designed and implemented to perform one or more barrier functions." **However, Hollnagel (Hollnagel, 1999) sees that "**the barrier system can be defined as the substrate or foundation of the barrier function". Then, the barrier system includes a description of the realization of the barrier function. The barrier system may consist of a set of elements and/or systems. These may include physical and technical components (hardware and software), human operational activities, or a combination of these.

1.2.7 Classification related to safety barriers:

Safety barriers are classified according to several criteria, these criteria can be: the origin of the barrier, the destination of the barrier, the location of the barrier, the barrier systems and finally the barrier functions **(Hollnagel, 2016)**.

In this work we are interested in the last two classifications, namely:

- The function of the barriers
- The barrier system

1.2.8 Classification of barriers according to functions:

Generally speaking, safety barriers do not have the same functions, so the function of the barrier can be changed, by changing its position in the system.

The most important functions can be listed as follows:

- Detection barriers: These barriers are intended to detect accidents or injuries when they occur and to trigger an alarm or other corrective action. They include items such as smoke detectors, fall detectors and emergency stop systems.
- Prevention barriers: These barriers aim to prevent accidents and injuries from happening in the first place. They include items such as machine guards, locking systems and safety devices.
- Monitoring: it ensures the proper functioning of parts of the system; it can be human or technical;

- Protective barriers: These barriers aim to protect people and property from damage in the event of an accident or injury. They include items such as airbags, seat belts and protective clothing.
- Organizational: Organization is an extremely important starting point for any job.

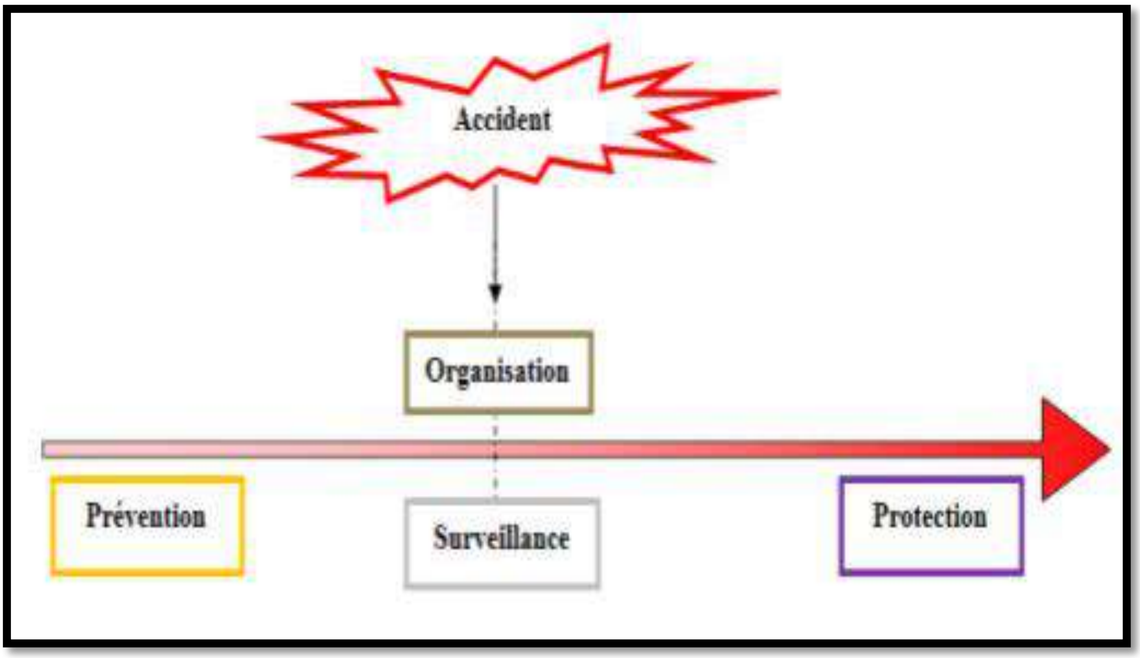


Figure I.1 : The functions of safety barriers

1.2.9 Different types of barriers:

In the context of EDD, safety barriers must correspond to one of the three categories as defined in the **INERIS OMEGA 10 guide [2008]**:

- Technical Safety Barriers (BTS): On the one hand, are made up of a safety device and on the other hand of an instrumented safety system (SIS) which opposes the chain of likely events to lead to an accident.
- Organizational Safety Barriers (BOS): Are made up of a human activity (operation) which opposes the chain of events likely to lead to an accident.
- Safety Manual Action Systems (SAMS): Combination of the two previous types of barriers (BTS and BOS)

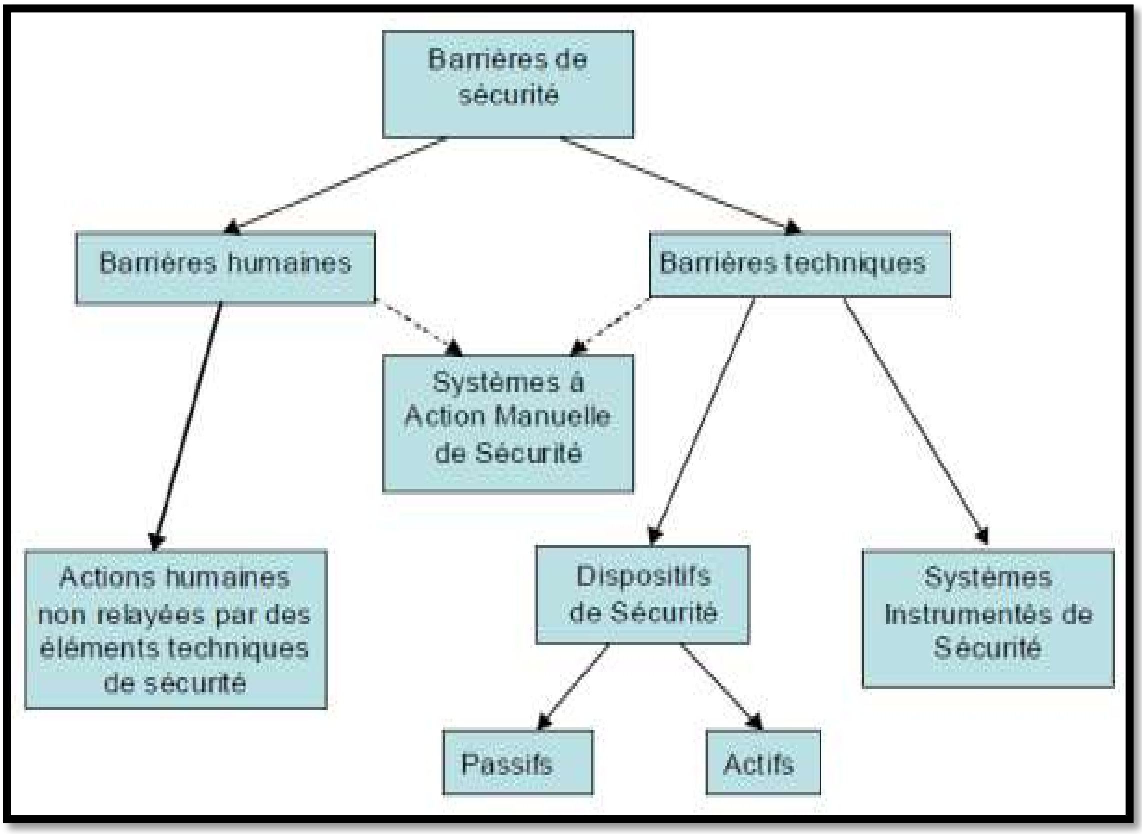


Figure I.2- Typology of safety barriers [INNERIS DRA 77, 2009]

1.2.9.1 Technical Safety barriers:

This is a set of technical elements necessary and sufficient to ensure a security function, they are also called **Risk Control Measures (MMR)**, they can be of very different nature. These may be safety devices or **safety instrumented systems (SIS)**.

1.2.9.2 Human Safety Barrier (BHS):

Dianous and Fièvez considered this type of barrier as "humanity" (De Dianous & Fiévez, 2006) and described this barrier as follows: "The effectiveness of these barriers is based on the operator's knowledge regarding

Reach the goal. Human actions are interpreted broadly, including the senses, communication, thought, physical activity, as well as rules, guidance, and safety principles. These actions are also considered part of the detection, diagnosis and treatment sequence. Human boundaries are described by Bourareche et al. For example: "They are made up of human actions and procedures which do not use technical safety barriers in order to prevent an accident from occurring" (Bourareche et al., 2011). According to Lauridsen, these are: "the actions and activities in which employees must participate in order to achieve a barrier function" (Lauridsen et al., 2016).

The human security barrier (also called physical or technical) includes all human efforts to prevent, protect or control a threat. (§11)

1.2.9.3 Security devices :

Safety devices are unitary, autonomous elements, intended to fulfill a safety function in its entirety.

These devices can be classified into two categories:

- Passive devices do not involve any mechanical system to fulfill their function. In this category we find in particular retention basins (figure 1.3), rupture discs, flame arresters as well as fire walls, etc.

Figure I.3 – Retention Bowl

- The active dispositifs are available in mechanical dispositifs (ressorts,…). On retrouve notation in this category of decharge soups (figure 1.4) and other clapets of debit.

Figure I4. – Safety valve

1.2.9.4 Safety Instrumented Systems (SIS):

play an essential role in the prevention systems of industrial installations. It is crucial to define safety functions, design, maintain and modify systems in a way that ensures the availability and reliability of the safety function under all circumstances.

- The standard [IEC-61511, 2000] for process industries provides comprehensive guidelines on best practices for SIS management.
- The standard [IEC-61511, 2000] defines safety instrumented systems as follows: “Instrumented system used to implement one or more safety instrumented functions (SIF)”
- The standard [IEC-61508, 2000], Safety operation of safety-related electrical/electronic/programmable systems. (§12.13.14)

A/ Definition and Role of a (SIS):

Safety instrumented systems (SIS) are made up of trios of sensors-processors-actuators intended to perform safety tasks. The system requires an external power source to start its components and perform its protective function. The objective of the system is to place the process in a safe state, i.e. a failure mode towards a real risk situation such as an explosion or fire, which can be maintained stably without adverse effects on people, property or the environment. (§15)

B/ Composition of an SIS:

SISs are made up of different unit elements linked together by means of transmission.

At a minimum, there is a sensor, a processing unit and an actuator in series.

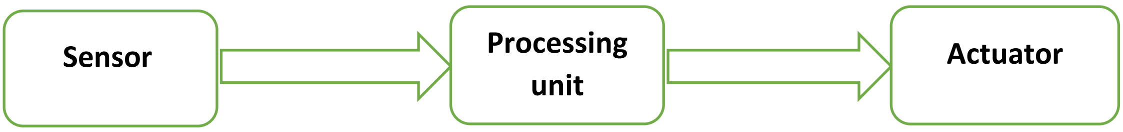


Figure I.5. – Diagram of a simple SIS (§5)

- **A sensor:** is a device that converts a physical quantity (such as temperature, pressure or light) into a measurable electrical signal (§5).

- **Processing Unit:** The processing function can vary in complexity. It may be limited to collecting a measurement from a sensor and displaying it. It can also involve activating the control of one or more actuators based on a combination of data provided by various sensors (§5).
- **Actuators:** Actuators, such as valves, motors or servomotors, have the ability to convert an electrical or pneumatic signal into a physical phenomenon that allows controlling the starting of a pump, the closing or opening of a pump. a valve, for example. Depending on the type of energy used, we distinguish between pneumatic, hydraulic or electric actuators (§5).
- **Finally, the connection** between the processing unit and the sensors as well as the actuators is ensured by means of transmission such as electric, pneumatic, hydraulic, etc.

1.2.10 Classification of barrier systems:

Regarding the categorization of barrier systems, no agreement has been found. Consequently, a security border can be a physical barrier or a mixture of human or administrative components (**De Dianous & Fiévez, 2006**). In 1980, W. JOHNSON proposed that physical or non-physical barriers be classified as such (Johnson, 1980). Kecklund et al. proposed that classification should be both technical and human (Kecklund et al. 1996). Other classifications have been maintained in the literature (Sklet, 2006).

The following table (table I.1) summarizes the most important stations according to this classification.

Tableau I.1 : Different classifications of the barrier system

Barrière matérielle		Barrière non- matériel		Références	Année
physique		Non-physique		(Johnson,1980	1980
physique	technique	facteur humain /organisationnel		(Svenson, 1991)	1991
technique		Humain /organisationnel	Humain	(Kecklund et al., 1996)	1996
Défense dure		Défense souple		(JamesReason, 2016) 1997	1997
physique	technique	administrative		(Wahlstrom & Gunsell,1998)	1998
technique		organisationne	opérationnel	(Bento, 2003)	2003
Matériel		comportemental		(Hale, 2003)	2003
Passive	active	symbolique	Action humaine	(De Dianous & Fiévez, 2006)	2006
physique	fonctionnel	symbolique	incorporelle	(Hollnagel, 2008)	2008
technologique		Organisation	Personnel	(Kang et2016)	2016
Matériel		Humain /organisationnel		(Grattan,2018)	2018

1.3 Crude Oil Storage

1.3.1 Definition Crude Oil Storage:

A crude storage bin is a tank used to store crude oil before transport to a refinery or sale. It can be of different shapes and sizes, but the most common are horizontal or vertical cylindrical tanks.

Crude storage bins are typically made of steel, but some can be made of concrete or composite materials. They must be designed to withstand the stresses imposed by crude oil, which is a heavy and flammable liquid. (§16)

1.3.2 the reason to stock Crude Oil :

The stock of the brut is a crucial rôle in the petroleum industry and gas, and to ensure the fluidity of operations and to contribute to the stability of operations.

- The availability of the offer and the demand are essential in the petrolière industry.
- The production of petroleum buds can produce fluctuations in various factors such as mechanical conditions, geopolitical events and demand fluctuations. The excess petroleum stock contains the available demand periods and a liberation on the market pens the forte demand periods to allow for stable price maintenance and to remove the pénuries or excess surplus items.

- The petroleum gas strategies are crucial to ensuring security.
- Energy and prevent economic crises. The gouvernements and the main petroleum enterprises that serve to protect against the powerful perturbations of the application, tell the geopolitical conflits or the natural catastrophes. These strategic reserves have a basic value in the protection against external problems and ensure stability in the petroleum application.
- The storage of petroleum duct facilitates the transportation and distribution of this city Ressource précieuse. The petroleum jelly can be transported over long distances by children, navies or campsites. In stock of the petroleum brut in the endroits strategies on the long transport routes, to facilitate the distribution of the petroleum brut to raffineries and aux consommateurs finaux. This allows you to remove the transportation costs and optimize the petroleum application logistics, ensuring an efficient distribution and a viable economy.
- In case of urgency, it is crucial to provide a suitable application in the air. Cela
- Apply to protect your face, close-up pannes or natural catastrophes. The reserves of stored breasts may be used in order to protect the security générateurs and maintain the critical operations in case of perturbation of the normal application.
- The production of raffineries is based on an essential aspect. for High-efficiency function, the raffineries on the screen always appear. The stock of the brut à proximité of the affineries allows for the adjustment of the application and the production interruptions. This will guarantee a fluid function and continue the raffinage operations. (§17.18.19)

1.3.3 Classification of crude storage bins:

Crude storage tanks are classified based on several criteria, including:

1.3.3.1 Roof type:

a/ Floating roof: Rests on the surface of the crude oil, reduces vapor emissions and minimizes fire risks.

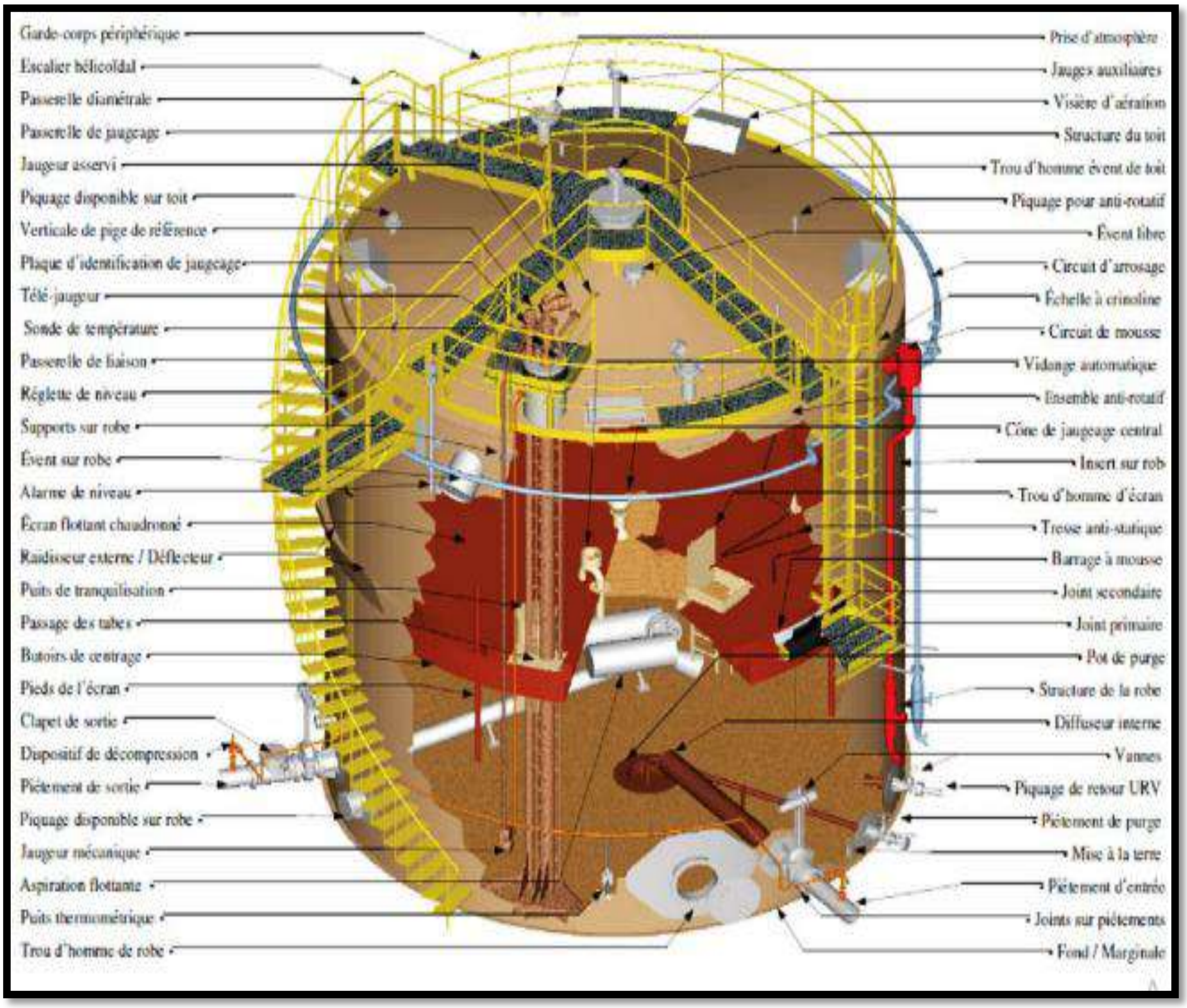


Figure I.6 : Internal floating screen tank. (§23)

b/ Fixed roof: Fixed to the tank structure, can be flat or conical, less effective in reducing vapor emissions than the floating roof, but generally less expensive to construct.

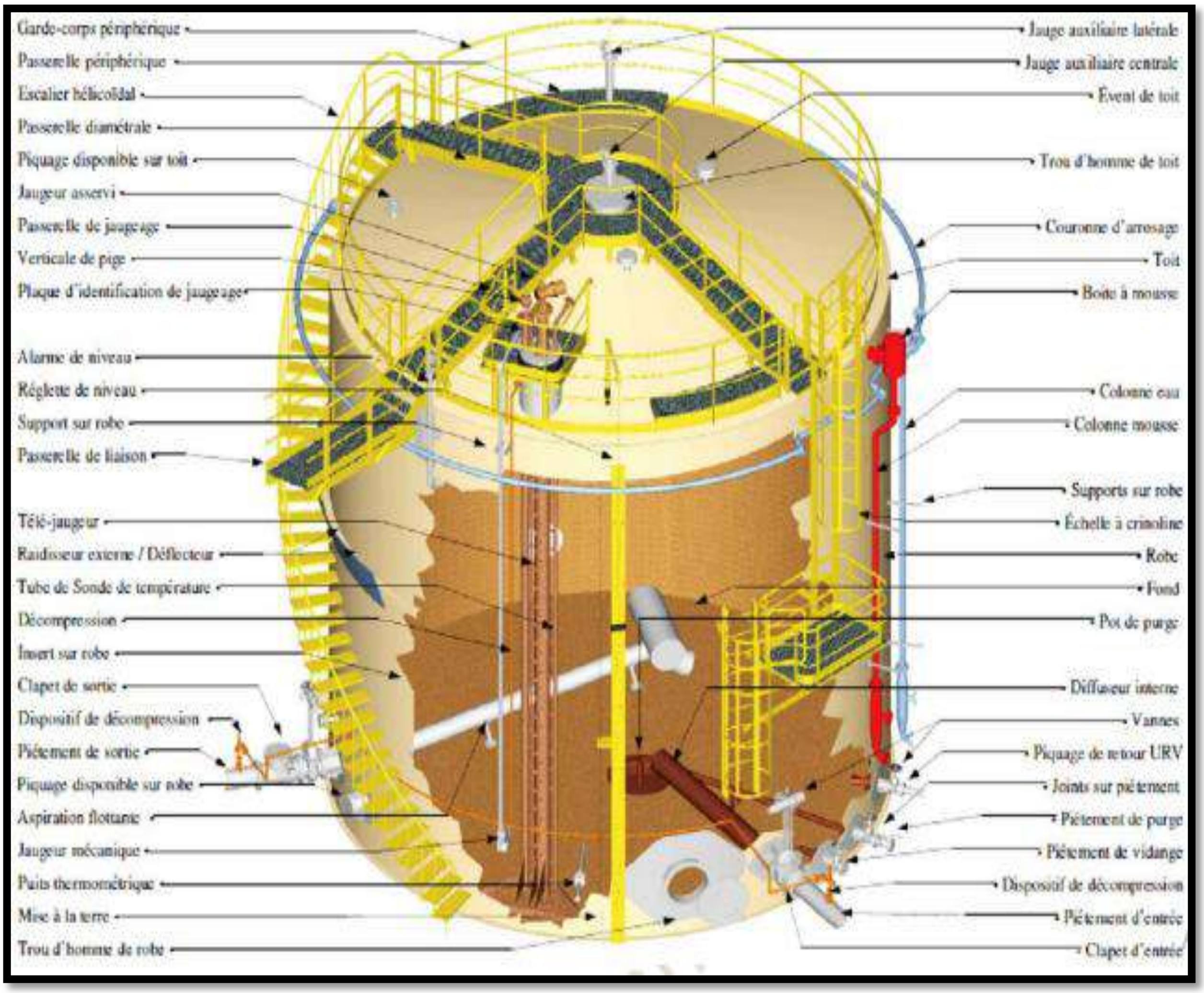


Figure I.7: Tank with fixed roof (§23)

1.3.3.2 Storage pressure:

- Storage at atmospheric pressure: The tanks store the crude oil at ambient pressure.

- Pressure storage: Tanks keep crude oil under pressure, which reduces the amount of steam and improves safety.

1.3.3.3 Building material :

- Steel: Steel is often used to make crude oil storage bins because of its strength, durability and affordability.

- Concrete: Large capacity tanks are generally constructed of concrete because it is a more economical option than steel for large sizes.

- Composites: Composite materials, such as fiberglass or fiber-reinforced plastic, may be chosen for crude storage tanks due to their lightweight, corrosion resistance and thermal insulation ability.

1.3.3.4/Ability :

- Small tanks: Small tanks can store up to 10,000 barrels.
- Medium-sized tanks: Medium-sized tanks can store between 10,000 and 100,000 barrels.
- Large tanks: Large tanks can store more than 100,000 barrels.

1.3.3.5 Utilization :

Production storage: These tanks are used to store produced crude before transportation to a refinery.

Transit storage: These tanks are used to store crude oil while it is being transported from one place to another.

Strategic storage: These tanks are used to store crude reserves for energy security reasons.

1.3.4 Standards and regulations:

The rules and laws that govern the construction and operation of crude oil storage tanks are designed to ensure safety and environmental preservation. These regulations may differ depending on countries and regions. (20.21.22)

Depending on the material used for their construction:

In general, in the oil industry, steel storage bins are used, the choice of steel depends on three factors which are:

- The mechanical resistance of steel.
- Corrosion resistance.
- Working conditions (pressure and depression).

But we also find other construction materials such as:

- Steel storage bins.
- Reinforced concrete storage bins.
- Storage bins made of flexible materials.

Depending on their operation:

- Fixed storage bins;

- Mobile storage bins;
- Semi-fixed storage bins.

Depending on their position relative to ground level:

- Overhead storage bins;
- Semi-buried storage bins;
- Underground storage bins.

Storage Bin Types:

The types of storage bins to be used depend on the nature of the product to be stored. Certain products must be stored under pressure (liquefied gases) and require very resistant storage bins (spherical); others are stored under medium pressure (oil, gasoline) or at zero pressure.

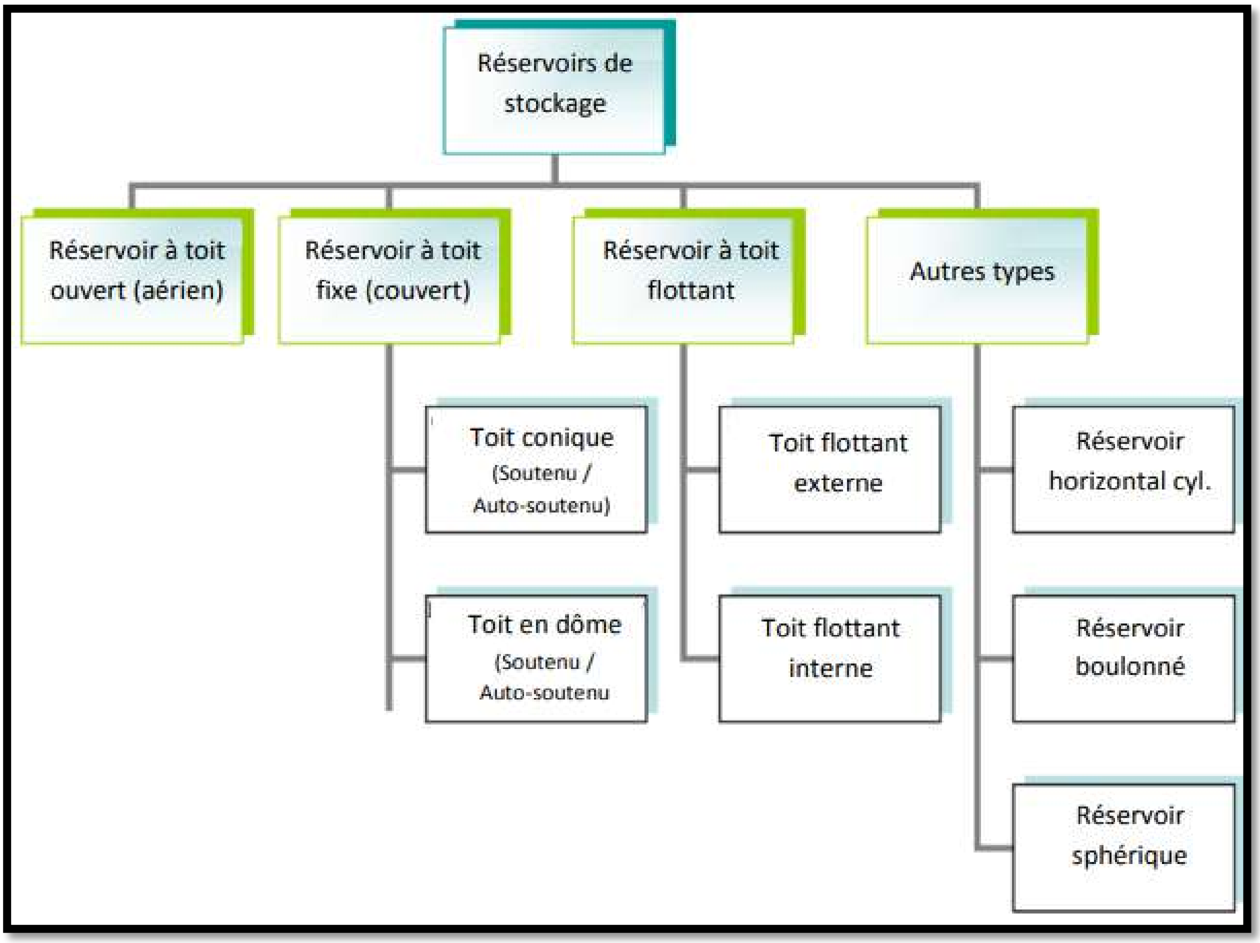


Figure I.8 : Types of hydrocarbon storage tanks. (23)

1.3.5 Devices and accessories:

1.3.5.1 Devices to combat overpressure:

- Vents: these are permanent openings placed in the upper part of the tank to evacuate excess hydrocarbon vapors in hot weather.

- Valves: these are automatic mechanisms that release excess steam once the pressure of the gas phase inside the tank reaches a limit or critical value. This pressure is called set pressure.

1.3.5.2 Safety accessories:

(a) Safety valves: Their purpose is to protect the tank against excess pressure and depression. There are two (02) in number. The safety valve for the annular zone is between the (floating) roof and the skirt, and the automatic relief valve.

(b) NH and NB alarm devices: These emit an audible signal as soon as the product reaches its high level (NH) and low level (NB).

(c) The retention basin: It is designed to collect 75% of the contents of the tank in the event of leaks. Bowls containing multiple tanks must be divided into compartments, the number being determined based on the total capacity of the tanks.

(d) The fire network: This is equipped with water pipes and foam delivered under pressure by a system of pumps.

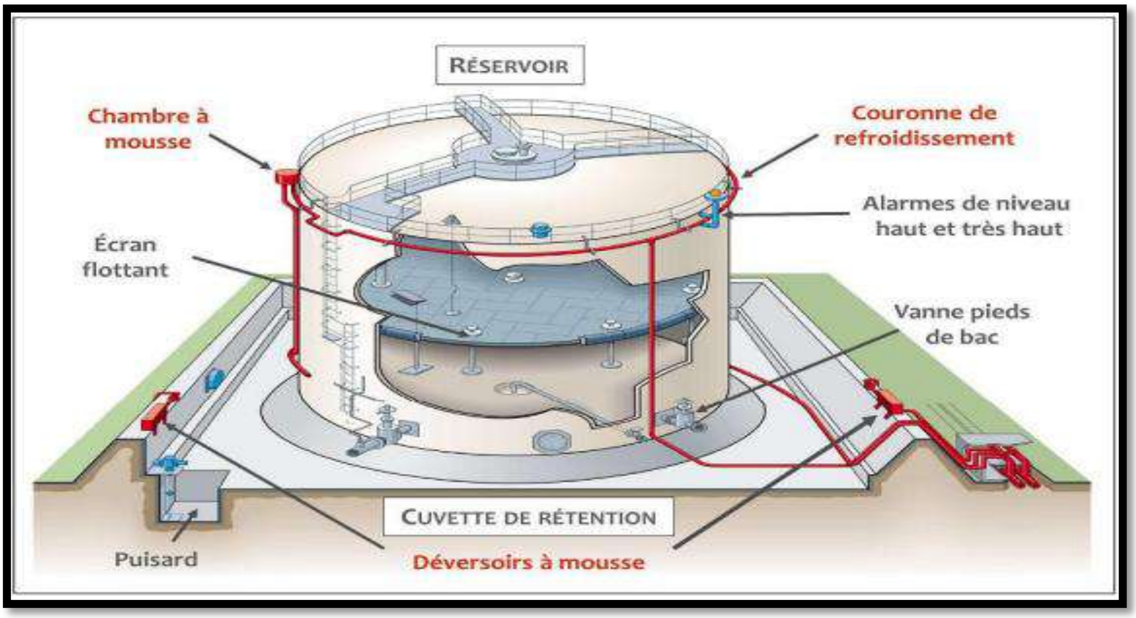


Figure I.9 : Firefighting Safety Accessories.

1.3.5.3 Corrosion protection accessories:

a. Passive protection of the tank is done by applying a layer of paint accompanied by cathodic protection by anode.
b. External protection of the tank is obtained by drawing off the current.
c. The interior surface of the bottom of the tank is not protected by cathode, but a layer of epoxy resin is provided against internal corrosion due to the chemical composition of the stored product such as the salt and sulfur content.

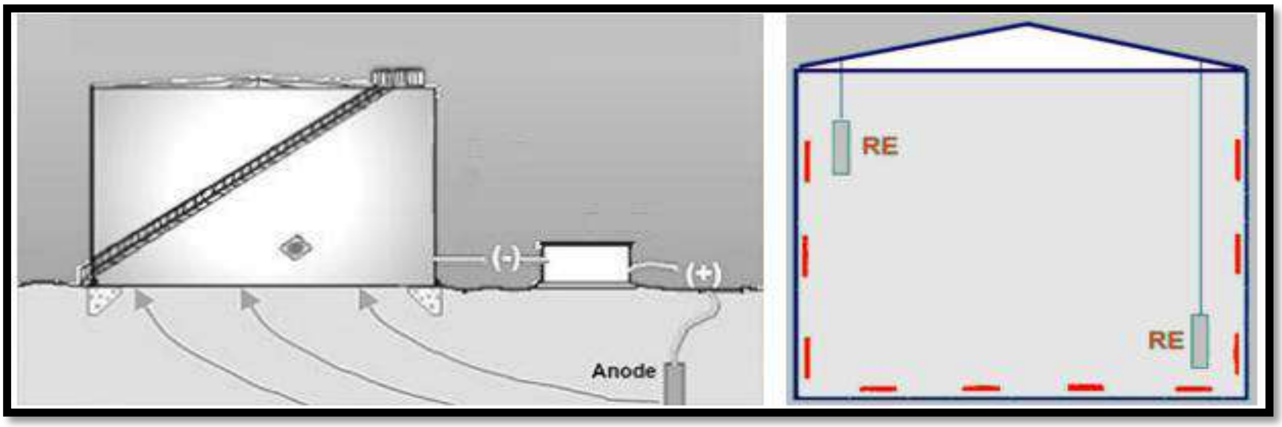


Figure I.10 : protection of tanks against corrosion.(23)

1.3.5.4 Safety devices for crude storage bins:

Crude storage tank safety features are of paramount importance to avoid serious incidents such as leaks and fires. These reservoirs, which contain crude oil, are equipped with sophisticated systems to protect the environment and the economy from the disastrous consequences that could arise from such events.

Security devices are divided into two main categories:

a. Leak prevention systems:

- Secondary containment walls: A containment tank or dike surrounds the main tank in order to retain the crude in the event of a leak or rupture.

- Leak detection systems: Sensors continuously monitor the integrity of the tank and piping system to detect even the smallest leaks.

- Emergency shut-off valves: Automatic or manual valves allow you to quickly isolate the tank and interrupt the flow of crude in the event of a problem.

- Drainage systems: Pipes collect and evacuate potential leaks to appropriate treatment or storage areas.

b. Fire prevention systems:

- Extinguishing foam: Automated foam systems can flood the tank and extinguish a fire by depriving the fire of its oxygen.

- Sprinklers: Automatic sprinklers diffuse water or foam to cool the tank and protect surrounding structures.

- Gas detectors: Sensors monitor the atmosphere around the tank to detect flammable vapors and alert operators.

- Lightning rods: Lightning protection devices deflect electrical discharges to prevent the ignition of crude vapors.

In addition to these physical safety systems, strict operating procedures and rigorous maintenance programs are essential to ensure the safety of crude oil storage tanks.(25.26.27)

2. Evolution of risk and safety barriers in crude oil storage

2.1 Identification of risks at the industrial centre:

Industrial zones are urban or peri-urban areas where industrial activities are grouped together. These activities include manufacturing, production, storage, and distribution of products such as chemicals, petroleum products, raw materials, finished products, waste, and construction materials. These activities can pose risks to workers, residents, and the environment. Worker risks include exposure to chemicals, fire hazards, explosion risks, injury risks, and risks related to machinery and equipment. Residents of industrial zones may also be exposed to the same risks, as well as air and noise pollution. Additionally, industrial activities can have a negative impact on the environment, such as water and soil pollution.

Machinery used in industrial zones are essential equipment for the production of goods and services. However, if these machines are not used correctly, they can pose risks to the workers using them, as well as to other workers and individuals nearby. Risks related to machinery can include injuries, occupational illnesses, property damage, and financial losses. Machines can cause serious injuries, such as amputations, fractures, burns, electric shocks, cuts, and bruises. These injuries can occur when workers use machines without proper training or without wearing appropriate personal protective equipment. Workers can also be injured when attempting to repair a faulty machine or clean it without properly locking it out or powering it down.

2.2 Risk of explosion:

A risk of explosion is the possibility of a rapid and violent chemical reaction occurring, suddenly releasing a large quantity of energy and hot gases. This explosion can cause significant damage to property, infrastructure and people in the vicinity.

Figure I.11 : Ghana's only crude oil refinery shut after explosion by News Agency On 20/06/2024 11:10 AM

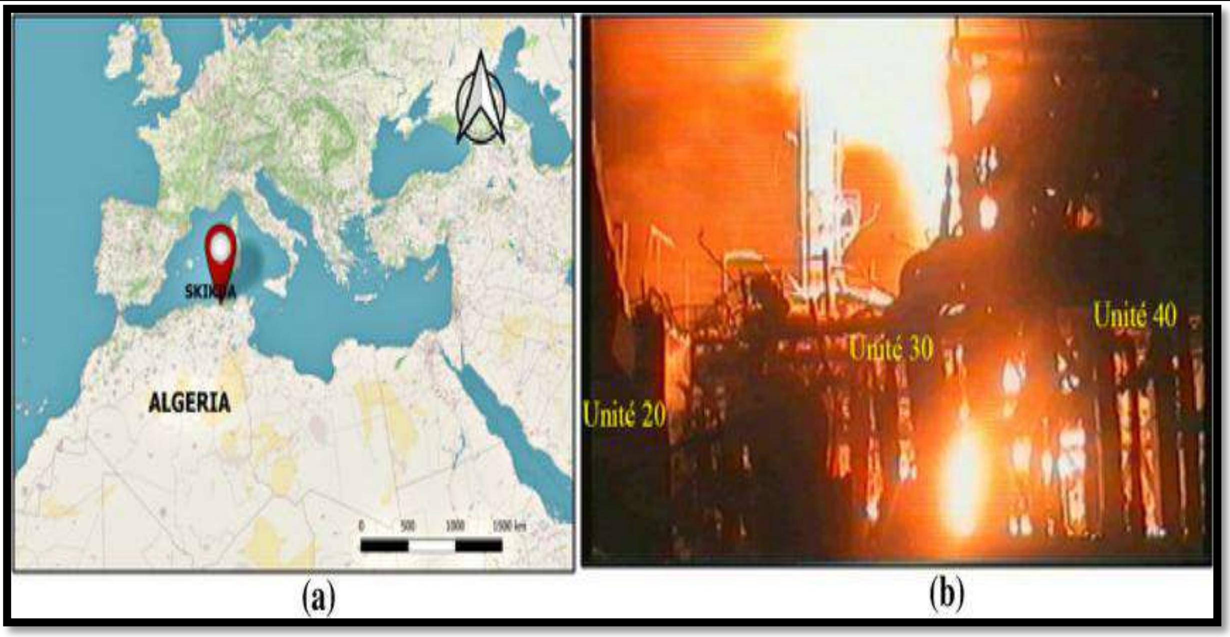


Figure I.12 : a Location of Skikda b the explosion of LNG Unit at Skikda in 2004 (Source: a Authors, by Qgis, 2021; b Civil Protection of Skikda, 2004). (§33)

Effect:

- **Deflagration and detonation:**

Deflagration is characterised by the propagation of an excess pressure of the order of a few bars per second with a suppression of the order of 4 to 10 bars (bars - 10 Pa). The explosion is even more violent, producing a shock wave travelling at more than 1000 metres per second and an overpressure of 20 to 30 bars.

- **Manifestations of explosion:**

From 0.3 bar, suppression can have adverse effects on buildings and humans, with risks of typical neurological damage, at 1 bar, and in the ear and lung ionograms. At 5 bar, suppression can be fatal. Flame penetration may be greater than the initially explosive mixture, causing a fire. Projections of all types of shrapnel cause a great deal of damage.

2.3 Fire Risks :

A fire risk refers to the possibility of an uncontrolled fire igniting and spreading, potentially causing property damage, injuries, and loss of life.

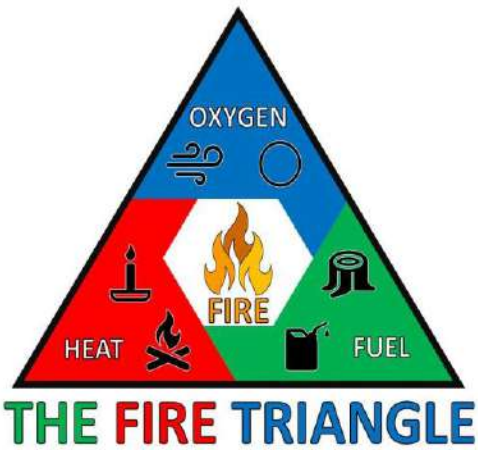


Figure I.13 : The fire triangle

2.3.1 Factors Contributing to Fire Risks:

Ignition Sources: Open flames, electrical sparks, improperly extinguished cigarettes, overheating of electrical appliances, etc.

Combustibles: Flammable materials present in the environment, such as wood, paper, fabrics, flammable liquids, etc.

Oxygen: Oxygen in the air is necessary to sustain combustion.

Chain Reaction: The combination of these three factors (ignition source, fuel, oxygen) creates a self-sustaining chemical reaction that can lead to a fire.

2.3.2 Fire Risk Prevention Strategies:

Fire prevention relies on several key principles:

Limit Ignition Sources: Maintain electrical systems, avoid smoking in hazardous areas, use electrical appliances appropriately.

Control Combustibles: Store flammable materials safely, dispose of combustible waste properly.

Public Education and Awareness: Learn fire prevention practices and how to use a fire extinguisher.

Install Smoke Detectors and Fire Extinguishers: Early detection of a fire allows for a swift response.

Develop an Emergency Evacuation Plan: Identify escape routes and have a plan in case of a fire emergency. (§28)

2.3.3 Causes of fire:

We find energy in the form of heat as a general cause, so heat sources, whether chemical, mechanical, electrical or luminous, must be seriously studied in (fire hazards in facades). Information about the thing is given according to its nature, but the causes of fire can be grouped into the following categories

2.3.3.1. Technical causes:

Thermal, mechanical, chemical, electrical and biological.

2.3.3.2. Human causes:

Carelessness, recklessness, carelessness, carelessness, indifference, disorder, indiscipline, ignorance, forgetfulness, daring, recklessness, recklessness, recklessness, recklessness, recklessness, malice, accident, frivolity, fire, and often the result of human error.

2.3.3.3. Natural causes:

➢ **Lightning:** Inflammation of a gaseous mixture on a hydrocarbon reservoir.

➢ **Sun:** Rays that penetrate window glass and ignite dust trapped in spider webs.

➢ **Spontaneous ignition:** Pal de Cotton, oxidation of pyrite, coal and fermentation.

2.3.3.4. Causes of accidents:

➢ **Causes:** Sparks caused by friction or overvoltage, metal parts in machine teeth, circuits, brackets, etc.

➢ **Chemical reactions:** Water with quicklime, grease on bottle taps, copper, acetylene and oxygen, sodium and water.

2.3.4 Consequences of the fire:

➢ **Smoking:**

In the event of a fire, and particularly with technical products (e.g. photocopiers), it is very important that vapours are released in the form of aerosols made up of fine solid and liquid particles. These micro-particles are toxic, irritating, opaque and aggressive. They are the cause of many deaths in fires.

➢ **Combustible gases:**

Emitted depending on the type and quality of combustion. These gases are hot and highly toxic (e.g. CO = colourless, odourless). These gases cause a drop in O2 in a combustion chamber. There are derivatives of chlorine, ammonia, hydrogen cyanide and nitrogen dioxide.

➢ **Heat - Flame:**

They are all the more important as combustion is rapid and the calorific value of the fuel is high. Thermal expansion over time leads to deformation and destruction of materials until the structure collapses.

2.4 Noise and vibration risk:

Noise and vibration are considered as pollution of the working environment, which may constitute a psychological or physical injury to a person.

2.4.1 Noise source:

Noise and vibration at the drilling site is generated by:

• Vibrating screens.

• Caterpillar Electric Diesel Engine (1500KVA)

• Electric slurry and auxiliary pumps

• Job site noise level reaches 90db

2.4.2 The impact of noise on the body:

Noise can cause unpleasant sensations and have a significant effect on the nervous system. The harms of noise include:

➢ **Non-auditory effects:** cardiovascular and neurological adverse effects, fatigue, stress, etc.

➢ **Auditory effects:** Causes occupational deafness, which is a permanent decrease in hearing sensitivity.

2.4.3 Electrical risks:

Electrical hazards refer to potential hazards associated with the use of electricity, which may result in serious injury, fire and property damage.

These risks occur when an individual comes into contact with an electricity source or when faulty electrical installations cause short circuits or overloads.

2.4.3.1 Risk of electrocution:

Caused by people touching live parts of the facility

The higher the voltage, the more humid the environment, the more conductive it is and the more dangerous it is to touch it.

Current voltages of 127-220V can be lethal (wet hands near metal blocks, conductive floors) and only so-called safety devices up to 3000 V are considered safe.

2.4.3.2 Current Impact:

The current impact affects two parts:

- Material.
- Workers.

About the material:

Electricity not only causes accidents for workers, but also damages equipment, and short circuits can cause serious accidents such as explosions

2.4.4 Protective measures against electrocution hazards:

2.4.4.1 Avoid direct contact with:

This protection may be obtained by:

- Panisse replaces the obstacles.
- Distance to live parts.
- Isolation of live parts.
- Use of the grounding.

2.4.4.2 Avoid indirect contact:

When the operator indirectly comes into contact with a dangerous voltage, that is, it touches the ground body which is accidentally electrified after an insulation fault. In case of danger, two protective measures must be taken at the same time. (§29)

2.5 Risk of Thunderstorms:

2.5.1What is Thunderstorms

Figure I.14 : Thunderstorms definition (§35)

Figure I.15 : Thunderstorms shocked crude oil. (§34)

2.5.2 Prevention against thunder :

To protect against lightning strikes, a ground cathode is placed connected to the roof so that high waves of electricity descend to the ground

2.6 Mechanical risks

This is a group of physical factors that can cause injury from machine tool components, parts or the mechanical action of solid materials or projected fluids.

2.6.1 Cause of accident:

a) Reasons for lack of preventive measures by operators:

- Do not use PPE.
- Relaxed monitoring and concentration.
- Failure to follow safety instructions.

b) Machine Reasons:

Elemental mass and stability (potential energy of elements that may be under the influence of gravity).

Their mass and speed (the control of the kinetic energy of the motion of the elements is not controlled.

Their potential acceleration against elastic elements (springs) or liquids or gases under pressure or vacuum.

2.6.2 Mechanical Hazard Prevention:

Intrinsic prevention and designer protection for:

- Hazards are avoided or minimized as much as possible by appropriate selection of certain design features.
- Limit exposure of people to unrealistic hazards.
- Fixed guards (core protectors, etc.) are used when access to the hazardous area is not required during normal machine operation

2.7 Risk to the environment:

Industrial activities have a negative impact on the environment due to various factors such as waste generation, air and water pollution, soil contamination, destruction of fauna and flora, and the consumption of natural resources. Industrial areas can also contribute to climate change by emitting greenhouse gases and fine particles. The most common environmental risks include:

2.7.1 Air pollution:

Air pollution is a major environmental problem that is closely linked to industrial areas. Plants, power plants and transportation emit greenhouse gases and air pollutants when burning fossil fuels, impacting air quality, human health, the ecosystem and climate. Fine particles, in particular, can penetrate deep into the lungs and cause respiratory problems such as asthma, chronic bronchitis and emphysema. In addition, air pollutants can contribute to the formation of acid rain, which can damage ecosystems and buildings.

Figure I.16 : Air pollution in Dubai and Abu Dhabi(§36)

2.7.2 Water pollution:

Industrial activities discharge chemicals into wastewater, leading to groundwater and surface water contamination, which impacts the quality of water available for human and animal use. Moreover, these industrial effluents can fuel the growth of harmful algae and bacteria. The repercussions of water pollution extend to aquatic ecosystems, causing fish mortality, habitat degradation, and a decline in water quality.

Figure I.17 : water pollution(§37)

2.8 Soil pollution:

Industrial activities can result in soil contamination due to the release of toxic chemicals, the generation of hazardous waste and the handling of potentially hazardous materials. Contaminants can include heavy metals, hydrocarbons, solvents, pesticides and other hazardous chemicals. Human health effects may include cancer, neurological disorders, fertility problems, birth defects and other health problems. In addition, soil pollution can affect terrestrial ecosystems by altering soil composition and reducing biodiversity. Plants and animals living in contaminated areas can also be exposed to toxic substances, which can affect their health and survival. Soil remediation can be an expensive and complex process that can take years or even decades to be done properly. (§30.31.32)

Figure I.18 : Soil pollution(§38)

3. Evolution safety barriers in crude oil storage by methods

3.1 Principles of some risk analysis methods

3.1.1 ADD Fault Tree:

Allows to determine the various combinations of events that generate a unique undesirable situation, whose logical diagram is realized by means of a tree structure

3.1.2 APR (Preliminary Risk Analysis):

To identify the various dangerous elements present in the system studied and to examine for each of them how they could lead to a more or less serious accidental situation, following an event initiating a potentially dangerous situation

Table I.2: Example of "APR" type table [40]

Function or System:							
1	2	3	4	5	6	7	8
N ◦	Product or Equipment	Situation of danger	cause s	consequences	Security existing	Proposals improvement	observatio n

3.1.3 ADC Consequence tree:

Provides a diagram of the set of contingencies resulting from various combinations of events. The development of the tree begins with an initiating event and progresses according to a binary logic: each event leads to identify two possible successive states, one acceptable and the other not. This approach thus provides the logical sequence of the various events likely to occur downstream of the primary event and therefore allows their evaluation.

3.1.4 AMDE and AMDEC;

- **AMDE:** consists in systematically considering, one after the other, each of the components of the studied system and analyzing the causes and effects of their potential failures
- **AMDEC**: equivalent to **AMDEC**, with the addition of the criticality of the failure mode, the estimation of which requires knowledge of the probabilities of occurrence of failures, and the gravity of their effects

Table I.3: Example of a type table AMDEC [40]

1	2	3	4	5	6	7	8	9	10	11
necessary equipment	Function are	mode of failure	failure cause	local effect	final effect	Means detection	replacement devices	P	G	Remarque

3.1.5 Hazard and Operability study (HAZOP):

Studies the influence of deviations of the various parameters governing the process analysed in relation to their nominal operating values. With the help of keywords, the imagined excesses of each parameter are systematically examined in order to highlight their causes, their consequences, the means of detection and the corrective actions

Table I.4: Example Table for HAZOP [40]

Date: Line or Equipment:								
1	2	3	4	5	6	7	8	9
N°	keyword	parameter	Causes	consequences	detection	Safeties existing	Proposals improvement	observations

3.1.6 Method Nœud de papillon:

Nœud de papillonis a tool that combines a fault tree and an event tree. It can be presented in the following form:

The central point of the bow tie, referred to here as a central feared event, is usually a loss of containment or a loss of physical integrity (decomposition). The left side of the Butterfly Node is similar to a fault tree in which the causes of this loss of containment are identified. The right-hand side of the Bow Tie is concerned with determining the consequences of this dreaded event like a tree of events. On this diagram, the safety barriers are represented in the form of vertical bars to symbolize the fact that they [39]

3.1.7 Quantitative risk assessment QRA:

QRA - Quantitative risk assessment is an analysis that has historically been used in nuclear and aeronautical industries, before being used almost systematically in the petroleum industry since the 1990s.

It is a form of detailed analysis that attempts to translate the best possible by calculation, the risks to an individual, or a group of individuals, depending on their exposure and the severity of the consequences. Regional quality procedures are risk analyses that make it possible to assess the acceptability of risks and integrate the contribution of all hazardous phenomena.

3.1.8 Layer Of Protection Analysis (LOPA):

LOPA stands for Layer Of Protection Analysis. It is a barrier-oriented method just like ARAMIS. Moreover, the first steps are quite comparable to those of the ARAMIS method, in terms of general

principles, although many differences remain in the details of the two methods. On the other hand, LOPA does not provide a cartographic representation of severity and vulnerability.

The LOPA method can be broken down into six main steps:

1. Establish criteria for selecting the scenarios to be evaluated.
2. Development of accident scenarios
3. Identification of initiating event frequencies
4. Identification of safety devices and their probability of failure on demand.
5. Risk Estimation
6. Risk assessment against acceptability criteria

LOPA does not import any predefined criteria type and thus proposes four categories of criteria:

• A criticality grid with a limit of acceptability in terms of severity and frequency;

• A purely quantitative criterion concerning the level of consequence of the scenario;

• A criterion specifying the number of independent devices necessary to consider that a scenario is sufficiently controlled;

• A cumulative risk criterion for a site or process [41]

3.1.9 Methods Organized Systemic Analysis Risk MADS/MOSAR:

The Definition and History of method MADS/ MOSAR :

The MADS MOSAR method was born from the work of **P. PERILHON** and a reflection led by the Methodology for the Analysis of Dysfunctions in Systems working group, or MADS, bringing together actors from the Atomic Energy Commission (or CEA) of Grenoble, the National Institute Superior of Nuclear Techniques (or INSTN) and the IUT Hygiene, Safety, Environment of Bordeaux. Developed in the early 1980s, it has been successfully applied in large Structures such as EDF and the CEA. The MOSAR method is an approach:

- Structured, which allows in particular, [42] through systemic analysis to take into account the interfaces between the constituent elements of the entity considered and thus to have a global view and not reductive .

- Gradual and progressive, "operating in stages with the possibility of stopping temporarily or definitively at each level" depending on the entity considered and the objectives targeted;

- Participative, because led by a multidisciplinary working group, capitalizing on the know-how and appealing to imagination and experience.

3.1.10 SIL (Safety Integrity Level)

The standards NF EN 61508 and NF EN 61511 are based on the method.

The NC is issued by SIL (Safety Integrity Level) that defines the norms

NF EN 61508 (for electrical systems, electronics and electronics)

Programs related to security) and NF EN 61511 (for systems)

Security tools for the transformation industry sector.

The concept of NC is based on all types of dispositifs.

Note that the standard NF EN 61511 relative to these instrument systems

Security concerns the security systems and equipment that are based on them.

The use of electronic technology / electronic / programmable electronic technology.

However, it is recommended in the norm that concerns the capteurs.

And the elements at the end of SIS, which means that it is technologically advanced.

According to the standards NF EN 61508 and 61511, the evaluation of the reduction factors

Risk repos on deux aspects:

• Aspect quality: the architecture defines SIL maximums;

• Aspect quantitatif: the fiability calculations allow the device to be determined

Paramètres liés à la fiabilité (Probabilité moyenne de défaillance PFD avg et aux

Instantaneous failure (PFH) that adjusts the life of SIL.

This minimum SIL is issued by several applications that do not include them.

for the SIL system.

The INERIS reacts, in the clear display in the present rapport, les

aspects qualitatifs10 . It is also possible for these characters to appear

Systems (données of relatives in the fiabilité) allow for discrepancy in the contrainte

quantitative11. This hypotheses may not be valid under certain conditions.

(Frequence of tests is valid, SFF can raise the container at one time at another time.)

A SIL rises by the architectural contrast, including dangerous defects

élevé).

Non-equivalence SIL <-> NC

The norms of all phases of the cycle in global systems

Security instruments (SIS). In consequence, it will be used as a considérer

NC donné implique un SIL donné. L'allocation of SIL a un dispositif suppose le

Respect the number of exigences complémentaires.

In contrast, the SIL from the dispositif can be connected to the NC terminal, sous réserve.

The problem is to adjust the system on the site and the conditions of the

Certification of the dispositif related to the messages that use the dispositif on the cells.

site.

3.2 Experience feedback:

Knowledge is nowadays considered as a significant source of performance improvement, but may be difficult to identify, structure, analyse and reuse properly. A possible source of knowledge is in the data and information stored in various modules of industrial information systems, like CMMS (Computerized Maintenance Management Systems) for maintenance. In that context, the main objective of this paper is to propose a framework allowing to manage and generate knowledge from information on past experiences, in order to improve the decisions related to the maintenance activity. In that purpose, we suggest an original Experience Feedback process dedicated to maintenance, allowing to capitalize on past activities by formalizing the domain knowledge and experiences using a visual knowledge representation formalism with logical foundation (Conceptual Graphs); extracting new knowledge thanks to association rules mining algorithms, using an innovative interactive approach; and interpreting and evaluating this new knowledge thanks to the reasoning operations of Conceptual Graphs. The suggested method is illustrated on a case study based on real data dealing with the maintenance of overhead cranes. [43]

3.3 The INERIS Methodology to Evaluation Security barriers:

INERIS has developed a methodology evaluation of the performance of safety barriers. This methodology takes into account, both for technical barriers than human, the specific context at the industrial site: feedback and constraints specific to the environment working practices, operational practices procedures and operator training, organization of maintenance, ergonomics of the workstation

a) Independence:

The barrier is independent of

process and/or cause of

the accident.

b) Efficiency

The barrier is sized to

ensure the expected function:

➜ sizing based on

recognized standards, return of

nothing…,

➜ sizing to constraints

specific (corrosive atmosphere, etc.),

➜ accessibility, position…

c) Response time

It is compatible with the kinetics of

phenomenon to be controlled.

It comes from feedback,

on-site tests and laboratory tests.

d) Trust level

The probability of failure of the

barrier is compatible with the objective

risk reduction.

e) Mastery over time

It is essential to assess the capacity

of the organization to maintain a

level of security over time

and to face developments

external or internal. Evaluations

organizational measures carried out by

INERIS meets this objective [46]

Conclusion:

There are many and varied methods for evaluating security and safety barriers in the oil field, including methods and programs, especially modern methods and advanced technology.

Chapter II Applied Part:

Methodology and Application Methods to evolution safety barriers inCrude oil storage

Chapter II Applied Part:

Methodology and Application Methods to evolution safety barriers in Crude oil storage

Introduction

Starting the new stage in an interlance professional master's institute and specializing in QHSE, which interests us in order to carry out an apprenticeship for me at company level in order to acquire professional experience.

I chose SONATRACH as a national company and it benefits from many positive aspects in many areas, it is also a crossroads of professional experiences from everywhere and a meeting of many work cultures due to its partnership contracts with many other national, private and foreign actors. companies...

The destination of our vision was chosen from the Internship in the Haoud Berkaoui Regional Directorate.

Thus, the report consists of presenting the company and the Regional Management and its historic district of Haoud Berkaoui. , the organizational structures and services it contains, as well as the tasks and activities assigned to me and entrusted to me as part of the internship

1- Identification of the company and establishment:

1.1 The SONATRACH company:

SONATRACH is the Algerian national company for research, production, pipeline transport, transformation and marketing of hydrocarbons and its derivatives. It also operates in other sectors such as electricity generation, new and renewable energies and seawater desalination. It operates in Algeria and throughout the world where opportunities arise. SONATRACH is divided into four activities: Upstream, Downstream, Pipeline Transport and Marketing. the Production Division (DP) is an integral part of the Upstream Activity. The production sites of the Production Division are distributed according to the following nine Regional Directorates:

- The Hassi Messaoud Regional Directorate includes the following production sites: CINA, CIS, Satellite Units, El Borma and Mesdar.
- The Regional Directorate of Rhourde Nouss to which the Directorate of the Hamra site is attached
- The Regional Directorate of Gassi Touil
- The Regional Directorate of Hassi R'Mel including the following production sites: Center, North, South, Djebel Bissa, Oued Noumer and Ait Kheir.
- The Regional Directorate of Haoud Berkaoui including the sites of Guellala and Benkehla
- The Regional Directorate of In Amenas
- The Regional Directorate of Stah
- The Regional Directorate of Tin Fouye Tabankort
- The Regional Directorate of Ohanet.

1.2 The Regional Directorate of Haoud Berkaoui:

Haoud Berkaoui's management is part of the Upstream Production Division of Sonatrach. the first oil processing center was put into operation in 1967: today there are 5 oil processing units and 1 gas processing unit.

The number of producing wells is 95, including 49 by gas lift for secondary recovery. To improve recovery capacity, we have 28 water injection wells. Each production center receives crude from various wells, stabilizes it, stores it in bins to ship it to Haoud El-Hamra.

The gas recovered from the stabilization is compressed and transported to the Guellala gas processing plant (UTG/GLA) which extracts GPL, sales gas and gas lift.

In 2010 the Haoud Berkaoui region had an oil processing capacity of 26,100m^3/d (5800T/d), 1,236,000 Sm^3/d for gas processing, 500T/d for LPG and 90T/d for condensate. The oil storage capacity is 28,300 m^3 and 3,400 m^3 for gas. including the sites of Haoud Berkaoui, Guellala, Benkahla, Guellala North-East and Drâa-Tamra. These sites bring together the following production units:

a. The HAOUD BERKAOUI oil processing center
b. The BENKAHLA oil treatment center
c. The GUELLALA Center oil treatment center
d. The GUELLALA North-East oil treatment center The DRAA-TAMRA oil treatment center As well as:

e. The GUELLALA gas treatment unit

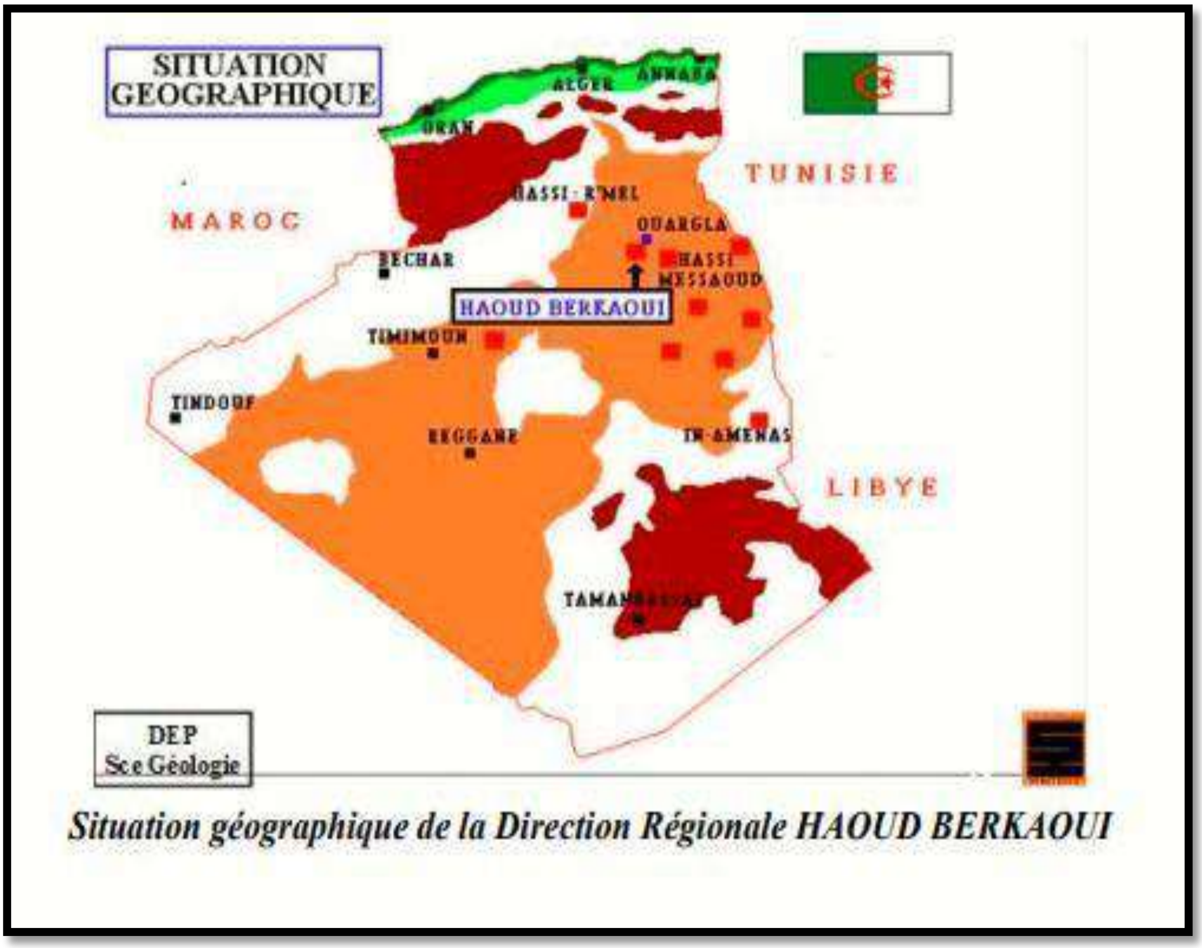
f. Boosting units (Benkahla, Guellala, Haoud Berkaoui)

g. The Haoud Berkaoui de-oiling station.

1.3 GEOGRAPHICAL SITUATION:

The Haoud Berkaoui region represents one of the ten main producing areas of Algerian hydrocarbons. It is part of the Oued Miya basin which is located in the North-East of the Algerian Sahara and whose configuration is that of a NE-SW depression. On the so-called oil road No. 49 linking Ghardaïa to Hassi Messaoud, it is located at:

- 35 km from the southwest of Ouargla.
- 100 km west of Hassi Messaoud.
- 770 km southeast of the capital Algiers.



Situation géographique de la Direction Régionale HAOUD BERKAOUI

Figure II.1 : GEOGRAPHICAL SITUATION -HBK

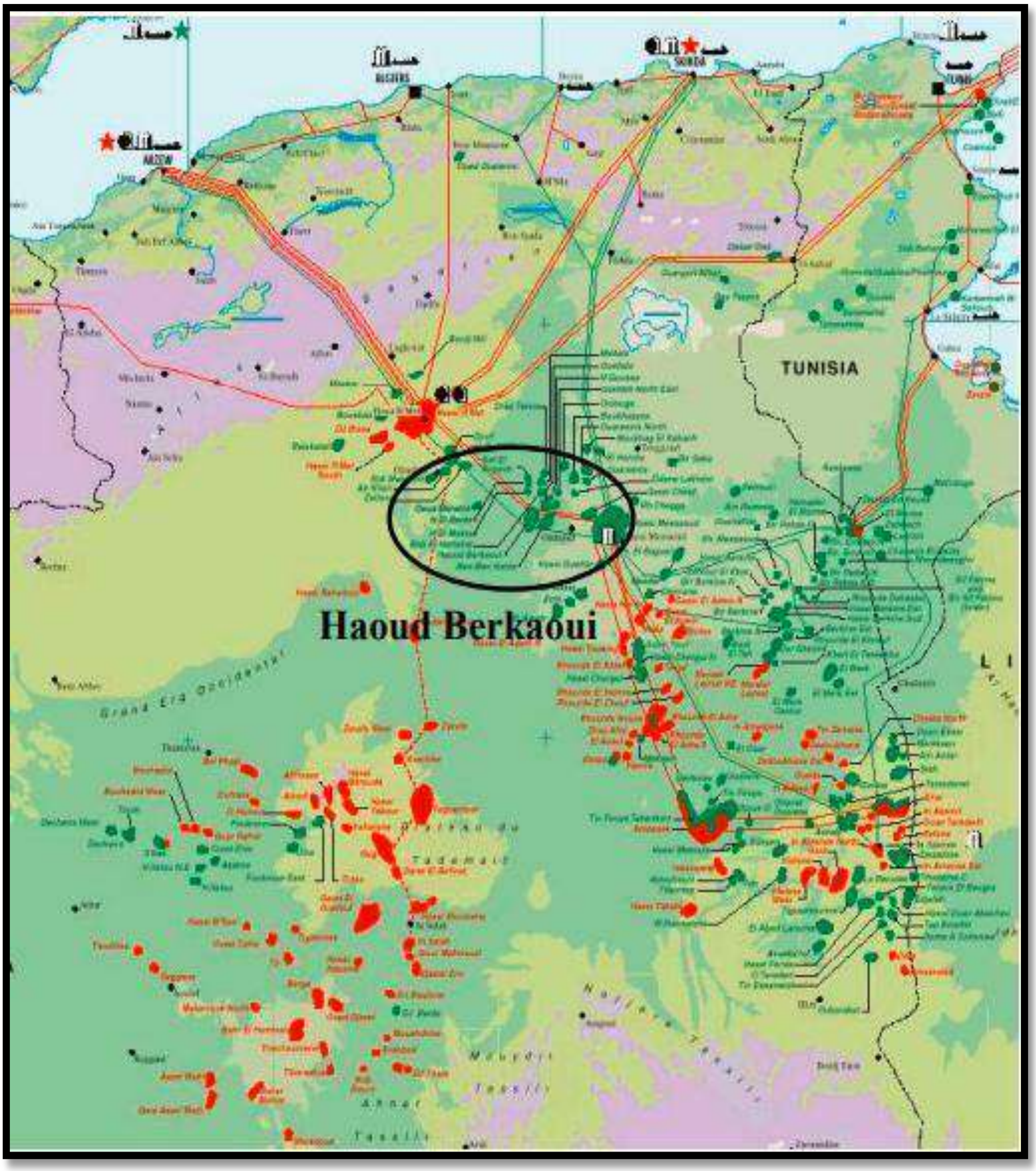


Figure II.2 : GEOGRAPHICAL SITUATION -HBK

1.4 History of the Haoud Berkaoui Region:

Table II.1 History of the Haoud Berkaoui Region:

Le tableau suivant reprend les 4 étapes de développement Haoud Berkaoui :

Etape 1
1963 : Découverte du champ oulouga par le sondage OA1
1965 : Découverte du champ HAOUD BERKAOUI par le sondage OK101 situé au sommet de la structure.
1966 : Découverte du champ de BENKAHLA par le sondage OKP 24.
1967 : Mise en service du centre de traitement huile Haoud Berkaoui composé de deux batteries de séparation, 03 bacs de stockage et 02 motopompes diesel pour l'expédition par la mise en production du premier puits (OK 101).
1970 : Extension du centre BERKAOUI pour recevoir la production de BENKAHLA.
1971 : Mise en service du centre de traitement huile Benkahla
1972 : Découverte du champ GUELLALA NORD-EST par le sondage de GLANE
1976 : Création de la région+ Mise en service du centre de traitement huile Guellala
1978 : Mise en service du centre de traitement huile Guellala Nord Est
1979 : Mise en service du centre de traitement huile Drâa Tamra
Etape 2
1981 : Démarrage station injection d'eau Haoud Berkaoui + Benkahla (11 000 m^3/j)
1993 : Mise en service de la nouvelle station injection d'eau Benkahla + Guellala
1995 : Mise en service de la nouvelle station injection d'eau Haoud Berkaoui (8000 m^3/j)
Etape 3
1992 : Mise en service des 3 stations de compression de gaz torchés dans les centres de production Haoud Berkaoui, Benkahla, et Guellala (boosting) capacité totale de compression de gaz torché = 2 379 000 Sm^3/j
1993 : Mise en service de l'unité de traitement de gaz de Guellala
Etape 4
2000 : Mise en service des 3 stations de déshuilage à Haoud Berkaoui, Benkahla et Guellala
Capacité totale = 4800 m^3/j d'eau huileuse.

1.5 General organization chart of Haoud Berkaoui:

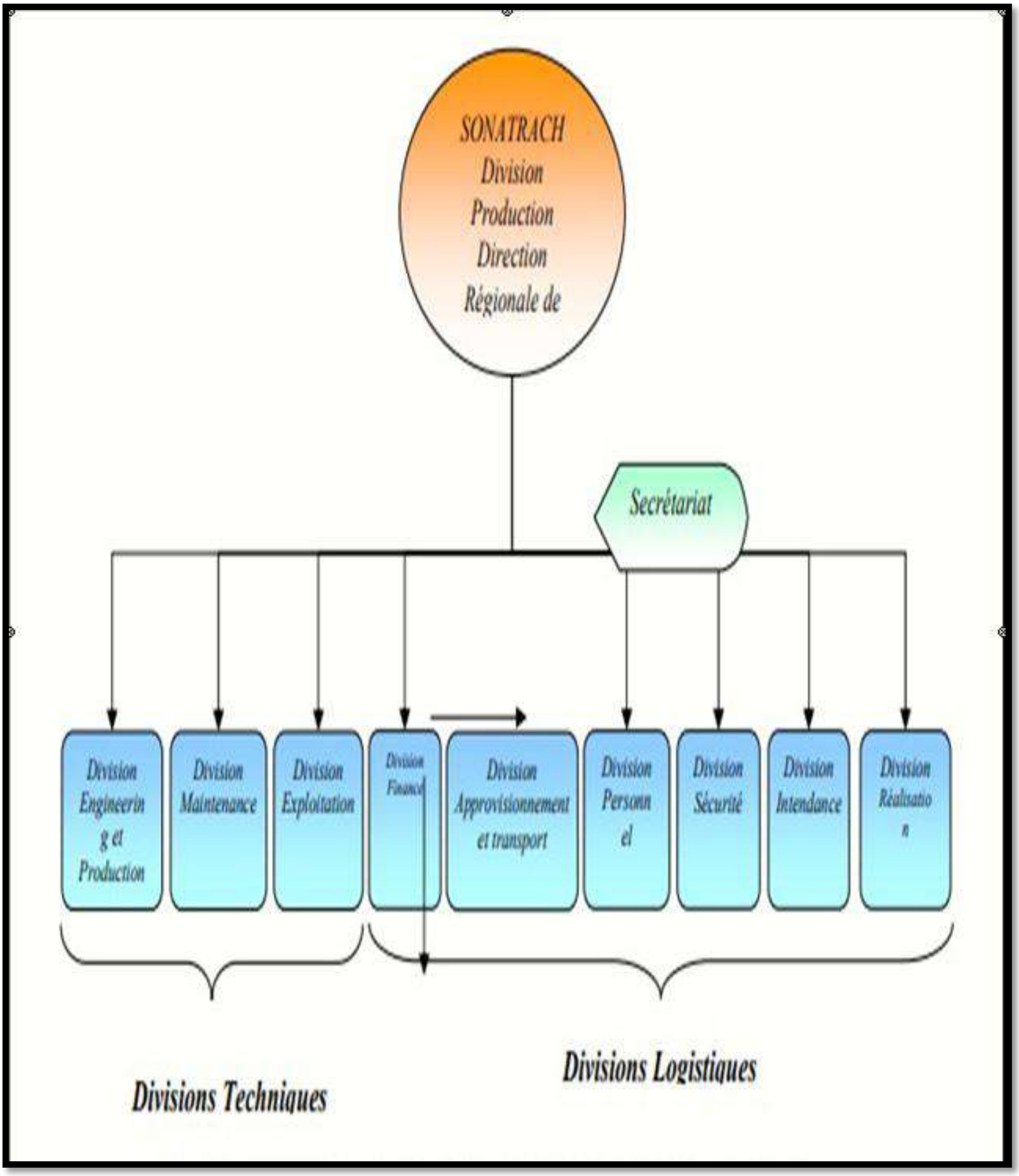


Figure II.3 : General organization chart of -HBK

1.6 HSE DIVISION:

The Security Division is made up of:

1. Prevention Service.

2. Intervention Service.

3. Environmental Department.

4. Security Service Guellala Center

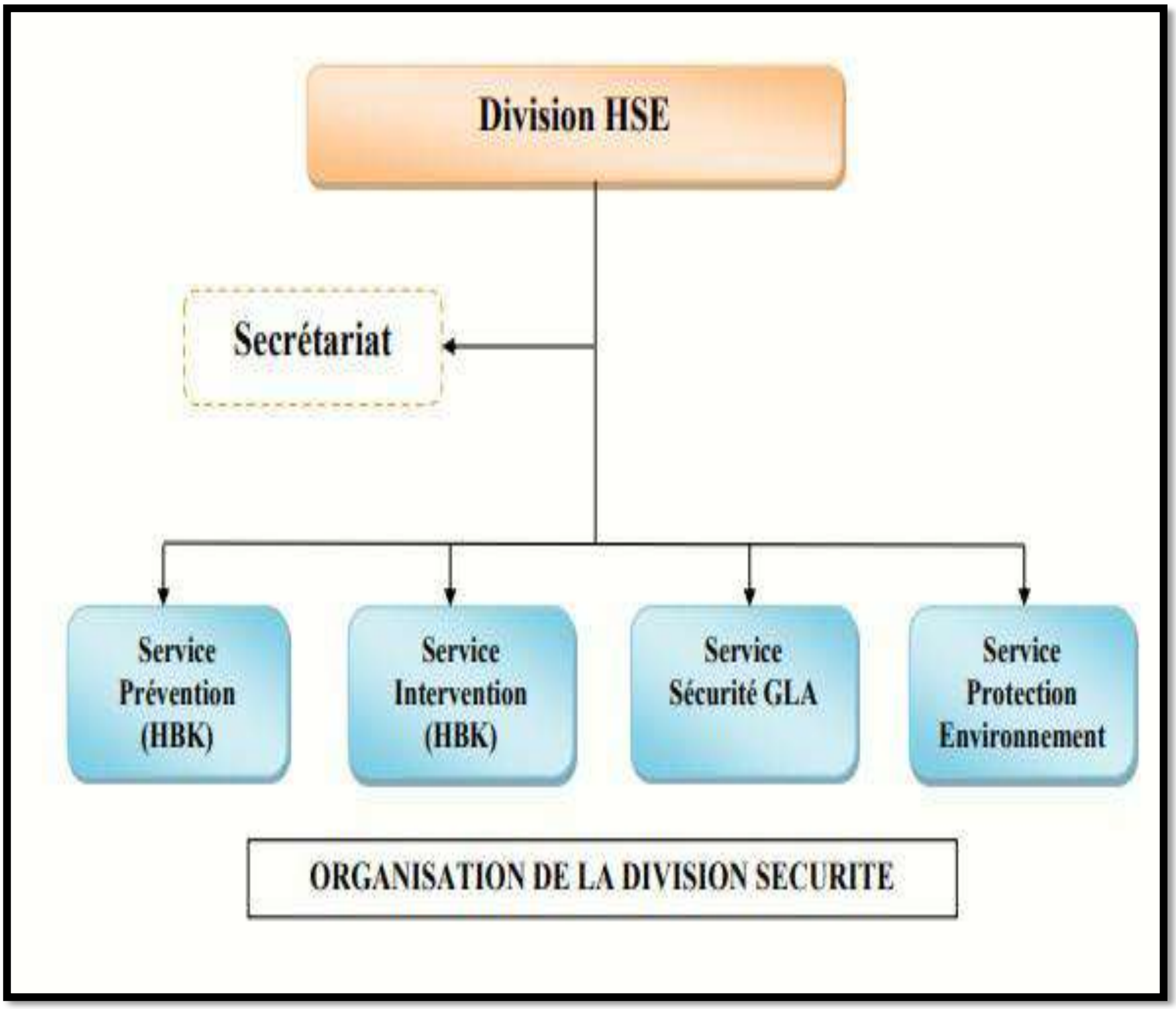


Figure II.4 HSE DIVISION of -HBK

1.7 THE TASKS AND MISSIONS OF THE SERVICES:

1.7.1 Prevention Service:

- ✓ Work in collaboration with other structures, regarding new projects, modification work on installations to give its opinion on the safety aspect in accordance with the standards and regulations in force.
- ✓ Recommend the various safety instructions during work (welding, handling, etc.).
- ✓ Attend the various tests of safety equipment on Snubbing and drilling devices.
- ✓ Organize staff awareness campaigns regarding HSE instructions.
- ✓ Instruct staff on the use of first aid means.
- ✓ Proceed to display the various safety instructions.
- ✓ Prepare monthly and annual reports relating to these activities and analyze the causes of accidents or incidents.
- ✓ Carry out daily checks of equipment at production centers, construction sites and the various workshops of the Regional Management.
- ✓ Ensure the monitoring of work under optimal safety conditions.
- ✓ Participate in the study and modifications concerning the installations.
- ✓ Carry out security audits of installations.
- ✓ Write general and specific safety instructions.
- ✓ Work in collaboration with the occupational physician.
- ✓ Ensure the application of various regulatory controls and inspections of equipment.
- ✓ Develop and study work accident statistics.

1.7.2 Intervention service:

Its main mission is to intervene in the event of an alert at the Regional Management level and to monitor the installations at the production center. To successfully accomplish his mission he is called to:

- ✓ Maintain and periodically check the equipment (motor pumps, rolling motor pump vehicles, fire network, etc.).
- ✓ Ensure preventive maintenance of protection systems.
- ✓ Coverage for dangerous work.
- ✓ Prepare information sheets for each person passing through and hand out badges.

- ✓ Establish, update and apply intervention plans.
- ✓ Carry out periodic exercises on real or simulated fire in collaboration with technical services or Civil Protection.
- ✓ Enforce general and specific safety instructions.

1.7.3 Environmental Department:

The HBK Regional Directorate is one of the first Regions to have made a lot of efforts in the creation of environmental protection infrastructures. To this end, it should be noted that the HBK Regional Directorate is equipped with:

• Three (03) de-oiling stations intended to treat industrial liquid effluents generated by the three Production Centers: HBK, GLA and BKH

• One (01) domestic wastewater treatment plant.

• One (01) Technical Landfill Center for the storage of household waste.

• One (01) storage area for ferrous and non-ferrous waste

• One (01) storage area for inert waste With regard to atmospheric emissions, once commissioned, the RGA project installations will make it possible to improve the recovery of associated gases.

The main tasks and missions assigned to the Environment Unit are:

- ✓ Identification of environmental aspects and sources of pollution
- ✓ Assessment of the intensity of different types of pollution.
- ✓ Presentation of mitigation measures.
- ✓ Updating regulatory monitoring in terms of environmental protection
- ✓ Information and awareness dedicated to staff on themes related to environmental protection. [44]

2.Components and basic systems in the station of storge crude oil :

2.1 Storage crude oil R06 and equipment of intervention:

Through the **Figure II.**, we mention the basic components and show some pictures that we have collected in the waiting stage

Figure II.5 Storage crude oil R06 and equipment of intervention cannon

Figure II.6 Storage crude oil R06

Figure II.7 equipment of intervention Fuel engine

Figure II.8 equipment of intervention Electric pump

Figure II.9 Equipment of intervention Fireproof foam tank

2.2 Storage crude oil R06

2.2.1 Structural and function description of the tank R06

2.2.1.1 Description of the system studied "Petroleum storage tank R06 / CP.HBK"

The R06 tank, of the fixed roof type, is a cylindrical piece of equipment with a capacity of approximately 5000 m3. It was carried out to increase the oil storage capacity (at atmospheric pressure) at the Haoud Berkaoui production center. This equipment was installed by the MES Company in 2009 according to the “API 650” standard.

Table II.2 technical information of R-06

Year of construction	2009
Made by	ALSIM Cosider
Mounted by	MES Spa
Calculated density	0,815
Nominal diameter	24m
Nominal height	10,81m
Nominal capacity	4880m^3
Material of construction	A.283.C
Operating temperature	80/-5 °C
Calculated Pressure	Atm
Partial annealing	No
Revision No.	/
Code used	API 650

Table II.3 Tank R-06 main equipments

filling line (has two valves)	• MOV146: automatic valve • manual valve (guard valve)
A shipping line (has two valves)	• MOV156 : automatic valve • manual valve (guard valve).
Two purge systems	• Pipe 4" (inch). • Two manual valves (one of the valves is a guard valve). • a purging gaze

- An access ladder
- Three manholes.
- A remote metering system.
- Four vents with flame arrestors.
- Four grounding connections.
- A cooling crown (For fire safety of the tank).
- Three foam chambers (For fire safety of the tank)
- Four foam overflow outlets (For fire safety of the tank

2.2.1.2 Operation of the R06 oil storage tank:

a) Filling phase;

Oil is supplied to Tank R06 by opening the automatic valve E11, which is remotely controlled from the control room, the oil arrives from the LP (Low Pressure) separators via the 10" filling line. After opening the automatic valve, the SS5 remote gauging system follows the variation in the level of Tank R06 and transmits the measurement instantly to the control room. The system is set to transmit to the operators of the control room a first high level "High Level" at 8.50m, then a second very high level "High-High Level" at 9.50m, but without automatically stopping the filling operation which can only be done after operator intervention.

b) Settling phase and elimination of water ;

After filling the R06 tank, a phase of physical decantation of the water is necessary before starting the shipping operation. This decantation takes place thanks to the difference in density between water and oil. The heaviest water accumulates in the bottom of the tank and the oil comes on top, without forgetting a certain quantity of gas. which emerges through the vents in the roof of the tank. Once settling is complete, the water removal operation (purge) begins by manually opening the SS3 purge valve which discharges into a manhole connected to the purge network and then to the de-oiling station. Generally the settling is done in about four (04) hours and the purge in two (02) hours. The objective of decanting and purging is to optimize the elimination of water and reduce the salinity Figure 17 Oil storage tank R-06 Application of HAZOP-LOPA-ADE methods 48 of the oil even after the separation batteries, in order to comply with the standards for marketing the product.

c) Expedition phase:

After decantation and elimination of the water,the shipping phase begins by opening the automatic valve E41, thus ensuring the supply, via the 14" line, of the BJ-1 and BJ shipping electric pumps -2 or TA-1 and TA-2 turbo pumps which in turn deliver the oil via the 12" shipping line to the Haoud El Hamra /TRC pipe. In this phase also the variation of the tank level is monitored by the same remote gauging system preceding SS3. Like the filling phase, the system is set to give two alarms. The first low level alarm “Low at 3.50m” and the second very low level alarm “Low-Low at 3.00m”. Once shipping is complete, shipping valve E41 is closed voluntarily by the operator

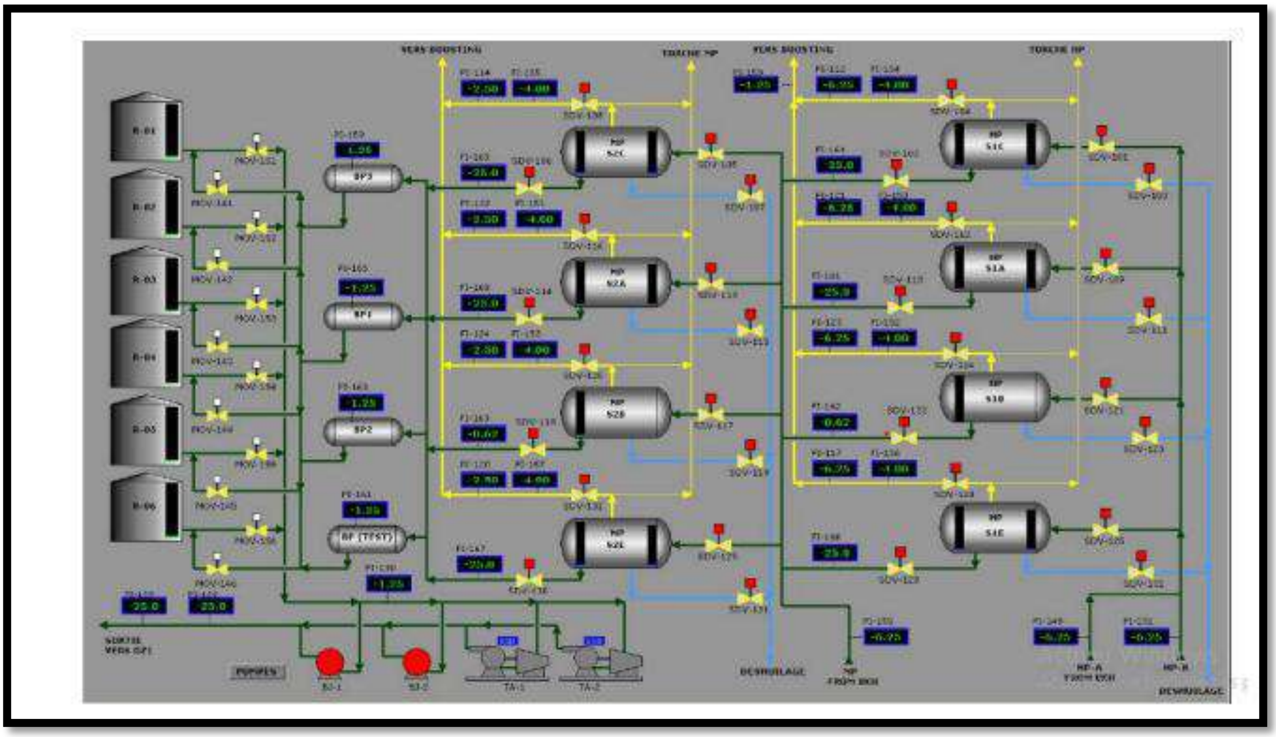


Figure II .10 PFD of HBK center

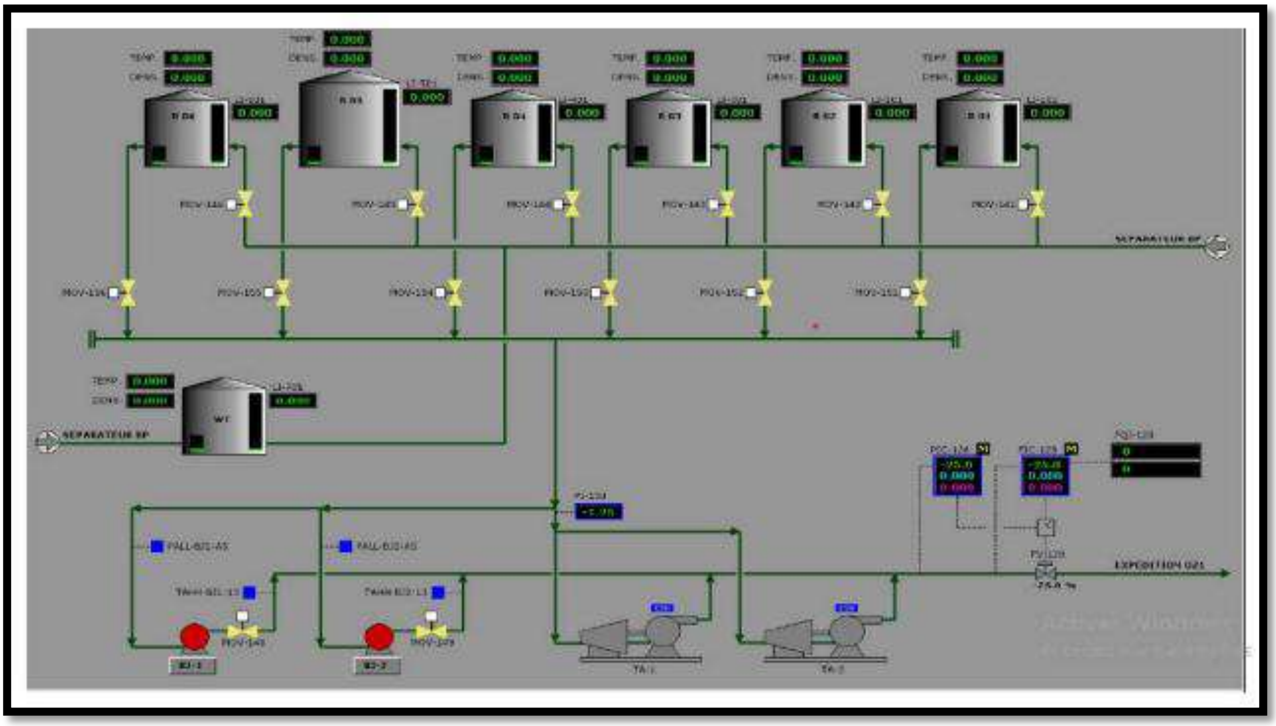


Figure II.11 Storage zone of HBK

Table II.4 Risk Matrix adopted from SH DP HBK

Severity				
S1				
S2				
S3				
S4				
	P1	P2	P3	P4

Probability

Table II.5 Risk level

Risk classification	Description
(green)	Acceptable
(yellow)	Tolerable
(red)	Unacceptable

Table II.6 Frequency and probabilities

Probability	Description	Frequency
P4	Very probable Occurred frequently within SH	1/year
P3	Likely Occurred (or could occur) within SH, could occur during lifetime of the facility	10-2 à 10-1/year
P2	Unlikely Already (or could be) met in an organization similar to SH	10-4 à 10-2/ year
	Definitely Unlikely Never met or heard of but physically possible (or extremely rare)	< 10-4 / year
P1		

Table II.7 Severity of hazard

Severity	Production/goods
S1	significant damage and total stoppage of production
S2	Localized damage and partial unit shutdown
S3	Minor damage and brief stop production
S4	ace of damage, no stoppage of production

3. To evolution safety barriers

The company operates with a technical position specialized in daily and weekly monitoring and inspection of safety, prevention and intervention equipment

Exp:

a) An electrician checks the effectiveness of thunderbolts and electrical wires to avoid accidents and sparks
b) Mechanical specialist checking the operation of tools and faucets
c) Checking the quality of the tank metal
d) Apply anti- corrosion agents and inject anti- corrosion chemicals
e) Checking surveillance devices
f) Monitor tank operation from a control room
g) Chek-list

3.1 Types and constructions of safety barriers:

Barriers can be:

3.1.1 Techniques

Device or Instrumented Safety Systems, technical barriers are made up of: Passive barriers-Active barriers-Instrumented safety system.

Exp:

− Relief valves / Retention basins

− Automatic closing of the inlet valve in the capacity upon detection of a very high level

LAHH

3.1.2 Organizational

Procedures/organizations opposing the chain of events likely to lead to a accident.

Exp:

− Instruction book

− Shunt management, systematic testing procedures.

3.1.3 Human

Safety barrier requiring one or more human interventions (detection / diagnosis /action)

Exp:

− Detection of a gas leak near a tank during an operator round, then decision to implement water curtains to contain/dilute the gas cloud.

− Checking the tightness of a circuit before commissioning.

3.1.4 Mixed

Combination of 2 or 3 technical/human/organizational barriers.

Exp:

− Leak during truck loading: activation of the emergency stop by the operator triggering the automatic station security

They can act by:

3.1.5 Prevention

By reducing the occurrence of the feared event. These are measures to take before the potential for danger becomes a feared event. These measures aim to reduce the probability of this event occurring and therefore creating an incident.

Exp:

The equipotential connection during the pumping operation at the well level, avoiding a spark produced by the static electricity of the pump truck. Gas detector (GID) next to a compressor avoiding the formation of an ATEX environment.

3.1.6 Mitigation

By reducing the occurrence of the accident, they come just after the feared event.

3.1.7 Protection

These are measures intended to reduce the severity of the consequences of the accident (radiation, overpressure, pollution, etc.) while protecting the installation, personnel and the environment.

NB:

- ✓ Prevention ⁄ protection barriers can be barriers:
- ✓ Passive ⁄active or: technical ⁄ human ⁄ organizational
- ✓ They can be of a nature

3.1.8 Passive

No energy or human intervention is necessary for their implementation.

Exp:

-Safety distance (concerning the location or the presence of personnel near of facilities)

-Retention basin for hydrocarbon storage tanks.

-Equipment design (metallurgy, pressure resistance, etc.)

-Anti-explosion fire wall covering the manual valves.

3.1.9 Active

A source of electrical, pneumatic, hydraulic and human energy is necessary for their proper functioning.

3.2 Passive fire protection PFP:

3.2.1 Purpose

Prevent the fall or damage of equipment and structures, depending on fire scenarios developed in order to:

a) Protect staff:

Protect personnel in the facility.

Allow the evacuation of personnel in optimal conditions.

b) Protect property

Protect equipment and structures.

Limit the size of a fire.

Preserve emergency access.

c) Protect the environment

Protect equipment which, in the event of fire, causes serious damage to the environment.

3.2.2 Fire scenario and extension of the PFP

The fire zone according to the scenarios selected (flaming fire or puddle fire) is the zone in which equipment may release combustible or flammable products capable of burning with sufficient intensity or duration to cause damage to structures or materials; SO the distance taken into consideration for the PFP depends on the nature of the fuel to be burned.

According to API 2218:

Liquid hydrocarbons:

Extension of 6 to 12 m horizontally and vertically, from the leak point.

LPG:

Extension of 15m around the capacity, or retention zone

3.3 Methodology for evaluating technical safety barriers by the INERIS

3.3.1 Minimum criteria

Before studying in detail the performance of Technical Safety Barriers (BTS), it is necessary to Firstly, ensure compliance with the minimum criteria. These criteria are as follows:

a) Independence

The BTS must be independent of the initiating event that could lead to its request to be able to be retained as a barrier acting on the scenario induced by the event
initiator.
Its performance must not be degraded by the occurrence of the initiating event.
Exp:
If a fire is identified as a potential cause of pipe rupture, we will not be able to retain the safety function associated with closing a safety valve on the pipeline if the valve is not fire safe.

b) Safety design features

The technical description of the BTS must specify that it is designed for use in
security only. It must present a certain number of characteristics (for example: simple design, robustness).
When these conditions are met, we can therefore evaluate our barriers and propose solutions.
corrective actions in order to limit the consequences of the feared event, the criteria to be studied are :

- Efficiency.
- Response time.
- The level of confidence.

3.3.2 Application to active devices and safety instrumented systems

3.3.2.1 Effectiveness

Effectiveness is the ability of the safety barrier to fulfill the safety function for which it was chosen, in its context of use and for a given duration of operation.
The effectiveness measure is expressed as a percentage of accomplishment of the safety function defined, this percentage may vary during the BTS solicitation period. In many situations, the efficiency is 100%, a perfectly sealed valve will allow to isolate a substance leak in the event of loss of containment on a pipe. But some safety barriers may not be 100% effective; Thus, a curtain of water can bring down a cloud by X%. The water curtain can be used as a barrier but the phenomenon dangerous associated with the operation of the water curtain involves the part of

the cloud not destroyed, or (100-X)%. It should be noted that the 100% effectiveness of a BTS does not mean that there is no phenomenon dangerous associated with the operation of the barrier,

Exp:

A closing time of a valve 30 seconds will thus lead to a dangerous release. The principle of evaluating the effectiveness of an active barrier is also based on 3 factors:

a)-Adapted sizing principle

The equipment is said to satisfy the principle of suitable sizing when it is designed on the basis of recognized norms and standards and when the sizing is carried out on the basis of operating conditions adapted to the site. Its sizing must also take into account

feared events to be controlled and must meet specific specifications.

The question that arises is:

Is the system put in place well sized to deal with the risks it must

master ?

b)- Principle of resistance to specific constraints

This principle consists of verifying that the BTS has been designed to withstand the specific constraints linked

− To the products involved (corrosive, etc.)

− The environment (weather conditions, seismic risks, etc.)

− During operation (high working pressure, high temperature, etc.)

− Resistance, where applicable, to overpressure, thermal effects, etc.

Resistance to specific stresses must be validated by calculation notes, tests or by

certificates from the manufacturer.

c)-Positioning ⁄ accessibility

In certain cases, the positioning of the barrier makes it possible to optimize its ability to fill the function assigned to it. These are for example:

− Sensors (gas, flame, temperature, pressure, etc.).

− Extraction systems (position of the extraction duct in the building in the lower part or higher than the premises).

− Valves (optimize their positioning with regard to leaks).

Is the barrier easily accessible?

Exp:

Emergency stop button

3.3.2.2 Response time

Response time corresponds to the time interval between the moment when a safety barrier, in a context of use, is requested and the moment when the security function provided by this barrier and carried out in its entirety.

According to this definition, the response time includes:

− The time required for incident detection to operate following its request,

− The time

NB:

- ✓ Replacing an active barrier requires human energy for its operation by another pneumatic or electrical energy will always reduce the response time of the barrier.

3.3.2.3 The level of confidence

The evaluation of the probabilities of occurrence of dangerous phenomena involves the factors of reduction of risks induced by safety barriers. Conservatively, it is often assumed that NC is associated with a reduction in the risk of 10NC.

For instrumented systems the SIL is equivalent to the NC or can lead to determining the NC,
as we already saw in the previous chapter, the NC is related to the SIL and the probability of failure to demand (PFD), the risk reduction rate and the failure rate in
security (SFF).

In general for active and instrumented systems the (SFF) is between 60 and 99% as well as the NC
increases with increasing (SFF).

For safety instrumented systems, it is first necessary to determine the level of confidence
of each of the subsystems before evaluating that of the system.

The architecture of A and B gives us an indication of combination, we take the Min of the levels of confidence because in the event of an anomaly one of the two subsystems can intervene
Between the combination of (A, B) and c we take the Max because in the event of an anomaly of (A, B) there is no
other subsystem that can initialize the action of C

NB:

- ✓ For the same safety function the redundancy of the same barriers or reinforcement with another active barrier takes a high confidence level 3

- ✓ The orientation of the barrier towards another function which is not security which will not weaken the trust level .(45)

4. Application method ADD and ADE:

To evaluate safety barriers, we applied the method ADD and ADE as shown in the two fig in crude oil storage **R06**

4.1 Application Methode ADD:

We have applied the method to immediately eliminate failures and weaknesses in security barriers and equipment that cause an undesirable event, which is a tank fire/explosion.

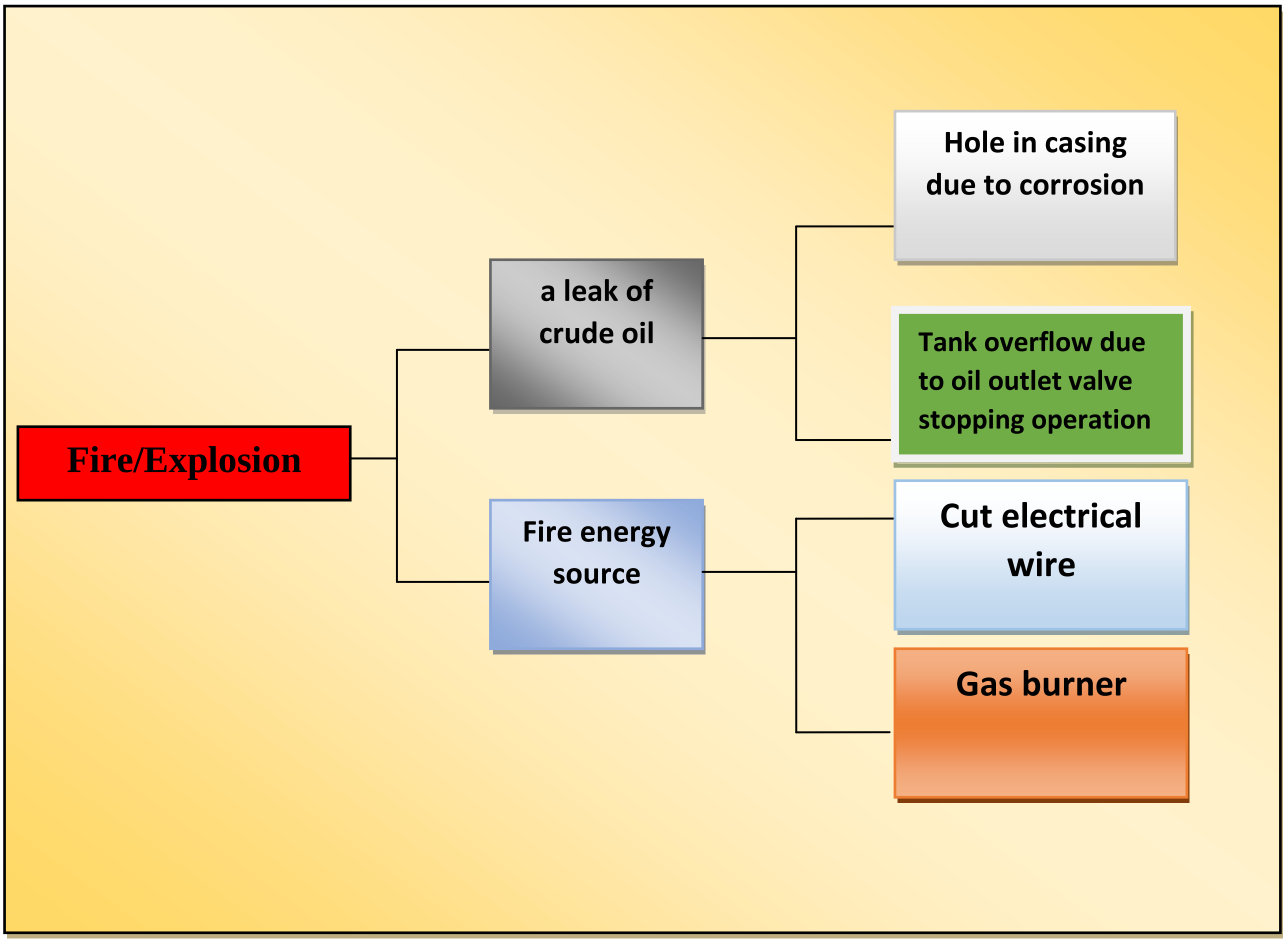


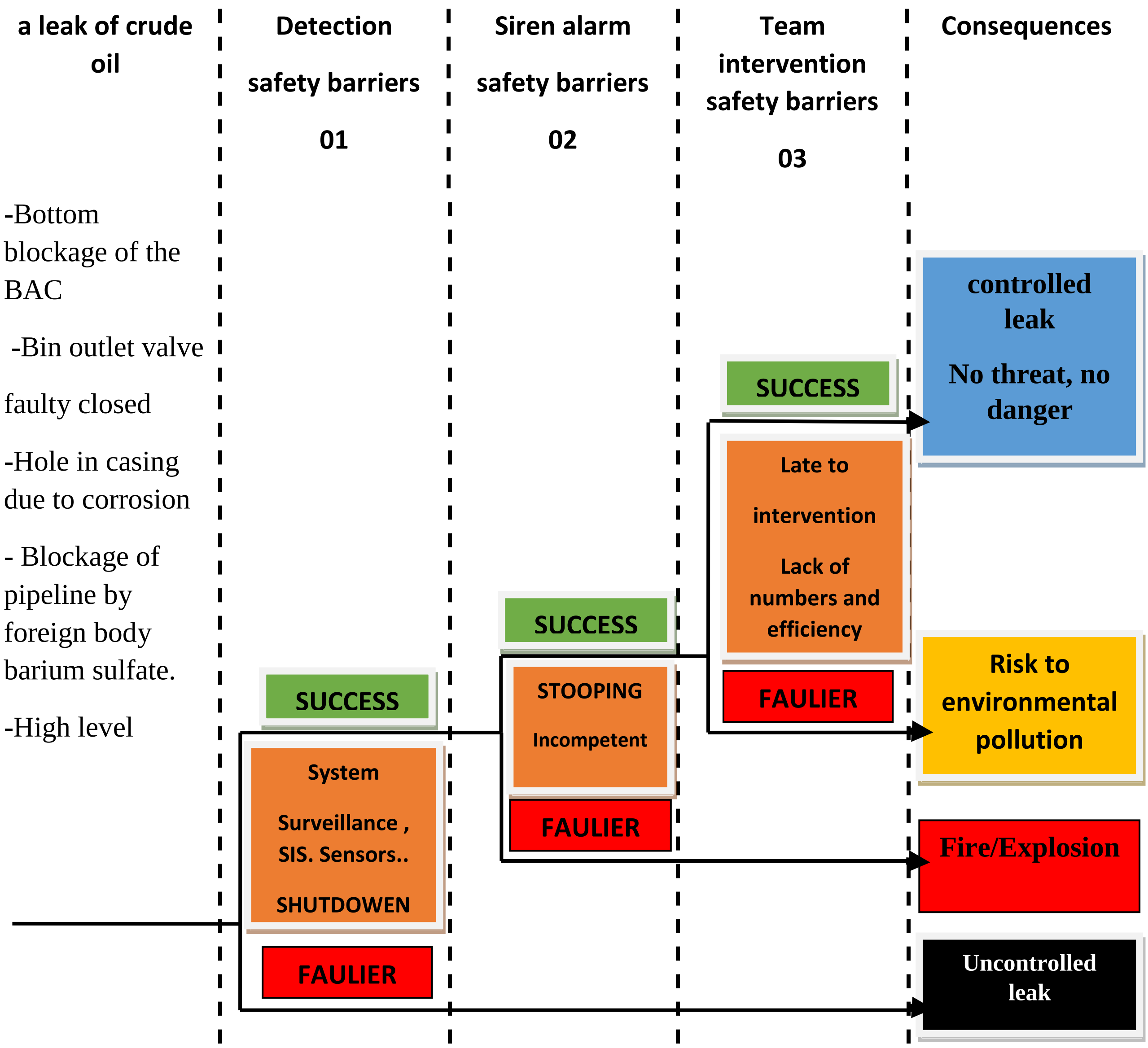
Figure II.12 Application Method ADD In a scenario tank fire/explosion

4.1 Application Methode ADE :

We are studying some cases that could occur and which could result in serious consequences at the tank level

This method to immediately eliminate failures and weaknesses in security barriers and equipment that cause an undesirable event in table

Table II.8 Application Method ADE crude oil storage R06



5.Safety prevention:

In order to avoid accidents, you must do :

- ✓ Emergencies plan (IIP
- ✓ Intervention
- ✓ Alarm system.
- ✓ Surveillance cameras.
- ✓ DCS.
- ✓ extinguishing system.
- ✓ Marlon -purge system.
- ✓ Intervention tools (fixed and mobile).
- ✓ TVR measuring

Conclusion:

By applying two methods ADD/ADE to analyze risks and evaluate security barriers for various failures that led to undesirable situations, we analyzed and evaluated some risks and developed preventive measures to reduce them.

General conclusion:

Oil and gas facilities are likely to face significant risks. They can go as far as disasters with catastrophic human, financial or... environment, which negatively affects the company's reputation and brand image. We must therefore take measures to control, to an acceptable level, the risks threatening the world Safe stability in the workplace. The safety of our installations depends in particular on the proper functioning of barriers and Measures: Preventive, preventative or mitigating measures which must do several good Practices and selection criteria.

These barriers may deteriorate over time or be insufficient with development. Technological.

This summary addressed the risk analysis of fuel and oil storage at a separation station
Identifying the potential risks of such analysis has shown this;
• Equipment risk potential is mainly attributable to circumstances
The Committee's proposal is based on that of the Council and the Committee.
• The incidents referred to in the accident study are mainly characterized by events related to gas leakage from the station's compressed systems caused by human error or shocks/external projections.
Existing safety systems and specific risks.
It also led to attention to the scary events that led to major incidents.
Its consequences have been assessed.
- Potential risks associated with oil and fuel storage tanks
- Possible risks associated with the separation and linking systems to one another
Through the study, we found the importance of evaluating hazards and establishing safety and security measures to avoid damage to the environment and human beings.

The recommandations

The recommendations **The main recommendations for this scenario are:**

- ✓ Ensure operators are trained and informed to know and master any disturbances that may occur might happen.
- ✓ Respect the periodicity of the equipped loop tests and the frequency of calibration Rotors.
- ✓ Establish electrical and ATEX (areas, periodic suitability review) procedure Manage the installation of ATEX non-electrical equipment.
- ✓ Use SIS more effectively and adapt to IPL standards through adaptive SIL.
- ✓ Using automatic system
- ✓ Regulation loop which changes the principal line by bypass automatically
- ✓ Provide very low level and very high level alarms for storage bins .
- ✓ Regularly follow the Inspection of all the equipment of the Storage Bins.
- ✓ Respect the procedures, operating instructions (filling procedures and monitoring shipping, purging bins, cleaning, etc.),
- ✓ Ensure the training and information of operators to know and master all the deviations that may occur.
- ✓ Check the tightness and condition of the retention basin.
- ✓ Ensure and reinforce the simulation exercises concerning the fires of the Bins, the basins and pool fire Install foam spillways at the level of the retention basin
- ✓ Ensure the regular and periodic cleaning of the funds of the Bins.
- ✓ Ensure the availability of intervention means at the production center level.
- ✓ Delimit the Hydrocarbon storage areas and display the plates signaling.
- ✓ The use of modern and advanced techniques to detect fire, such as cameras, monitor panels, robotic robots, smoke and fire detectors, explosion detectors, smart alarms , the artificial intelligence
- ✓ An increase in the number of workers, provision of rapid response and intervention, and making the workers the same as the intervention team, i.e. training them

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Le guide Omega 20 : Évaluation des Barrières Humaines de Sécurité
Ces guides sont téléchargeables sur le site Internet de l'INERIS :
http://ineris.fr/badoris
Le portail d'accès Badois fournit des fiches d'info- mations techniques relatives aux dispositifs de sécurité.

ANNEX

Definitions

1)-The danger:

This is a source or situation that is brighter than others, coming to the sanitary, doming it. The environment or the travel situation, or the combination of these elements.

2)-The risk:

The combination of the potential and the (des)consequence of the survenue of the event Dangerous specified, nutriment did:

Risk=danger x exposure risks.

3)-The risk of danger:

This is the main feature of the system, and the general maintenance of the system in the open.

Operation (procedures of function, maintenance, inspection).

This may contain more risks.

Exp:

Product⁄ materiel, reaction chemicals, operating conditions….

4)-The initiator event

This is the danger warning, as it combines with the effective danger response. The event redouté.

Exp:

Modification, external influence, failure (technique, organisationnelle, humaine).

5)-The dreaded central

This is the most powerful library of danger, a suite for an innovative development.

In the event of an accident, the events may be connected to an accident, the central redout

Correspond to other consequences during a drive or failure affecting an equipment.

dangereux.

It will bring you generation to a complete confinement or a complete physical operation.

6)-The dreaded secondary event

Consequence directing the central reroute, the secondary reroute event, failure

The term source of the accident (ex. formation of a flame, a new color…

7)-The accident

It is an unintentional event resulting from a failure: material and/or human which has measurable consequences on people, property or the environment.

8)- Risk management

Risk management is a process including the risk assessment phases

(risk analysis and assessment), risk acceptance and risk control or reduction.

The stages of risk management are:

- Risk analysis
- Risk estimation
- Risk assessment
- Risk acceptability
- Risk reduction

9)-The criticality matrix

The two main parameters of criticality are the probability of occurrence and the severity of consequences. We generally give four to five levels to each parameter:

a)-Frequency

Very unlikely, unlikely (rare), likely (occasional), very likely (common)

b)-Severity

Low, medium, severe, very severe.

Rather than multiplying the two values, we construct a matrix and these are the areas of the matrix

which indicate criticality.

10)-Acceptability and level of risk

ANNEX

This is the goal or final phase in risk assessment procedures and is what it is acceptable or not there are 3 levels:

a)-Priority risk

Immediate action is necessary, so safety barriers must be put in place toreduce this risk to a lower level.

b)-Tolerable risk under conditions (ALARP) "as low as reasonably practicable"

We must confirm that the effort involved (cost, implementation) is not disproportionate to the reduction

of the expected level of risk.

c)-Acceptable risk

No action is necessary