Romanian Journal of Petroleum & Gas Technology
VOL. VI (LXXVII) • No. 1/2025

ASSESSMENT AND REDUCTION OF ENVIRONMENTAL RISKS RELATED TO THE TRANSPORT, STORAGE AND DISTRIBUTION OF PETROLEUM PRODUCTS IN KINSHASA – A SEP-CONGO CASE STUDY

Gracias Kingombe Manianga [1,2*]

Albert Mbosei Lobota [4]

Alfred Ngangura Amisi [2]

Denis Esongo Lomonde [1]

Augustin Bangama Kabongo [1]

Jean Iyolo Lungembo [3]

[1] Petroleum Management and Economics Department, Faculty of Oil, Gas and Renewable Energies, University of Kinshasa, D.R. Congo
[2] National Committee for Protection against Ionizing Radiation, D.R. Congo
[3] Department of Exploration-Petroleum Production, Faculty of Oil, Gas and Renewable Energies, University of Kinshasa, D.R. Congo
[4] Physics Department, Faculty of Science, University of Kinshasa, D.R. Congo
* email (corresponding author): kingombegracias82@gmail.com

DOI: 10.51865/JPGT.2025.01.02

ABSTRACT

Assessing and managing environmental risks in the oil industry is crucial to ensuring operational safety and corporate sustainability. In the case of Sep-Congo in Kinshasa, where petroleum product transport, storage and distribution activities are intensive, a proactive approach is required. Petroleum products present hazards such as toxicity, flammability and volatility, requiring rigorous risk identification. Dynamic risk assessment methods, such as DyPASI and DRA, enable potential accident scenarios to be updated in real time by incorporating data on past incidents and monitoring safety indicators. These approaches provide a visual representation of risks and help to make informed decisions to minimize hazards. By integrating these methodologies, Sep-Congo can strengthen its safety measures and ensure effective operation in the face of environmental challenges.

Keywords: business, risks, toxic, flammable, volatile.

INTRODUCTION

The objective of this study is to examine and reduce the environmental risks faced by SEP-Congo during the transportation, storage, and distribution of petroleum products. To provide a comprehensive understanding of the issues raised, this study will address four key elements:

- An overview of the different petroleum products that SEP-Congo transports, stores, and distributes, including their hazardous characteristics.
- A detailed analysis of the risks associated with these operations, highlighting potential dangers such as spills, leaks, and accidents that could impact the environment and public health.
- An examination of the quantitative evolution of petroleum products handled by SEP-Congo from 2014 to 2018, illustrating trends in transportation and storage volumes.
- A discussion on the mechanisms employed by SEP-Congo to assess and reduce environmental risks, including compliance with safety regulations and the implementation of best practices.

This article aims to fill a gap in existing literature by providing a targeted analysis of SEP-Congo's operations in Kinshasa, emphasizing the economic benefits of effective environmental risk management. The novelty of this study lies in its comprehensive approach to understanding how mitigating environmental risks can enhance operational efficiency and sustainability in the petroleum sector.

The scope encompasses an in-depth exploration of SEP-Congo's logistics operations in Kinshasa, evaluating both the environmental implications and the economic advantages of effective risk management strategies. While previous studies have addressed general environmental risks in the petroleum industry, this research specifically targets the unique operational challenges faced by SEP-Congo and opportunities for improvement in Kinshasa.

This study proposes innovative recommendations to strengthen safety measures and operational practices at SEP-Congo, thereby providing valuable insights for policymakers and industry stakeholders seeking to balance economic growth with environmental protection.

RESEARCH METHODS AND TECHNIQUES

In order to gather data and information for our study, we used various methods and techniques to make our scientific research a reality. It is important to note:

- **Methods used**

Method encompasses all the thoughtful steps taken to achieve a goal. Technique encompasses all the processes used to produce a work in order to achieve a specific result [1]. Accordingly, we have used the following techniques:

- We used descriptive and analytical methods to describe and analyze all the measures taken by SEP-Congo SA authorities to manage risks during the transport, storage and distribution of petroleum products at SEP-Congo Kin I.
- We used the comparative method to compare the safety measures implemented between 2014 and 2018 for the management of risks during the transport, storage and distribution of SEP-Congo Kin I petroleum products.

- **Techniques used**

For our work, we used the following methods:

– The use of documentary techniques gave us the opportunity to consult documents related to our subject of study in order to extract ideas.

– The interview method gave us the opportunity to conduct interviews with professionals who have access to the Internet to obtain relevant information [18].

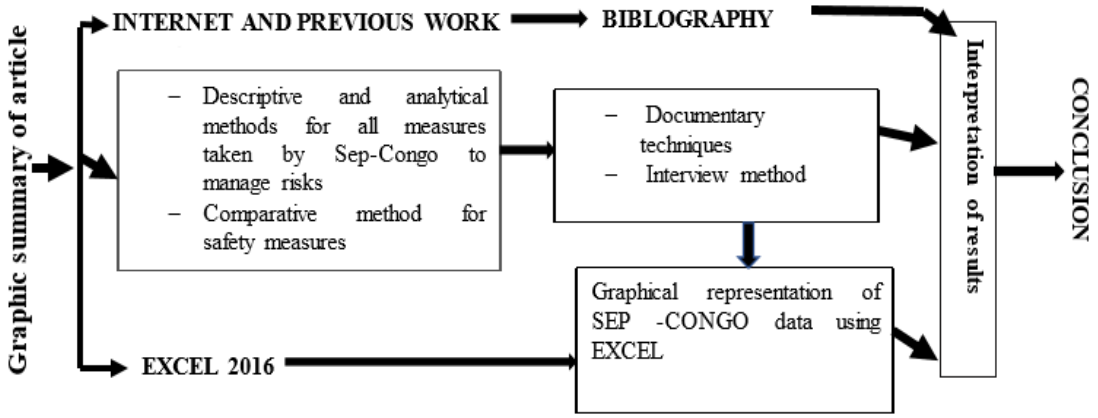

Figure 1. *Graphic summary*

DIFFERENT TYPES OF PETROLEUM PRODUCTS TRANSPORTED, STORED AND DISTRIBUTED AT SEP-CONGO FROM 2014 TO 2018

Crude oil is a liquid composed mainly of hydrocarbons, but also of organic sulfur, oxygen and nitrogen compounds. According to Joseph, petroleum is a combination of concentrated organic matter [14]. Considered a fossil fuel, petroleum plays an essential role in the modern industrial economy. Oil, which is dense, easy to store and transport, makes up almost all liquid fuels. It is also widely used in petrochemicals (rubber, plastics, textiles, chemicals) [23]. Oil is constantly sought, searched for, tracked down and often found. It is immediately extracted, refined and consumed more rapidly [15]. SEP-Congo used the various petroleum products transported, stored and distributed between 2014 and 2018 for consumption, energy production and raw material. [12]

- **Current consumer goods**

Petroleum products imported by the Democratic Republic of Congo include super fuel (petrol), gasoil, fomi, kerosene, jet A1 and gas. These petroleum products are sought by individuals, companies or both [2].

– Gasoline, also known as premium fuel, is a fuel used in gasoline engines. This fuel is used to run internal combustion piston engines (gasoline engines) in the presence of air. It is the most widely transported, stored and distributed product.

– Super fuel and diesel are the most popular, as they are used as vehicle fuels; A1 jet fuel is used in the aeronautical industry;

– The kerosene lamp for lighting;

– In the DRC, gas is very rarely used in gas stoves. On the whole, it is used in cars with compatible engines.

- **As an energy source [3]**

In the DRC, industry had been invaded by FOMI. The brewing industry, the textile industry, cement factories and bakeries. Electricity gradually replaced it, but not entirely. Today, it is used by certain industries such as cement and brewing;

- **As a raw material [19]**

The petrochemical industry is a sector of the chemical industry that utilizes products derived from petroleum as its primary raw materials. This category includes a range of industries, such as plastics, tire production, rubber manufacturing, and more.

RISK ANALYSIS FOR TRANSPORT, STORAGE AND DISTRIBUTION IN SEP-CONGO FROM 2014 TO 2018

Petroleum products are considered high-risk goods. Certainly, any damage caused has adverse consequences for the interests of the Republic of Congo. When damage occurs, SEP-Congo has to spend considerable sums to repair it. SEP-Congo has therefore drawn up a few rules concerning the dangers and risks associated with handling them. SEP-Congo has storage depots that could explode if safety measures are not properly implemented, with consequences for the environment and the health of employees. It is important to note that hydrocarbon storage facilities can involve considerable risks for personnel and the environment. The products handled present a risk of fire or explosion due to the physical and chemical characteristics of hydrocarbons (volatility, flammability). Hydrocarbons present physiological hazards such as intoxication, benzolism and lead poisoning. There is a risk associated with lightning (thermal effect and effect caused by strikes), not to mention induction effects which can have an impact on equipment sensibles [26]. Because of the effects of petroleum products, SEP-Congo has introduced a series of rules designed to prevent hazards and fires, such as electric shocks caused by direct or indirect contact, as well as burns and fires caused by short-circuits or prolonged heating. The risk of contamination can lead to fatal illness. The risk when there's a spill.

Risk management implemented during the storage of petroleum products

Risk is also associated with the severity of the consequences of a hazard with a high probability. It is therefore defined as the probability of an undesirable event (illness, death, accident), the probability of a probable danger or hazard [6].

Storage management

Management applies to just about every field, but to differing degrees. In the case of petroleum product storage, effective management is essential, as the products stored in tanks are extremely hazardous [26]. It is therefore necessary to have at least a few management principles to effectively manage the storage of products in tanks [13]. Staff responsible for managing storage processes need to be given more training in the principles of storing liquid fluids. Petroleum products are stored in tanks at the Kin I Gombe depot. A tank, with a flat or concave bottom and always overhead, is a vertical tank with a fixed or floating roof, depending on the operating pressure and the quality of

the products to be stored. Fixed-roof tanks are particularly common at the Kin I depot. However, the fixed-roof tank is designed exclusively for the storage of heavy products, such as diesel and Fomi, for example. The Kin I depot also handles light volatile and flammable products such as petrol, kerosene and Jet/A1. In general, light products can be stored in a temporary fixed-roof depot in cases of force majeure. In other words, not for very long, due to the volatility of the light product and the nature of the fixed-roof tank. The storage of light products in fixed-roof tanks at the Kin I depot is distinguished by the modification of the tanks that receive the light products, i.e. the installation of a valve that opens automatically in the event of high pressure on the stored light products. In the tanks, under the influence of heat emitted by the sun, for example. If the pressure rises, the valves open automatically to release the value of the product's volatility, thus avoiding explosions such as those seen in tanks.

Acceptance procedure [15]

Preparing tanks to receive the product to be stored

It's impossible to store products directly in tanks without preparing them. It's impossible to have tanks in poor condition; you can have tanks containing contaminated products, for example.

Consequently, it is necessary to designate tanks according to their storage capacity for petroleum products in cubic meters (m^3). Before filling the tanks, SEP-Congo creates a document specifying the nature of the products, drawn up by the receiving body according to the quantity of product and the hollow.

The laboratory department must examine the document in question in order to guarantee product quality. Given the complexity of the loading operation, SEP-Congo has established a few guidelines to be followed:

- At least two hours beforehand, all receiving containers are positioned on the line according to the nature of the product to be stored;
- The empty heights (hollows) of these containers are taken.
- The levels and temperatures of products already in the tanks are also recorded;
- Density measurement before intake. It is essential to take a sample from the receiving tanks;
- Water evaluation by purging, especially for Jet-A1.

Setting up fire-fighting equipment during storage of petroleum products

As hydrocarbons are fairly flammable products, there is a considerable risk of fire or even explosion in storage facilities. However, combustion can only occur when the following three elements are present at the same time. These are:

- The oxidizer;
- Gasoline;
- An inflammation factor.
- When the three elements are combined, combustion can occur.

In a tank farm, it is imperative that oxidizers meet. Therefore, it's important to remain alert to all possible sources of ignition. However, ignition only occurs when the fuel emits an adequate amount of vapor [23] to maintain an appropriate proportion in the air; the mixture must not be too weak or too rich in fuel vapor. There are two types of limit: LEL or LII, corresponding to a lower explosive or flammable limit, and LES or LSI, which corresponds to an upper explosive or flammable limit. Above these concentrations, combustion is impossible.

Figure 2. *Lower and upper explosive or flammable limits* [2].

LEL and LEL values for the main products encountered in a tank farm are presented in table 1.

Table 1. *Upper and lower limit values for various petroleum products.*

Flammability limits in %in air at 20°C	***Lower***	***Upper***
Gasoline vapors	1.5	7.6
Kerosene steam	1	6
Diesel vapour	6	14
Fuel oil vapour	6	14
Bitumen vapour	6	14

These risks have harmful consequences for man and nature, and cause extremely catastrophic damage. SEP-Congo has the following resources at its disposal to combat this situation [17].

Fire extinguishers are in use.

- A fire extinguisher is a portable device that projects the anti-combustion agent it contains in the desired direction. It can be used to put an end to a fire.
- 2 large water reservoirs of 1100 and 1500 m^3 each;
- A 150 m^3/hour motor-driven fire pump;
- A maximum of 1600 m^3 of water storage;
- A 4000 L/min unit;
- Two 5000 L/min channels;
- Quantity of emulsifiers available;

- An 8000-litre tank;
- 21 small tanks of 2000 L;
- There are many causes of fires, just mention a word to that effect;
- Human causes can be;
- Smoking neglect;
- Misunderstanding;
- Unconsciousness;
- Neglect;
- Malice.

Natural origins can be:

- A flash of lightning;
- Solar radiation (magnifying glass effect, overpressure of gas cylinders, drums, etc.).

To increase safety, it's essential that fire-fighting equipment is always accessible. Kin I depot authorities monitor the causes of fires and deploy the fire-fighting resources at their disposal to prevent them. The handling of petroleum products can also be a cause of fire in the event of human error.

Since water plays an essential role in fire-fighting, it is constantly present in the drums and basins at the Kin I/Gombe depot.

In a tank farm, it is imperative that fuel and oxidizer meet. It is therefore essential to be extremely attentive to all possible sources of ignition. However, it is important that the fuel emit enough vapour to ensure good protection in the air, which means that the mixture must not be too weak or too rich in fuel vapour [7].

In the event of a fire, the Kin I depot has established a few guidelines to follow, namely:

- Keep calm, take quick action, but don't rush;
- Notify the rescue team;
- Stop all product circulation by closing the appropriate valves.
- Request interruption of pumps;
- Immediately activate the fire extinguishers nearest to the house;
- Constantly attack the fire using the wind at your back;
- Use a dry ice extinguisher when there is a fire on electrical equipment;
- Tanker trucks and cars must be kept well away;
- Evacuating personnel is not necessary.

QUANTITATIVE EVOLUTION OF PETROLEUM PRODUCTS TRANSPORTED, STORED AND DISTRIBUTED AT SEP-CONGO FROM 2014-2018

The item quantities presented in this study cover the period from 2014 to 2018 and are calculated on the basis of the various items transported, stored and distributed at Sep-Congo.

Quantity of products transported by SEP-Congo 2014 to 2018

The quantities of products transported by SEP-Congo from 2014 to 2018 are presented in the table 2.

Table 2. *Change in quantities of products transported from 2014-2018 in m^3*

Year / **Estimate**	**2014**	**2015**	**2016**	**2017**	**2018**
Quantity	191956.1	276039.2	190378	182731	260197.4
% change	-	43.8	-31.03	-4.01	42.3

Analysis based on data from SEP Congo/DTN. To determine the variation we used formula 1 [4].

$$\frac{\text{Year B} - \text{Year A}}{\text{Year A}} \text{ x } 100 = \% \text{ change} \quad (1)$$

This situation can be represented graphically as follows (figure 3):

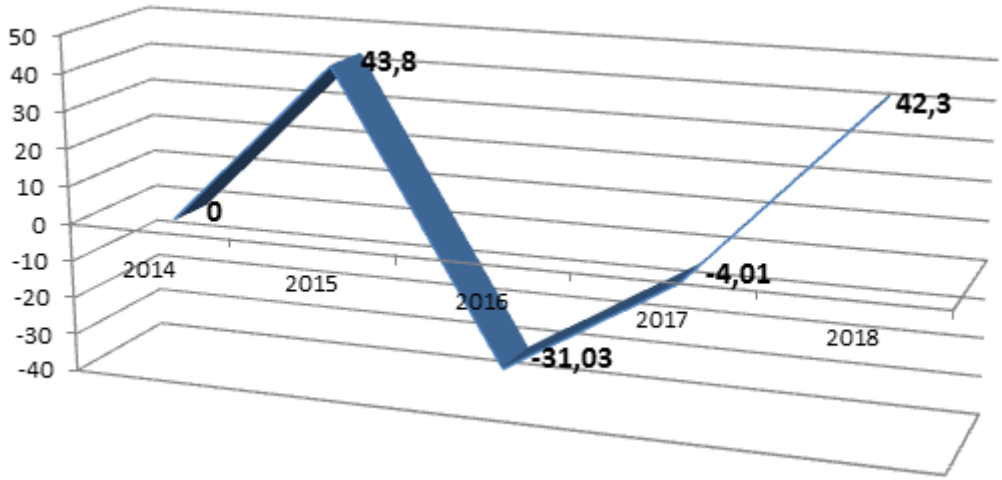

Figure 3. *Illustration of the development of products transported from 2014 to 2018.*

Comment: From the graph in figure, it is clear that petroleum products transported from 2014 to 2018 did not just evolve positively. Moreover, they also experienced a negative evolution in 2016 and 2017, with respective rates of -31.03 for 2016 and -4.01 for 2017. This decrease was caused by lower demand for petroleum products in 2016.

Quantity of petroleum products stored at SEP-Congo from 2014 to 2018

The quantitative evolution of petroleum products stored at SEP-Congo from 2014 to 2018 (Table 3).

Table 3. *Change in stored products in m^3*

Year / Period	2014	2015	2016	2017	2018
Quantity	495237	498431	441022	479918	501973
% change	-	0.65	-10.9	-3.1	1.36

* Table based on data from SEP Congo/DTN. [4]

$$2015 = \frac{498431-495237}{495237} \text{ x } 100 = 0.65\% \quad (2)$$

$$2016 = \frac{441022-495237}{495237} \text{ x } 100 = -10.9\% \quad (3)$$

$$2017 = \frac{479918-495237}{495237} \text{ x } 100 = -3.1\% \quad (4)$$

$$2018 = \frac{501973-495237}{495237} \text{ x } 100 = 1.36\% \quad (5)$$

This situation is illustrated in figure 4 [16]:

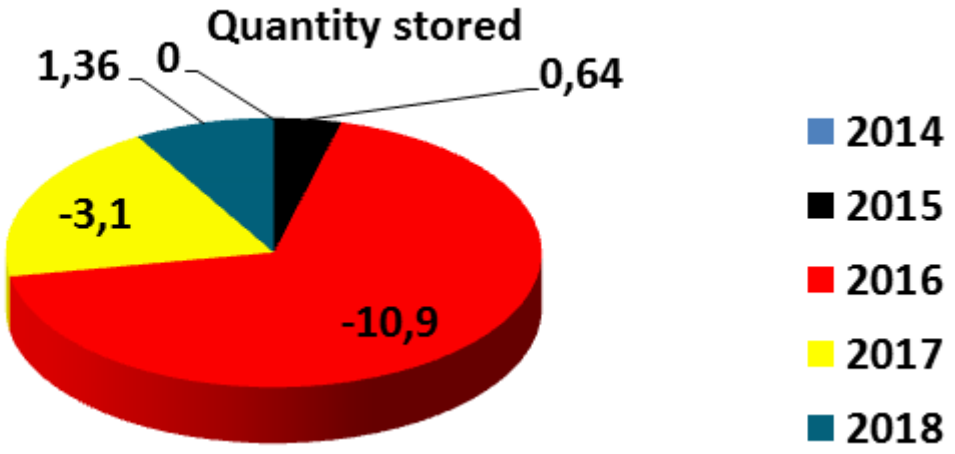

Figure 4. *Illustration of the progression of the quantity of products in stock.*

According to the information presented in this graph, the various petroleum products stored at SEP-Congo between 2014 and 2018 showed a positive evolution for the years 2015 and 2018, with an increase of 0.65% for the year 2015 and 1.36% for the year 2018. This positive trend simply means that the products stocked in 2015 and 2018 are

higher than in the reference year, 2014. These products not only showed a positive trend, they also showed a negative trend for the years 2016 and 2017. In other words, the quantity of products stocked in 2016 and 2017 is lower than in the reference year, i.e. around -10.9% for 2016 and -3.1% for 2017.

Quantity of products distributed

***Table 4**. Evolutionary table of products distributed from 2014 to 2018.*

Year / Companies	2014	2015	2016	2017	2018	Total	%
Cobil	136521	129333	123781	131779	153672	675086	21.4
Engen	283527	302520	268713	266543	287851	1409154	44.7
Total	222322	199557	177043	162043	161108	922073	29.2
Sonahydroc	6312	5175	4359	6393	180	22419	0.7
GNPP	14014	24419	33219	31772	9731	113155	3.5
Miscellaneous	1249	0	0	0	3979	5228	0.1
Total	663945	661004	607114	598531	616522	3147115	100
%	21.0	21.0	19.2	19.0	19.5	100	
% change		0.4	-9.3	-10.9	-7.6	78.9	

***** Table based on data collected at Sep Congo. [17]

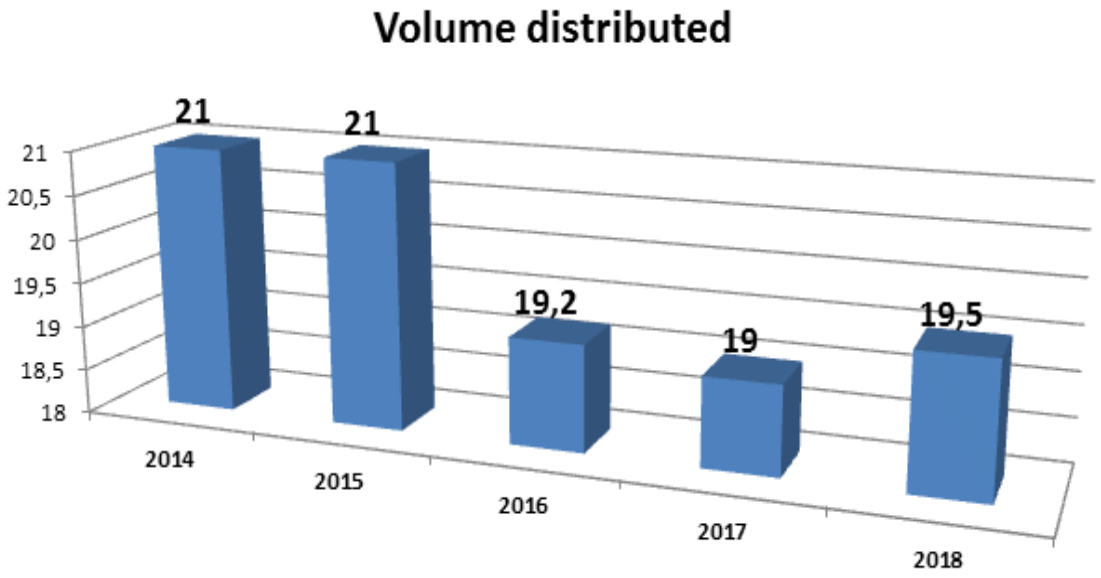

Fig.4. Evolutionary graph of products distributed from 2014 to 2018.

Comment: According to this illustration (17), SEP-Congo supplied petroleum products to Socom: Cobil, Engen, Total, Sonahydroc SA, GNPP and various SMEs. The volumes distributed in 2014 were 663945 m^3 and 661004 m^3 in 2015. A decrease in quantities delivered was observed in 2015. This trend continued in 2016 and 2017. In 2018, volumes delivered increased.

Employee training as a means of preventing hazards and accidents [20]. As an activity aimed at improving an employee's skills [25], staff training on safety measures is considered a hazard and accident prevention measure for SEP Congo. Staff are prepared and informed about the dangers of petroleum products and their harmful effects on human health.

According to Sep-Congo, staff working in the Kin1Gombe depot receive regular training to teach them how to avoid potential risks and accidents.

For the SEP-Congo authorities, vocational pre-training is provided by the various school curricula, accompanied by practical on-the-job training. However, it seems that this is no longer adequate today to guarantee the company's competence and enable it to cope with the rapidly changing socio-economic context. A need for adaptability and creativity is replacing the need for adaptation, which relies entirely on the company's human potential [21].

These strategies, which were conceived with the primary aim of maximizing productivity, must now take into account the need to stimulate the innovation discovery processes essential to the company's survival in a fluctuating economic and social context.

SIGNAGE AS A SAFETY TOOL FOR RISK REDUCTION [10]

Warning signs as a means of hazard prevention

In some oil depots, hazardous areas can be marked out to avoid risks. In other words, signs describing the nature of the hazards are installed to give workers or visitors added precaution. It is therefore essential to have warning signs in oil installations, given the risks associated with the products to be handled.

In the Kin I depot, there are a few safety signs to alert workers and visitors to potential hazards and accidents. Visitors are therefore not allowed to enter hazardous (prohibited) areas.

We are going to illustrate the road sign models as described in the Kinshasa/Gombe base depot.

No smoking sign

Smoking is strictly prohibited on SEP-Congo premises, as there is a risk of fire or explosion due to the volatility of petroleum products.

No calling sign

Cellular phones cannot be used during loading and unloading of petroleum products in the Kin I depot.

Vehicle positioning sign

Vehicles must be parked in the parking lot; the engine must be switched off when the car is parked.

Traffic access sign

This sign marks areas where people can move around. Since storage facilities are extremely dangerous places, it is impossible to move around SEP Congo at any time.

Flammability panel

Risks: flammable substances heat up when subjected to a source of energy (flame, spark, etc.) at temperatures varying according to their nature and in the presence of air. Some products even heat up below 0°. Flammable substances can be solid, liquid or gaseous. The fire triangle is made up of flammable products, oxidizer and energy source.

Toxic sign

Risks: dangerous substances when they enter the body through the nose, mouth or skin.

- Substances that induce these cancers;
- Mutagenic substances that cause genetic mutations leading to cancerous tumors or have an impact on reproduction.

GENERAL RULE OF SAFETY MEASURES AS A MEANS OF RISK REDUCTION

Access to the facility

It is strictly forbidden to enter the SEP-Congo premises, unless authorized by the reception desk manager or invited.

Traffic and parking

In order to prevent hazards and accidents, a comprehensive system has been set up at the Kin I-Gombe depot to ensure safe circulation of vehicles, personnel and tanker truck parking.

Accident prevention [3]

When handling products, accidents, risks and hazards can occur. This is why various rules have been put in place at the Kin-Gombe depot to prevent any potential accidents.

Tank maintenance before storage to avoid risks

Thank-you maintenance is carried out by a specialized team using appropriate equipment. It is even possible to open the lower part of the tank so that the designated agents, equipped with all the necessary protective equipment, can enter to carry out radical maintenance.

Tank maintenance is carried out after three years, usually at Sep Congo Kinshasa/Gombe. Tank maintenance lasts 3 years for GO and 5 years for super fuel. SEP Congo has qualified technicians for this purpose.

In the event of an accident, SEP-Congo has a rescue center on its premises, including an ambulance for first aid.

In the event of serious accidents, a company ambulance or available vehicle must transport the injured to the nearest major hospital as quickly as possible.

Problems related to safety measures in the transport of petroleum products at SEP-Congo

The difficulties concerning safety measures when transporting petroleum products concern the following elements:

- If the fire cannot be quickly brought under control, it is often followed by explosions;
- The question of pollution, when petroleum products penetrate soils and contaminate groundwater;

Material damage (tanks, warehouses) and the loss of petroleum products are a major problem.

Pipeline failure, loss of containment, rupture or wear, as well as leakage caused by external events, are frequent problems.

Following this analysis, it is clear that the various factors examined are mainly:

- Human-related causes 33.3%;
- Hardware failure 22.2% ;
- Unknown causes 18 to 22%.

When handled, petroleum products are hazardous to the environment and to human safety due to their nature (toxic, volatile, flammable).

- The development of transport infrastructures and the increase in transport capacity and traffic are increasing the risk of road accidents.
- The development of transport infrastructures and the increase in transport capacity and traffic are increasing the risk of road accidents.
- On inland waterways, numerous incidents occur in connection with the loading, transport or unloading of petroleum products [9].

Risk assessment [16]

By assessing risks at SEP-Congo each year, it will be possible to detect the company's major risks and develop action strategies. Risk assessment is part of a development approach aimed primarily at strengthening social dialogue through group work, and improving working conditions once action plans have been put in place.

Ongoing crew training

They say prevention is better than cure. In risk management, prevention is the number one rule [24]. And for prevention to be effective, it is imperative to constantly raise the awareness of crew members and anyone who passes by on floating units.

N.B.: The presence of large numbers of local residents aboard oil tanker convoys on the river represents a considerable risk of fire and other accidents. The following areas of awareness are mentioned:

Fire prevention [4]

- Regular practice of fire training or drills;
- Knowledge of fire information to communicate to crews in order to avoid risky situations;
- Adequate quantities of fire-fighting equipment in clearly visible and easily accessible places;
- The pictograms “Smoke prevention”, “Smartphone use prevention” or “Flame spread prevention” are placed on the various bridges.

Accident prevention

- The aim is to make crew members aware of dangerous behaviors and risky situations to avoid.
- Appropriate and necessary wearing of equipment.

Risk reduction

In order to reduce risks, we believe that this implies:

- Encourage people who come into contact with a difficult public, and organize the reception of the latter;
- Clearly establish the responsibilities of each employee and establish transparent and fair personnel management.
- Acknowledge the efforts made by your employees when they are overworked, and express your gratitude (in writing or by word of mouth, through bonuses, remuneration, ...);
- At the first sign of tension, discomfort, isolation or danger to employees, it's essential to react.
- Plan changes early so that your teams are better prepared;
- Adjust working hours to suit family and social life (taking into account crèche closing times).

Economic advantages

The risk of fire, explosion, drowning, running aground on sand or rocky bottom, inhalation of hydrocarbon vapors, asphyxiation or poisoning results in considerable losses, which can run into millions of dollars.

These accidents and/or malfunctions will have major human, financial and legal repercussions for SEP-Congo.

In this way, SEP-Congo will be able to reduce, mitigate and prevent risks in order to reduce potential disasters (loss of life, products, equipment, etc.), to guarantee economic growth and environmental preservation.

CONCLUSIONS

The conclusion underlines the crucial importance of proactive risk management of petroleum products at SEP-Congo. Although the accident rate is relatively low at 20%, it is imperative to maintain constant vigilance to avoid catastrophic incidents such as fires or leaks. The hazardous nature of petroleum products, characterized by their toxicity, flammability and volatility, calls for rigorous and appropriate safety measures.

To enhance safety, it is recommended that SEP-Congo implement a risk sampling system to quickly identify potential hazards. In addition, reinforced monitoring of handling operations and replacement of worn-out equipment are essential to minimize risks. It is also essential that the state plays its part in strengthening regulations in the oil sector, ensuring strict supervision of storage and transportation practices.

In short, collaboration between SEP-Congo and the relevant authorities is necessary to establish a safer and more sustainable operating environment, protecting not only the company but also the surrounding community.

REFERENCES

[1] Le Robert Dixel Mobil 2015 version 1.2.1, 2023

[2] Eyonga Batanga N., Gbiabelo Z.C., La gestion de transfert fluvial des produits pétroliers et sa contribution au développement économiques de la RDC, Cas des services des Entreprises Pétroliers Congolaises (SEP-Congo), Faculté de Pétrole et Gaz/UNIKIN, 2015.

[3] Rapport du Directeur général sur l'activité de l'AIEA en reaction à l'accident de Fukushima, juin 2011.

[4] Mbosei A., Notes des cours de Réseau de distribution des produits pétroliers, 2ème grade gestion, Faculté de Pétrole et Gaz, (inédit). 2019

[5] Bisengimana R.B., La part des produits pétroliers dans la fixation des prix, 3ème édition, Goma, 2008

[6] Wafula D., Cours d'analyse des risques en exploration pétrolière, 1er grade gestion et économie pétrolière, UNIKIN, 2017.

[7] Boka M., La prévention contre les risques et accidents au sein du dépôt d'une entreprise pétrolière, Institut du Pétrole et du Gaz (I.P.G), 2017.

[8] SEP-CONGO, Pertes et coulages, 2007.

[9] Leclerc A., Transport maritime du pétrole Analyse historique et prospective de la demande, Université de Montréal, Page 26, 2002.

[10] SEP-CONGO, Dépôt de Kinshasa, Procédure de chargement de barge citerne, 2000.

[11] Imbungu E., La prévention des risques et accidents au cours de chargement des barges citernes en produits pétroliers au sein d'une entreprise pétrolière, Cas de la SEP-Congode 2008-2012, Institut du Pétrole et du Gaz (I.P.G), 2017.

[12] Wuithier P., Le pétrole raffinage et génie chimique. 2ème édition, Tome I, Editions Technip, 27 Rue Ginoux, 75737, Paris, Cedex 15, 1972

[13] Tremblay N., Manuel de gestion de Parc des réservoirs, Paris, Page 26, 2009

[14] Sidorov N., Forage et exploitation des puits de pétrole et gaz, Ed. Mirmoscou, traduction française, Ed. Mir, p.1986, 1990

[15] Marving G., Le pétrole, une richesse inquiétante, Ed. Bordin, Paris, p.7, 2003.

[16] SEP Congo/Unité logistique, Manuel de la structure de l'unité logistique, Kinshasa, 2009.

[17] Feruzi N.F., Prévention des risques et accidents pour le personnel affecté au transport de produits pétroliers par camion-citerne, Cas de SEP-Congo de 2010 à 2014, Institut du Pétrole et du Gaz (I.P.G), 2017

[18] Lubelanu M.E., Gestion des enjeux environnementaux au cours de transport des produits pétroliers par pipe-line, Cas de PL 46-De SEP-Congode 2009-2014, Institut du Pétrole et du Gaz (I.P.G), 2017.

[19] Maila K.H., Problématique de la gouvernance des revenus pétroliers en RDC, Faculté de Pétrole et Gaz/UNIKIN, 2015.

[20] Buloba A., Rapport de stage effectué au dispatching/PL et Laboratoire de Chimie, Base de Ndolo et Masina SEP-Congo. 1995

[21] SEP-Congo Document, éd. 2016.

[22] Mbuyi Muteba J., Comportement des produits pétroliers dans leurs transports, Stage SEP-Congo, éd. 2015.

[23] https://www.connaissancedesenergies.org/fiche-pedagogique/petrole consulté le 31/01/2024

[24] https://waahooo.fr consilté le 10 juin 2024 www.unige.ch

[25] http://www.wikipédia.org

[26] https://www.officiel-prevention.com

Received: November 2024; Revised: January 2025; Accepted: January 2025; Published: January 2025