International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Journal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-9, Issue-9; Sep, 2022
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.99.16

The logistical challenges to implement the environmental management system in a natural gas company in the North Region

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Received: 15 Aug 2022,

Received in revised form: 07 Sep 2022,

Accepted: 11 Sep 2022,

Available online: 14 Sep 2022

***Keywords*— Environmental management system, ISO 14001, Natural gas.**

***Abstract*—** *The implementation of the environmental management system (EMS) in large companies arises from the need to standardize operations and reduce environmental impacts. The general objective of the study is to develop a protocol for an environmental management system based on ISO 14001 standards in a natural gas company in the region of Amazonas-AM. The monitoring data, indicators of the SGA used in this work were collected in a gas pipeline company in the North region, located in Manaus. In the development of this work, the methodology used consists of exploratory, documentary, with quali-quantitative data, where a survey of information about the EMS of the companies and the logistical system used for the execution of the EMS activities was carried out. The information was collected through interviews and questionnaires applied to the company's environmental professionals. It is concluded that in an internal context, the company is well strengthened because within its processes in the value chain, there are well-structured areas such as Social Management, Environmental Management in its licensing, monitoring and environmental auditing segments, which contribute to ensuring legal, contractual and international standardization requirements, such as those of the ISO 14001:2015 standard. However, the work found, in a comparative analysis with other regions, that the region's logistics system is the main challenge for the company that works with natural gas that affects organizational activities and, consequently, its EMS is affected. Therefore, it appears that the aspect that must be developed immediately to improve the EMS is logistics.*

I. INTRODUCTION

Natural gas is a mixture of gaseous hydrocarbons, being composed almost entirely of methane. It also contains hexane, nitrogen, water vapor and some contaminants such as hydrogen sulfide – H2S and carbon dioxide – CO2.

Natural gas is lighter than air, has no smell or color. It is found in Nature, underground in large reservoirs, associated or not with oil. It is a non-renewable energy source. Like oil, natural gas results from the degradation of organic matter, animal fossils, plants that have been accumulated in rocks for many years. Withdrawal is

through drilling. Raw natural gas comes from three types of wells: oil well, gas well and condensate well.

In recent years, natural gas consumption has been directly linked to the growing need in Middle Eastern countries, with 16% of natural gas demand, and Asian countries, with 13%. As for the countries that are in the Organization for Economic Cooperation and Development (OECD) bloc, they use 46% of the natural gas extracted from various continents, and in the case of North American countries, only the United States uses 22% of the global production, followed by Russia with 11% and China with 8% [1].

In Brazil, in its greatness, there are numerous contributors to its fuel production, starting with the use of coal and fossil fuels as a source of energy. The use of natural gas chemically defined as a hydrocarbon based on methane, ethane, propane and butane, which allows conversion into energy production, has resulted in reduced deforestation and fires. Another factor that has been expanding the gas market is the dollar swings, which contributed to the rise in the prices of oil-derived fuels, causing a migration in the consumption of natural gas by the industry in the last 3 years, with a growth of 50%, followed by motor vehicles with 8% of the use of gas kits. For Brazil, in its gigantic territorial scale and water resources, natural gas is still an underexplored resource [2].

Amazonas has a benefit relationship with natural gas, after switching fuels in thermoelectric plants, reducing up to 73% of polluting gases. Other cities that are part of this route, which also had a significant improvement in air quality were Coari, Anori, Anamã, Codajás and Caapiranga. These cities also had an improvement in aspects of reducing the traffic of ferries and trucks that took the fuel to the plants [3].

The Urucu reserve has one of the lowest extraction costs compared to other Brazilian states. Its extraction capacity is set at 5.5 million m3 per day. The distribution of this gas since 2009 is the responsibility of Companhia de Gás do Amazonas (Cigás), and the role of natural gas commercialization is also attributed, which resulted in a change in the environmental scenario of several cities after the implementation of pipelines that supply thirteen thermoelectric plants responsible for the production of electric energy in the state [3]. The change in the energy matrix, changing the use of diesel oil for natural gas, represented a reduction in the environmental impact of 70 million liters of diesel, responsible for releasing carbon monoxide (CO), Nitrogen Dioxide (NO2), Sulfur (S), among other gases identified as direct agents of global warming and damage to the ozone layer [4].

Thermoelectric plants have fossil fuel feeders that convert the burning (heat) into electrical energy and, although natural gas represents a reduction in pollutants, it is still quite shy, being used by only 9.6% of the energy produced by this energy matrix [5].

The role of thermoelectric plants in the northern region of Brazil has a strategic action in order to meet the electrical needs of the population and industry and can also help in the production of surplus energy in cases of water crisis and other problems that make the notorious blackouts possible. [6].

To achieve energy security, companies seek studies with an emphasis on the environment through ISO 14004:2018 or Integrated Management System (IMS). It seeks to minimize the environmental impact, reducing the pollutants generated in the process of extracting natural gas in all its stages. Another important step towards this objective is related to the electrical system, which allows for diversification in the energy matrix and reduces dependence on oil and conflicts in the fluctuating price of a barrel. And this contribution directly affects society, which now has a more competitive and secure market, thus avoiding energy production through coal and nuclear energy. For the economy, this is an expansion in the range of energy production through free market competitiveness. It attracts new investments to the sector and favors local development. In terms of business itself, it starts to use an old modal, which is the gas pipeline, which greatly avoids atmospheric pollution, congestion and favors the development and investment in new plants that represent cheaper energy production, new jobs and more local attractions. [7,8].

The implementation of Integrated Management Systems (IMS) in large companies arises from the need to standardize operations and reduce environmental impacts. In this sense, this study justifies the emphasis on directing a business policy establishing guidelines related to the quality system, well-being, environment, health and practices that guarantee labor, technical and environmental safety [9].

The environmental management system (EMS) of a natural gas company tends to communicate all other sectors, minimizing possible environmental impacts through public and private policies. To this end, the company under study was a pioneer in the reservoir-to-wire (R2W) management model, which allowed the production of thermal energy generated in the extraction fields and terrestrial producers of natural gas on shore, taking the surplus to the National Interconnected System (SIN) by the transmission networks deployed nearby. This ensured an improvement in regional supply in distant areas, minimizing the blackout in that region [10,11].

These actions must be related from the mission, vision and values perpetuated in organizational behavior and corporate culture. The extraction of natural gas is directly linked to that of oil, which puts it at risk of major environmental impacts, and, in the face of such risks, a functional system allows for direct action in cases of environmental accidents, preparing the company to reduce possible impacts and minimize those that may happen [12].

However, the operational competencies needed to engage with the EMS can also support the organization's efforts to minimize environmental impact along its supply chain. Organizations that practice EMS directly adapt green initiatives into their organizational supply chain operations. Therefore, EMS operators can rely more on knowledge-based resources that combine them to work with their networks of suppliers and customers to reduce environmental impact around the world.

However, Moreira, De Freitas Junior and Toloi [13] point out that in Brazil, it is estimated that 344 million reais are used in logistics costs per year, with the road system being one of the most used modes, and its participation comprises 61.1% in relation to other modes. However, the road network does not offer an adequate infrastructure when compared to other countries, since 12.9% of the roads are paved, taking into account that only 60% are considered to be in poor condition.

In the North region, this gap is even greater, as the lack of a land connection with Manaus currently represents a significant barrier to migration to Central and Northern Amazon. A variety of changes would be required prior to paving the road if these potential impacts are to be mitigated. This includes zoning, creating reserves and increasing governance in a variety of ways, including deforestation licensing and control programs, as well as heavy financial investments because it is a major highway.

In this way, this work brings the search not only to reduce the environmental impacts generated by natural gas activities, but to show the logistical challenges in carrying out environmental management in one of the most challenging regions of Brazil: Amazonas, which has unique and complex characteristics for the execution of large-scale activities such as gas pipelines. It has periods of floods and ebbs in its rivers and tributaries, and dense forests. As it is a basically isolated region, the purchase of equipment, products and services to carry out activities takes longer, which makes it much more difficult to carry out activities in the state. The logistics adopted in the state of Amazonas need to be well planned due to several local peculiarities. Transport is basically by waterway, which makes logistics time-consuming and expensive.

Therefore, the objective of the study is to analyze the logistical challenges to implement the environmental management system in a natural gas company in the North region.

II. METHODOLOGY

The study areas are divided into 3 regions in Brazil, the North region being the main study area.

The city of Manaus is part of the Legal Amazon, located at 3ºS latitude and 60º W longitude, between the Negro and Amazon rivers. Located in the interior of the state of Amazonas, the city of Coari is situated at an altitude of 34 meters, at 4° 5' 6" S and 63° 8' 30W. Operations of the Urucu-Coari-Manaus gas pipeline began in 2009, with the capacity to transport 6.85 million m3 per day. Its extension is 139.3 km distributed in 09 branches. Its route crosses the municipalities of Manaus, Iranduba, Manacapuru, Caapiranga, Anori, Anamã, Codajás and Coari. The map below shows the location of the area covered by the gas pipelines in Amazonas.

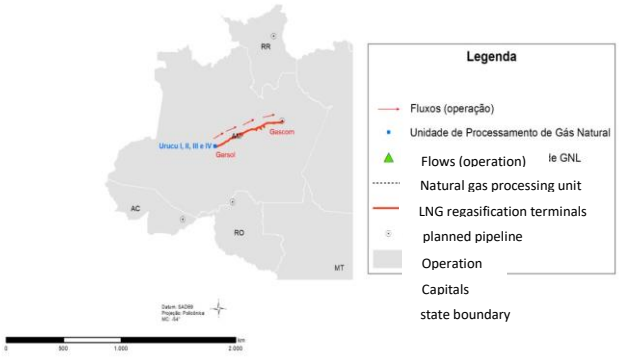

Fig.1: Scope of gas pipelines in the North region

Source: Adapted from Ministry of Mines and Energy [14]

Transpetro is responsible for the operation and maintenance of more than 7,155 km of gas pipelines. This network integrates the Northeast and Southeast regions, allowing great operational flexibility. It also includes the transport of natural gas from Urucu to Manaus, in the North region. 75% of all natural gas consumed in Brazil flows through this pipeline network [15].

The Gas Pipelines in the Northeast region cross 7 states: Bahia, Ceará, Paraíba, Sergipe, Rio Grande do Norte, Alagoas and Pernambuco and 147 municipalities, allowing a great operational activity.

However, in the Southeast region, the pipelines cross 2 cities from Rio de Janeiro to Espírito Santo, and 23 cities along the Southeast region. The map below shows the

location of the area covered by the gas pipelines in the Northeast and Southeast regions of Brazil.

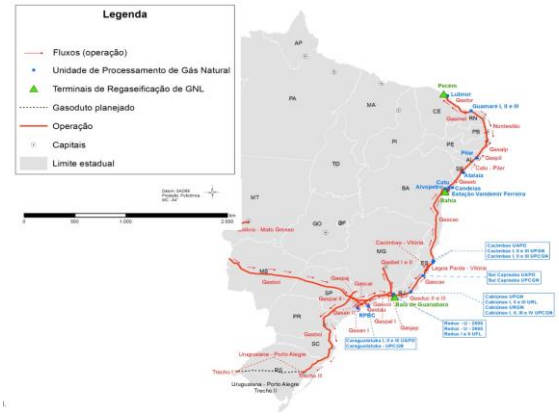

Fig.2: Coverage area of gas pipelines in the Northeast and Southeast regions of Brazil

Source: Adapted from Ministry of Mines and Energy [14]

Natural gas in Brazil is distributed in the North, Northeast and Southeast regions and has the capacity to move 74.67 million m3/day. Being of great importance to Brazil, within this chain of activities performed, is the Environmental Management System and its diversities of logistical modes. The North region stands out for the great challenges, since some points of the North gas pipeline are located in remote areas.

The work emphasizes the existing logistical challenges in the Environmental Management process in a natural gas company in the North region. The study was based on the collection of information related to the EMS indicators used by the company. For this, the company's management processes in three different regions of the country were analyzed. The purpose of this analysis is to obtain an overview of the possible logistical challenges in applying environmental management. Below is a description of the study steps to carry out this work, which is summarized in the flowchart shown in Fig. 3.

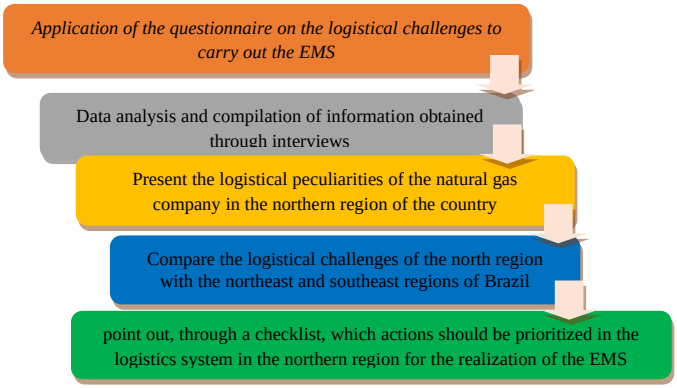

Fig.3: Flowchart for carrying out the study.

Source: Authours (2022).

First Step: *Application of a questionnaire on the logistical challenges to carry out the EMS.*

At first, a survey of information was carried out on the EMS processes carried out in the core of natural gas companies located in the North, Northeast and Southeast regions. The purpose of this step was to understand the logistical organization of the activities developed in the company, as well as the fulfillment of the activities schedule for each indicator of the Environmental Management System. For this, on-site visits were carried out, and in them interviews with the 10 specialized professionals of the SGI of the natural gas company. As an aid in the standardization of the process, 14 standard (discursive) questions were applied about the experience as environmental managers and the logistical challenges in the applicability of the EMS (Appendix A), in addition to topics such as logistics and waste management; of water resources and atmospheric emissions.

Through the application of the questionnaire, the logistical peculiarities of the natural gas company in the North region of the country are obtained, as well as information to compare the logistical challenges of the North region with the Northeast and Southeast regions of Brazil.

From the results obtained in the previous step, it was possible to obtain an overview of the reality of EMS managers today, in addition to the challenges faced by them regarding logistics in environmental management. The analysis of the information collected took place through a qualitative approach, which made it possible to compare the environmental management activities carried out, and the challenges of each of the regions analyzed.

Finally, the research is finished by presenting the actions that should be prioritized in the logistics system in the North region for the realization of the EMS.

III. RESULTS AND DISCUSSION

Application of a questionnaire on the logistical challenges to carry out the EMS

With the application of the questionnaire to the employees of the natural gas company who apply the EMS in their daily lives, it was found that they have a series of challenges that will be presented below.

Through Question 1, it was possible to verify from the 10 employees trained for the function, that 90% of them pointed out that logistics would be the biggest challenge in the North region, due to the geographic and environmental conditions of the region. This problem was also pointed out by Ferreira [16] in a study on the challenges to logistics operations in the Amazon: the difficulties of

friction in the supply of border units. On the other hand, when the question was made to the same profile of employees, but in different regions of the country (Northeast and Southeast), they did not indicate any type of problem and/or challenge in logistics.

When the focus of the question was on the logistics used in the monitoring of sanitary and industrial effluents (Question 2), that is, the logistics to carry out the collections in their respective region for the environmental monitoring, according to CONAMA Resolution No. /11, 90% of the interviewees showed that: in the North region, effluent monitoring is done through an efficient schedule, since some units are in extremely remote areas, where the travel time between facilities and cities is around 9 hours by boat [17]. Therefore, a whole logistical planning is necessary. In this perspective, Teixeira et al. [18] points out that 50% of the inhabitants have an active connection to the sewage system, that is, half of the population residing in Manaus discard their effluents directly into the receiving water body, causing the pollution of water courses, as well as the proliferation of waterborne diseases, which are among the main reasons for the increase in infant mortality in the city of Manaus. On the other hand, in the Northeast and Southeast regions, the effluent collection process is carried out by means of a car, carried out in a single day, and in some points, it may take only a few hours.

As for the disposal of common waste (class II) - question 3, 90% of the answers show that in the North region, the disposal of waste is carried out at the Manaus facilities on a weekly basis by a duly licensed company. However, in cities in the interior of Amazonas, such as the city of Coari and nearby locations, logistics take place every six months or around 5 days for the process to be completed. In comparison to the other regions, the Northeast and Southeast give a destination to their common waste weekly, through the services of a duly licensed company, using a collection truck for transport.

Question 4 refers to the organization of Class I waste disposal activities. Employees of companies operating in the EMS in the North region show this class of waste as one of the biggest challenges in the region, where 90% responded that the logistics for the destination of these wastes in the interior of Amazonas is carried out through a schedule, taking into account all the security processes, as the activities are carried out through two different modes of transport (Munck truck and ferries), taking an estimated time of 9 to 10 days for the final destination. At the same time, at the Manaus units, the programming takes place in 1 day, being transported by trucks, following the indications of the norms and legislation in force. The biggest challenge of the units located in the municipalities of the state of Amazonas is the lack of companies duly licensed for the correct disposal of waste, and that can comply with the legislation. According to Mello and Sehnem [19], 90% of the companies in the country dispose of Class I waste through outsourced companies, because depending on the type of Class I waste, this may require pre-treatment, such as sorting, neutralization and chemical stabilization. However, in the Northeast and Southeast, these residues are transported in trucks following the rules and legislation in force.

Question 5 asks what are the biggest challenges for carrying out waste disposal activities at the units where you operate. 80% of the people who participated in the survey pointed out that the biggest challenge in the North is the issue of logistics and the units located in the municipalities of the state of Amazonas do not have properly licensed companies, where waste can be disposed of correctly and in compliance with legislation. De Souza Mafra, Do Nascimento and Da Silva [20] explain that a study of data from the Municipal Department of Cleaning and Public Services (SEMULSP) proves that in Manaus, 163 tons of recyclable waste are collected monthly, which is equivalent to only 0.17 % of all waste produced. Due to the lack of waste processing industries, a good part of this input ends up being sent to the Southeast for reuse or returns to the common waste, and therefore the need to invest in public policies to attract investors is understood. Thus, when comparing the other regions of the country (Northeast and Southeast), it seems that the biggest challenges are the distances from one municipality to another, but all routes are carried out by land, public roads.

Following the compilations of the analyzed questions, in question 6 we try to identify what public bodies act in the transport of waste, which in the North region is carried out by the environmental agency of the state and municipality, in addition to the Brazilian Navy. In this line of reasoning, Viana [21] states that 56.6% of Brazilian cities had initiatives aimed at recycling materials in 2019. This number increased to 70%. However, despite advances, recycling rates in the country are below 4%. In cities like Manaus, the annual production of waste reaches almost 933 thousand tons, with less than 1% of this total being recycled or reused. But in the Northeast region, the institutes are IBAMA, a state and municipal environmental agency. Finally, in the Southeast region, those responsible are IBAMA, the state environmental agency.

Question 7 is related to the compliance with IBAMA Ordinance No. 85 of October 17, 1996, which stipulates the creation of an internal program to inspect emissions from diesel transport. Respondents pointed out that in the North, Northeast and Southeast regions, controls are carried out on vehicles, as recommended by the referred

standard [22]. Leite and Dutra [23] point out that the company analyzed by them maintained a performance of 84.6%, contributing to air quality and that the correct maintenance of this equipment is an indispensable factor to allow the control of emissions, due to the environmental impact caused by diesel-powered equipment.

When asked if the natural gas company to which they belong carries out the disposal of waste from the Oily Water System (OWS) (Question 8) in their region, 90% of respondents in the North region answered that the disposal of waste generated in the OWS of the units in the municipalities in the interior of Amazonas, are stored annually and sent by ferry to Manaus, taking around 10 days. And when it needs to be disposed of, a logistics schedule is carried out with risk analysis of the activity of the vessels that will be used, in line with the rules for the disposal of hazardous waste. However, in the Northeast and Southeast regions, a risk analysis of the activity is carried out, and a schedule and destination through public roads. Usually the final destination happens in 1 day.

Question number 9 addresses Ordinance No. 5/2017, which establishes the responsibility for controlling and monitoring the quality of water for human consumption, and its potability standard [24]. It was noticed that 90% of the interviewees pointed out that the collections for the analysis of water potability are carried out as a logistical schedule, given that some units are in extremely remote areas, where the estimated travel time is approximately 9 hours, using a speedboat. But in the Northeast and Southeast regions, the collection of water samples is carried out by car in a single day, and the activity can take place in some locations in a few hours.

The purpose of question 10 was to understand the logistics in cases of environmental emergencies at the facilities. Around 80% of the interviewees pointed out that in cases of emergency, the North region presents a very complicated logistics, and due to the geographic isolation of the region, displacements demand a lot of time. In some types of emergencies, heavy equipment and materials not available in the region are required. On the other hand, in the Northeast and Southeast regions, the biggest challenge may be the availability of materials available in the units at the time of the environmental emergency.

Regarding the challenges to meeting constraints in their region (Question 11), 90% of respondents point out that in the North region, logistical displacements to meet constraints require a schedule in advance, and in the case of inspections, meetings or technical follow-up by the agency environment, and sometimes it is necessary to reprogram. However, in the northeast and southeast regions, compliance with conditions is well-organized, requiring no programming.

Question 12 presents the biggest challenges in hiring companies to provide environmental services to your region. According to the research participants, 90% point out that the North region has many difficulties in hiring companies both in Manaus, but mainly, as in the municipalities of the interior of the state. Companies from outside Manaus are usually hired, which greatly increases the costs of activities and equipment. However, the Northeast and Southeast regions have a greater diversity of companies and services, which makes hiring easier, and mainly because all logistics are basically by automotive transport.

Question 13 describes the biggest challenges to ensure that the EMS is complying with current legislation. After the investigation, 80% point out that in the North region the greatest difficulty is related to logistical challenges, compliance with legislation, as for some we do not have the necessary acceptable parameters as required by legislation, and hiring companies in places where they have facilities, and in cases of compliance with rules and legislation, reports are always made emphasizing compliance. In the Northeast and Southeast regions, the challenges are smaller than in the North, once the activities are carried out with more logistical facilities, and because the facilities are located close to more developed cities.

When asked about the biggest challenges for water scarcity in their region, 80% of the answers point out that each region has a peculiarity, since in the North, unlike other locations, in relation to water resources, there are no risks of scarcity. In the Northeast, in some points, due to water supply difficulties, a contract with a water truck is carried out to supply the facilities. Finally, in the Southeast, the units have an artesian well with controls and water rationing due to periods of drought.

The last question of the survey comprises management activities in which environmental indicators are carried out safely, and 90% pointed out that, in common to all regions, all environmental management activities in the natural gas company are always carried out with advance planning, with meetings of the areas involved, establishing a system for the application of the Preliminary Risk Analysis (PRA) technique, with a view to anticipating, identifying, evaluating and controlling the risks to Safety, Environment and Health in the facilities and/or areas covered by the company:

- Identification of the need for risk assessment;
- Constitution of the PRA team when necessary;
- Collection of data and information;
- Identification of aspects and hazards;

- PRA preparation when necessary;
- Analysis, completion and approval of the PRA when necessary.
- In cases of less critical activities, monitoring of these activities by a responsible professional is carried out.

For all regional offices, meetings are held before the activities to address safety, health and environmental aspects related to the activity to be carried out. Before entering the units, all service providers must attend the safety briefing, know the company's facilities and know how to leave the area in case of emergency siren alarms.

Compilation and Analysis of information obtained by managers

Improving environmental performance becomes increasingly important to the success of an organization. Through this study, which focuses on the interaction between environmental performance and logistics system in the North region, compared to the Northeast and Southeast regions of the country, we seek to find a way that helps organizations to achieve the ideal condition of obtaining cost efficiency. and environmental responsibility at the same time.

The best choice for organizations to achieve sustainable development is to effectively control costs as well as reduce waste and environmental pollution. This is a double effect that, once organizations adopt the Environmental Management System (EMS), they can examine the possibilities of improving the performance of their logistics system, reducing the negative impact on ecosystems in the logistics operation, as well as discovering proactive solutions to optimize their costs [25].

As discussed throughout the work, the ISO 14001:2015 standard (or Environmental Management System) is a tool created to assist the management of organizations and balance socioeconomic and financial interests with the impacts generated by their activities, which can help them to identify, prioritize and manage their environmental risks [7, 26]. Environmental performance indicators aim to demonstrate organizational practices in order to minimize the impacts on the environment resulting from their activities [27].

The study has the proposal to gather information about the EMS in a natural gas company, relating the challenges of logistics in Amazonas. The environment management system is used to increase its performance in relation to environmental responsibilities, being one of the most used standards by several sectors of the industry, including natural gas [28].

In general, the different variables that are part of this process are under the perspective of the ISO 14001:2015 standard, thus identifying the different stages that compose it and the impacts generated on the environment, which serve as an input to a starting point in order to establish and implement the different control alternatives aimed at the source of the impact, its environment and people, establishing then, environmental guidelines that contribute to preventing, mitigating, correcting and/or compensating for the damage generated in the environment caused by the identified environmental problem, as well as complying with the obligations established in the exploration and drilling contracts awarded to the company [7, 29].

The ISO 14001 standard is part of a family of standards that refer to environmental management and protection applied to the company with the aim of formalizing the systematization of processes and tasks that have a direct or indirect impact on the environment. This standard establishes requirements on the systematic work that must be carried out in relation to activities that generate an environmental impact [7, 30].

ISO 14001 is applicable to any organization, regardless of support, type or nature. It is used in the environmental aspects of its activities, products and services that the organization determines that it can control or influence its life cycle. It can be used in whole or in part with the idea of improving environmental management, however, it is necessary to fulfill all the requirements of environmental management in the organization [7, 31].

It is necessary to know that the adoption of ISO 14001 requirements does not in itself guarantee excellent environmental results. The success of the standard lies in the commitment of all functions and levels of the organization, under the leadership of senior management. Helping an organization to achieve the expected results, adding value to its environmental management system, adds value to the environment, to the organization itself and to its stakeholders [7, 32].

CONAMA Resolution 430 of May 13, 2011, provides for the conditions and standards of effluent discharge, in which the analysis parameters are: physical-chemical and biological: Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), total oils and greases, total and thermotolerant coliforms. These parameters are those required in the quarterly report to be sent to the State Environment Agency (CPRH), the State's environmental control agency [17, 33].

As we can see, the North and Northeast regions deal with the disposal of SAO waste differently, but they are carried out in different ways due to the logistical issue that impact on the destination. In Silva's view [34] the oily

waste is formed by heavy metals, oils and greases; thus, having a high toxic level. Therefore, if ill-disposed in Nature, they will have negative and lasting impacts. Consolidation Ordinance No. 5/2017, from the Ministry of Health (MS), establishes the procedures and responsibilities related to the control and surveillance of the water quality for human consumption and its potability standard, and other measures [24, 35]. Both are properly implemented and developed by the oil and gas company of the North region and more regions.

The challenges for water scarcity in the region were analyzed, and it was found that the North region does not have a lack of freshwater resources to meet the standard demand for water when compared to the Northeast, which due to difficulties in water supply, contracts with water trucks are carried out. The Southeast, on the other hand, has an artesian well with controls and water rationing due to periods of drought.

The consequences of water scarcity, which not only includes the lack of water, but also the worsening of its quality in water bodies, the imbalance between demand and availability, among other factors that may have to come from the reduction of biodiversity to the competition between different sectors and segments of the society for water [36].

However, after some scenarios of water scarcity and pollution, the initiative on the part of companies has increased. The organization invests in research and technological development related to the management of water resources in partnership with companies, research institutions and Brazilian universities in order to optimize the use of this resource through improvement development [37]. This strategy seeks to sponsor projects related to the management of water resources, the protection of springs and forests, the preservation of the biodiversity of aquatic species, rational use of water and monitoring and promotion of the quality of water resources. In addition, it seeks to implement conservation practices in production processes, in the restoration of forests, native fauna and environmental education actions [38].

Based on the fact that the level of pollutants caused by the emission of smoke from diesel engines, one of the actions carried out by the company to reduce atmospheric emissions is presented in IBAMA Ordinance nº 85/96 of 1996, which describes the internal program of self-inspection of the correct maintenance of vehicles in all companies. The correct maintenance of vehicles is important to allow the control of pollutants, minimizing the effects of pollution by black smoke, which in this way contributes to the degradation of the environment, altering air quality and causing problems related to health [22, 39]

Fig.4: System modules

Source: Abreu [40]

In Fig. 4. we noticed that in this Pressure Reduction Station (PRS) there are several mechanical, electrical and automation components. Among them, the logistics for maintenance in all the equipment of the main line of ducts, as in the Natural Gas Compression Station (ECOMP's), Pressure Reduction Station (ERP's) and Delivery Point (PE's), and observing the structure of these stations, the system allows the maintenance activity to be safe.

Regarding the waste indicators of its operational units, they are hazardous and non-hazardous, being classified as class I and II waste. Regarding common waste destinations (class I and II), Amazonas and other Northeast and Southeast regions carry it out according to existing legislation, but with different deadlines and longer programming of activities, and with various logistical modes.

Class I (hazardous) wastes are those that pose a risk to public health or the environment, characterized by having one or more of the following properties: flammability, corrosiveness, reactivity, toxicity and pathogenicity. Class II residues are divided into A and B. Class II-A wastes (low hazard) offer chemical reaction capability in certain modes. This type of waste may show properties such as biodegradability, combustibility or water solubility. Class II-B residues are those that have a low reaction capacity and can be disposed of in landfills or recycled, as they do not undergo any type of change in their composition over time [41].

Although hazardous wastes need special care because they contain chemical substances in their composition, such as heavy metals, these wastes are usually disposed of improperly, often together with Class II waste, culminating in the contamination of final disposal sites and causing damage to the soil and water table, and consequently to the health of the population [42].

In addition, the research sought to analyze the logistical challenges facing the EMS. Fig. 5 presents the National Control and Logistics Center (CNCL), located in the city of Rio de Janeiro, which monitors pipeline failures.

Fig.5: Meshes controlled by CNCL

Source: Abreu [40]

The operators electronically detect changes in the information transmitted by the system instruments, and activate the support, operation and maintenance team, which, depending on the dimension of the anomaly, will provide the emergency service, in the event of contingency or interference in service to the customer, or even wait for a greater contingency of orders for that station, to meet the request made by CNCL.

The biggest challenge in the North is the logistics issue and the units located in the municipalities of the state of Amazonas, which do not have properly licensed companies where waste can be disposed of correctly, in compliance with the legislation.

Each transport modal has its variation in the initial investment of capital (fixed costs), and in the maintenance of the system (variable costs) [43]. However, in a survey carried out by Fundação Dom Cabral, which tabulated the logistical costs on the billing of organizations, it was shown that in 2017, the sum of logistical costs incurred by companies corresponded, on average, to 12.37% (Fig. 6).) of their gross sales, which compared to foreign companies are relatively high costs [44].

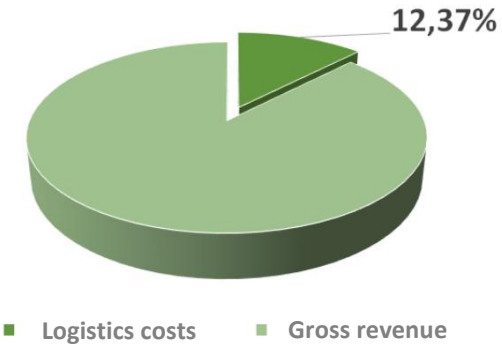

Fig.6: Average percentage of gross revenue of companies spent on logistics costs in 2017

Source: FDC [44]

Most of the production involves the movement of inputs such as raw materials, labor and fuel from different locations, so organizational strategies linked to logistics are important because they influence the organization revenue and the value of the final product. So, transport services are linked to the cost characteristics of each type of service, as each service has different cost characteristics, each modal may obtain advantages from the other transport service.

The latest statistical data published by the Brazilian Transport Planning Company indicated a total length of paved roads of approximately 123 thousand kilometers. To this total must be added about 1.3 million kilometers of unpaved roads. Today, the national road network is quite deteriorated, with extensive stretches requiring massive resources for its recovery. This situation greatly harms road freight transport, increasing travel times and increasing operational costs [45]. Fig. 7 shows the percentage of road infrastructure with pavement in Brazil.

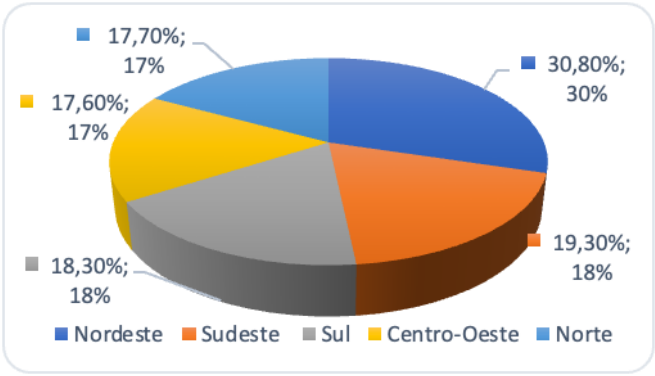

Fig.7: Percentage of road infrastructure with pavement in Brazil

Source: Adapted – CNT [46]

Fig. 7 shows, through data from the study carried out by the National Transport Confederation [46], that the road network in the normal region is one of the most outdated, with only 17.70% being paved, resulting in high logistical costs for companies, difficulty of locomotion for people and the search for other modal alternatives, often even more expensive or time-consuming for the transport of goods and people.

Prioritization actions for the logistics system in the North region to implement the EMS system

According to information found with the application of the questionnaire and through bibliographic research, it is understood that the logistics system in the North region should be prioritized considering the following aspects:

Table 1: Prioritization of logistics in the North region of Brazil

ACTIONS	JUSTIFICATION
Road resurfacing in the Industrial District;	one of the main ones is the problems of traffic accidents that can be caused by failures in the roads and delay for those who need to use them.
Make the BR-319 and BR-230 highways passable for cargo vehicles;	they need to be paved to provide a continuous flow of vehicles
Decongest the cargo terminal at Manaus International Airport;	increase business productivity, generate more jobs, connect urban and regional transport networks, recovering the economy, and offer new business opportunities.
Improve port facilities in Manaus Moderna; the economy, and offer new business opportunities.	Offer a supply system for fairs and markets, as this is the link that reciprocally feeds the city of Manaus and the interior of the State.
Nautical signaling of the rivers' gutters in Amazonas;	provide essential information to direct the movement of the ship or vessel safely and economically.
Improve the safety of navigability in the Amazon waterways;	It makes it possible to contribute to the preservation of the environment in the Amazon Region, as it will assist in the training of the crew of the vessels that navigate the Amazonian rivers to transport important commodities for export, as well as emphasizes the need for investments necessary to take advantage of the excellent potential of waterways.
Invest in regional infrastructure improvements through the implementation of maritime police stations and traceability of waterway communication	The model will contribute to the improvement of results in the transport market
Improve airports in the interior of the state to increase the transport flow	increase connectivity, enabling the expansion of the flights offer

Soruce: Authours (2022)

According to ISO 14004:2018, "increased resources and logistics required to support regional product returns can significantly increase the cost per unit of production" (p. 69). Therefore, logistical support is adequate and contributes to the EMS, as it facilitates access for receiving and sending waste, as well as enabling good traffic flow [7, 47].

The ISO 14001 standard economically improves business results, as it saves on solid waste management, which implies market positioning, as it gives organizations an image of an environmentally friendly company that meets national and international standards [48]. The activities that most contribute to the eco-efficiency of the oil and gas production chain are energy reduction programs, environmental care in the selection of suppliers, solid waste management plans and environmental licensing [49].

However, it is important to note that not all companies have the necessary skills to reconfigure their processes so that they can reduce waste, material replacement and other activities that lead to a change in the organization operations [49].

In short, it should be noted that the EMS ensures that an organization is able to maintain performance in line with established goals and effectively respond to changes in regulatory, social, fiscal and financial pressures, as well as environmental risks. It provides the company with a structured process to achieve continuous improvement, always with a high degree of environmental awareness of all the people who make up the organization. Through ISO 14001, companies position themselves as socially

responsible, differentiate themselves from the competition and reinforce their corporate image internally, due to the international scope of the standard. Companies optimize the management of resources and waste, reducing the negative environmental impacts derived from their exercise. They also promote innovation and productivity, with the aim of reducing waste management costs, reducing risks, obtaining new lines of financing and obtaining a greater competitive advantage over competitors. For a better understanding of EMS activities in the North region, a checklist was prepared to guide the activities in the midst of the existing logistical challenges, presented in an appendix that can be implemented in the natural gas company in the North region and in others, with the purpose of working on the EMS and the logistics system.

IV. CONCLUSION

As exposed throughout the work, it is increasingly common to see how organizations choose to implement EMS that help them improve the efficiency of their procedures and improve their position in the global market. A fundamental reason why companies decide to implement an EMS resides in the fact that they must comply with a volume of environmental requirements imposed by the administration, customers and society.

Environmental management is integrated with the ISO 14001 standard, which establishes the environmental aspects and impacts associated with the company, implements environmental controls, requires suppliers to also implement environmental management in their processes, and all this to offer companies competitive advantages, encouraging them to adopt quality systems, environmental management and investment in new clean technologies that contribute to the environment. The ISO 14001 standard also gives companies institutional legitimacy and access to foreign markets by focusing not on the end product, but on the process. It is what will make the organization different, because even if there is an organization of the same sector, of the same size and performing the same activity, the implementation of ISO will make a difference, generating great economic benefits.

With the development of the EMS, many companies achieve environmental improvements through the implementation of the EMS. Also, "green logistics" turns out to be a popular issue. But the combination of environmental issues and logistics system is rarely found in previous research. Therefore, environment-oriented logistics system design becomes the topic described here.

Determining the most progressive options to shift the logistics industry towards more sustainable goals will require careful planning and coordination between multiple parties. Consumers, the government and also the companies themselves will have a role in the implementation of solutions that will reduce environmental impacts, especially when talking about the North region, as it is an isolated location in Brazil.

The case study allowed us to evaluate several factors that can help a natural gas company in relation to its EMS. It is identified that the company's internal context is well strengthened, because within its processes in the value chain, there are well-structured areas such as social management, environmental management in its licensing, monitoring and environmental auditing segments, which contribute to ensuring legal, contractual and international standardization requirements, such as those of the ISO 14001:2015 standard.

During the process of diagnosing the company's environmental situation, it was possible to establish important points to be taken into consideration during the environmental review of the natural gas company. Thus, environmental aspects were identified in the development of activities carried out in the company located in the North region, compared to other Brazilian regions, such as legislation, challenges, processes, as well as the destination of production waste. However, it was found that the region logistics system is the main challenge for the company that works with natural gas, which affects organizational activities and, consequently, its EMS is affected.

As listed throughout the work, the main activities in the logistics system that must be carried out to achieve the EMS in the natural gas company, considering the reality of the North region, are: to requalify the roads of the Industrial District; to make the BR-319 and BR-230 Highways passable again for cargo vehicles; to decongest the cargo terminal at Manaus International Airport; to improve the facilities of the two ports of Manaus Moderna; to install nautical signposts on the rivers along the Amazon gutters; to improve the safety of navigability in the Amazon waterways; to invest in improving regional infrastructure through the implementation of maritime delegations and traceability of waterway communication; and to improve airports in the interior of the state to increase the transport flow.

That’s why it seems that the aspect that must be developed immediately to improve the EMS is logistics. However, it appears that this responsibility is solely of the company, as these are federal highways. To carry them out, investment and environmental impact studies are required. In this sense, by creating workflow strategies for all EMS activities in this region, we were able to direct activities in a way not only to comply with legislation, but

also to carry out a set of adequate and safe working conditions. And for that, it is important to have a direction indicated in the work through a check-list so that everyone who comes to carry out EMS work in the North region, can understand the logistical issues in a broader way.

It is important to emphasize the need to recover the environment, as it belongs to everyone, and it is also our duty to care for and protect it. In this way, we can provide a better environment and future for our children. The responsibility of industries to raise awareness and implement ecologically correct technologies in their processes is essential for everyone who contributes to achieve positive results for the environment.

It is noteworthy that the execution and realization of this study are feasible, since all the objectives proposed at the beginning of the work were successfully achieved, in addition to enabling researchers to acquire practical knowledge about the theory studied. It is also worth mentioning that all the information and data cited in this research are real, reliable and valuable; These tools will contribute to interested parties a vision as an instrument of interest for further studies on the subject.

Of course, a case study is not enough to show all environmental activities in a logistics system. More research is needed to analyze the logistics activities of a company, and their influence on environmental performance. For an in-depth study of the possibilities in the challenges of implementing the EMS, it is necessary to analyze the reduction of environmental impact and the cost efficiency for the company. More quantitative research is needed to improve data collection for the analysis of the environmental management system.

As part of the company value chain processes, we recommend establishing a final report model in which the project closure dossier is generated, ensuring compliance with the requirements established in the orders issued by the control entities, as well as in the commitments acquired in the operation licenses. In addition, research is suggested in which it is highlighted how the deficient logistics system affects companies in other sectors such as civil construction, commerce or hospital institutions in relation to the EMS.

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