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EMERGENCY SERVICE PLAN: CASE STUDY APPLIED TO A RECYCLING INDUSTRY PRELIMINARY DIAGNOSIS

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Abstract: According to ABNT NBR 15219 - Emergency plan - Requirements and procedures, the Emergency Action Plan (EAP) formalizes and describes the set of actions and measures to be adopted in the case of a critical situation (accident or incident), aiming to protect life and property, as well as reduce social consequences and damage to the environment (ABNT, 2020). The objective of this article is to present an EAP applied to a recycling industry, aiming to guarantee the safety of employees, compliance with regulatory standards and mitigation of environmental risks. The environment/ context of the research is a small recycling industry located in an urban area. The investigative problem addresses the need for a suitable EAP for the industry, considering the presence of venomous animals, flammable and toxic materials in the recycling process, which can lead to accidents and negative impacts on the environment. To develop the plan, a bibliographical study was carried out on current legislation, technical standards and best practices related to emergency management in recycling industries. The method involved the identification of the main risks, the elaboration of emergency procedures, defining response teams and carrying out practical training with employees. The results presented a detailed emergency response plan adapted to the reality of the industry, contemplating preventive measures, response actions and recovery in case of incidents. The conclusions highlight the importance of a well-structured emergency response plan for recycling industries, aiming at the safety of employees and the protection of the environment, in addition to ensuring compliance with applicable regulations.
Keywords: Emergency Response Plan, Occupational Risks, Occupational Health and Safety.

INTRODUCTION

Nowadays there is a need to discuss the application of the Emergency Action Plan (EAP) in the recycling industry, since this is a prominent sector, of which the associated risks are generally imminent, given the high fire load that large volumes of paper, cardboard and plastic stored offer, and the physical risks such as cutting and crushing, accidents arising from the operation with vehicles and the possibility of the presence of venomous animals given the spaces between the materials, which attracts several species.

In Brazil, the last and fateful episodes related to dams awakened the need to revisit the concepts of safety management and survey of the dangers and risks related to these undertakings. With the collapse of the Fundão dam, owned by Samarco Mineration, on November 5, 2015, in Mariana-MG and the dam in Brumadinho, controlled by Vale S.A, on January 25, 2019, the importance of the topic and of its application, with regard to prevention, preparation and response to emergency scenarios (OLIVEIRA, 2022).

In the literature review, it was observed that given the most varied tragedies that affected Brazil and that threaten different regions of the country, an approach of publications of bibliographic reviews regarding studies of PAEs of Dams (SAMPAIO, 2017), Power Plants Hydroelectric (BEZERRA & SOBRINHO, 2013) and engineering company (ROSA, 2017), but none that focus on the recycling branch, despite this being a growing sector.

According to research on the mechanical recycling of material for the year 2021, commissioned by representatives of the plastic transformers and recycling sector, published by Exame magazine (2022), 23.4% of post-consumer plastic waste was recycled in Brazil. Globo's G1 news portal (2022), using data from SindRecicla-RN, reported

that the recycling and disposable industry in Rio Grande do Norte has grown by more than 300% in the last decade and currently 18% of the waste produced is repurposed.

The report portrays a reality about the development and growth of the recycling industry in the country

The Emergency Action Plan (EAP), according to IT nº 16 (BAHIA, 2018) and ABNT (2020) establishes the responsibilities, guidelines and information, which seek the adoption of technical and administrative procedures, structured in order to provide quick and effective responses in emergency situations, in addition to protecting life, the environment and assets, as well as enabling business continuity.

The potential risk of accidents involving recycling activities and storage of combustible materials (flammable substances), cohesive with the significant impacts on the environment affected by these occurrences, raises the need for planning and investments in preventive and corrective actions, such as, for example, the object of study of this work, which aim to prevent and minimize the risks of this activity.

It is important to carry out a risk analysis to identify the possible emergency scenarios that may occur in the work environment. Some examples are fires, chemical spills, accidents with venomous animals, electrical problems and explosion.

In this sense, the study aims to analyze the existing EAP in a recycling company, in light of: preservation of the health and physical integrity of employees, collaborators, visitors, the community, the environment and the heritage of a recycling company, in order to minimize the probability of occurrence of emergencies and the negative impacts resulting from accidents, proposing improvements and updates.

From this, the specific objectives were directed towards identifying and characterizing the operation of the product storage and recycling sectors, potential emergency scenarios, the necessary resources, actions and combat procedures, in all its phases and according to the scenario. previously identified, defining the activation strategy, presenting actions and procedures in the post-emergence phase.

METHOD

The diagnosis of the plan was developed within the scope of the establishment through documentary and bibliographical research and field study, considering the job position, as well as the positions, activities carried out and the number of workers. Furthermore, the composition of this study will be described in its respective stages, which were based on tools and methodologies applied in work safety.

In addition, the work proposes as a result the elaboration of model diagrams "Business Process Model and Notation (BPMN)", translated as Notation and Model of Process and Business Management, to structure the processes of response to emergencies in the company, finally were proposed georeferenced thematic maps that identify and locate the risks, as well as possible responses.

The creation of risk, fire and emergency maps was done using the free software QGIS v3.28.3© (2020).

CASE STUDY

The recycling company object of this study is located in the neighborhood of Águas Claras, Salvador - BA, its main activity is to provide services for the collection, transport and disposal of hazardous and non-hazardous waste, decontamination and other waste management services. The unit is licensed by the state of Bahia to transport hazardous waste (100 t/month) and by the municipality of Salvador/BA for recycling (18.4 t/day) of

metallic materials, screening of recyclable materials and recycling services paper, cardboard and the like, glass and metallic materials.

The material, in shavings, is purchased from cooperatives and various companies. The work in the main warehouse consists of receiving the shavings, which come in bulk, in the process there is manual separation of other materials such as plastic, pressing, baling and transporting the bales to another final destination.

In support of waste collection activities, the company has a supervision, planning, administration and operation team that is responsible for planning activities and administrative controls in general. The fixed population of the environment studied is 8(eight) peoples.

As basic stages of the production process of providing waste management services to its customers, the process flowchart of the main activities carried out is presented below:

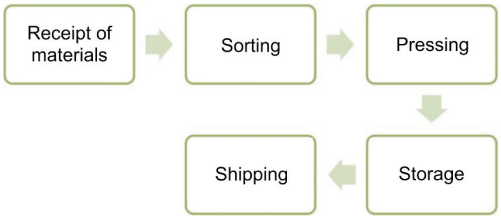


Figure 2. Process flowchart.

Source: The Authors, 2023.

The operational waste management activities correspond to:

- Segregation, packaging and collection and final disposal of waste.

Administrative support and support activities for waste management services correspond to:

- Activity planning;
- Contact and schedules with customers;
- Control of documents necessary for the activity;
- People management such as control of working hours, benefits, among others;
- Internal audits with monitoring of activities.

In an on-site assessment and in the Risk Management Plan (PGR) effective between 2022 and 2024, the potential risks that generated the demand for the preparation of the PAE were observed, among which the following can be highlighted: Physical Risks: Noise, Chemical Risks: Chemical burns due to remnants of material, Risks of accidents: being run over, fire, attack by venomous animals, cuts, falls from the same height and crushing.

In view of the identified risks, it was possible to list the documents, procedures, devices and equipment observed in field visits that the company has to prevent and combat emergencies. The company has an open shed of 952.77 m², with a height of 7.73 m, being classified according to Decree No. 16,302 (BAHIA, 2015) as risk class Deposit J4, with a total land area of 5,600.85 m².

Table 1 presents the diagnosis of equipment available in internal and external areas for emergency action.

Description	Amount	Location
CO2 extinguishers	09	External and internal area
Powder Extinguishers	12	External and internal area
AP fire extinguishers	09	External and internal area
fire hydrants	02	External and internal area
Fire Hoses 1½	08	External and internal area
adjustable nozzle	02	External and internal area
10 hp diesel pump	01	External area
7.5 hp electric pump	01	External area
Jockey Pump 1.5 HP	01	External area
alarm central	01	Internal area
Smoke detector	12	External and internal area
key storz	02	External and internal area

Table 1. Equipment diagnostics.

Source: The Authors, 2023.

Figure 1. Company location map.

Source: The Authors, 2023.

Figure 3. Map of company risks, meeting point and escape routes.

Source: The Authors, 2023.

It also has 2(two) stretchers, 1 first aid kit containing gauze, adhesive plaster, scissors, splint, gloves, saline solution, adhesive dressings, sterile gloves, sterile bandage and antiseptic. Sink with faucet in open area, Water and Oil Separator Box (SAO) and Chemical Product Detention Basin. The unit does not have an eyewash device or an emergency shower.

The Fire Brigade was dimensioned for a J-4 Group and Division, General Depots, containing a High-Risk Degree. The sizing was made for a fixed population of 8(eight) employees who work in the warehouse, totaling at least 6(six) brigade members, however the company adopts 8(eight) in the composition of the brigade. Being 01(one) brigade coordinator, 01(one) brigade leader, and 06(six) brigade members.

Description	Amount
brigade coordinator	01
brigade leader	01
brigade member	06

Table 2. Diagnosis of human resources.

Source: The Authors, 2023.

In view of the organizational chart shown in Figure 4, the proposed functions of each brigade member are objectively presented:

Brigade Coordinator: Activate the EAP in case of occurrences, acting on the three fronts (Evacuation, Combat and First Aid) to guarantee order, communication, efficiency and effectiveness of the measures adopted, based on training and guided by procedures.

Brigade Leader: Ensure a quick response to the cause of the fire emergency based on the appropriate measure for the motivating risk factor. Communicate with the Brigade Leader, letting him know the whole situation.

Fire Brigade: Ensure a quick response to the cause of the fire emergency based on the appropriate measure for the motivating risk factor and promote adequate pre-hospital care for individuals affected by emergencies, in more serious cases call SAMU 192, knowing how to explain in an objective and logical way the sequence of events and the address of the company. Ensure the rapid evacuation of the area by visitors, collaborators and employees, taking everyone to the meeting point in an orderly manner and without panic.

Based on the visits made to the enterprise and the documental analysis carried out, it was possible to frame the existing risks (Table 1), as well as to identify whether the situation of the enterprise is consistent with the prerequisites of the applicable legislation[2], considering its particularities.

In view of the observed risk factors, the respective Diagrams in BMPN are proposed:

According to the fire plan shown in Figure 6, it was possible to observe the position of the technical fire reserve of 32 m^3, consisting of two reservoirs of 16 m^3 each, communicated, these were located behind the pump house. Next to technical reserve there is a ladder that gives access to one of the emergency exits. Outside on the sidewalk, at the top of the slope there is a booster hydrant. While the risk of electric shock was observed given the general power board and a hydraulic press. There are remnants of dangerous products stored in drums, buckets and drums that are allocated inside the shed and outside, all these packages have lids and were sealed. Two 2½ double expedition fire hydrants on the side of the shed, while there is access for the Military Fire Brigade vehicles.

The preparation of the map in, Figure 10, took into account the emergency response units closest to the enterprise and that had operational support capacity to assist in occurrences.

It was identified through contact with the Military Fire Department of the State of Bahia that the unit of the 1st Group of Military

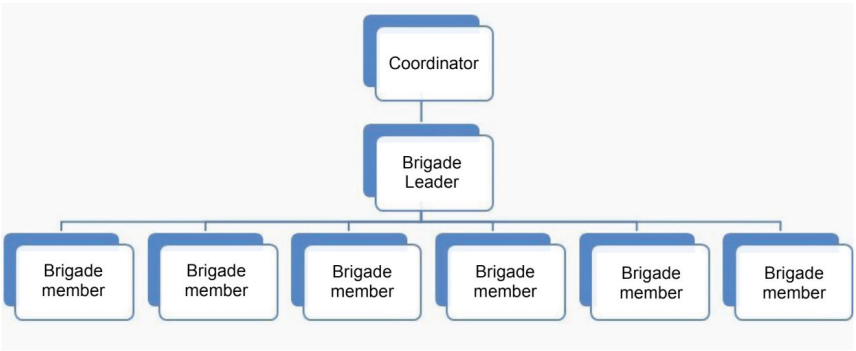


Figure 4. Emergency Brigade organization chart.

Source: The Authors, 2023.

Risk	Control measures	Identified Situation	Legal requirements	Ideal Situation
Accident: Fire	System of prevention and Combat to Fire	In full operation and state of conservation	IT CBMBA 16/2018	In full operation and state of conservation
	Accomplish inspection of systems weekly	In full operation	IT CBMBA 16/2018	In full operation

Table 1. Analysis of the existing PAE, control measures, identified situation and ideal situation.

[two]Legal requirements: Decree nº 16.302/2015, Law nº 12.929/2013, ABNT NBR 15219/2020 and IT CBMBA nº 16/2018.

Risk	Control measures	Identified Situation	Legal requirements	Ideal Situation
	Trained emergency brigade	in full activity	IT CBMBA 16/2018	Valid training certificates, recurring meetings and simulations
	stroke updated	Within the time limit	IT CBMBA 16/2018	Valid and up-to-date documentation
	There is a procedure	Well-defined procedures in the PAE, but with opportunities for improvement	IT CBMBA 16/2018	Update flowcharts, maps and training schedule
Chemicals: Chemical Burns	Keep the Chemical Product Safety Data Sheet (FISPQ) of the packages received in a place accessible by the brigade leader and the first aid leader	The FISPQs were not identified as documents in files available to the brigade members, with only summarized information on the packaging label	All employees and collaborators must be aware of the existing chemical risks, according to the Operational Information Spreadsheet model (ANNEX D) IT CBMBA 16/2018	Seek to make an inventory of the main packages received, with the respective MSDS of the products, leaving it documented and accessible to the Brigade Leader
	Position eyewash and emergency shower	It does not have	It does not address	Install and maintain eyewash and emergency shower inspected and in full working order

Risk	Control measures	Identified Situation	Legal requirements	Ideal Situation
	Keep Products that still contain residues in a specific area with Detention Basin and Water and Oil Separator Box	Existing and operating area	It does not address	Maintain facilities, carry out periodic cleaning and training
	Train the team at least once every semester	Procedure performed	It does not specifically address	Maintain training and document
	Provide and monitor the use of PPE	Procedure performed	It does not specifically address	Maintain training and document
Accident: Venomous Animals	Prepare a list containing a record of possible animals that may appear in the area	Necessary action	It does not specifically address	to implement
	Prepare a list containing the names of employees belonging to the Homogeneous Exposure Group (GHE), blood type, and basic information such as: Names and phone numbers of People.	Necessary action	It does not specifically address	to implement

Risk	Control measures	Identified Situation	Legal requirements	Ideal Situation
	family, partners, or friends, whether the individual is allergic to any medications			
	To train Theteam	Necessary action	Does not specifically address	to implement
	Have a procedure and Action Plan	Necessary action	IT CBMBA 16/2018, ABNT NBR 15219/2020	to implement
	Map distance and travel time to the nearest hospital specialized in caring for the type of attack that occurred	Necessary action	Does not specifically address	to implement
	Maintain ASOs and PCMSO updated and available for leaders to access	Identified and updated documents	Does not specifically address	To maintain
	Charge for the use of PPE	Procedure performed	Does not specifically address	Maintain training and document
Accident: Run over	Train drivers and operators	Procedure performed	Does not specifically address	Maintain training and document
	Flag the desktop	Procedure performed	Does not specifically address	Maintain training and document

Risk	Control measures	Identified Situation	Legal requirements	Ideal Situation
Accident: Electric shock	Perform maintenance on the premises	Procedure performed	Does not specifically address	Maintain facilities and their safety devices
	Conduct training	Procedure performed	Does not specifically address	Maintain training and document
Accident: Press, Cut, Fall from the same height	Conduct training	Procedure performed	Does not specifically address	Maintain training and document
	Perform maintenance on the premises	Procedure performed	Does not specifically address	Keep security devices

Source: The Authors, 2023.

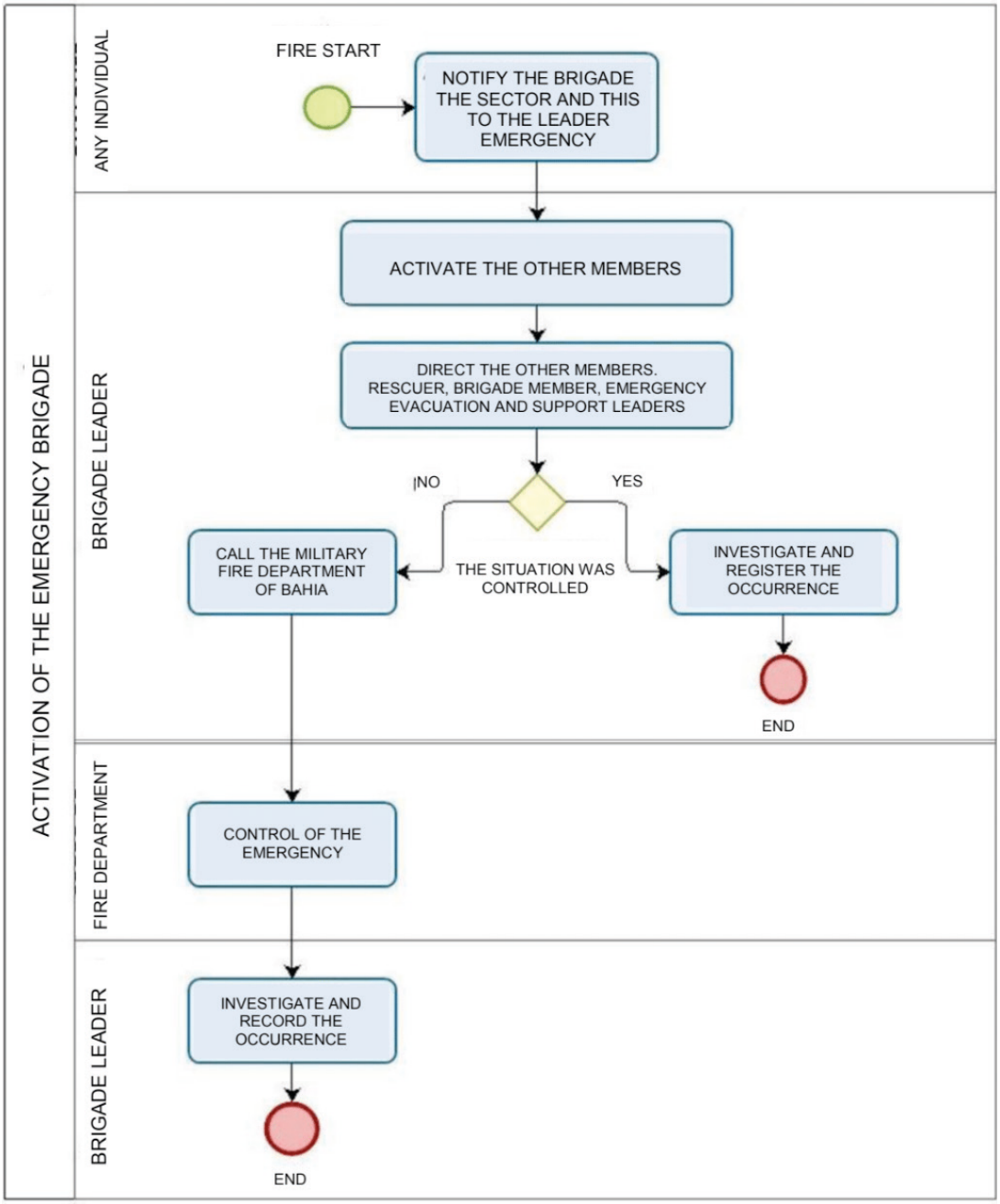


Figure 5. Activation of the Emergency Brigade.

Source: The Authors, 2023.

Figure 6. Fire Plan.

Source: The Authors, 2023.

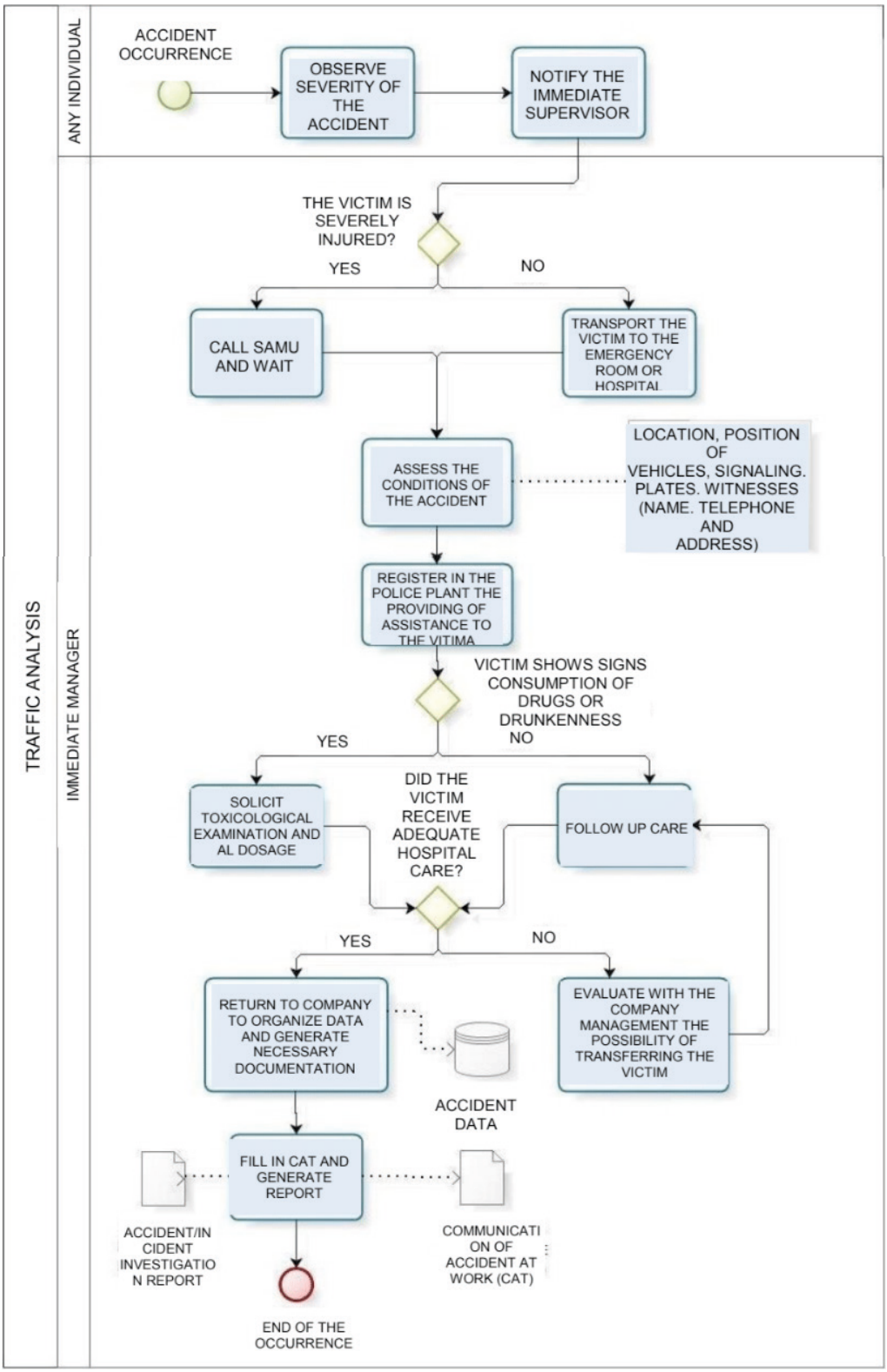


Figure 7. Traffic Accidents.

Source: The Authors, 2023.

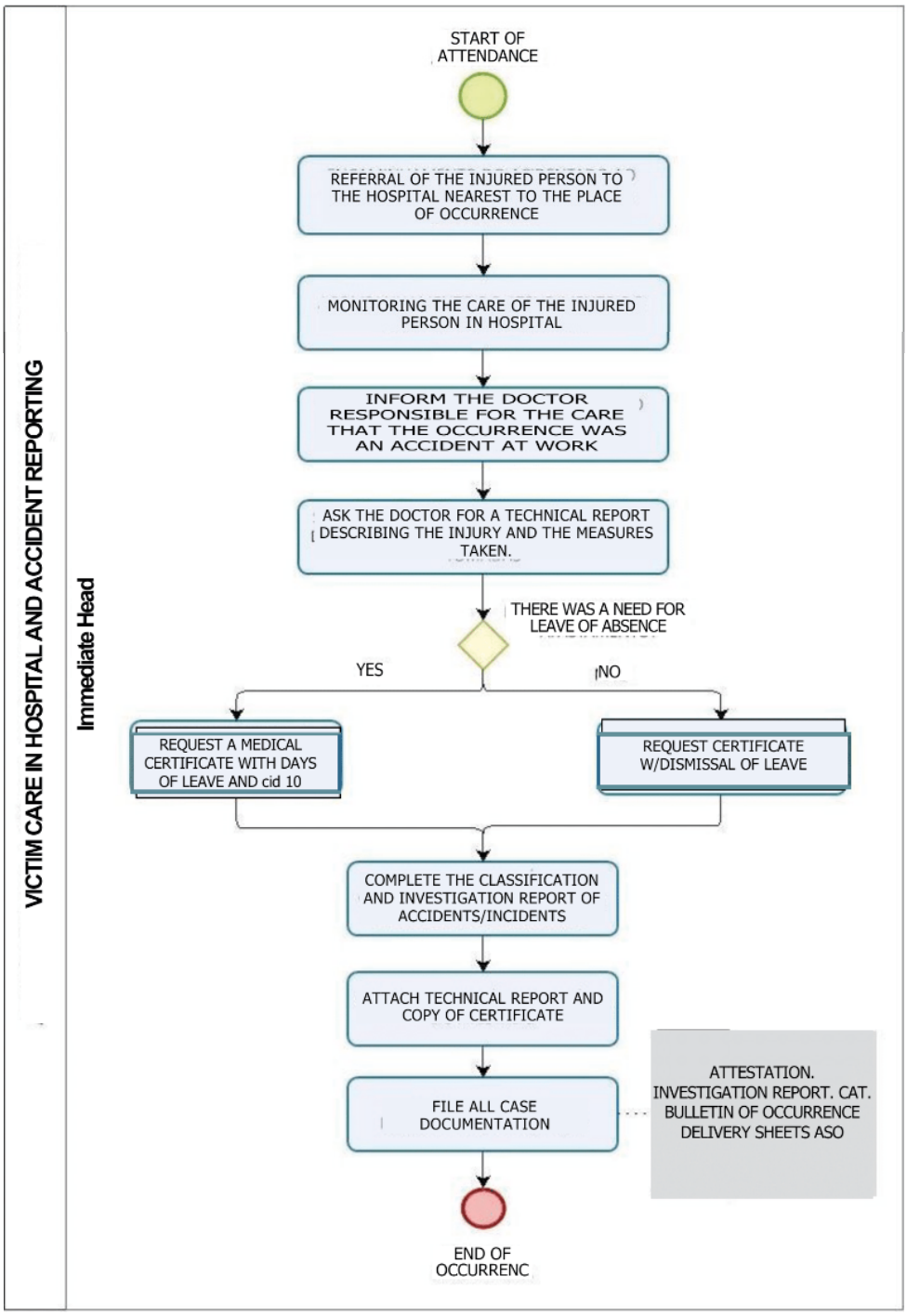


Figure 8. Victim Care at the Hospital and Accident Reporting for Chemical and Physical Risks.

Source: The Authors, 2023.

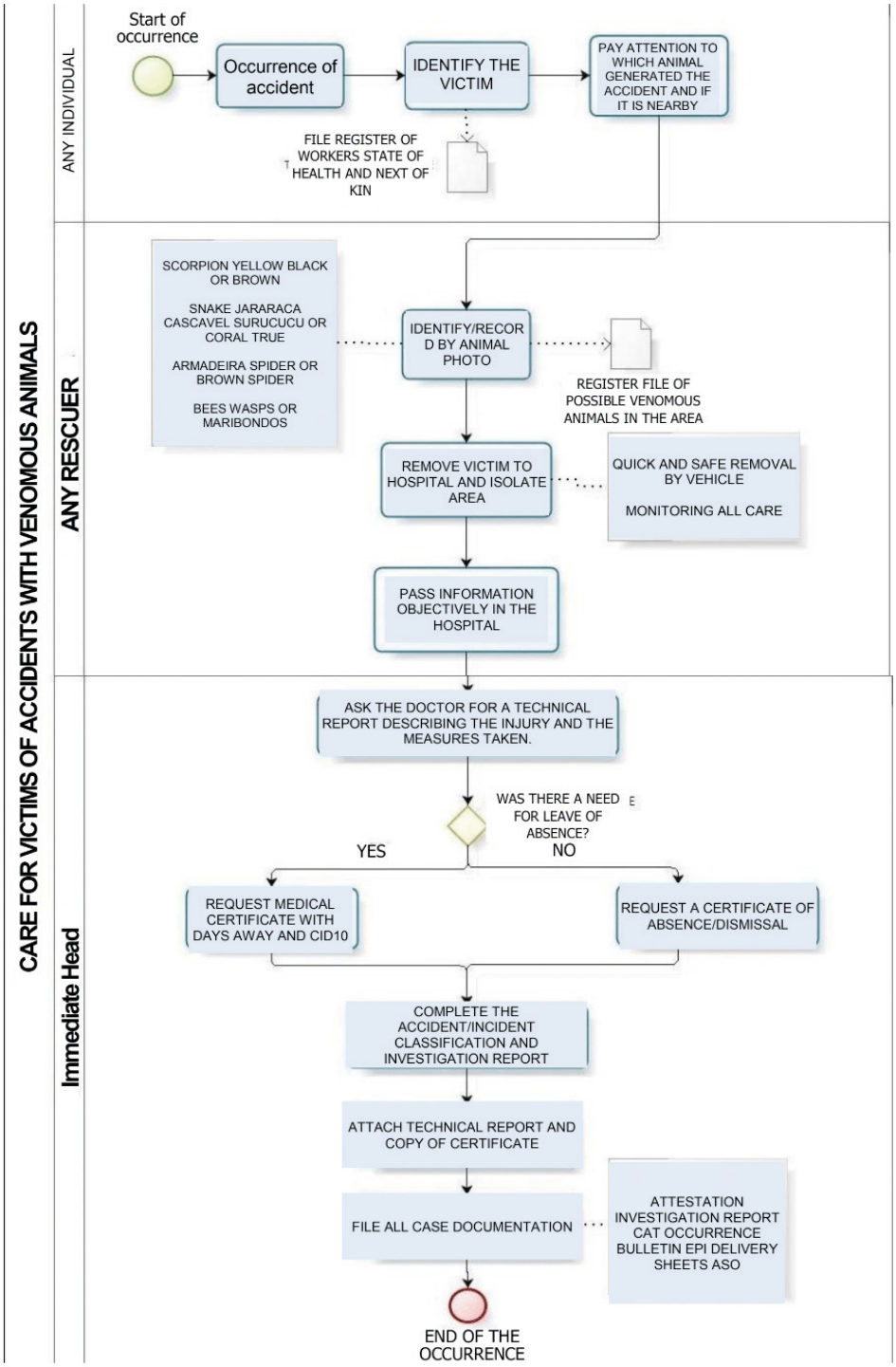
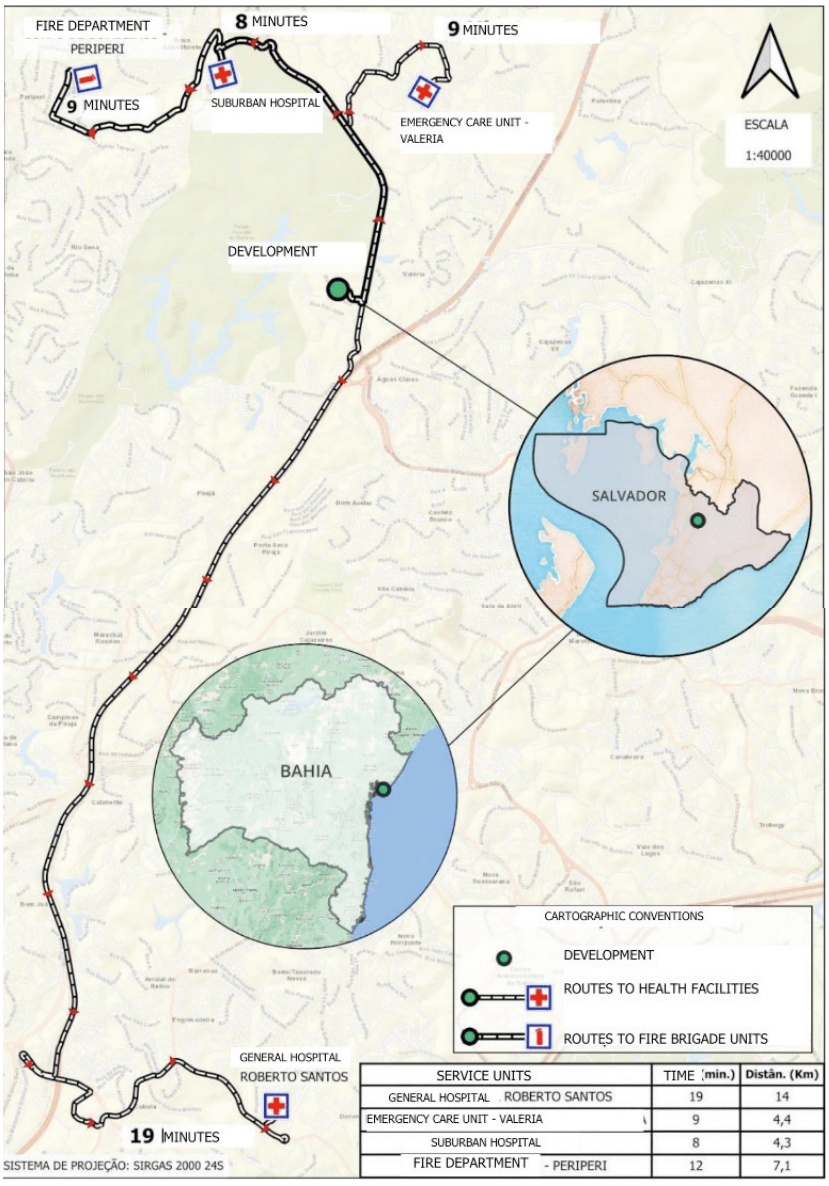


Figure 9. Assistance to the Victim at the Hospital and Reporting an Accident Attack by Venomous Animals.

Source: The Authors, 2023.



SERVICE UNITS	TIME (min.)	Distân. (Km)
GENERAL HOSPITAL . ROBERTO SANTOS	19	14
EMERGENCY CARE UNIT - VALERIA	9	4,4
SUBURBAN HOSPITAL	8	4,3
FIRE DEPARTMENT - PERIPERI	12	7,1

Figure 10. Distance and time of response to emergencies in relation to the project.

Source: The Authors, 2023.

Firefighters of Periperi is the one that serves the region where the company is installed in cases of fire. In the case of accidents with venomous animals, Roberto Santos's Hospital is the one that has procedures in place to promote care in a more efficient manner for victims. While for accidents in general, Valéria's UPA and Suburb's Hospital were the fastest solutions identified. It must be noted that in addition to these there are numbers as shown in, Table 4, that may be useful in cases of emergencies.

FINAL CONSIDERATIONS

According to IT No. 16/2018 of the CBMBA, the EAP is mandatory for buildings and companies, being an important instrument, since it enables the identification, control and extinction of emergencies, benefiting the entire affected population, property, surroundings and the environment. The implementation of the EAP reduces and even prevents the emergency from causing victims in places of human concentration, having as its main cause the lack of knowledge of the best places to exit and contain the emergency.

In view of what was observed through document analysis and visits to the enterprise, it is clear that it meets the minimum prerequisites established in Work Instruction _IT nº. 16 _ both in terms of equipment and documentation, however, when it comes to other applicable legal requirements, the company still needs more adaptations. The present work proposed a graphic form that facilitates elements for the team and decision makers to instruct employees and facilitate the understanding of new members of the emergency brigade, such as maps and diagrams containing procedures and operational flows for decision making.

An effective emergency response plan must be based on preventive measures, such as training and equipment maintenance, as well as establishing clear and effective procedures for emergencies, such as evacuation and firefighting. Prevention is always the best strategy to minimize risks and ensure the safety of all employees and the company's assets.

The Emergency Action Plan must propose well-defined actions, with deadlines and tangible goals. According to item 4.7.3 of ABNT NBR 15219 - Emergency plan - Requirements and procedures, the EAP must be revised whenever there is a significant change, an increase of more than 50% in the number of people in the plant (fixed and floating populations), possibility of improvement and/or completing 24(twenty four) months of its last review (ABNT, 2020). What is not observed in practice, when the document is shelved after approval by the competent body.

For future work, it is suggested the elaboration of a Mutual Aid Plan, since in the surroundings of the company, there are other activities that in case of emergency occurrences will allow the organizations to work together to protect lives, minimize damages and facilitate actions in critical situations.

SAMU	Ambulance	192
CODESAL	Civil defense	199
Forwarder	savior	156
Police	violence or attack	190
Police	DMV	3343 - 2000
coelba	Coelba – Turn on Light	0800 - 710800
base	base	0800 055 5195
Antivenom Center	Antivenom Center	0800-2844343
INEMA	bahia	(71) 3118-4267
Suburb Hospital	More serious accidents	(71) 3217-8600
Roberto Santos Hospital	Accidents with venomous animals	(71) 3117-7540
UPA Valeria	Less serious accidents	(71) 3273-4695
CBM-BA, 1st GBM periperi unit	Fire	193 / (71) 99920-0134
Military police	violence or attack	190

Table 3. Emergency telephone numbers for external agencies.

Source: The Authors, 2023.

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APPENDIX A - ADDITIONAL INFORMATION

Table 1. List/schedule of brigade training and simulations.

MODULE	MONTH YEAR
PRESENTATION OF THE RISK MAP	JUL 2023
PAE PRESENTATION	JUL 2023
PRESENTATION OF THE PGR	JUL 2023
SIMULATION OF THE EVACUATION PLAN	JUL 2023
SIMULATED FIRE FIGHTING	JUL 2023
TRAFFIC ACCIDENT FLOW	AUG 2023
REFERRAL OF EMPLOYEE TO HOSPITAL	AUG 2023
SIMULATED ACCIDENT INVESTIGATION	AUG 2023
ANNUAL ACCIDENT INDEX	AUG 2023
TREE OF CAUSES	AUG 2023
ACCIDENT CLASSIFICATION STANDARD	SEP 2023
BRIGADE TRAINING AND EDUCATION	SEP 2023
BRIGADIST'S RESPONSIBILITY	SEP 2023
PRE-HOSPITAL CARE COURSE	SEP 2023

Source: The Authors, 2023.

Table 2. Model of employee identification form, blood type, if you have any type of allergy to medicine, contact of 2 closest people for emergencies, validity of aso, date of admission.

NAME	FUNCTION	ADMISSION DATE	BLOOD TYPE	DO YOU HAVE ANY TYPE OF ALLERGY?	VALIDITY OF THE ASO	CLOSEST PEOPLE TO CONTACT IN CASE OF EMERGENCY

Source: The Authors, 2023.