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## AUDIT OF OCCUPATIONAL HEALTH AND SAFETY (OHS) IN A THERMAL POWER PLANT IN THE STATE OF AMAZONAS/BRAZIL

### AUDITORIA DE SAÚDE E SEGURANÇA NO TRABALHO (SST) EM UMA USINA TERMELÉTRICA NO ESTADO DO AMAZONAS/BRASIL

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#### ABSTRACT

This research aims to carry out an audit of occupational health and safety (OHS) at a thermal power plant located in the state of Amazonas/Brazil. The research is characterized by quantitative with regard to the problem, exploratory as to the objectives and a case study with respect to the technical procedure. This study used a quantitative survey through the form of auditing and a qualitative survey by the application of direct observation of the productive environment and semi-open interviews. Among the main results achieved, we highlight the systematic analysis of the activities developed in the enterprise through an ergonomic intervention action; identification of risk factors in different sectors through the application of occupational safety and health auditing based on regulatory standards and the study indicates that NRs more focused on worker participation tend to have greater implementation difficulties. The relevance of this study is to demonstrate that ergonomic decisions can be made to improve safety, satisfaction, reducing errors and accidents, aiming to improve the health and productivity of the entire enterprise.

#### RESUMO

Esta pesquisa objetivou realizar uma auditoria de saúde e segurança do trabalho (SST) em uma usina termelétrica localizada no estado do Amazonas/Brasil. A pesquisa é caracterizada como quantitativa em relação ao problema, exploratória quanto aos objetivos e um estudo de caso com relação ao procedimento técnico. Este estudo utilizou uma pesquisa quantitativa por meio de um formulário de auditoria e uma pesquisa qualitativa mediante aplicação da observação direta do ambiente produtivo e entrevistas semiabertas. Dentre os principais resultados alcançados, destaca-se a análise sistemática das atividades desenvolvidas no empreendimento, por meio de uma ação de intervenção ergonômica; identificação de fatores de risco em diferentes setores por meio da aplicação de auditorias de segurança e saúde no trabalho com base nas normas regulamentadoras e o estudo indica que as NRs mais focadas na participação dos trabalhadores tendem a ter maiores dificuldades de implementação. A relevância deste estudo é demonstrar que decisões ergonômicas podem ser tomadas para melhorar a segurança, a satisfação, a redução de erros e acidentes, com o objetivo de melhorar a saúde e a produtividade de toda empresa.



## 1. INTRODUCTION

Ergonomics is the discipline related to understand the interactions between humans and other elements of a system. The emergence of the ergonomics is due to concerns about improving the efficiency of the human work and the reduction of obstacles faced at work, thus preventing risks to his health. It is a science applied to the design of machines, equipment, systems, and tasks, to improve safety, health, comfort and efficiency at workplace. It is based on knowledge of other scientific areas, involving anthropometry, biomechanics, physiology, psychology, toxicology, among others (IEA, 2019; Falzon, 2007; Dul & Weerdmeester, 2004).

Ergonomics aims to transform work, in order to contribute to the design of work situations that do not interfere with workers' health. Occupational health and safety encompasses the social, mental and physical well-being of workers based on health and safety measures that require the collaboration and participation of both employers and workers in health and safety programs. In many situations, occupational health and safety programs are designed and oriented normally to comply with the legislation on the subject (Guérin, et al., 2001; Oliveira, 2003; Bureau Internacional do Trabalho, 2009).

In the case of Brazilian legislation, the regulatory norms complement the Consolidation of Labor Laws (CLL) through obligations, rights and duties to be fulfilled by companies and workers in order to guarantee safe work, preventing the occurrence of illnesses and accidents at work (Escola Nacional da Inspeção do Trabalho, 2020).

This research aims to carry out an audit of occupational health and safety (OHS) at a thermal power plant located in the state of Amazonas/Brazil. The work is structured in three parts: (1) literature review (ergonomics and regulatory norms); (2) methodology; and (3) results, discussion, conclusion, and references. The relevance of this research is to demonstrate that ergonomic decisions can be made to improve safety, satisfaction, reducing errors and accidents, aiming to improve the health and productivity of the entire enterprise.

## 2. LITERATURE REVIEW

### 2.1 ERGONOMICS

Ergonomics has two objectives: (1) focus on organizations and their performance, which includes efficiency, productivity, reliability, quality, and durability. (2) focus on people and unfolds in different dimensions, such as safety, health, comfort, ease of use, satisfaction, work interest, pleasure, and others (Falzon, 2007).

The areas of specialization of ergonomics are three: (1) physical ergonomics, related to anatomical, anthropometric, physiological and biomechanical characteristics related to physical activity; (2) cognitive ergonomics, related to mental processes, such as perception, memory, reasoning and motor response, as they affect the interactions between humans and the other elements of a system; and (3) organizational ergonomics, deals with the optimization of sociotechnical systems, including their organizational structures, policies, and processes (IEA, 2019).



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It covers various administrative sectors working in communion to improve working conditions. The contribution of ergonomics is classified as (1) conception, (2) correction, (3) awareness and (4) participation. The ergonomics of design makes an analysis of the situations that can happen, that is, it occurs during the design of the product, the machine, environment or system. When a correction is applied to solve the problem that is interfering with safety, causing excessive fatigue, illness in the worker or quantity and quality of production, it is referred to as ergonomics of correction. The ergonomics of awareness seeks to enable workers to detect and correct the problems that occur from day to day. Participation ergonomics seeks the help of workers to find the solution to the problem detected (Iida, 2005).

Ergonomics seeks to correct the imbalances caused by the disproportion between the care given to the development of machines and those who operate the services. There is a diversity of forms of the ergonomic action intervention, either by the way implementation of actions as a diagnosis to understand the difficulties encountered or the health problems, enrollment in processes of change or conduction of projects. It can be applied in production or service system by both ergonomists and by untrained people in the area, such as a designer, who could use ergonomics through general standards or recommendations. Therefore, the ergonomic action is based on the capacity to gather knowledge and methods adapted to each situation (Daniellou & Béguin, 2007).

The main purpose of ergonomic action is the transformation of work so that it can contribute to the conception of work situations that do not interfere in the health of the operators, where they can carry out their competences, individually or collectively, valuing their abilities, besides achieving the economic objectives determined by the enterprise. Ergonomics has as its object the study of work and can designate the working conditions (hard work, heavy work), the result of the work (if the work was poorly done, or if it is the first job) or the activity itself (how to do the work meticulously and without overcharging) (Guérin, et al., 2001).

Ergonomics seeks to influence the design and redesign of the working environment through recommendations made after an environmental analysis. The design of the means of work implies in complex processes that the ergonomist must to know and participate in order to influence them and to obtain significant results. In the ergonomics of the design, work is the object of ergonomic intervention, where the ergonomist needs to develop approach to analyses the activity. This approach should implement operative modes that are compatible with the chosen criteria, in terms of health, productive efficiency, personal development and collective work (Daniellou, 2007).

One of the characteristics of conception is paradoxical temporality, which is the production of something that is not yet known, since in the beginning one does not have the prediction of the future situation, and in the end, there is already much more information. On the other hand, there are initially many possibilities of choices, but as choices are made, the actors' degrees of freedom diminish. The conception is a group work, whatever the work or product to be conceived will require more than one person to solve it, in this way, tasks are differentiated, distributed and attributed to the actors according to the technical specialty of each one (Béguin, 2007).



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## 2.2 REGULATORY NORMS

The development of safety at work occurred in conjunction with the search for social welfare, where this security is not only seen as a science or a requirement of public agencies, but rather as a path traveled by humanity seeking social welfare, promoting improvement in workers' health and safety. The safety at work is concerned with identifying risks, analyzing and evaluating each activity to eliminate and to control them (Chibinski, 2011).

In 1943, the Consolidation of Labor Laws was instituted, but only in 1977 (law 6,514) the Regulatory Norms (NRs) were approved by approval of the ordinance 3,214 of 1978. The norms cover legislation and health at work and their absence in the prevention of occupational risks can lead to occupational diseases, accidents at work, unemployment, disability, and reduced functional capacity. The Federal Constitution of 1988 guarantees punishment to companies in which workers do not act inappropriate ergonomic conditions (Rocha, 2004).

The main research-related NRs will then be presented in order to have an understanding of each of them.

NR-4 (Specialized Services in Safety Engineering and Occupational Medicine) aims to promote and to protect the health and integrity of the worker in the workplace. This NR must be applied in companies that have more than 50% of their employees in establishments or sectors whose activity is higher than the main activity (Brasil, 1978).

The NR-5 CIPA (Internal Commission for the Prevention of Accidents) aims to prevent accidents and diseases arising from work. The CIPA is mandatory for companies that have employees with a job link. It must be constituted taking into consideration the number of employees effectively linked to the bargaining regime (Brasil, 1978b).

NR-6 (Personal Protective Equipment) aims to avoid susceptible hazards that may threaten safety and health at work. This NR says that the enterprise is obliged to provide its employees with a PPE (personal protective equipment) that is free of risk, in a perfect state of repair and operation, provided that the general measures do not offer complete protection against the risks of accidents. Work, while collective protection measures are being implemented and to respond to emergency situations (Brasil, 1978c).

The Occupational Health Medical Control Program (NR-7) aims to promote and preserve the health of all its workers. It is recommended that this NR be applied in all contracting companies of service providers and should inform the existing risks, assisting in the elaboration and implementation of the PCMSO (Medical Control Program and Occupational Health) in the workplaces where the services are being rendered (Brasil, 1978d).

The NR-8, which deals with buildings, aims to establish minimum technical requirements that must be observed in buildings, with the purpose by ensuring safety and comfort to those who work there (Brasil, 1978e).

NR-9, which deals with the Environmental Risk Protection Program (PPRA), aims at preserving the health and integrity of workers through the anticipation, recognition, evaluation and consequent control of the occurrence of existing or emerging environmental risks to existing in the workplace, taking into account the protection of the environment and natural resources. The actions of this NR should be developed depending on the characteristics of the risks and the control needs of the companies. The application within the enterprise must take into account a series of risks, which are environmental, physical, chemical and biological, that exist in the workplace and that, due to their nature, concentration or intensity and time of exposure, are capable of cause damage to the worker's health (Brasil, 1978f).



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Safety at work in machinery and equipment (NR-12), aims to guarantee the health and physical integrity of workers, establishing minimum requirements for the prevention of accidents and occupational diseases in the design and use of machinery and equipment of all kinds. This NR serves for the employer to adopt protective measures for work on machines and equipment, ensuring the health, physical integrity of workers, and appropriate measures whenever people with disabilities are directly or indirectly involved in work (Brasil, 1978g).

NR-14 for furnaces states that ovens must be solidly constructed, lined with refractory material, so that the heat does not exceed the tolerance limits established by NR-15 (unhealthy). The NR-15 that treats the unhealthy, aims to avoid unhealthy activities or operations above the limits of tolerance, not to cause damage to the health of the worker during his working life. This NR mentions that companies should request the Ministry of Labor, through the DRTs (Regional Labor Stations) to carry out expertise in their establishment or sector, in order to characterize and classify or determine unhealthy activity (Brasil, 1978h; 1978i).

The aim of NR-17 regarding ergonomics is to establish parameters that allow the adaptation of working conditions to the psychophysiological characteristics of the workers, in order to provide maximum comfort, safety, and efficient performance. This NR must be applied in companies whose working conditions include aspects related to lifting, transportation, and unloading of materials, furniture, equipment and environmental conditions of the workplace and to the organization of work. In order to evaluate the adaptation of working conditions, it is the responsibility of the employer to perform the ergonomic analysis of the work, and at least the working conditions must be addressed, as established in this regulatory standard (Brasil, 1978j).

NR-23 (Fires) aims to prevent fires. This NR must be applied by all employers for fire prevention, in accordance with state legislation and applicable technical standards. The employer must provide all workers with information on the use of fire-fighting equipment, safe evacuation procedures and existing alarm devices (Brasil, 1978k).

### 3. METHODOLOGY

This study used a quantitative survey through the form of auditing and a qualitative survey by the application of direct observation of the productive environment and semi-open interviews.

As for the objectives, the approach used was exploratory. The exploratory research aims to provide greater familiarity with the problem in order to make it explicit or to construct hypotheses (Silva & Menezes, 2005). The study sought to make explicit ergonomic and safety-related issues and work health in a thermal power plant.

The technical procedure used was the case study, which seeks to examine the contemporary events where the behaviors of the research subjects cannot be manipulated, with the theoretical prepositions being generalizable (Yin, 1994). The case study was applied to a thermal power plant located in the state of Amazonas/Brazil.

The case study is a methodological procedure in which it examines a phenomenon in its natural setting, employing multiple methods of collecting data to collect information from one or a few entities, such as individuals, groups or organizations (Benbasat, et al., 1987).

For this research, the model presented by Castro & Okawa (2016) was used, which sought to identify the risk factors in the different work sectors in relation to the equipment; substances and materials; ergonomic factors; and organizational factors.





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The audit of occupational health and safety considered occupational, physical, chemical, biological, ergonomic and accident hazards.

The form consists of 55 affirmative questions and organized into 11 items related to the regulatory standards of Specialized Services in Safety Engineering and Occupational Medicine - SESMT (NR-4); Internal Commission for the Prevention of Accidents - CIPA (NR-5); Personal Protective Equipment - PPE (NR-6); Medical Occupational Health Control Program - PCMSO (NR-7); Buildings (NR-8); Program of Prevention of Environmental Risks - PPRA (NR-9); Safety in Work in Machinery and Equipment (NR-12); Ovens (NR-14); Ergonomics (NR-17); Fires (NR-23); and Unhealthy (NR-15).

Each observed situation was classified on a scale from 0 to 3 as follows: (0) does not apply; (1) does not answer; (2) partially implanted, in implantation or partially executed; and (3) yes, answer.

The sampling used in the research was intentional non-probabilistic. Marconi and Lakatos (2002), affirm that in the intentional non-probabilistic sampling the opinion of certain elements of the population represent of a certain social body.

The research techniques used, according to Marconi & Lakatos (2002), were: (1) indirect documentation, through documents made available by the enterprise; (2) bibliographic research; (3) direct documentation carried out through field research in the energy sector; (4) Intensive direct observation implemented through semi-open interviews; and (5) Extensive direct observation through the audit of occupational health and safety form.

The study was carried out in three moments: (1) individual semi-open interviews (carried out with manager of the enterprise, productive area, and work safety technician) and collective interviews with workers of the productive process (Vergara, 2009) based on Guérin, et al., (2001), where key information was identified for completing the form applied in the enterprise later; (2) documentary research was carried out in order to collect preliminary data on documents made available by the enterprise (standard operations, flowchart, production plans, quality indicators, among others);

Then, (3) the structured observation (Vergara, 2009) of the execution of the activities by the employees of the productive sector happened. In the structured observation, a better understanding of the enterprise was sought through the analysis of the physical infrastructure of the production, the gestures, postures, actions, and communications between the employees of the sectors and between them; (4) application the audit of occupational health and safety form in the Organization & Methods and Quality departments (after interviews and structured observation).

The quantitative data of the audit form were analyzed in a way that would allow an adequate understanding of how these practices occur within the enterprise and enable the visualization through the spider chart.

The qualitative data obtained from the responses of the roadmap were tabulated in a summary table, grouped according to the content and stratified according to the structure of the form. The documentary information collected at the second moment was integrated and triangulated with the information collected by the interviews in order to ensure rationalization and validation.

The methodology proposed by Kvale (1996) was used as method of qualitative data analysis. Firstly, it has been described the subject from the experience of the owner, manager of the



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productive area and occupational safety technician during individual interviews and with workers in collective interviews. After, new relationships of the theme and how respondents observe and put it into practice was sought.

During the interviews, sought to condense and to interpret the meaning of what the interviewees described, disseminate and return in feedback until there is only one possible interpretation or multiple understandings of the subject by the subjects. The transcribed interviews were interpreted. The information was structured and clarification followed in order to eliminate repetitions and distinctions between the essential and the nonessential. The analysis involved the development of the meanings of the interviews, bringing the proper understanding of the theme, as well as providing new perspectives of the researcher on the phenomenon analyzed.

As conclusion, the interview had a character of action by enabling those involved, from the questions, the beginning of new insights on safety and health activities in the workplace that could be adopted by the enterprise.

## 4. RESULTS

### 4.1 ENTERPRISE CHARACTERIZATION

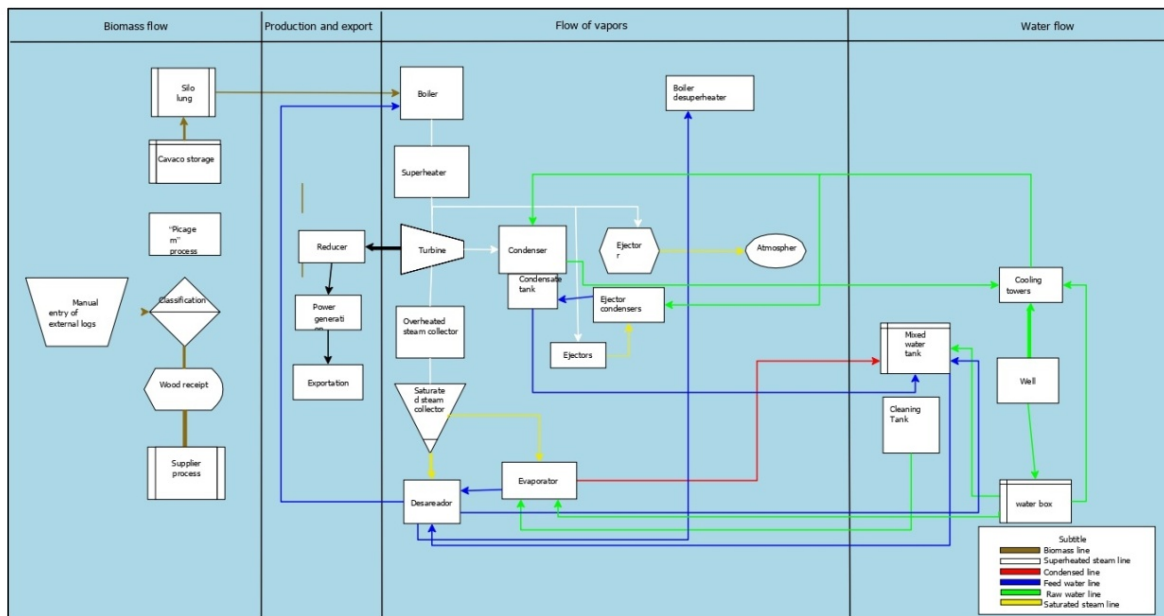
The enterprise studied is in the field of electric energy production, located in the state of Amazonas/Brazil, is a Thermal Power Plant (UTE), had its construction started in 2001, operating since November 2002, is moved to biomass and uses wood residues as fuel for its operation. The enterprises' average generation availability over this 15-year period of operation is 91.5%. The UTE has an installed capacity of 9MW, consumes about 350 tons. of chips per day, producing approximately 45-ton./h of steam, at a working pressure of 42kgf/cm<sup>2</sup>. Its production process is of the continuous type; therefore, it has a high level of automation.

The process flow begins with the processing of wood waste discarded by the supplier enterprise. The waste is collected on belt conveyors and then crushed in a device called "Picador". The next step in the process is the storage of waste, which is done in a vertical silo with a capacity of 1,500 m<sup>3</sup> of biomass. This material is then transported to the boiler (steam generator) and consumed according to the need for steam production. All the saturated steam formed by the boiler passes to a device called a superheater, which in turn raises the temperature of the gases to the turbine and then the generator. The last step is the export of energy to the enterprise(customer) that is responsible for distributing energy to the city where it is installed. In the vaporization process, a part of the supply's material is condensed and returns forming a new cycle of the process, The Figure 1 show the productive process flowchart of the Thermal Power Plant.



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Figure 1. Process flowchart of the studied enterprise. Source: Authors.



Source: Authors

#### 4.2 APPLICATION OF THE AUDIT OF OCCUPATIONAL HEALTH AND SAFETY IN A THERMAL POWER PLANT

The application of the audit in the enterprise was carried out by interviews with the enterprise manager, according to adapted method from Castro & Okawa (2016). The production area and the health and safety technician of the work were studied.

A total of 11 (eleven) regulatory standards were considered and addressed, which were asked specific questions following what is pre-established in the ordinance of each standard. The method seeks to identify if the standards are being applied or not in the enterprise; if the practices adopted in the enterprise obey the regulations. Based on the research carried out and responses obtained through the form, an analysis of the NRs was made regarding their adoption in the enterprise.

Through of the audit it was possible to analyze more deeply the regulatory standards implemented and partially implemented in the enterprise, allowing the opening for a greater discussion regarding its execution, operation and the way the enterprise deals and contributes to the health and safety of its workers. Based on the data obtained about each NR implanted in the enterprise, it was found that not all of them obey the basic concepts of safety imposed in the regulations.

The SESMT (NR-4) is linked to the risk gradation of the main activity and to the total number of employees of the establishment. It is implemented in the enterprise, and it is not mandatory under the standard, as the enterprise has 45 employees. However, the enterprise has a work safety technician, adopting the dimensioning of SESMT at-risk level four.

With respect to CIPA (NR-5), the enterprise complies with what is established in relation to its duties, functioning, training and the electoral process. It was observed that the safety technician stays daily in the enterprise to analyze what concerns the health and safety issues in the workplace. In addition, the map of risks classified and represented by their colors is drawn up, seeking to raise workers' awareness, which reduce the number of work accidents and





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damage to their health within the enterprise. The training required by NR-5 is carried out through external and internal courses and the electoral process for choosing CIPA occurs periodically.

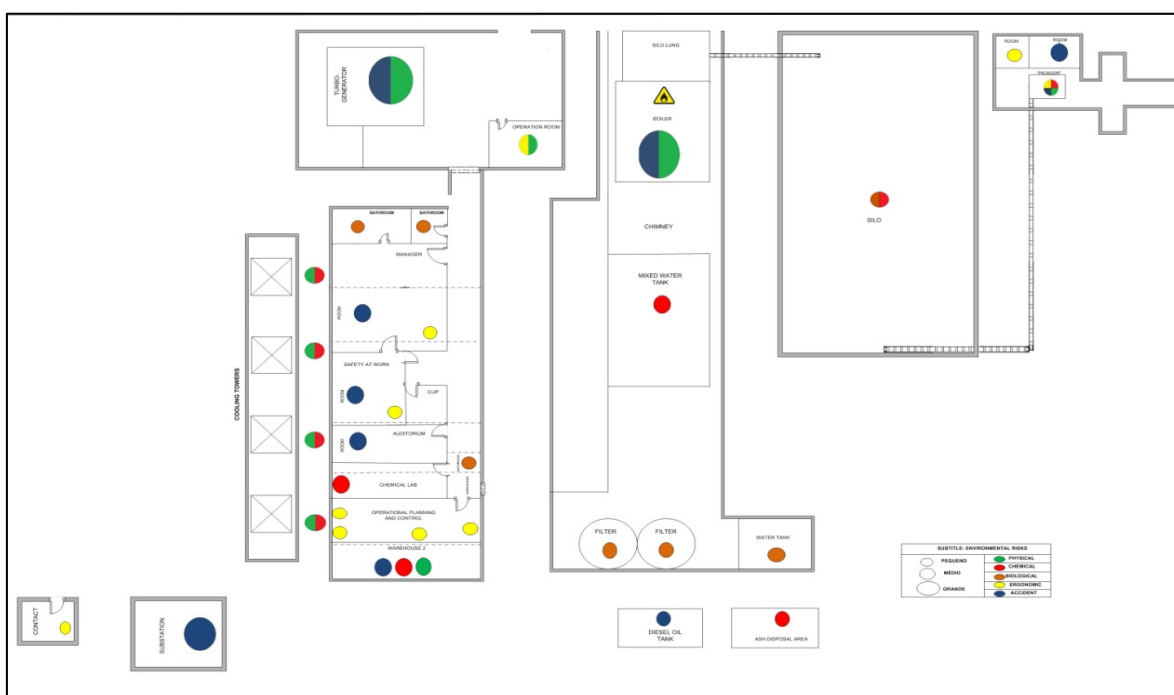
NR-6 states that the enterprise is obliged to supply personal protective equipment (PPE) free of charge and in perfect condition and functioning, adequate to the risk that each worker is subject to. It was observed that the majority of the enterprises' workers are not making the proper use of PPE, especially with regard to protective helmets, which are only placed over their heads, and can move out of place with the least possible effort. There was little use of hearing protectors and masks, even with constant noise and dust.

The PCMSO according to NR-7 aims the prevention, screening and early diagnosis of work-related diseases. This regulatory standard is linked to NR-4 since its structure is related to the dimensioning of the SESMT according to the degree of risk where enterprise is placed. It was observed that the enterprise is not within the dimension established in the SESMT, according to the Labor Technician. Because it has a number of employees below the established minimum, it counts on a doctor to make annual evaluations on its employees, analyzing the conditions of day-to-day operational risks, seeking to ensure the health of workers.

NR-8 deals with buildings and aims to establish the technical requirements in buildings, which guarantee the safety and comfort of workers. It was observed that the enterprise meets the NR-8 with respect to the floors being leveled and the existing ramps are all non-slip. The ramps and stairs are in good condition, the guardrails are at the required height in relation to the level of the floor and the roofs existing in the enterprise have a place against rain and avoid insolation.

With regard to NR-9, the enterprise has implemented the PPRA and considering its economic activity, workers are exposed to physical, biological and chemical agents daily in the production area. Figure 2 shows the risk map of the studied organization.

**Figure 2:** Risk map of the studied enterprise.



Source: Authors



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It was observed that the enterprises' machines and equipment do not have the necessary demarcations, which are indispensable for the safe movement of material and workers. However, it was observed that in the area of the extrusion process, there is an aerial movement of the production material over the workers, as well as the floors of the places where machines and equipment are installed and the circulation areas are dirty and objects are deposited on them. and tools that can offer accident risks, which is at odds with NR-12. In return, the enterprise adopts the necessary measures in relation to the signaling and identification of the risk of electric shock, restriction of access, security systems, as well as requiring only authorized persons to travel in these areas.

The enterprise uses an oven to burn its products following the NR-14 regulations regarding being coated with refractory material and complies with the heat tolerance limits. It was observed that the enterprise is always monitoring the exit of the flared gases from the chimney, adopting the technical norms on air pollution.

With the assistance of the safety technician, the enterprise seeks to measure annually the aspects chemical, physical and biological. According to the technician, the noise tolerance limit, which is present in the extrusion area, is complies with regulatory norm. However, they have access to the PPE for the ears. According to observations, workers who are in the "oven" function are the ones most exposed to heat and also those who perform the heaviest service within the enterprise. However, it was not found that they have the necessary rest time established by NR according to the level of work required.

With regard to Ergonomics, it was observed that there are many sectors in which the working conditions are not adapted to the work being performed, in some sectors the employees do all the work standing up and there are no chairs available for their rest, not obeying the NR-17 with regard to work performed on foot and the arrangement of seats for workers during breaks.

Finally, the enterprise provides fire-fighting equipment in strategic areas in compliance with NR-23 regulations. However, the evacuation exits are partially signposted and it was not possible to observe existing alarm devices.

## 5. GENERAL ANALYSIS AND DISCUSSION

Regarding NR-4, although the enterprise does do not need to have SESMT due to the low number of employees, the organization maintains a work safety technician. As for NR-5, the standard is being met by the enterprise in terms of attributions, operation, training, and the electoral process.

As for NR-6, the enterprise should be concerned with monitoring and demanding the correct use of PPE by workers, guiding and training them on the proper use, care and conservation. As well as providing clothing appropriate to the risks of thermal origin in which workers are exposed daily in the dryer. The adaptation of PPE for disabled employees is also indicated. Due to the number of employees, the enterprise does are not fit the dimension established in SESMT because it has the number of employees below the minimum established by NR-7 and NR-4.

NR-8 is being satisfactorily met by the enterprise regarding the technical requirements in buildings in order to guarantee the safety and comfort of workers. With regard to NR-9, due to the exposure of workers to physical, biological and chemical agents, it is necessary to reinforce the awareness of the use of PPE in the productive environment.



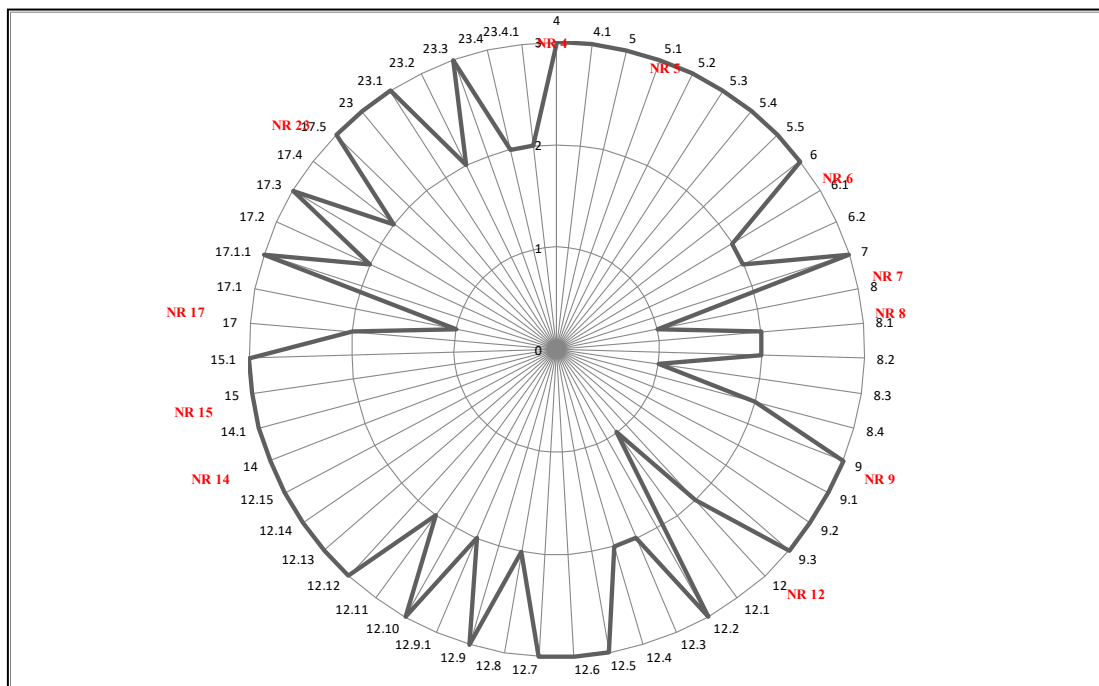
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With regard to NR-12, the organization needs to mark the circulation areas close to the plant's machinery and equipment, considering that the enterprise operates in an activity in which the production area has machines working at high temperatures. Circulation areas must be kept clear. Perform preventive maintenance on electrical installations and equipment within a maintenance plan. It is recommended to implement total productive maintenance (TPM) in the enterprise.

Regarding the NR-17, it is necessary to carry out Ergonomic Work Analysis (AET) in the furnace activity and in the warehouse sector due to the characteristics of these activities. Finally, as for the NR-23, it is necessary to improve the evacuation exits and the alarm devices in order to make them more efficient.

Figure 3 summarizes the discussion of occupational health and safety auditing in the enterprise studied by presenting it in the form of a radar chart. In general, a meets all the regulatory standards analyzed in the study, however, there is a need for better management with regard to standards 6 (PPE), mainly in the awareness of workers in the use of individual equipment; 12 (safety in the work of machines and equipment) regarding the improvement in the demarcations; and 17 (ergonomics) due to the need for ergonomic intervention in critical activities.

**Figure 3:** Spider chart resulting from the occupational health and safety audit.



Source: Authors.

In terms of literature review, the work made it possible to understand the interaction between man and work through the observation of the practical application of NRs in a productive environment. The objectives of ergonomics (Falzon, 2007) were possible to be analyzed by observing people regarding safety, health, and comfort in the work environment. Therefore, three of the four ergonomic objectives are used by the enterprise: (1) conception, (2) correction and awareness working together to improve working conditions (Iida, 2005). NRs relate to the area of specialization in ergonomics called physical ergonomics (IEA, 2019) given its character of identifying and adapting human factors.



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Regarding the methodology, the audit provided a broad view of the organization's degree of compliance with regulatory standards. In fact, it was observed that the standards with performance below the others (NR-6, NR-12, and NR-17) have a higher rate of subjectivity and need to involve senior management and employees. In other words, the study indicates that NRs that are more focused on worker participation tend to have greater implementation difficulties. The application of the audit allowed an action of ergonomic intervention in line with Daniellou & Béguin (2007) who deal with the diversity of forms of ergonomic intervention that can be applied to products or services using general standards or recommendations.

## CONCLUSION

The general objective of this research was to perform an occupational safety and health audit at a thermoelectric plant in the state of Amazonas/Brazil, seeking to verify the priority sectors for the application of the audit instrument. Through of the results obtained and the audit analysis, it is believed that the objective has been achieved.

Among the main results achieved, we highlight (1) the systematic analysis of the activities developed in the enterprise through an ergonomic intervention action; (2) identification of risk factors in different sectors through the application of occupational safety and health auditing based on regulatory standards; (3) distinguishing between different stages of implementing NRs in the organizational environment; and (4) the study indicates that NRs more focused on worker participation tend to have greater implementation difficulties.

The methodology used based on an occupational health and safety audit instrument proved to be adequate in the search for a broad view of the organization's level of compliance with regulatory standards. The results reinforce the work of Baxter & Jack (2008), McCutcheon & Meredith (1993), Barrat, et al., (2011) and Voss, et al., (2002) with regard to the use of the case study in the areas of operations management and related.

As for the limitations of the study, the application in only one enterprise is identified, configuring itself as a single case study and as suggestions for future studies, it is suggested the application of the audit in other companies in the same branch.

In conclusion, the relevance of this research is to demonstrate that ergonomic decisions can be made to improve safety, satisfaction, reducing errors and accidents, aiming to improve the health and productivity of the entire enterprise.

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