INTERNAL SAFETY PLAN OF ALHANDRA PRODUCTION CENTER IN CIMPOR - REVISION AND IMPLEMENTATION

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Abstract

The safety plan of the Alhandra Production Center (APC) of Cimpor was revised. Based on the analysis of the existing document (2009), the adaptation to the actual legislation was made focused on the principal aspects that account for the technological, natural and social risks, prevailing in the cement industry.

The 2009's safety plan was not in conformity with the legislation in force, concerning mostly fire safety. The main topics requiring updates were the categories of fire risk and the designation of places of risk. Additionally, several aspects of the safety management were revised, e.g. the designation of the elements of the safety team and creation of flowcharts with action measures in case of emergency. Safety procedures and instructions were also created.

The structure of the safety plan is based on ensuring the protection of human lives, material goods and preservation of the environment. Self-protection measures are considered at every point of the process in the factory, thus a systematic and regular review of the internal safety plan is frequently required. All the essential topics created or updated in the plan, due to the revision made, will be demonstrated in this article.

Key words: Internal Safety Plan; Fire Safety; Self- protection measures; Cement Industry; Fire

1 Introduction

CIMPOR is a member of the World Business Council for Sustainable Development (WBCSD), and helped creating the Cement Sustainable Initiative (CSI), which contributes to the development of objective and concise methodologies to create sustainable solutions for cement industry. Cimpor also follows up the OSHAS 18001:2007/NP 4397:2008, documents that provide and implement control measures for occupational health and safety. The objective is to minimize the accidents risks and diseases in workers, associated to the job they have.

It is very important to have a document that establishes all the prevention and mitigation procedures to deal with all emergencies, especially the fire risk. The various causes of fire can be thermal origin (solar radiation), electric (static electricity), mechanical (friction) or chemical (exothermic reactions); but also, can come from human causes due to carelessness, ignorance or criminal hand. Having a safety plan updated in conformity with the law is essential, the previous one in Cimpor was not, therefore, it needed to be reviewed. The legislation in force, such as the Decree-Law no. 220/2008, November 12 (MIN. INT. AFFAIRS [1]), now updated by the Decree-Law no. 224/2015 from October 9 (MIN. INT. AFFAIRS [2]), establishes the self-protection measures to safety against fire in buildings. The National Civil Protection Authority (ANPC), created by the Ministry of Internal Affairs in Portugal, is the responsible for the audits in the establishments, and for the elaboration of Technical Notes in the scope of application to fire safety, in order to help the companies to be in conformity with the law.

The Production Center of Cimpor in Alhandra is classified with 3rd category of fire risk, rated in a scale of one to four. Therefore, having all the facilities classified and frequently updated by their fire risk is essential. The self-protection measures such as prevention and intervention measures, were also highlighted in the revised internal safety plan. Throughout this manuscript, references will be made to the revised and updated topics based on the legislation previously set forth, regarding the safety plan of CIMPOR and its implementation measures at the plant.

2 Methodology

The methodology used was based on the analysis of the fire risk at each zone in the factory, the analysis of the characteristics of the firefighting equipment, as well as the number of employers at the plant (in cases of evacuation it is very important for everyone to know how many workers and where those are at the plant). It was also necessary to verify how the human resources were organized to improve their efficiency and effectiveness in workers' training, empowering them to prevent and act in emergency situations.

The designation of the type of establishments that exist in Cimpor was needed. There are, in the legislation (ANPC [3]), twelve types of classifications. By exploring each facility in the plant to see its characteristics, it was attributed a type-utilization (UT) to each one. Safety and emergency plan views, prevention procedures, and safety instructions were also analyzed in order to be improved in the plan. The emergency management such as the emergency team and flowcharts were also analyzed and improved. It was intended to provide concise and objective information regarding the organization of the human resources, since the safety management in terms of general emergency was previously scarce. All the results obtained by these improvements are identified in the chapters 3 and 4.

There were two main topics that require some specific methodology, which were the category of fire risk and the identification of places of risk for the facilities in the factory, that will be shown next.

2.1 Modified Fire Load Density

In industrial facilities, the category of fire risks is identified by the "modified fire load density" (q_s). The fire load is the calorific energy that is released during complete combustion by the total of existing elements in the considering space. The mathematical formulas to obtain the q_s value are determined by the Dispatch No. 2074/2009 from January 15 (ANPC [4]) which are the deterministic and the probabilistic formulas. The deterministic calculation is used when the quantity and quality of the material is known; the probabilistic one is used when directed to the activity that is carried out, like production or storage.

In the attachments of the mentioned Dispatch, there is a table I, dedicated to the determinist formula, that gives the values of the lower calorific value (H_i), depending on the type of material that is used. There is also a table II, designed for the probabilistic formula, that gives the values for the dimensionless coefficient of activation for fuel constituent (R_{ai}), the fire load density for production activities in MJ/m^2 (q_{si}) and finally, the fire load density per unit of volume relative to storage areas in MJ/m^3 (q_{vi}). The R_{ai} value can be 3 (high), 1,5 (medium) or 1 (low) depending on the activation risk related to the activity.

Deterministic Calculation is shown in equation 1.

$$q_s = \frac{\sum_{i=1}^{N_c} M_i \times H_i \times R_{ai}}{S} \ (MJ/m^2) \qquad (1)$$

Where:

M_i - Mass (kg) of the fuel constituent (i).

C_i - Coefficient of combustibility of the fuel constituent (i). Calculated in accordance with No. 6 of referred dispatch (ANPC [4]), and may present values of 1 (low risk); 1,30 (medium risk) or 1,60 (high risk).[†]

N_c - Number of fuel constituents present in the compartment.

S - Area of the fire compartment (m^2).

Probabilistic Calculation, shown in equations 2 and 3 are distinguished, respectively, for production and storage activities.

For activities inherent to UT XI (Libraries) or UT XII (Industry facilities), equation 2 is used when it is not known the quantity or quality of the material but, the activity used in the facility/equipment. The equation 2 cannot be used for storage activities.

$$q_s = \frac{\sum_{i=1}^{N_a} q_{si} \times C_i \times R_{ai}}{S} \ (MJ/m^2) \qquad (2)$$

Where:

S_i - Area affected by the zone of activity (i), (m^2);

S - Area of the fire compartment (m^2);

N_a - Number of different activities zones.

For storage activities the equation 3 is used:

$$q_s = \frac{\sum_{i=1}^{N_{ar}} q_{vi} \times h_i \times S_i \times C_i \times R_{ai}}{S} \ (MJ/m^2) \qquad (3)$$

Where:

S_i - Area affected by the zone of activity (i), (m^2);

S - Area of the fire compartment (m^2);

[†] Its definition is the same in equation 2 and 3.

h_i - Height of the storage area (i) (m);

N_{ar} – Number of distinct storage areas.

The criteria that exists between the obtained value of q_s and the category of fire risk is represented in table 1.

Table 1. Classification of the inherent risk of fire based on fire load density.

Category of fire risk	Indoor		Outdoor
	Modified Fire Load Density (q_s) (MJ/m^2)	Number of floors occupied below the reference plane	Modified Fire Load Density (q_s) (MJ/m^2)
1st	≤ 500	0	≤ 1000
2nd	≤ 5000	≤ 1	≤ 10 000
3rd	≤ 15000	≤ 1	≤ 30 000
4th	> 15000	> 1	> 30 000

The maximum limits for modified fire load density in UT's XII, intended exclusively for storage, should be 10 times higher than the identified values in table 1.

The 1st category represents a very low risk, the 2nd a low risk whereas the 3rd one represents a high risk and the 4th represents a very high risk of fire.

There were facilities that were not classified yet, and some had their characteristics out of date. The information about the fire risk category, and also the fire load density in some establishment, is relevant because it provides the information about the structure of the plan. In the table I of the Technical Note No. 21 (ANPC [5]) are shown the self-protective measures that should be selected for the creation of the safety plan, according to the fire risk category and the type of utilization of the establishment.

2.2 Places of Risk

In the Technical Note No. 05 (ANPC [6]) there is a definition for each type of place according to the risk they have in case of fire, and each one has a classification from A to F. Places labeled with letter A do not show special risks, and the number of occupants does not exceed one hundred people. The B designation is attributed to the public or people who work in the establishment, the effective can be more than one hundred people. The C areas show very high risks of fire and fire development, due to the activities developed therein, or to the characteristics of the existing products, materials or equipment. Places designated by letter D are establishments where people are bedridden, which intended to receive children up to six years of age, or disable people who cannot perceive or respond to an alarm. The E areas are establishments intended for sleeping, where people do not present the limitations indicated in places of risk D. Finally, places of risk F have essential systems for the continuity of relevant social activities, namely the neuralgic centers of communication, command and control.

There is also a place designed by C^+, which is a local C aggravated. It is important to know mainly the C, C^+ or F sites of the APC, because those are the dangerous and neuralgic points of the plant and must have safety instruction made for them. The C or C^+ places are classified by the modified fire load present in that area, and also by the quantity of material or activity that is being made there.

3 Prevention Plan – Results and Discussion

The prevention plan corresponds to the first volume of Cimpor's internal safety plan, which contains the prevention procedures and all the information regarding the characterization of the factory facilities, as well as all the information aimed at the prevention of emergency situations, such as maintenance of safety conditions, training of employees and awareness of them.

This chapter will deal with the update made on the first volume of the 2009 edition of the Production Center of Alhandra's plan.

3.1 Prevention Procedures

The procedures required by the legislation did not exist in the previous edition of Cimpor's internal safety plan, thus new documents were required. They correspond to the fields concerning the operation/maintenance of safety equipment and systems, and the exploration/maintenance of technical installations. The following sub-chapters refer to the procedures developed.

3.1.1 Procedure – Operation and Use of Technical Installations for Fire Protection

This procedure aims at the efficient operation of the technical facilities in the APC, so that they are in permanent operation, respecting the fire safety conditions. The characteristics of electrical, heating, confection and food storage facilities, as well as gas and liquid fuel tanks were also featured in the procedure.

The list of electrical rooms and transformation stations (electrical installation that transforms average levels of electricity voltage to low voltage levels) was updated, as these are included in the list of dangerous points of the factory, illustrated in the safety plan view, due to possible electric discharges. Because of their fire risk, these rooms must comply with safety instructions that were also improved.

Regarding the existence of lightning arresters, twelve equipments were found in different installations of the APC. This is a relevant information because a lightning arrestor is intended to protect buildings by attracting electric discharges to their metal tips, which are at the highest point of the building. In the factory there are high-altitude buildings, and it is known that they have a greater tendency to receive electrical discharges from storms, thus the existence of lightning arresters is a great measure for fire prevention and now it is highlighted in the recent plan.

As a way of optimizing the procedure, several operational safety instructions (OSOI) were created, such as "Safety in the use of electrical installations", "Safety in the use of confection and food storage facilities" and "Safety in the use of lifting and cargo handling equipment". These instructions had been created after the 2009 plan was edited. With the review, the instructions were transposed for the plan, and updated to the required format by InterCement.

3.1.2 Procedure- Firefighting Equipment Management and Fire Detection Systems

This procedure was not considered in the previous plan therefore, its importance was highlighted as well as the need for its documentation. This procedure designates a set of measures that promote the effective management of fire detection and firefighting systems, for them to be in permanent operation.

To create this procedure and to improve the safety plan, all the firefighting equipment were revised and now there is a list with the number of all equipments, e.g. fire extinguishers, and armed fire network such as reels and fire markers. Consequently, there are now in the plant 498 extinguishers and 44 different types of equipment from the armed fire network.

Having all the firefighting equipment frequently revised is important because they are the first ones to be used when an emergency occurs, thus a special maintenance for them is needed.

3.1.3 Procedure- Management of Emergency Signalization and Illumination

This procedure, also created for the plan, aims to ensure the clarity and accessibility of information related to emergency lighting and safety signage, ensuring that there is no lack or excess of information, and that maintenance is ensured.

Emergency lighting comprises ambient lighting of places where people are normally present, and beaconing or circulation lighting which facilitates visibility when evacuation to a safe location is required (ANPC [7]).

Signage plates should be constructed of rigid material, be photo luminescent and should not have radioactive or toxic substances. They must be allocated in well-lit places, in appropriate positions in a visible distance, considered convenient. In table 2, the different shapes and meanings of safety signage are shown.

Table 2. Emergency Signage

Function	Example	Shape
Signage for danger		Triangular shape and yellow color
Information signage for emergency situations		Rectangular shape and green color
Fire Fighting Signage		Rectangular shape and red color
Bond Signage		Circular shape and blue color
Prohibition Signage		Circular shape and red color
Labeling Pictograms		Diamond-shaped pictograms

It was made for this procedure a table with the management of signage and the lightning equipment that goes through the lifting of the required signage/lighting equipment, to the removal of the damaged ones, also mentioning who the responsible for each action is.

Safety signage or lightning equipment represents the most important passive measures in occupational safety, because they provide essential information to avoid risks and also help people on how to react in emergency situations like when evacuation is needed, therefore a good management is essential to improve their efficiency.

3.2 Identification of the type – utilization of facilities

The type-utilization (UT) identification of the facilities was identified in the revised plan. The social building and the centralized control room were classified with UT – III because they are projected for administrative services. The control room is necessary to the explorer entity because of the equipment/systems control that exists there. Also, their area is less than 20% of the global area of the factory unit.

The kitchen located on level 0 of the administrative building, was defined with UT VII, since they carry out restoration activities under the normal occupation regime. Their workforce is less than 200 people, and the space considered is differentiated from the social building.

In the Alhandra's cement manufacturing plant, the old laboratory and the Hoffman furnace were no longer active and so, they were turned into museums (spaces where the historic and successful achievement of the factory are exposed). As museums they are classified with the UT X. The rest of the facilities of the Production Center, are UT XII because they are all industrial facilities.

None of the buildings were classified in the previous plan (2009) of APC and it is important for the knowledge of what type of self-protective measures should be used, in conformity with the law.

3.3 Categories of fire risk of the facilities in APC

An improvement of the category of fire for the liquefied petroleum gas (GPL), oil and fuel tanks was made. It was also calculated the category of fire risk for facilities which were not identified in the previous plan, such as the silo of refused derived fuel (RFD's), the park tires and non-hazardous waste, the warehouse of the Ribatejana and the warehouse of pallets.

With the deterministic calculation, from equation 1, the facilities observed in table 3 were identified with their modified fire load density (q_s), in comparison with table 1 the risk category was found, as it is shown in table 3.

Table 3. Deterministic calculation and the category of risk associated for facilities in APC

Facilities	Modified Fire Load Density (q_s) (MJ/m^2)	Category of Fire Risk
GPL tank	78 826	2nd
Oil tank	278 460	2nd
Fuel tank	37 886	3rd
RFD silo	14 364	2nd

The modification of the fire risk in GPL tank was due to the existence of one less tank nowadays in the factory, thus the reduction of the dough to half led this tank to the 2nd category.

The Oil and Fuel tanks had their q_s determined by the probabilistic mode in the previous plan, where the value used for q_{vi} was incorrect, because it was not what was given from table II in the Dispatch no. 2074/2009. To keep their q_s more realistic, it was considered the deterministic calculation because it was known the quantity and quality of the material used. By using equation 1, the oil tank changed from 2nd to 3rd category and the fuel tank remained its 2nd category of fire risk.

The RFD silo came to APC in 2011 as a consequence, it was necessary to classify it. Due to its concrete coating it was identified with a low risk (2nd category of risk).

The facilities observed in table 4 were determined with the equation 3 from probabilistic method.

Table 4. Probabilistic calculation and the category of risk associated for facilities in APC

Facilities	modified fire load density (q_s) (MJ/m^2)	Category of fire risk
Tire Park	23 519	2nd
Ribatejana Warehouse (outdoor)	42 750	2nd
Ribatejana Warehouse (indoor)	57 000	3rd
Pallets Warehouse	14 820	2nd

The facilities represented in table 4 were not identified in the previous plan. The tire park was only approved by ANPC in 2015, and the Warehouses because they did not have their license, at the time, in conformity with the law.

Previously the APC, in its generality, was classified with 3rd category, with all the changes and improvements, it was observed that the category of fire risk in the plant remained the same. The maintenance of the 3rd category was good because if it had raised for 4th category it would have been necessary to implant new and more aggressive safety measures according to the new legislation.

3.4 Places of Risk in Alhandra's Production Center

The previous plan had scarce information concerning the classification of the risk in the facilities. The main parameters for their classification, knowing that only can exist A, B, C or F, are in table 5.

Table 5. Parameters for the classification of places of risk in APC

Parameters	A	B	C	F
Total Effective	≤100	>100	-	-
Aggravated fire risk	No		Yes	-
Continuity of socially relevant activities	-			Yes

All the risk facilities that were recently identified were establishments designed for UT XII, generally with fire risk. Sixteen facilities were identified with C^+ classification like the RFD silo, oils warehouse or GPL tank; three with C classification such as the machine shop, and other three facilities were determined with F classification (commercial and administrative order and, pumping station).

It is important to classify these places because the employers need to know the dangers that they are dealing with when they are working. All the places classified with C or C^+ were classified dangerous points and were highlighted in the new safety plan view. Due to the risk of fire in these areas, it was also made safety instructions for them.

3.5 Safety Post

The safety post is a permanent watch point (24h/day in the week), which controls all surveillance, safety systems, means of alert and internal communication in the factory.

Prior to 2009, the Centralized Command Room (CCR) was designed as the safety post of Cimpor. After the recent review, it was considered for the best to have two safety posts that complement each other, and so the Administrative Order was claimed a safety post too. The Administrative Order is permanently occupied 24 hours/day, with the advantage of being the area that controls all the entrances and exits of APC employees, it is also located near the administrative building, far from the dangerous places of the factory.

In this matter, with the analysis of the plan, a procedure was created for the Safety Post and included in the plan, where all the information regarding its characteristics was identified, as well as a set of applicable legal obligations, fulfilling the Decree-Law. In that procedure, the means of emergency in the control room were mentioned, for example: the triggering command of the alert, first-aid equipment, exemplary of the internal safety plan, illumination of emergency, and the fire control and detection system. In the Administrative Order was mentioned that there was a fixed emergency telephone, a keyring of all APC facilities, as well as a master key dedicated to consignment locks and a first aid box.

The safety posts were identified with identification plates in their entries as a mean of the plan implementation. It was very important to do this because no one knew where the safety posts in the plant where. They are the neurologic sites of the plant, that is why they are classified by "neuralgic points", now identified also in the safety plan view of the Production Center Plant.

3.6 Safety Plan View

The safety plan views referenced in the previous edition (2009) were out of date, so the revision carried out, led to their update, creating new versions of these. Three new safety plans were made, one for the location of the firefighting equipment, the other for the identification of the factory areas, and finally, one for the management of the emergency which does reference to categories and places of fire risk, the meeting points, the gas, energy and water cut-off areas, the traffic routes, the dangerous and neuralgic points, medical post, and the entrances into buildings.

The existence of updated safety plan views is very important to an emergency situation. Those responsible for emergency teams can more easily respond to emergency situations with the existence of these designs. For example, in a bomb threat situation, it is an armed forces intervention team that assumes responsibility for safety management, and they have no knowledge of the factory facilities, therefore the safety plan views facilitates the management of the situation.

4 Emergency Plan – Results and Discussion

4.1 Safety Management

The mere existence of physical means does not guarantee risk prevention, it is necessary to consider the importance of the human component, in particular the responsibilities of the safety team, who should promote the best safety conditions in terms of evacuation, self-protection measures and to ensure the maintenance of technical installations, and safety equipment and systems.

At Cimpor although the 2009 edition of the plan referred to a safety commission and an emergency director, officially the workers did not know who represented them. The aforementioned delegations in 2009 fell into disuse, and a solid emergency team was organized based on the new delegations required by the legal regime. Figure 1 shows the new positions imposed, concerning safety management, and the relationship at a hierarchical level between them.

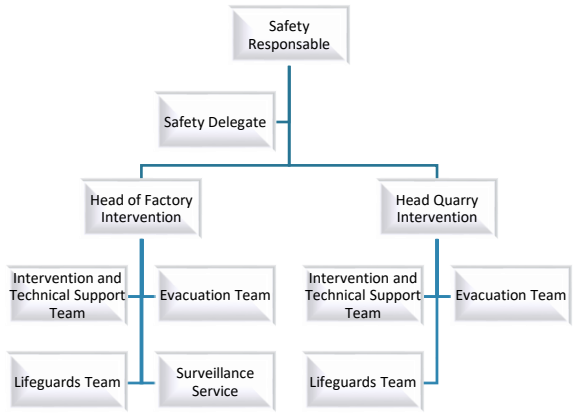

Figure 1. Emergency team of APC

The Safety Responsible who is the director of the Alhandra Production Center and the only one who can declare the need to activate a general alarm and the only one who can finish it, manages an Emergency Team consisting of fixed elements. He elects a Safety Delegate that will exercise in his function, reason why the Safety Delegate must provide all the necessary information to guarantee the logistical support, the evaluation of the impacts of the accidents, ensuring the safety of the APC and the improvements of the internal safety plan.

The Head of factory intervention manages the Intervention and Technical Support Team (ITST). The existence of such a team is to deal with an emergency; they are the first ones to move to the affected site, in order to study the situation and to be able to act. If they cannot solve the problem, then they contact, usually, the firefighters and INEM. The Chief of Intervention works in partnership with the Safety Delegate.

The evacuation team is responsible for conducting victims to a safe location, usually one of the designated meeting points located at strategic points in the APC.

The Supervision Service (SS) is made up of two employees who are in the Administrative Order, under the normal occupation regime. Although in the reduced occupation regime, only one employee is working. The SS is responsible for controlling entry and exit of the employees, as well as for maintaining a permanent and effective service as a safety post.

These teams and delegations were the new designations that were implemented in the revised safety plan. During the review it was made a list of Cimpor employees for each one of the safety teams so that in case of an alarm all the management to deal with the situation goes well with the minimum of victims as possible.

A new flowchart was made for the action measures in case of an emergency. It was important to do that, because in an emergency, a person must follow certain steps, and usually when that occurs the person panics, becoming incapacitated to act properly or in a careful way. The new detailed flowchart provides all the necessary emergency action information to someone in need.

The Safety Delegate may elect an Emergency Management Room (EMR), which will be used to meet the emergency team leaders to decide on measures to act in case of general emergency, or partial if necessary. This room was not active in the factory. Therefore, it was selected a room for those situations, a signage plate was placed in this room in order to be highlighted to all the workers. In addition, the emergency room was placed with also a fixed telephone line, flashlights, first-aid box as well as a copy of the internal safety plan, and the respective safety design plants.

4.2 Safety Instructions

The action in case of emergency depends on the area of the factory in question, and on the type of emergency. There are three main types of emergent situations: fire/explosion, gas leakage or spills. The following measures are the main ones that need to be taken in cases of fire or spill, presented in most of the new instructions created for Cimpor's internal safety plan.

Measures to be taken in case of fire:

-If you have received training, try to extinguish the fire by using extinguishers in the area. Stand at a safe distance from the outbreak of fire. The fire extinguisher you will use will have a sufficient range to deal with the fire - without risk.

-If possible, cut off the electrical current from the sector.

-Leave the place in order, without panic - close all doors and windows, if possible. Remove combustible materials from the nearby fire area.

-If you do not know how to operate, or do not have the means to fight the fire, or the conditions gets worse, leave immediately and go to a safe place.

-When evacuating the area and if do not tolerate fumes, then soak a towel and put it near the respiratory tract.

-When the ITST arrives at the location, the Head of factory intervention will take over the situation. Follow his instructions.

Measures for action in case of spill:

-If possible, limit the spill using the containment equipment available in the area and clean the site with sand or flour, but never with sawdust or other combustible material.

-Please note that if the accidental situation involves chemicals, you should know the risks associated with the safety data sheets (SDS).

-Take all necessary precautions in terms of the use of personal protective equipment (PPE) in order to avoid contact with those substances.

-Ensure a perimeter of safety and prevent people from entering the area. Avoid breathing the emitted compounds.

-If it is a flammable product spill, always avoid the approach or movement of people smoking, vehicles, or any objects or elements that constitute a potential source of ignition. If the spill is confined to a space, ventilate the area.

-Absorbent material used for spill containment and residues resulting from such cleaning must be carefully packed, removed and transported in identified waste bins.

-If the spill still shows a potential risk, notify the administrative order. When the ITST arrives at the place, they transmit all the necessary information to the Head of Intervention, who will take over the situation.

New safety instructions were made for the next facilities: Alternative Fuel Warehouse; Storage of grinding aids; Pallet Warehouse; Palletizing Building; Electrofilter; RFD facility; Grinding Facilities; Provisional Installation of Liquid Oxygen; Flour Installation; Package; Tire and RNP Park; Calcium hydroxide reservoir (CaOH2); Ferrous Sulfate Silo (FeSO4); Cyclone tower. All these facilities represent fire risk and did not have safety instructions for them in the previous plan, that is why it was created formal documents of them to put in InterCement data basis. Were also improved the instructions for the other facilities that were in the 2009 plan.

5 Internal Safety Plan Implementation

It is not enough just to update an internal safety plan, it has to be implemented in the factory so that all the direct employees, service providers, visitors, know how to act safely inside the factory, avoiding accidents, or in case that happens, they are able to know how to act in order to minimize the consequences.

With the analysis of the 2009 safety plan, it was found that much of the information contained in it was unknown by the workers, perhaps due to the lack of training actions. As such, after approval of the new improved plan, it will be provided in several meetings, the main themes described in the plan.

It was intended to convey directly to the people in charge what their responsibilities were, since they were not aware of the positions assigned to their own. First-aid training will be provided to a new team (also created with the implementation of the plan). It was decided to allocate emergency telephones in strategic locations of the factory to communicate directly with the firefighters, in order to facilitate the transmission of the emergency. Concerning the creation of safety instructions, posters were placed near the facilities and leaflets were also created with the main measures, containing an emergency plan view along with the new flowchart of action, illustrated in the brochure that is intended for the direct workers and collaborators of the APC.

6 Conclusion

The improved safety plan was made, and it was concluded that the factory maintains the 3rd category of fire risk. Several factory zones were classified by the risk of fire they represent, from A to F, and it was found that most of the facilities were C^{+} or C which means fire risk. Several safety instructions for those facilities were made and

allocated in the Document Manager System from InterCement and implemented in leaflets to be distributed to all the workers.

Four new prevention procedures were also made for technical installations, for the safety post, and for the firefighting equipment too. The implementation of these new documents will help the efficiency of the systems in the plant and improve the safety conditions in it.

In what concerns the safety management, new teams were created in order to develop the safety in the factory. It was also created along with the new safety plan, a new safety post, the Administrative Order, because of its strategical location, and also because of the services it provides by improving the security of the plant.

A continuous improvement is required not only due to the characteristics of the factory, but also because of the legislation imposed by the Government. It is therefore necessary to follow regularly the published rules and decrees in order to maintain the factory safety plan in accordance with the legislation.

The regular investment in both industrial and occupational safety is critical, as all employees must work with the best working conditions possible, without endangering their health, or even their own lives. It is advisable to have frequent audits and training actions that also translate into improvement of the safety plan, as well as the improvement of safety in general at the Alhandra Production Center.

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