TECHNICAL MAINTENANCE OF WORLD CLASS INCREASE THE AVAILABILITY OF EQUIPMENT

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ABSTRACT

The contemporary industrial scenario is characterized by constant seek for better results, what it is directly related with the high global competition and the increase of demand by consumers. Thus, the organizations incessantly seek methods to ensure its sustainability. So that an enterprise becomes more competitive, their basic functions or departments also have to present excellent results. The Maintenance, as department member of the enterprises, also has to seek better results supported by the best known practices. The present work was elaborated aiming a study and application of technical philosophy of World Class Maintenance (WCM) in sector of Electrical Maintenance, basing in a structured analysis of historical data of stop of the equipment and maintenance performance indicators through the Method of Analysis and Troubleshooting (MAT), in the suggestion and execution of improvements of action plans and in the analysis of results obtained. The method applied proved to be effective in reducing corrective maintenance and reducing electrical indicator Electrical Downtime in equipment worked, directing the electrical maintenance of the enterprise for the concept of World Class Maintenance.
Key words: Electrical Maintenance, World Class Maintenance (WCM), Maintenance Performance Indicators, Method of Analysis and Troubleshooting (MAT).

1. INTRODUCTION

Currently the enterprises are immersed in a business environment increasingly competitive, through studies which seek to reduce costs, become increasingly excellent (Pereira, 2010). This preoccupation is specially identified in first world countries, where their enterprises seek are situated between the excellent enterprises or the best of the world, and so that an enterprise is excellent their several segments also must to be. Based in this necessity, the sector of maintenance of these enterprises constantly seek improvement supported in the best practices known, being considerate so, like World Class Maintenance (NASCIF, 1998; PEREIRA, 2010). The maintenance department normally becomes the main cost center of an industrial organization, being necessary a management through the application of better practices, as the implantation of a WCM program, to reduce costs, maintaining the operability and reability of the equipment (Hamrick, 2007). In this context, so Kardec and Nascif (2009) the maintenance in an enterprise need to leave to be only efficient and becomes effective, not just by repairing the equipment or installations as soon as possible, but mainly to keep the equipment available for operation by reducing the likelihood of a stop. Another factor that began to demand greater efficiency and the maintenance organization is the great technological developments in machinery, where the need for skilled labor is crucial. This work has as general objective the review and introduction of philosophic techniques of World Class Maintenance (WCM) in sector of electrical maintenance to increase the availability of process equipment.

2. THEORETICAL FOUNDATION

2.1 The World Class Maintenance (WCM)

According Nascif (2005), the pursuit of excellence in maintenance or the called World Class Maintenance, require identifying and implementation of best maintenance practices, modifying how to perform the maintenance. The implementation of a excellence program in maintenance, if applied with discipline, can take of 3 to 5 years to achieve the desired status. The pursuit of excellence has to be guided by indicators and management programs lasting and ongoing. There are still three aspects to achieve the WCM: have an appropriate structure, trained and qualified personnel and action plan well elaborated through the Plan, Do, Check and Action (PDCA) methodology. Moreover, the routine maintenance have to be stabilized, aiming the predictability, and have to be implemented improvements in seek of the competitive (NASCIF; DORIGO, 2005). For Hamrick (2007) to achieve the status of WCM in electrical maintenance is necessary a corporative culture of support to continuous improvement, integrating with activities of preventive and predictive maintenance and programs like Reability Centered Maintenance (RCM), Total Productive Maintenance (TPM), etc. Moreover, it is important keep the focus in fulfillment of the programs to improve of performance, productivity and reliability. For Filho (2008), historically, the advent of the introduction and availability of electricity in industrial environments has brought the need for a group of people with specific knowledge into electricity and then in electronics, forming part of the maintenance crew in the enterprises.

2.2 Maintenance performance indicators

The indicators are developed and used by managers to measure the performance and guide the pursuit of the operational goals defined by enterprise. These indicators have to show where and what improvements have to be introduced to improve the processes or even to highlight the
satisfactory performance (KARDEC; FLORES; SEIXAS, 2002). According Xenos (2004), the indicators or control items, have to be established to ensure that are simple, relevant and that can be useful to generate some concrete action. It is important keep just a number of indicators which are useful and actually necessary, because they require great effort in data collect and cannot represent a wasted effort. The maintenance indicators, when well-managed, have to promote great improvements in performance of the equipment and of the own maintenance and can express some simple results, as the maintenance cost for a period, rate or the production interruption time for a period of time, or even the number of failures in a given period (XENOS, 2004). Many are the indicators of maintenance that can be used, as we show Kardec and Nascif (2009) and Filho (2006), however, according Tavares (1999), some of them are known as Class Indicators World.

Highlighted for the Uptime and Downtime indicators (FILHO, 2006):

• Uptime: Time when the equipment is able to perform its function;
• Downtime: Time when the equipment is not in conditions of use due to some abnormality or breakdown.

The application of indicators in the maintenance, according Kardec, Flores and Seixas (2002), is fundamental, because without it is almost impossible evaluate the maintenance performance and their weaknesses.

2.3 Tools to increase the reliability

2.3.1 MASP – Method of Analysis and Troubleshooting

The MAT methodology is a technique of analysis and troubleshooting which is based in PDCA (Plan, Do, Check and Act) methodology (KARDEX; NASCIF, 2009). When adopted to treat failures occurred in the past, this systematic depend of a reliable historical reality of failures which occurred in the process. Moreover it is important depend with a documented process and that the analysis is accomplished for a multidisciplinary group and preferably with the participation of an executing of the maintenance task, to rescue details which do not always included in the historical. Filho (2009) reaffirms that the MAT is based in the PDCA methodology. Moreover, the author described MAT as a logic sequence of steps to achieve a desired goal through the analysis and solutions of problems. During the application of the methodology many other tools of the quality can be used in process, among them we have the Ishikawa Diagram, Pareto Graphic, Brainstorming, Stratification, Gravity-Trend-Urgency (GTU) Diagram, Check Sheet, Flowchart, Structured Action Plan (5W1H / 5W2H), among others.

2.3.2 RCFA – Root Cause Failure Analysis

The RCFA method – Root Cause Failure Analysis is a ordenated method to seek of the root cause of a problem and of determination of actions to prevent its recidivism (KARDEC; NASCIF, 2009). Yet according the author, its methodology is originated of the techniques of Total Productive Maintenance (TPM) and Total Quality Management (TQM) known as “5 whys”. Although the technique are quite simple, its investigation have to be rigorous and documented, and the sequence of questions have to be used until it cannot longer be answered or do not make more sense, in other words, when it reached the root cause.

3. MATERIALS AND METHODS

With basis in the theoretical grounding and the data available in the enterprise, as process indicators and historical data of failures in equipment and occurrences of maintenance, it was defined a methodology of failure analysis based in continuous improvement. The maintenance and process indicators are originated and available monthly by sector of Planning and Control of the Maintenance
(PCM) and by sector of Planning and Control of the Production (PCP) of the enterprise, respectively. The occurrences of maintenance are collected of a system of computerized management where are launched the Work Order of Maintenance, a system called SAP. In a second moment, it was accomplished an evaluation of the actual situation of the sector of electrical maintenance of the enterprise through the analysis reports on shutdown of equipment. This analysis aim identify which electrical failures have occurred in the equipment and, through the use of the methodology chosen of continuous improvement, it was proposed actions in order to improve the availability of a group of equipment through the reduction of the Downtime Electric indicator. Still with basis in data relating to indicators, historical of maintenance and stops of the process, also was evaluated the Downtime Electric indicator, as to their truthfulness, in other words, if it expresses the reality found in the productive process, through the comparison of the releases of stops with respect to maintenance history. For this evaluation, it was used the descriptive research methodology, which it is based in observation, register, analysis and correlation of the facts or phenomena without manipulate them. Its intuit is discover with the best precision possible the frequency that a phenomena occurs, its nature and characteristics (CERVO; BERVIAN, 2007). According Cervo and Bervian (2007), this type of researching seek study the reality present, having in data collect on of its major operations. Such data collect can be used of several instruments or techniques, like the observation, the interview, the survey and the formulary. These techniques of data collect seek both describe the background of the problem as illustrate the problem itself.

4. RESULTS AND DISCUSSIONS

4.1 Definition of the methodology for analysis of failures

Through the theoretical reference can conclude that the method more appropriate to analyze the electrical failures which occur in productive process evaluated is the MASP method. This technique is based in PDCA tool and encompasses the phases of analysis, planning, action and verification, besides being quite effective for treatment of failures have occurred, what is quite convenient since the enterprise has a history fairly broad stop and occurrences in maintenance. The application of this method, in the planning phase, was with the Root Cause Failure Analysis (RCFA), because the results of the actions are more effective as best identified the real causes of the failures. The planning phase, that consist in earlier survey of data, data analysis and proposal of the action plan, occurred between the months of June and July 2012. The implementation of the proposed actions in the action plan which were validates occurred in the months of July, August and September 2012, being considered the data as results as from October 2012.

4.2 Analysis of the electrical stops and prioritization of the work

In this stage of the work, was analyzed the data rearranged collected in spreadsheet in order to identify the historical Electrical Downtime indicator between the months January to June 2012. As sequence, it was raised data of stop of machines in the same period separating the data by productive group. These data of stop was organized, taking into account its share of contribution to the Electrical Downtime indicator of the plant, in other words, as the indicator take into account the theoretical production of the equipment, faster machines tend to contribute more to the indicator. So, two machines that obtain the same time of stop but have different design speeds contribute proportionally to the indicator.
Graphic 1 – History of General Electric Downtime of the Plant (January – June 2012)
Source: Developed by author of the work, 2012

The graphic 1 show the historical of general electrical Downtime of the plant before of the introduction of techniques of world-class maintenance. Already the graphic 2 show this historical separated for group of machines.

Graphic 2 – History of Electric Downtime by Group of Machines (January – June 2012)
Source: Developed by Author of the work, 2012
As indicated by Graphic 2, the groups of equipment that more contribute to raise the indicator were the group of machines 31P1, 22P1, 32P1, 16P1 and 15P1. As the groups 22P1 and 32P1 are in replacement process in the plant, they were not considered as work priorities.

4.3 Application of MAT method

For the application of the MAT methodology in the groups of machines prioritized was initially taking the historical of stop of the equipment to verify which the cause most frequent and most impressive of electrical stops in the three groups. The data of this taking was organized and stratified, mainly for machines of the group to which the stops referred and subsequently causes the stops. After the stratification, it was defined a working group which included members of industry electrical maintenance, respecting the criteria of experience, knowledge or participation in problems occurred in these equipment. During these sections of investigation and data analysis, it was used more two quality tools, the Ishikawa diagram, for the taking of the hypotheses, and the Root Cause Failure Analysis (RCFA) through the 5 Whys technique in five hypotheses that the group determined as a priority by vote. After these evaluations had been made, the group accomplished the elaboration of an action plan for each group of equipment with actions to correct the fundamental causes (or roots) prioritized through the vote. Such action plan was discussed with the supervision of maintenance and defining some actions which could be put into practice according with the maintenance budget and equipment availability.

4.4 Evaluation of the truthfulness of the Electrical Downtime indicator

During the stages of analysis of historical stops of equipment it was identified which in some cases the releases were made in machines or parts that do not belonged to that group of machines, what confirms that the Electrical Downtime indicator has significant deviations. Moreover, it was evaluate and confronted the stops posted in the system with the taking releases accomplished by maintenance in SAP system and were not found significant deviations. Other point verified during the analysis of historical stops is that the time released in some cases do not represent a compatible time with the necessary a correction or electrical intervention, because this if necessary would cause stop greater than that seen at launch. As the evaluation was accomplished only in one group of machines due the great amount of available historical for analysis, need not achieved or quantifying the deviations, however they have been proven.

4.5 Data and results obtained after the application of the MAT

After the implantation of all action plan proposed and validated, it was considered and collected again the data stops of machines and Electrical Downtime indicator. Analyzing the results obtained after the application of the MAT, as Graphic 3, it is verified that the Electrical Downtime indicator of the plant did not present significant improvement compared to previous periods. However, this fact can be explained by inconsistency of production in the last months, by the change of equipment installed in the plant and deep mechanical maintenance performed on some machines. With relation to Graphic 4, the same demonstrates the position of the machines most impactful in Electrical Downtime indicator in October 2012, indicating the machines worked, the machines not worked and the machines that have changed during the period and therefore were not included in the study.
Graphic 3 – History of General Electric Downtime of the Plant (January – November 2012)
Source: Developed by author of the work, 2012

Graphic 4 – History of Electric Downtime by Group of Machines (October 2012)
Source: Developed by author of the work, 2012
5. CONCLUSION

Through the accomplishment of this work it is evidenced the importance and the necessity of the maintenance management in an enterprise regarding the preservation of their assets in order to increase its availability and consequently its profitability. It is also shown that this is a vast field where there is opportunity for improvement that surely will lead to an increase of results of the entire business. The method of continuous improvement used during the accomplishment of this work, the MAT, it is shown effective in the search for better results within an industrial process. Its application in sector of electrical maintenance of the enterprise was favored by vast amount of historical data stops and maintenance occurrences available for analysis, however, this same factor, the amount of data, become analytical work longer. With relation to the veracity of the indicator, although they were found deviations in releases of stops during analysis, they do not represent high values compared to the amount of data analyzed and therefore does not cast doubt on the values of the Electrical Downtime Indicator in general.

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